Antarctica's Geologic and Ice Sheet History from Isotopic Sedimentary Provenance Studies

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ABSTRACT

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Within the constraints of uncertainty in the nature of erosion and transport in the sub-glacial environment, the study of glacialy-derived material from marine sediments located off the margin of East Antarctica provides a means for characterizing the sub-glacial geology obscured by the more than 98% ice cover of the continent. These insights into the geology of East Antarctica in turn provide characterization of sedimentary source areas, the knowledge of which can be applied to sediment provenance studies of ice rafted detritus (IRD) and thus about East Antarctic ice sheet history. Much of what has been learned of East Antarctica's Cenozoic ice sheet evolution has been achieved through the study of marine sediments, as ice sheets tend to erode their own history and much of what is preserved is, like the geology, obscured the ice sheet. Determining the provenance of ice-rafted detritus allows for spatial and temporal reconstructions of ice sheet behavior. Accordingly sedimentary provenance studies are key to documenting how Antarctica's ice sheet evolved through the Cenozoic.

In this work, I have taken samples of marine sediments and used grain size and physical properties to separate different terrigenous components, and I have examined the sand fractions under a microscope. Following the sedimentological characterization, I have separated specific minerals from the sand fraction and employed isotopic measurements - $^{40}Ar/^{39}Ar$ on detrital

hornblende and biotite grains, U-Pb on detrital zircons. I have also employed Nd isotope measurements on the terrigenous fine (< 63μm) fractions of these same samples..

Chapter 2 is published in the journal *Paleoceanography*, and chapters 3 and 4 are to be submitted to *Earth and Planetary Sciences* and *Paleoclimatology, Palaeoecology & Paleoceanography*, respectively. In Chapter 2, I demonstrated that (1) four main sectors between the Ross Sea and Prydz Bay, separated by ice drainage divides, are distinguishable based upon the combination of $^{40}Ar/^{39}Ar$ ages of detrital hornblende and biotite grains and the ε_{Nd} of the bulk fine fraction, (2) $^{40}Ar/^{39}Ar$ biotite ages can be used as a robust provenance tracer for this part of East Antarctica, and (3) sediments shed from the coastal areas of the Aurora and Wilkes sub-glacial basins can be clearly distinguished from one another based upon their isotopic fingerprints. This is particularly significant as the Aurora and Wilkes sub-glacial basins have elevations significantly below sea level, and thus are likely prone to being destabilized during warm climates. My work confirms and extends previous published evidence for episodes of massive ice rafting from these sectors.

In Chapter 3, I addressed the relative merits of U-Pb zircon and the ^{40}Ar-^{39}Ar hornblende and biotite systems for sedimentary provenance studies. U-Pb zircon is a widely used detrital provenance tool. In polar and subpolar regions where chemical weathering is minor, hornblende and biotite are viable alternatives, and because they are more abundant in crystalline rocks it is possible to find significant populations in the relatively small samples that are available from marine sediment cores. My work has demonstrated that (1) detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages all faithfully record the geologic history of East Antarctica, as expressed in their respective age populations, although different aspects may be accentuated in one or another (2) a number of previously unknown source regions have been identified (though

not found on the continent yet) with this method (3) there is benefit to combining the three chronometers where possible as they are not completely redundant.

Chapter 4 concerns the middle-Miocene climate transition (MMCT) on the Wilkes Land margin. In this study I combined $^{40}Ar/^{39}Ar$ with ε_{Nd} of the terrigenous fine fraction across the MMCT in IODP Site U1356. The results from the two size fractions tell different stories and provide further support for the application of multiple tools. Specifically I found that (1) the hornblende ages in the MMCT of Site U1356 have a very dominant 1400-1550 Ma age population, which is not commonly found on the Wilkes land margin. I interpret these results, in the context of published geophysical interpretations of the sub-glacial geological boundaries, to require that the EAIS was greatly retreated in the Wilkes sub-glacial basin prior to and during the MMCT, and sat along the extension of the Mertz Shear Zone, at the western edge of the Wilkes Basin (2) While the hornblende evidence for provenance does not indicate large changes in iceberg sources, the ε_{Nd} of the bulk fine fraction shows excursions to more radiogenic Nd values, 8 epsilon units higher than the local signal during times of elevated IRD concentrations at this site. The data reveal evidence for three events, which closely correspond with periods of glacial outburst floods responsible for carving part of the spectacular scabland topography (the Labyrinth) found in the Dry Valleys, and with provenance signals consistent with a significant sediment contribution from such a source and (3) the major pulse of dropstones to IODP Site U1356 occurs between ~14.0 and ~13.7 Ma, corresponding to the timing of the major pulse of IRD at ODP Site 1165 from near Prydz Bay, as well as to the timing of published records interpreted to indicate significant ice volume growth from oxygen isotope records and eustatic sea-level reconstructions. Collectively these observations allow tying together direct evidence for EAIS growth from proximal glacial-marine sediments and results from far field proxies.

Overall, this work demonstrates the efficacy of isotopic and geochronological provenance tools for studying East Antarctica's geologic and ice sheet history. Furthermore the application of this approach to studying East Antarctic ice-sheet dynamics across the mid-Miocene Climate Transition (~14 Ma), one of the most important periods of East Antarctic ice sheet growth, highlights the powerful potential for future discoveries.

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Dedication

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Chapter 1

Introduction: East Antarctic ice sheet and geologic history

1. Motivation

Unraveling the geologic history of East Antarctica presents a challenge to geologists due to the extensive (>98%) and thick (over 3 km on average) ice cover, which prevents direct access to the vast majority of the bedrock (Figure 1). Studying the evolution of the East Antarctic ice sheet presents a similar challenge, in that ice sheets tend to erase their own history, and much of any terrestrial history that might have been preserved on the continent is, as mentioned above, covered in ice. The East Antarctic ice sheet, which holds the equivalent of ~ 52 m of sea-level rise [*Lythe et al.*, 2001], has played an important role in Earth's climate system (and continues to do so today) yet questions about its evolution over the Cenozoic remain.

The three fundamental goals for this dissertation were to:

1) Characterize the isotopic signature of ice-rafted debris (IRD) source areas in the vicinity of the Wilkes (Adélie and George V Land) and Aurora (Wilkes Land) (Figure 1) subglacial basins using individual $^{40}Ar/^{39}Ar$ hornblende and biotite ages in addition to neodymium isotope measurements on the < 63μm fraction,
2) Investigate the geology and thermochronology of ice-covered regions of East Antarctica through a direct comparison of detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages,

3) Apply the characterization of IRD source areas to investigate the evolution of the East Antarctic ice sheet over the Mid-Miocene Climate Transition (ca. 14 Ma) using cores from Integrated Ocean Drilling Program Site U1356A (Wilkes Land).

Thus the characterization of glacially-derived marine sediments from around East Antarctica serves the dual purpose of learning more about the sub-glacial geology in East Antarctica, while also providing a means for furthering our understanding of East Antarctic Ice Sheet history. Due to the limited access to outcrops, indirect means are required in order to fully investigate the geology of East Antarctica. One way in which to study the geology of East Antarctica is to look at glacially derived marine sediments recovered from sediment drill cores close to the continent, on the continental shelf. As ice flows over the continent, it carries material with it, either by eroding and entraining material beneath the ice's surface, or simply by carrying rock fall-in from the sides of valley walls. When the ice sheet reaches the ocean, the glacially entrained material can be deposited on the ocean floor either as glacial diamict, generally restricted to the continental shelf around East Antarctica, or, as the ice reaches the ocean, it can calve, forming icebergs that melt and deposit the entrained sediments as ice-rafted debris (IRD) as they travel in the ocean currents [*Ruddiman*, 1977]. The delivery and accumulation of glacial-diamict and ice-rafted detritus (IRD) to the ocean floor thus provides a way in which to indirectly sample the geology of the Antarctic continent. Studying these sediments will allow us to: 1) reach a more complete understanding of the thermochronologic history of the EAC, which is integral to the understanding of past plate configurations, e.g. Rodinia and Gondwanaland, since it was arguably the central component of both continental amalgamations [*Veevers*, 2004]; and,

2) characterize sedimentary source areas around East Antarctica, to be used in provenance studies of marine sediments recovered from ocean drilling cores in the open ocean.

Studies that use geochemical characteristics of ice-rafted detritus allow for a more detailed study of past ice-sheet dynamics since specific areas of the ice-sheet can be identified in ice-rafting events preserved in the marine sediment record (e.g., [*Gwiazda et al.*, 1996; *Hemming et al.*, 2002; *Teitler et al.*, 2010; *Williams et al.*, 2010]), an advantage that this paleo-proxy has over others. Indeed, the varied geology around the perimeter of East Antarctica makes such studies ideal. A combination of the geochemical provenance tracers discussed below (section 2) will allow for greater detail to be attributed to different sections of the ice sheet, which in turn will yield a more refined history for the East Antarctic Ice Sheet (EAIS).

2. Thermochronolgy

The main approach used in this study for characterizing geological provinces is thermochronologic studies of detrital minerals. Thermochronology uses pairings of minerals and radioactive decay systems to interpret the thermal history of that mineral. This thermal history can then be extrapolated to larger areas. Due to the kinetics of the daughter products of such decay systems as potassium (K)-argon (Ar) and uranium (U)-Lead (Pb), and the mineral structures of certain minerals, a mineral will not retain the radiogenic decay product until it has cooled below a certain temperature range, or closure temperature. In this study, I have measured U-Pb ages on detrital zircons and $^{40}Ar/^{39}Ar$ ages on detrital hornblende and biotite. Hornblende and biotite retain ^{40}Ar from the decay of ^{40}K once they have cooled below ~500˚C and ~300˚C, respectively [*McDougall and Harrison*, 1999; *Reiners et al.*, 2005]. The diffusion of Pb in zircon

occurs at such high temperatures (>900˚C) [*Cherniak and Watson*, 2000] that the U-Pb age measured in zircon in generally taken as the crystallization age of the mineral.

3. Geologic History of East Antarctica:

The bulk East Antarctica was formed during the Precambrian. It comprises a number of Archean cratons, surrounded by orogenic belts and accreted terranes of Proterozoic and younger ages (e.g., [*Tingey*, 1991]) (Figure 2).

The amalgamation of the continents to form the supercontinent Rodinia ~ 1100 Ma led to widespread occurrence of terranes with approximately Grenville (900-1300 Ma) ages. Fitzsimons [2000] compiled available U-Pb zircon data, and defined three distinct Grenville-aged zones in East Antarctica: Droning Maud land (1090-1030 Ma), Prydz Bay or Rayner Province (990-900 Ma), and Wilkes Land (1330-1130 Ma). The timing of the subsequent break-up of Rodinia remains controversial (as does the existence of Rodinia itself), with different studies arguing for different ranges of ages that span 1000 to 520 Ma, and for either continuous or multiphase rifting [*Goodge et al.*, 2002; *Cordani et al.*, 2003; *Meert and Torsvik*, 2003; *Veevers*, 2004].

A re-assembly of the continents occurred soon after rifting, with East Gondwana (India, Australia, and East Antarctica) colliding with West Gondwana (South America and Africa) to form Gondwanaland. During this time of continental amalgamation, two temporally close orogenies, the Pan-African and the Ross-Beardmore, affected the EAC.

The Pan-African orogeny (650-500 Ma) was the result of the Gondwana blocks colliding to form Gondwana, while the Ross orogeny (~400-550 Ma) was the result of collision between Gondwana and what would become the Pacific plate [*Tingey*, 1991]. During these partly

contemporaneous orogenies, the continued attachment of East Antarctica, India and Australia meant that parts of the craton - specifically Wilkes Land and part of Adélie Land - were buffered from the intense tectonothermal activity associated with these orogenies. The evidence for this buffering is the lack of a high-temperature overprint signal in the ages of in situ and detrital zircons and hornblendes; these parts of East Antarctica still maintain Grenville and Paleoproterozoic ages in $^{40}Ar/^{39}Ar$ hornblende and U-Pb zircon ages [*Tingey*, 1991; *Anderson*, 1999; *Peucat et al.*, 1999; *Fitzsimons*, 2000; *Di Vincenzo et al.*, 2007; *Roy et al.*, 2007; *Pierce et al.*, 2011]. This geologic history has left East Antarctica with dominant, characteristic age populations of ~3.0 Ga (cratons), 900-1300 Ma (Grenville Orogeny) and 400-600 Ma (Pan-African/Ross Orogenies).

4. Cenozoic East Antarctic Ice Sheet History

While much of what we know about EAIS history comes from the examination of the marine sediment record, many of the proxies for ice volume, e.g. oxygen isotopes in benthic foraminifera (Figure 3) offer a view of the ice sheet as a whole, and are unable to pinpoint specific areas of dynamic behavior, such as ice retreat from a particular subglacial basin. Thus, while studies of IRD concentrations alone can offer insights to overall ice-sheet behavior, studies that pair IRD measurements with provenance work can offer a more refined picture of ice-sheet behavior (e.g., *Hemming et al.* [1998; 2000]; *Williams et al.* [2010]; *Teitler et al.* [2010]) since they will indicate where the ice sheet is being most dynamic (and producing debris-rich icebergs). The development of multiple provenance tracers for East Antarctic IRD, both in terms of tracers used and a better characterization of the source areas, will play an important role in

further developing our understanding of how the EAIS has responded to changes in climate in the past.

It is generally agreed that the first major growth of the ice sheet occurred at the Eocene-Oligocene boundary (~34 Ma), as inferred by a relatively rapid ~1.0‰ increase in the oxygen isotope composition of benthic foraminifera [*Zachos et al.*, 2001; *Miller et al.*, 2005; *Zachos et al.*, 2008]; contemporary to this increase in $\delta^{18}O$ values is the appearance of ice-rafted detritus in the marine record, a further indication of glaciation [*Kennett*, 1977; *Zachos et al.*, 1992]. What caused the initial growth of the ice sheet at this time is still under debate, two contending hypotheses are that either the thermal isolation of Antarctica following the opening of the Drake Passage [*Kennett and Shackleton*, 1976] was responsible, or that the lowering of atmospheric CO_2 concentrations below a threshold of 2 to 3 times pre-industrial values allowed for the growth of the ice sheet [*DeConto and Pollard*, 2003]. Zachos *et al.* [1993] report that the ice sheet initially had a mass equivalent to at least 70% the of the present Antarctic ice sheet, and that the size of the ice sheet then declined through the latter part of the Oligocene due to warming. Coxall *et al.* [2005], however find that a face-value reading of the $\delta^{18}O$ data indicate that the initial ice volume was larger than present day, in agreement with Pekar and Chrsitie-Blick [2008], who find that ice volume varied slightly around 100% of today's EAIS volume at the Eocene-Oligocene boundary. During the Oligocene, the EAIS oscillated in size but was a permanent feature, based primarily on benthic foraminifera $\delta^{18}O$ values (and on limited IRD records) [*Zachos et al.*, 1993], and Pekar and Christie-Blick [2008] report on EAIS volumes ranging from ~ 25% to 100% of today's value during the this period.

The mid-Miocene climate transition (~14 Ma, Figure 4) is the second most significant event in the evolution of the East Antarctic Ice Sheet, following its inception ~34 Ma. At this

time another sharp increase in the benthic $\delta^{18}O$ record of ~1‰ [*Flower and Kennett*, 1994; *Zachos et al.*, 2001; *Shevenell et al.*, 2004; *Holbourn et al.*, 2005; *Shevenell et al.*, 2008; *Zachos et al.*, 2008] accompanied by a cooling of both surface [*Shevenell et al.,* 2004] and deep [*Flower and Kennett*, 1994; *Lear et al.*, 2000] ocean temperatures and an increase in the northward extent of IRD [*Kennett*, 1977] are evidence of major ice sheet growth.

Following this second, major expansion, opinions diverge as to the stability of the EAIS [*Kennett*, 1977; *Webb*, 1990; *Sugden et al.*, 1993]. For example, Hambrey and McKelvey [2000] argue for a dynamic EAIS starting in the earliest Oligocene and continuing through the Pliocene, based on evidence from the sedimentary record of the Pagodroma Group in the Lambert Graben (Prydz Bay). The Lambert Graben drains one-eighth of the EAIS, and the sedimentary record preserved in the Pagodroma Group indicates major excursions and retreats of the ice sheet since the earliest Oligocene, which would indicate significant changes in ice volume and sea level [*Hambrey and McKelvey*, 2000]. Shifts in the provenance of IRD delivery to Ocean Drilling Program (ODP) Site 1165 in Prydz Bay also support the idea of an unstable EAIS, particularly the area overlying the Aurora subglacial basin (Wilkes Land), during the late Miocene [*Williams et al.,* 2010]. $^{40}Ar/^{39}Ar$ dating of ice-rafted hornblendes indicate delivery of IRD to ODP 1165 at this time requires transport of icebergs from >1500 km away; these ice-rafting events are likely analagous to late Pleistocene Heinrich events of the North Atlantic [*Williams et al.,* 2010].

The modeling results of Huybrechts [1993] however, support the concept of quasi-stable EAIS from the mid-Miocene transition through the Pliocene, arguing that 1) the presence of the high-elevation Transantarctic and Gamburtsev Mountains allows for a persistent ice sheet during warming periods and 2) given the that Antarctica is a polar desert, a small warming (up to 5 K)

would increase the surface mass-balance of the EAIS, and it would require warming exceeding 15 K, a warming larger than indicated during this time period, to collapse the ice sheet.

The stability of the EAIS during the Pliocene is still a mater of debate. EAIS volume was slightly reduced during the early Pliocene (~5-3 Ma), when atmospheric CO_2 concentrations were ~ 30% higher than at present, global temperatures were 3˚ warmer, and global sea level reached 10-20 m higher [*Ravelo et al.*, 2004]. Specifically, the mid-Pliocene (~3.3-3.0 Ma) is viewed as a time when EAIS volume must have been reduced given maximum sea level estimates of 25 m higher than present [*Kennett and Hodell*, 1993]; if both Greenland (7 m of sea level) and the WAIS (5 m of sea level) melted, the difference of 15 m of sea level rise can only be explained by melting of the EAIS [*Raymo et al.*, 2006]. Raymo *et al*. [2006] further hypothesize that a dynamic EAIS persisted up to ~ 1 Ma, fluctuating at a 23 kyr periodicity, out of phase with northern hemisphere ice. Also consistent with a dynamic Pliocene ice-sheet are decreases in $\delta^{18}O_{SW}$ reported by [*Raymo et al.*, 2006].

Modeling results for this period offer different results on EAIS behavior during the Pliocene. Pollard and DeConto [2004] used a coupled ice-sheet/global circulation model (GCM) to look at EAIS dynamics during this period, and their results indicate little retreat of the EAIS in the low-lying Wilkes and Aurora subglacial basins during the Pliocene. Hill *et al.* [2007] also used a coupled ice-sheet/GCM to model Pliocene ice-sheet dynamics, indicating that while there was no wide-spread de-glaciation of East Antarctica, there was significant inland retreat of the EAIS in the areas of the Wilkes and Aurora subglacial basins. The IRD provenance study of Williams *et al.* [2010] also supports the idea of a dynamic Pliocene ice sheet, with evidence for large ice-rafting events at 4.8 Ma and 3.5 Ma, delivering IRD from the Adélie Land (Wilkes subglacial basin) and Wilkes Land (Aurora subglacial basin), respectively, to ODP Site 1165.

5. Outline of Thesis

In the second chapter, I use a combination of sedimentary provenance approaches to characterize sources of IRD along the East Antarctic margin (95˚ to 165˚E). This sector includes the Wilkes and Aurora basins, which are large, low-lying sub-glacial basins that may cause areas of ice weakness in the overlying East Antarctic ice sheet (EAIS). Previous work based on IRD provenance analyses found evidence for massive iceberg discharges from these areas during the late Miocene and Pliocene. In this chapter I characterize the sediments shed from the inferred areas of weakness along this margin by measuring $^{40}Ar/^{39}Ar$ ages of individual detrital hornblende and biotite grains from eight marine sediment core locations off East Antarctica, in addition to the neodymium isotopic compositions of the bulk fine fraction from the same sediments. From this work we conclude that (1) Four main sectors between the Ross Sea and Prydz Bay, separated by ice drainage divides, are distinguishable based upon the combination of $^{40}Ar/^{39}Ar$ ages of detrital hornblende and biotite grains and the ε_{Nd} of the bulk fine fraction, (2) $^{40}Ar/^{39}Ar$ biotite ages can be used as a robust provenance tracer for this part of East Antarctica, and (3) sediments shed from the coastal areas of the Aurora and Wilkes sub-glacial basins can be clearly distinguished from one another based upon their isotopic fingerprints. This work is collaborative with Sidney Hemming (Columbia University/L-DEO), Trevor Williams (L-DEO), Steve Goldstein (Columbia University/L-DEO), Tina van de Flierdt (Imperial College London) and Stefanie Brachfeld (Montclair State University), and was published as Pierce *et al.* [2011] in the journal *Paleoceanography*.

My third chapter is a comparison of the U-Pb zircon and $^{40}Ar/^{39}Ar$ hornblende and biotite systems for detrital provenance studies. U-Pb ages of detrital zircon grains provide an

extraordinary tool for sedimentary provenance work, given that they are ubiquitous, resistant to damage and weathering, and that the U-Pb age records the crystallization age of the mineral. Although not as widely used, $^{40}Ar/^{39}Ar$ dating of detrital hornblende grains can also serve as a powerful sedimentary provenance tool, particularly in situations where chemical weathering is minor. Certain natural biases exist between these mineral chronometers, e.g. zircon is an accessory mineral while hornblende and biotite are rock-forming minerals. Additionally, the $^{40}Ar/^{39}Ar$ system in hornblende and biotites has a closure temperature of ~500˚C and ~300˚C, respectively. Thus, for areas that have experienced a polymetamorphic history such as East Antarctica, combining these approaches can provide added detail to provenance studies. In this study I compare detrital $^{40}Ar/^{39}Ar$ hornblende, $^{40}Ar/^{39}Ar$ biotite and U-Pb zircon age populations from 28 marine sediment cores around East Antarctica (~30˚W to ~170˚E). This work is collaborative with Sidney Hemming (Columbia University/L-DEO), Trevor Williams (L-DEO), Tina van de Flierdt (Imperial College London), Stefanie Brachfeld (Montclair State University), George Gehrels (University of Arizona), Steve Goldstein (Columbia University/L-DEO), Pete Reiners (University of Arizona) and Stuart Thomson (University of Arizona), and is being submitted to the journal *Earth and Planetary Science Letters*.

My fourth chapter is a detailed examination of ice-rafted detritus peaks spanning the mid-Miocene climate transition (MMCT). The MMCT was a global climatic change occurring ~ 14 Ma, that had a profound effect on many Earth systems, including terrestrial biota, ocean circulation, ocean and terrestrial temperatures, sea-level and ice volume. Despite inferences on the total amount of ice growth on Antarctica as a whole, and agreement that this climatic transition marks a major step in the growth of the EAIS, little is known about the spatial evolution of the EAIS over the MMCT. In this study I apply geochemical measurements (e.g.

$^{40}Ar/^{39}Ar$ dating of hornblende and neodymium isotopes on the terrigenous <63 μm fraction) to samples from IODP Site U1356 in order to characterize the behavior of the EAIS in the vicinity of the Wilkes sub-glacial basin through this important transition. This work is collaborative with Tina van de Flierdt (Imperial College London), Sidney Hemming (Columbia Unviversity/L-DEO), Trevor Williams (L-DEO), Carys Cook (Imperial College London), Sandra Passchier (Montclair State University) and the IODP 318 Expedition Science Party, and is being submitted to the journal *Paleoclimatology, Paleocology, Paleoceanography.*

Overall, this work demonstrates the efficacy of isotopic and geochronological provenance tools for studying East Antarctica's geologic and ice sheet history. With this work I have generated an extensive data set of U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite data from around East Antarctica, which have identified new age populations and geologic terranes that have not been identified before; I have demonstrated that the application of these tools, in particular the $^{40}Ar/^{39}Ar$ ages of detrital hornblende and biotite grains, is extremely valuable for determining the provenance of ice-rafted material, which in turn informs us of where the ice sheet was most actively eroding and entraining material. Furthermore the application of this approach to studying East Antarctic ice-sheet dynamics across the mid-Miocene Climate Transition (~14 Ma), one of the most important periods of East Antarctic ice sheet growth, highlights the powerful potential for future discoveries.

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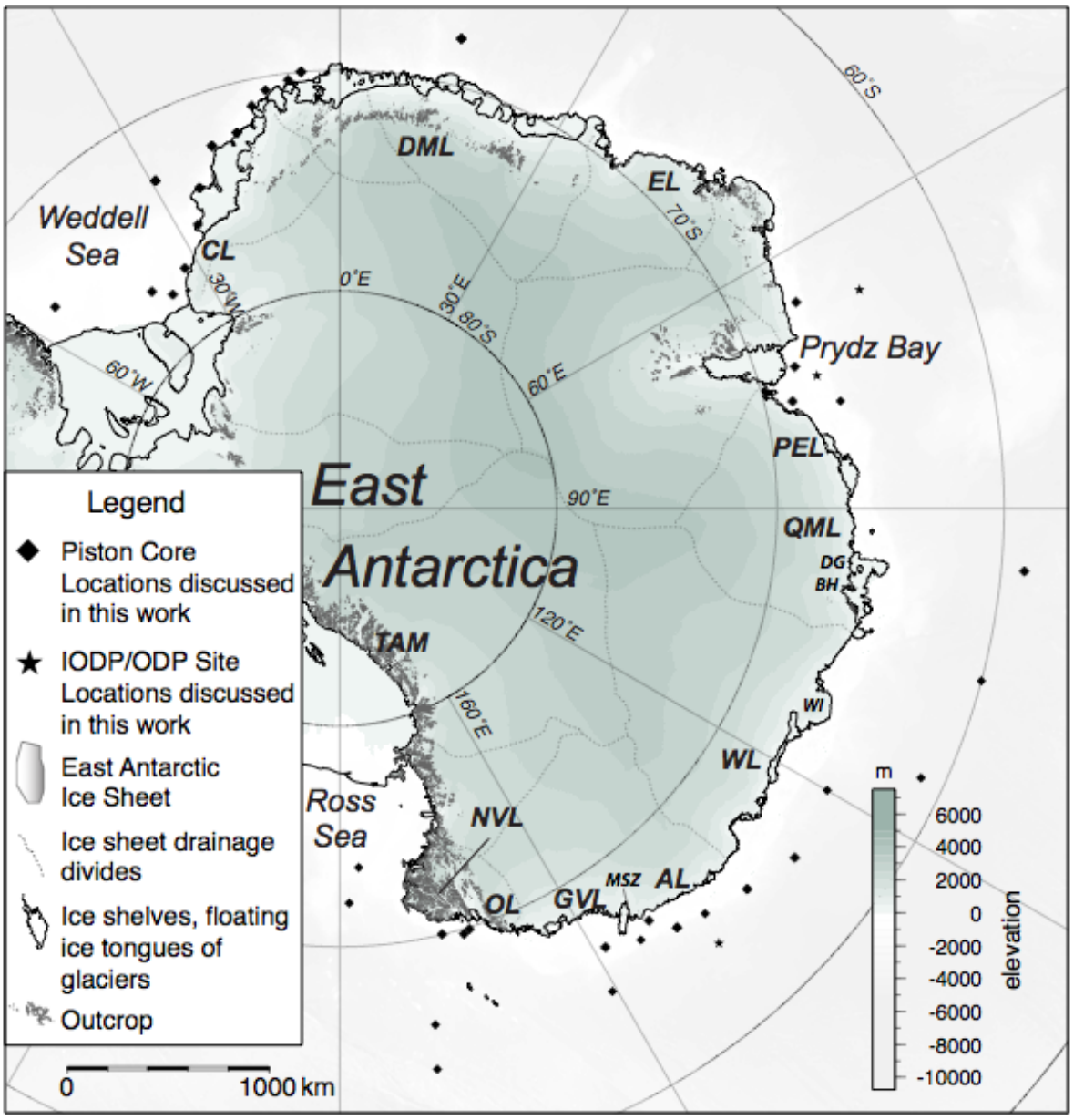


Figure 1. Map of East Antarctica showing marine sediment core locations discussed in this work, East Antarctic ice sheet thickness and extent, and outcrop locations. CL – Coats Land; DML – Droning Maud Land; EL – Enderby Land; PEL – Princess Elizabeth Land; QML – Queen Mary Land; DG – Denman Glacier; BH – Bunger Hills; WI- Windmill Islands; WL – Wilkes Land; AL – Adélie Land; GVL – George V Land; MSZ – Mertz Shear Zone; OL – Oates Land; NVL – Northern Victoria Land; TAM – TransAntarctic Mountains.

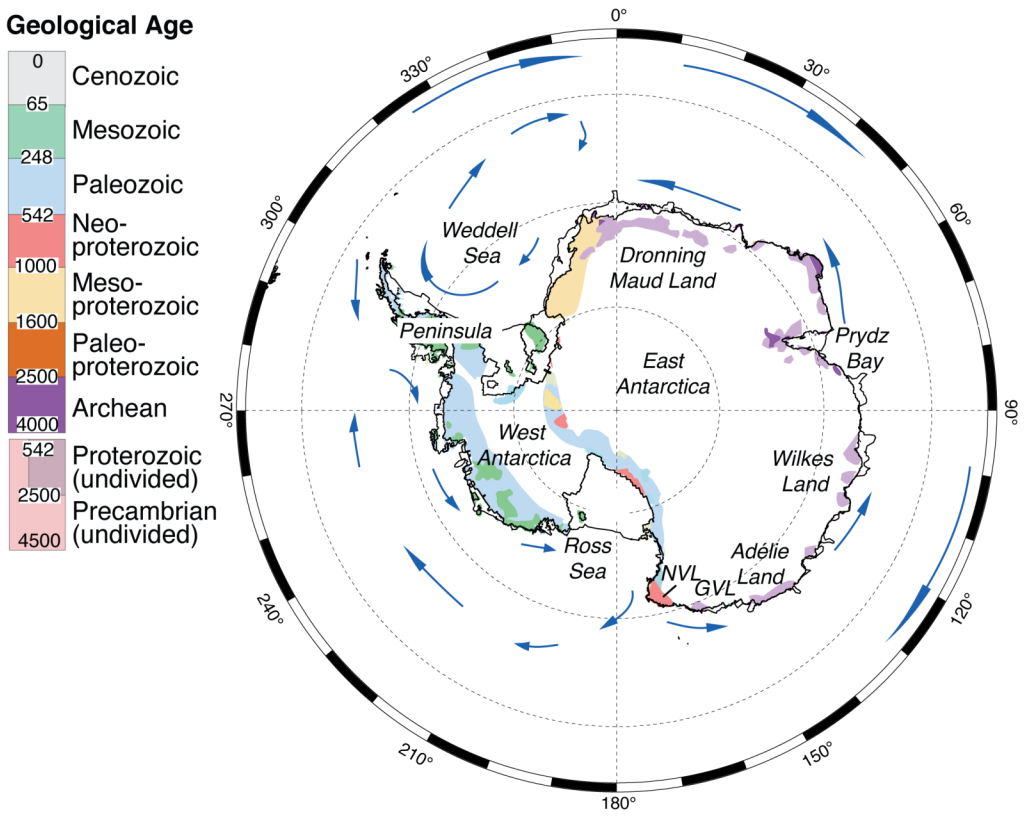


Figure 2. Map of East Antarctica showing basic geologic divisions (taken from Collins and Pisarevsky [2005]; modified from Roy *et al.* [2007]. GVL – George V Land; NVL – Northern Victoria Land.

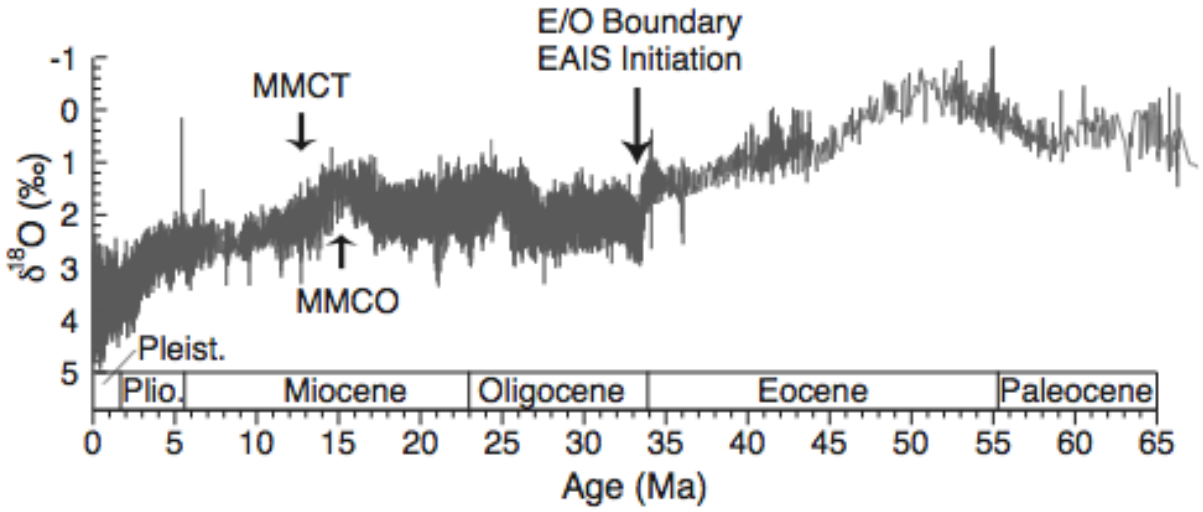


Figure 3. Cenozoic oxygen isotope record, modified from Zachos *et al*. [2008]. EAIS – East Antarctic Ice Sheet; E/O Boundary – Eocene/Oligocene Boundary; MMCO – Mid-Miocene Climatic Optimum; MMCT – Mid-Miocene Climate Transition.

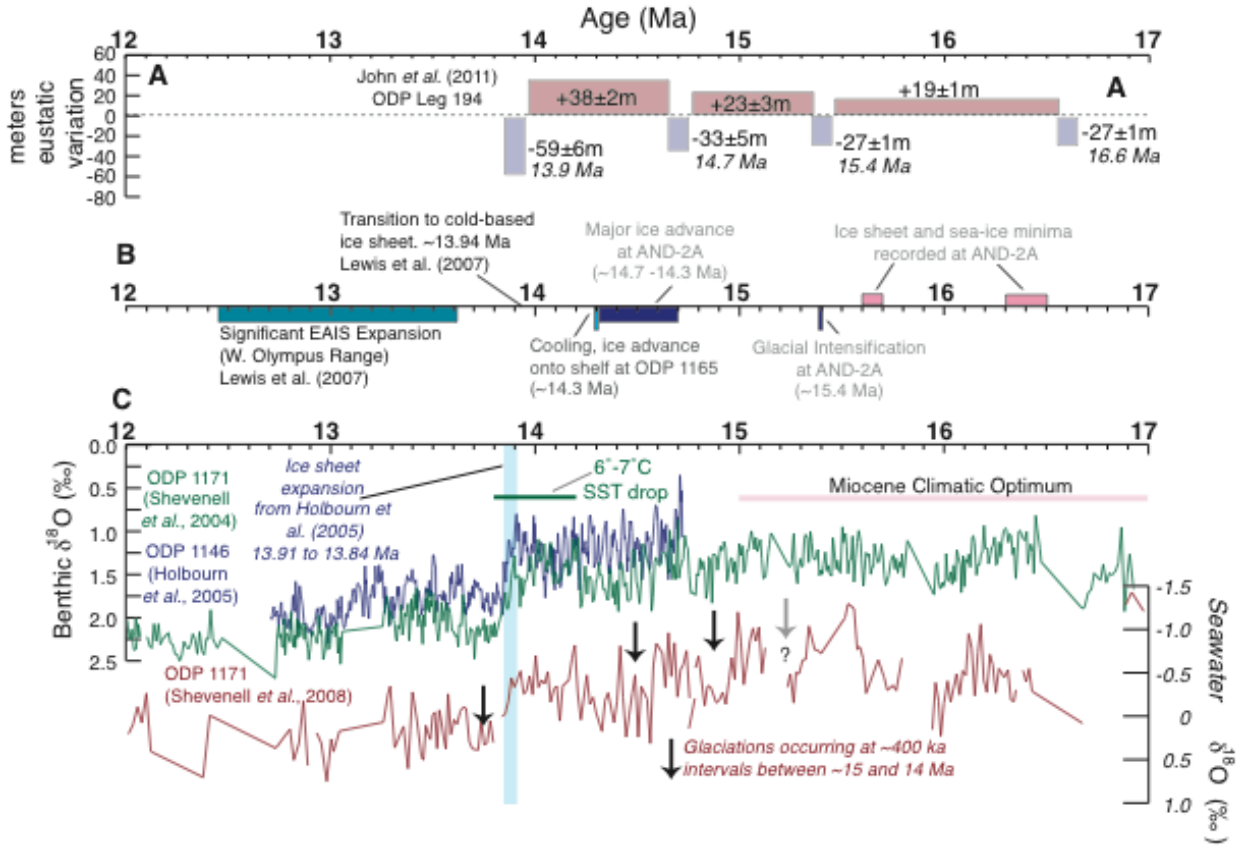


Figure 4. Compilation of records from across the mid-Miocene climate transition. **A**) Eustatic variations based on backstripped sediments from ODP Leg 194 (Marion Plateau, off the northwestern coast of Australia). Sea-level changes are the 'best combined estimates' from Fig. 7 in John *et al.* [2011]. The observed overall eustatic sea-level drop of 53-69m between 16.5 Ma and 13.9 Ma implies growth of > 90% of the East Antarctic ice sheet. **B**) EAIS behavior from ANDRILL-2A [*Passchier et al.*, 2011], from ODP Site 1165 [*Florindo et al.*, 2003] and from the Dry Valleys [*Lewis et al.*, 2006; *Lewis et al.*, 2007]. **C**) Benthic oxygen isotope records from ODP Site 1171 [*Shevenell et al.*, 2004] and ODP Site 1146 [*Holbourn et al.*, 2005], in addition to the sea-water oxygen isotope record from ODP Site 1171 [Shevenell et al., *2008*].

Chapter 2: Characterizing the sediment provenance of East Antarctica's weak underbelly: the Aurora and Wilkes sub-glacial basins

Abstract

The Wilkes and Aurora basins are large, low-lying sub-glacial basins that may cause areas of weakness in the overlying East Antarctic ice sheet (EAIS). Previous work based on ice-rafted debris (IRD) provenance analyses found evidence for massive iceberg discharges from these areas during the late Miocene and Pliocene. Here we characterize the sediments shed from the inferred areas of weakness along this margin (94˚E to 165˚ E) by measuring $^{40}Ar/^{39}Ar$ ages of 292 individual detrital hornblende grains from eight marine sediment core locations off East Antarctica and Nd isotopic compositions of the bulk fine fraction from the same sediments. We further expand the toolbox for Antarctic IRD provenance analyses by exploring the application of $^{40}Ar/^{39}Ar$ ages of detrital biotites; biotite as an IRD tracer eliminates lithological biases imposed by only analyzing hornblendes and allows for characterization of samples with low IRD concentrations.

Our data quadruples the number of detrital $^{40}Ar/^{39}Ar$ ages from this margin of East Antarctica and leads to the following conclusions: (1) Four main sectors between the Ross Sea and Prydz Bay, separated by ice drainage divides, are distinguishable based upon the combination of $^{40}Ar/^{39}Ar$ ages of detrital hornblende and biotite grains and the ε_{Nd} of the bulk fine fraction, (2) $^{40}Ar/^{39}Ar$ biotite ages can be used as a robust provenance tracer for this part of East Antarctica, and (3) sediments shed from the coastal areas of the Aurora and Wilkes sub-glacial basins can be clearly distinguished from one another based upon their isotopic fingerprints.

1. Introduction

1.1. East Antarctic Ice Sheet history

Much of what we know about the evolution of the East Antarctic Ice Sheet (EAIS) comes from an examination of marine sediments. Much of what we know from marine sediments, however, tells us about changes in the ice sheet as a whole, rather than changes in a specific region, e.g., $\delta^{18}O$ recorded in benthic and planktic foraminera [*Shackleton and Kennett*, 1975; *Kennett and Shackleton*, 1976; *Kennett*, 1977; *Zachos et al.*, 1992; *Zachos et al.*, 1993; *Zachos et al.*, 2001; *Miller et al.*, 2005], $\delta^{18}O$ paired with Mg/Ca measurements in foraminifera [*Flower and Kennett*, 1994; *Lear et al.*, 2000; *Billups and Shrag*, 2002; *Billups and Schrag*, 2003; *Shevenell et al.*, 2004], the presence of ice-rafted debris (IRD) [*Kennett*, 1977], calibrating $\delta^{18}O$ records with sea-level records [*Pekar and DeConto*, 2006], and seismic stratigraphy [*Escutia et al.,* 2005]. Due to the fact that 98% of East Antarctica is covered by thick ice, few areas exist where glacial features pre-dating the last glacial maximum are preserved at the surface (e.g., the Lambert Graben, [*Hambrey and McKelvey*, 2000] and the Dry Valleys [*Marchant et al.*, 1993; *Lewis et al.*, 2006; *Lewis et al.*, 2007]), and hence many insights into past ice sheet dynamics in a given area have to rely on modeling studies (e.g., [*Huybrechts*, 1993; *DeConto and Pollard*, 2003; *Hill et al.*, 2007]).

One way in which to evaluate the past stability of specific areas of the EAIS is to examine the provenance of glacially derived marine sediments. As ice flows over the continent, it erodes and entrains bedrock material. When the ice flow reaches the terminal point at the edge of the ice sheet, it can calve off into the ocean, forming icebergs that melt and drop their entrained material (IRD) as they travel in the ocean currents, e.g. [*Ruddiman*, 1977]. If the IRD possesses characteristics that allow it to be traced back to a specific geologic area, for example,

based on geochemistry or lithology, the delivery and accumulation of IRD to the ocean floor can provide a means for identifying changes in ice sheet behavior that can be linked to a specific source area, rather than the overall ice sheet. Geochemical provenance studies of IRD have been used successfully in the Northern Hemisphere to determine the source of the icebergs that delivered debris to the ocean, and thus the part of the ice sheet that underwent collapse [*Grousset et al.*, 1993; *Gwiazda et al.*, 1996; *Hemming et al.*, 1998; *Hemming et al.*, 2002; *Farmer et al.*, 2003; *Hemming*, 2004]. In general, studies that use geochemical characteristics of ice-rafted debris allow for a more detailed identification of source areas than studies of lithologic composition of the grains. The changing provenance of the IRD in the marine sediment record can then be interpreted in terms of past ice-sheet dynamics [*Gwiazda et al.*, 1996; *Hemming et al.*, 2002; *Hemming*, 2004; *Williams et al.*, 2010]

In this paper we focus on characterizing sediments shed from the margin of East Antarctica that lies between Prydz Bay and the Ross Sea (94˚E to 165˚ E). There are two reasons that motivate us to study this particular area of East Antarctica. First, the low-lying Wilkes and Aurora sub-glacial basins are contained within this sector and drain along this part of the East Antarctic margin. These are potential areas of instability to the EAIS due to the fact that the majority of both basins lies more than 500 m below sea-level [*Mercer*, 1978] (Figure 1). Second, previous evidence from a down-core study of the $^{40}Ar/^{39}Ar$ ages of individual ice-rafted hornblende grains in IRD-rich layers from Site 1165 of ODP Leg 188, located 400 km offshore of Prydz Bay and > 1500 km west of this sector, has been interpreted to indicate past instability of the EAIS along the Wilkes and Adélie Land coasts [*Williams et al.*, 2010] (Figure 1). We find it significant that the inferred source areas of this IRD coincide with the two sectors of the EAIS that are underlain by the vast sub-glacial Wilkes and Aurora basins (Figure1). If it is confirmed

that these two sub-glacial basins have been a locus of weakness in the ice sheet during warmer times in the past, they may pose a threat to EAIS stability in the future as Earth continues to warm.

Fundamental to any sedimentary provenance study is knowledge of the composition of potential source areas for the sediment that is being traced; this is a particular challenge in Antarctica where nearly the entire continent is covered by thick ice. By looking at glacially-derived marine sediments near East Antarctica we aim to provide information pertaining to the geology that is covered, in addition to adding information to areas where limited outcrops have been previously studied. Large parts of the coastlines of the Wilkes and Aurora sub-glacial basins have no outcrops, and therefore marine sediments provide our sole window into their sub-glacial geology.

1.2. Geochemical Provenance Tools

1.2.1. Nd bulk isotopes and $^{40}Ar/^{39}Ar$ ages of individual minerals

When choosing provenance tracers for a given sedimentary process, there are several important questions to consider. What are the potential lithologic sources of that tracer? Will all of the source areas be represented by this measurement, or will the measurement be biased toward a particular suite of rock types? To what extent are the source areas geochemically distinguishable from one another? In the case of mineral tracers, as in this study, it is important to consider what lithologies contain the minerals of interest, and if the minerals are a major constituent of those lithologies. Both hornblendes and biotites are major rock-forming minerals, and, combined, cover a wide spectrum of lithologies from felsic to mafic igneous rocks, and from low to high-grade metamorphic rocks. Neodymium isotopes on the bulk fine fraction

measure the integrated signal of the source area, as Nd can be derived from essentially any lithology, though in varying concentrations depending upon the source lithology [*Taylor and McLennan*, 1995; *Rudnick and Gao*, 2003].

Since 98% of Antarctica is obscured by ice, our approach to characterizing source areas for sediments cannot be as direct as an approach used to characterize an exposed coastline, where the exact sample locations are known. Using $^{40}Ar/^{39}Ar$ hornblende ages, $^{40}Ar/^{39}Ar$ biotite ages, and bulk <63mm ε_{Nd} values in marine sediments, we can however place constraints on processes such as glacial-marine sedimentation and ice-rafting and thus gain improved insights on geochemical provenance signatures. It is these signatures that we are trying to understand over the course of the evolution of the EAIS. Ice-rafting and the delivery of material by this process to a particular core site is ultimately dependent on the prevailing ocean currents. Around East Antarctica the westward flowing coastal current is the main transport mechanism for icebergs, potentially leading to a greater dispersal of IRD from a given sector. While *Roy et al.* [2007] found that icebergs around Antarctica today deposit IRD relatively close to their source area, material from one provenance sector could potentially be deposited offshore of another provenance sector.

The advantage to combining individual mineral measurements with bulk isotope measurements is that measuring the $^{40}Ar/^{39}Ar$ ages of individual minerals allows for characterization of all end-members, while the bulk isotope measurements represent the integration of all end-members. Additionally, by using glacially-derived sediments to characterize potential source areas, we are studying sediments that represent an integrated characterization of the lithology of a source area, even under ice cover. This way we can avoid

any bias in characterizing source areas that would arise if we only looked at on-land point-source measurements, which may not represent the true range of lithologies or isotopic compositions.

Limited outcrops and a circum-Antarctic core-top survey measuring $^{40}Ar/^{39}Ar$ ages in hornblende grains [*Roy et al.,* 2007] allow for a systematic division of East Antarctica into several sectors based on the ages of known, major tectonothermal events. *Roy et al.* [2007] also measured the epsilon (ε_{Nd}) neodymium values of the < 63 μm fraction; ε_{Nd} values are calculated as the deviation of the sample from the Chondritic Uniform Reservoir (CHUR) value ($^{143}Nd/^{144}Nd = 0.512638$),

$$\varepsilon_{Nd} = \left[\frac{^{143}Nd/^{144}Nd_{sample}}{^{143}Nd/^{144}Nd_{CHUR}} - 1 \right] x10{,}000$$

after [*Jacobsen and Wasserberg*, 1980]. *Roy et al*. [2007] identified the margin of East Antarctica from the Ross Sea west to Prydz Bay as a single 'Wilkes Land' sector, owing to limited numbers of IRD grains in the western half of this sector. However, this sector can be divided into two separate provinces based on zircon U-Pb ages from Antarctic outcrops and from the counterpart provinces exposed in Australia (e.g., [*Fitzsimons*, 2000]).

Previous work using $^{40}Ar/^{39}Ar$ hornblende ages as an IRD provenance tool inferred that the Wilkes and Adélia Land margins in East Antarctica were sources of IRD. Based on $^{40}Ar/^{39}Ar$ hornblende evidence for ca. 1100-1300 Ma sources in two layers and ca. 1500 Ma sources in a third layer from ODP Site 1165, *Williams et al.* [2010] reasoned that these two ages represent the Wilkes Land margin and the Adélie Coast, respectively, and potentially the Aurora and Wilkes sub-glacial basins. However, this inference was based on sparse source characterization data.

1.2.2. Biotite $^{40}Ar/^{39}Ar$ as an IRD tracer

In addition to providing an extensive new data set on $^{40}Ar/^{39}Ar$ ages of ice-rafted hornblende grains and bulk Nd isotopes, we investigated the potential for $^{40}Ar/^{39}Ar$ ages of individual biotite grains to be used as a tracer of IRD provenance in the Southern Ocean. First, initial observations of the >150 μm size fraction of the piston core samples used in this study revealed that in addition to a large number of hornblende grains, there are also a large number of biotite grains in most samples (Figure 2). As both minerals are major rock-forming minerals, this is not particularly surprising. Second, $^{40}Ar/^{39}Ar$ ages can be reliably measured on biotites in the 63-150 μm size fraction, due to their high potassium (and thus radiogenic argon) concentrations. This would make it possible to extend our studies to sites in the Southern Ocean where 63-150 μm biotite IRD grains are present in sufficient concentrations to define populations from the provenance source areas, but less-common >150 μm hornblende and biotite grains are not. Third, the combination of hornblende and biotite $^{40}Ar/^{39}Ar$ ages from the glacially-derived sediment in the piston cores is valuable because hornblende begins to retain ^{40}Ar at ~ 500˚C, while biotites begin to retain ^{40}Ar at ~300˚C [*Reiners et al.*, 2005]. Given the polymetamorphic history of East Antarctica, using two thermochronometers to further constrain the geologic age provenances could be advantageous as we may be able to apply these data to infer the metamorphic history of East Antarctica. Furthermore, the biotites may have ages different from the hornblendes, due either to the cooling rate following the last tectonothermal event, low temperature re-setting of the $^{40}Ar/^{39}Ar$ biotite ages, or both, which could potentially allow for further refinement of the provenance sectors that we are trying to characterize. Finally, by analyzing both biotites and hornblendes, we are increasing our representation of source areas as these two minerals

collectively represent a wide array of lithologies. Hence we can also assess any lithological bias in the provenance data from one mineral alone.

1.3. Goals for this study

Our goals for this study are: (1) to provide detailed constraints on the geochemical characterizations ($^{40}Ar/^{39}Ar$ and Nd isotopic composition) of the terrigenous material shed from the ice sheet in the inferred areas of past East Antarctic ice sheet instability between 94˚ and 165˚ E, which includes the Wilkes and Aurora sub-glacial basins. In order to provide a robust geochemical framework for the interpretation of EAIS evolution, we refine the *Roy et al.* [2007] study, which characterized this margin of East Antarctica as one provenance sector based upon sparse individual $^{40}Ar/^{39}Ar$ hornblende and ε_{Nd} measurements, and (2) to explore the use of $^{40}Ar/^{39}Ar$ biotite ages for IRD provenance studies in East Antarctica. In addition to evaluating $^{40}Ar/^{39}Ar$ biotite ages for characterizing the source areas between 94˚ and 165˚ E, we also present $^{40}Ar/^{39}Ar$ ages of ice-rafted biotite grains from the same depositional layers that *Williams et al.* [2010] used for measuring $^{40}Ar/^{39}Ar$ hornblende ages.

2. Importance of the Wilkes and Aurora Sub-glacial Basins

The Wilkes and Aurora basins of East Antarctica are large, low-lying sub-glacial basins extending from the center of the East Antarctic continent towards the George V/Adélie and Wilkes Land coastlines, respectively. The inference that these basins are potential foci for past and future ice sheet instability is based upon their elevation below sea-level [*Mercer*, 1978; *Drewry*, 1983] (Figure 1), the presence of many sub-glacial lakes in the hinterland [*Siegert et al.*, 2005a], and the hydrologic connection between the sub-glacial lakes and the margins of the ice

sheet [*Siegert et al.*, 2005a; *Siegert et al.*, 2005b; *Wingham et al.*, 2006; *Jordan et al.*, 2010]. It is becoming increasingly apparent that sub-glacial water plays an important role in ice dynamics [*Bell*, 2008], and further studies of the link between the sub-glacial lakes, the Wilkes and Aurora sub-glacial basins and ice sheet dynamics are an important goal for future studies of EAIS stability. Potential links between these are developed in *Erlingsson* [1994] and *Alley et al.* [2006], who both presented models for ice sheets overriding and 'capturing' lakes, which subsequently leads to the growth of the sub-glacial lake due to melting, and finally to jökuhlaups, in turn leading to ice stream surges. Evidence for instability in these regions also comes from modeled studies of past ice-sheet behavior e.g., [*Huybrechts*, 1993; *Hill et al.*, 2007], which show that warming leads to initial retreat of the EAIS in these regions, even in models that predict a relatively stable EAIS have some ice margin retreat in these areas [*Pollard and DeConto*, 2009].

Evidence from the marine sedimentary record for instabilities in this region comes from *Williams et al.* [2010], who argue for the collapse of ice streams feeding from these areas, leading to massive discharges of icebergs during the late Miocene and Early Pliocene as the best explanation for far-travelled ice-rafted hornblende grains observed at ODP Site 1165 in Prydz Bay (Figure 1). The $^{40}Ar/^{39}Ar$ hornblende ages from eight IRD layers in ODP Site 1165, spanning the Early Miocene to mid-Pliocene (19 – 3.5 Ma), show significant changes in provenance that are interpreted to reflect dynamic instability of the EAIS during warmer intervals [*Williams et al.,* 2010].

3. Sample Locations and Methods

3.1. Marine Sediment Core Locations and Sample Selection

The 16 core locations investigated are primarily located on the continental shelf, and form a transect around the perimeter of East Antarctica from 94˚ to 165˚ E, encompassing from west to east the Queen Mary Land, Wilkes Land, Adélie Coast, George V Land and Northern Victoria Land sectors.

Nine of the 16 samples provided by the Antarctic Marine Geology Repository at Florida State University (see Appendix A) yielded sufficient terrigenous sediment from the bottom layer of the piston core for analyses. We targeted the bottom layers of piston cores with the idea that these layers might be more likely to be rich in terrigenous material, assuming such layers would be difficult to penetrate with a piston core. We also assumed that the piston cores would not be able to penetrate far into glacial diamict, and that thus the samples would be no older than Last Glacial Maximum (LGM) in age. Further preliminary biostratigraphic study of the samples (C. Sjunneskog (AMGRF), personal communication) has revealed the ages for samples from Cores 5 and 15 (DF80-35 and ELT37-16) to be LGM/Holocene. The ages for the samples from Cores 7 (DF80-34) and 20 (ELT49-30) are however ~2.8-2.1 Ma and ~2-4 Ma, respectively (see Fig 1 and Table 1 for site locations). Further work is underway to constrain the ages of these samples. The working hypothesis that the bottom layers of piston cores would yield more terrigenous material was supported by the fact that we were able to find significantly more hornblendes from the core-bottom samples than *Roy et al.* [2007] found in core-top samples (see Cores 12 and 14 in Table 1). In addition to the core bottom samples, we sampled 2 layers (2305 and 2370 cm) of

LGM glacial diamict from sample location NBP01-01-JPC11 (Core 11, offshore Adélie Land; Figure 1 and Table 1) [*Leventer et al.*, 2006].

In order to determine the viability of $^{40}Ar/^{39}Ar$ biotite ages as a provenance tool for IRD in the Southern Ocean (see 1.2.2.) we measured biotites (63- 150 μm and >150 μm) from the same piston core samples discussed above for comparison with the $^{40}Ar/^{39}Ar$ hornblende ages. While we would not expect there to be a difference in the $^{40}Ar/^{39}Ar$ biotite ages from these two size fractions, we have decided measured $^{40}Ar/^{39}Ar$ biotite ages from both because 1) we traditionally have measured grains only in the >150μm fraction and 2) to eliminate any uncertainty that there might be a difference. As a second evaluation of the potential of biotite $^{40}Ar/^{39}Ar$ ages as an IRD tracer we analyzed biotites (>150 μm) from the same layers in ODP Site 1165 that were analyzed for hornblende $^{40}Ar/^{39}Ar$ ages by *Williams et al.* [2010], with depositional ages of 3.5, 4.65, 7.0 and 19.0 Ma (note that the 4.65 Ma depositional layer was originally reported by *Williams et al*. [2010] to have an age of 4.8 Ma; the age has since been refined to 4.65 Ma). The exact part of the core containing an interesting 1500 Ma population of $^{40}Ar/^{39}Ar$ hornblende ages during the IRD event at 4.65 Ma was completely sampled and hence we picked another layer, 1165B-6H1(70 cm), 30 cm upcore. This layer was also analyzed by *Williams et al.* [2010] as part of a sequence of samples spanning the '4.8 Ma event'.

3.2. $^{40}Ar/^{39}Ar$ Dating and $^{143}Nd/^{144}Nd$ Analyses

Bulk samples were dried, disaggregated and dispersed in de-ionized water, and sieved into the following size fractions: <63 μm, 63 to 150 μm and 150 μm to 1 mm. Following magnetic separations, hornblendes and biotites were handpicked (n > 30 when possible) from the 150 μm to 1 mm size fraction, with additional biotites picked from the 63-150 μm size fraction.

Hornblendes, biotites and standards were irradiated either at the Cd-lined in-core facility (CLICIT) at the Oregon State rector, or (also with Cd shielding) at the U.S. Geological Survey (USGS) TRIGA reactor in Denver, CO. $^{40}Ar/^{39}Ar$ ages were obtained using single-step CO_2 laser fusion at the Lamont-Doherty Earth Observatory (L-DEO) argon geochronology lab (AGES: Argon Geochronology for the Earth Sciences). J values used to correct for neutron flux were calculated using the co-irradiated Mmhb-1 hornblende standard (525 Ma; [*Samson and Alexander*, 1987]).

Neodymium isotopes were measured on the bulk <63 μm size fraction. For this study we did not remove any authigenic phases prior to analysis, because the Nd budget of marine sediments located close to the continent is assumed to be dominated by the terrigenous component. This assumption was confirmed to be valid as our Nd isotopic compositions from two sites that were previously analyzed by *Roy et al.* [2007] (samples that were leached prior to analyses) agree within error.

Approximately 0.1g ± 0.5% of sample and 0.4g ± 0.5% of lithium metaborate flux were weighed and mixed, and samples were fused at 1050˚C for 30 minutes. The molten sample was then dropped into 50 mL of 7% HNO_3 in a Teflon beaker and placed on a stir plate for 15 minutes to ensure dissolution. The pH of the samples was adjusted to 8 (using ammonium hydroxide) to precipitate iron, and co-precipitate the rare earth elements (REE). This approach leaves soluble elements such as boron and lithium from the flux and sodium, potassium and calcium from the sample in solution and thus reduces the ion load on the cation exchange column. Precipitates were rinsed with de-ionized water, and re-dissolved in 2N HCl. Neodymium was subsequently separated from the matrix by a two-step ion chromatography. Seven mL columns filled with AG50W-8X cation resin were used to separate the REE from the

matrix. The columns were cleaned with 10 mL of 4N HNO_3, equilibrated with 5 mL of 2N HCl, and the REEs were eluted with 10 mL of 4N HNO_3. The REE aliquot was dried down, taken up in 0.22N HNO_3, and then passed through 800 µL columns filled with Eichrom Ln-Spec resin to isolate the Nd from the other REEs. The columns were first cleaned with 6 mL of 3 N HCl, conditioned twice with 1 mL 0.22N HNO_3, and the Nd was eluted with 5.5 mL of 0.22N HNO_3. Neodymium isotope measurements were carried out in a static mode on the VG Axiom MC-ICP-MS at L-DEO. A $^{146}Nd/^{144}Nd$ ratio of 0.7219 was applied to correct for instrumental mass bias following the exponential law. Tests with doped standards showed that interferences from ^{144}Sm are adequately corrected, if the ^{144}Sm contribution is less than 0.1% of the ^{144}Nd signal. Samarium contributions of all our samples were significantly below that level. Repeated analyses of the JNdi standard during the two measurement sessions yielded $^{143}Nd/^{144}Nd$ ratios of 0.512116 ± 0.000020 (2sS.D., n =11) and 0.512097 ± 0.000013 (2s S.D., n =13). Since standards showed a drift over both analytical sessions, we bracketed sample runs by two standards on each side. Correction factors for samples were determined from averaged value of each set of four standards relative to the accepted JNdi value of 0.512115 (equivalent to a La Jolla value of 0.511858; [*Tanaka et al.*, 2000]).

4. Results

4.1. Marine Sediment Core Survey Around the East Antarctic Perimeter

We have measured an average of 78 (minimum of 29, maximum of 119) $^{40}Ar/^{39}Ar$ ages on individual hornblende and biotite grains from 8 marine sediment cores, in addition to measuring the ε_{Nd} of the bulk fine fraction from each sample. These measurements quadruple the

number of detrital $^{40}Ar/^{39}Ar$ analyses from glacial-marine sediments along this margin of East Antarctica.

$^{40}Ar/^{39}Ar$ hornblende and biotite ages and neodymium isotopic compositions from the marine sediment cores are summarized in Table 1, along with data on $^{40}Ar/^{39}Ar$ hornblende ages and neodymium isotopic compositions of the fine fraction from *Roy et al.* [2007] and *van de Flierdt et al*. [2008]. $^{40}Ar/^{39}Ar$ hornblende and biotite results are shown in Figure 3; neodymium isotope measurements are shown in Figure 4, and $^{40}Ar/^{39}Ar$ hornblende and biotite ages by core location are shown in Figure 5. Full results for all measurements are summarized in Figure 6 and can be found in Appendices B and C.

Three dominant $^{40}Ar/^{39}Ar$ age populations appear in our data: 400-550 Ma (Northern Victoria Land, George V Land and Prydz Bay), 1100-1200 Ma (Wilkes Land) and 1500-1800 Ma (Adélie Land), with 3 grains ~2500 Ma present in cores proximal to Adélie Land. Additional age populations include a < 50 Ma hornblende population, in which the majority are < 15 Ma, and a 300-400 Ma biotite population in cores off the coast of Northern Victoria Land (Table 1; Figure 3). Neodymium isotope measurements span a range of ~20 epsilon units from radiogenic values off Oates Land (ε_{Nd} = -3.3) to very unradiogenic values off Adélie Land (ε_{Nd} = -23.6) (Figure 4).

4.2. $^{40}Ar/^{39}Ar$ Biotite Ages from ODP Site 1165 (>150 μm size fraction)

Biotites were picked from the >150 μm size fraction of each of the four downcore samples, in order to compare the $^{40}Ar/^{39}Ar$ age distribution of the biotites with those of the hornblendes previously analyzed. Each sample contains a population of 450-550 Ma $^{40}Ar/^{39}Ar$ biotites ages, and an additional population 1100-1200 Ma of $^{40}Ar/^{39}Ar$ biotite ages(Figure 7).

5. Discussion

5.1. Characterization of IRD Source Areas

5.1.1. Geochemical characterization of ice drainage divides

Our new measurements of detrital $^{40}Ar/^{39}Ar$ hornblende and biotite grains, ε_{Nd} values allow us to identify 4 geologic provinces between 94˚E and 165˚E. As two of these geologic sectors coincide with ice-sheet drainages, and given our interest in applying these data to past studies of EAIS dynamics, we discuss our data in the context of the 4 ice drainage divides, described by *Vaughan et al.* [1999], that terminate at the East Antarctic margin between the Ross Sea and Prydz Bay (See Table 1, Figure 6).

Vaughan et al. [1999] improved upon the ice-flow and drainage basin divides of *Giovinetto and Bentley* [1985] and *Drewry* [1983], providing more accurate though not drastically different boundaries for the 26 drainage basins in Antarctica. We have labeled the four basins that drain to our study area (the D'D", DD', C'D, CC' basins of *Vaughan et al.* [1999]) as *A (~158˚E* to *~172˚E)*, *B (~133˚E* to *~ 158˚E)*, *C (~103˚E* to *~ 133˚E),* and *D (~73˚E* to *~103˚E)*, respectively (Figure 6). These 4 drainage basins combined cover a total area of 2619 x 10^3 km^2 (*A*=710 x 10^3 km^2, *B*= 684 x 10^3 km^2, *C*=1169 x 10^3 km^2, and *D*= 156 x 10^3 km^2) out of which ~ 1,110 x 10^3 km^2 are below sea level.

Previously published on-shore data are summarized in Figures 3 ($^{40}Ar/^{39}Ar$ and U-Pb) and 4 (Nd). Based on the onshore thermochronology data, four age sectors can be identified: 1) The Western Ross Sea, Northern Victoria Land, and Oates Land, which are characterized by $^{40}Ar/^{39}Ar$ and U-Pb ages of ~400-600 Ma, with a smaller population of younger $^{40}Ar/^{39}Ar$ ages from the McMurdo Volcanic Group in the western Ross Sea, 2) The Mertz Shear Zone and

Adélie Land, which are characterized by $^{40}Ar/^{39}Ar$ and U-Pb zircons ages of > 1500 Ma, 3) Wilkes Land, which is characterized by U-Pb zircon ages of 1100-1300 Ma (based on outcrop data from two ice free areas only), and 4) Queen Mary Coast, which contains the boundary between rocks with 1100-1300 Ma ages and rocks showing Pan-African overprinting of ~500 Ma (Figure 3, references are listed in the caption; see *Williams et al.* [2010] for a summary with references).

5.1.1.1. Ice Drainage A / Northern Victoria Land (~158˚E to ~172˚E)

Ice drainage *A* is characterized by $^{40}Ar/^{39}Ar$ hornblende age populations of 0-50 Ma and 450-500 Ma, $^{40}Ar/^{39}Ar$ biotite age populations of 350-400 Ma and 450-550 Ma, and ε_{Nd} values ranging from -2.7 to -10.3 (Figure 3, 4, 7, Table 1).

A likely source for the young hornblende grains (< 15 Ma) grains is the McMurdo Volcanic Group found off the coast of Victoria Land in the western Ross Sea (Figure 3A). This sector of the East Antarctic margin comprises the West Antarctic Rift System, and contains numerous volcanic rocks dated from Late Miocene through to the present e.g., [*LeMasurier and Thomson*, 1990; *Harpel et al.*, 2004; *Paulsen and Wilson*, 2007]. The population of 300-400 Ma biotites (Figure 3B) most likely reflect sourcing from the northern Bowers Terrane (~162˚E, ~70.5˚S), which has K-Ar dates of this age [*Adams*, 2006]. The 450-550 Ma biotite population reflects regional metamorphism associated with the Ross Orogeny [*Goodge*, 2007].

Sediment cores offshore of ice drainage *A* have the most radiogenic ε_{Nd} values (ε_{Nd} = -2.7 to -10.1) (this study; *Roy et al*. [2007]) (Figure 4). On-land values from 525 and 600 Ma granites on Surgeon's Island, Northern Victoria Land yield ε_{Nd} = -15.6 and -16.6 [*Borg and DePaolo*, 1991]. In fact, the vast majority of the published onshore Nd isotopic compositions (ε_{Nd} values of

approximately -13 to -17) are much less radiogenic (Figure 4; see Appendix D for compilation of ε_{Nd} values), than the values measured in the marine sediment cores. This mismatch indicates published onland Nd isotopic compositions from Sector A are not representative and that the area must be geologically more diverse. From our marine data it seems likely that mafic volcanic sources with more depleted Nd isotopic signatures (high ε_{Nd}) must exist next to the rather evolved granites (lower e_{Nd}; [*Borg and DePaolo*, 1991]) and metasediments reported from Northern Victoria Land [*Henjes-Kunst and Schussler*, 2003]. Indeed, substantial parts of Northern Victoria Land are reported to be comprised of mafic rocks, e.g. the Jurassic Volcanic belt of the Ferrar Group and the Precambrian meta-volcanics contained in the Nimrod and Wilson Groups [*Craddock*, 1972]. Studies on the Nd composition of the Ferrar Group show values ranging from -5 to -10 ε_{Nd} [*Fleming et al.*, 1995; *Elliot et al.*, 1999]

The area is an excellent example of why looking at glacially-derived sediments, which integrate the overall signal of a source area, can provide a better indication of the true isotopic signal of a source area than sparse outcrop data.

5.1.1.2. Ice Drainage *B* / Adélie and George V Land (including the Wilkes Subglacial Basin) (~158˚E to ~133˚E)

Ice Drainage *B* flows over two distinct geologic sectors, as seen in both our data and the on-land data. However since we are presenting our new data in the context of ice drainage (and below in the context of the Wilkes sub-glacial basin), we will discuss both provenance signatures together. Ice Drainage *B* is characterized by a dominant $^{40}Ar/^{39}Ar$ hornblende age population of 1500-1800 Ma with a smaller population of 450-500 Ma, $^{40}Ar/^{39}Ar$ biotite age populations of

450-550 Ma and 1500-1800 Ma, and ε_{Nd} values ranging from -12.4 to -23.6, with most values more negative than -20 (Figures 3, 4, 6, Table 1).

The Mertz Shear zone (Figure 6) has been dated ($^{40}Ar/^{39}Ar$ hornblende) at 1550 -1500 Ma, and represents the boundary between the Terre Adélie Craton to the west and rocks associated with the Ross Orogeny to the east *[Di Vincenzo et al., 2007]*. $^{40}Ar/^{39}Ar$ hornblende ages from the investigated cores nicely reflect this boundary and the local on-land geology. The Terre Adélie Craton contains evidence of large-scale thermal events at ~2450 Ma and 1700 Ma [*Peucat et al.*, 1999; *Di Vincenzo et al.*, 2007; *Duclaux et al.*, 2007; *Ménot et al.*, 2007]. The least radiogenic offshore ε_{Nd} values (ε_{Nd} = -23.6 to -12.4) are found in the Adélie Land sector ~137˚E to 145˚E (this study; [*Grousset et al.*, 1992; *Roy et al.*, 2007]), and agrees with known on-land ε_{Nd} values (-24.9, [*Grousset et al.*, 1992])(Figure 4).

5.1.1.3. Ice Drainage C / Wilkes Land (including the Aurora Subglacial Basin) (~133˚E to ~103˚E)

Ice Drainage *C* is characterized by an $^{40}Ar/^{39}Ar$ hornblende age population of 1100-1200 Ma, an $^{40}Ar/^{39}Ar$ biotite population of 1100-1150, and ε_{Nd} values ranging from -12.3 to -16.1 (Figure 3, 4, 7, Table 1). ELT37-13 (Core 14) has a dominant Grenville signature and is located close to the boundary between *B* and *C*. More data would be required to evaluate if the geological boundary extends a little to the east of the B/C drainage divide

The $^{40}Ar/^{39}Ar$ hornblende ages are in good agreement with the results of *Roy et al.,* [2007] and, though the Wilkes Land sector has few outcrops, those that do exist are consistent with the data from the marine sediment cores [*Post et al.*, 1996; *Fitzsimons*, 2000; *Post*, 2000] (Figure 3).

5.1.1.4. Ice Drainage D / Queen Mary Land (~103˚E to ~73˚E)

Ice Drainage *D* is characterized by only two marine sediment cores, which have $^{40}Ar/^{39}Ar$ hornblende age populations of 1100-1250 Ma and 450-600 Ma, $^{40}Ar/^{39}Ar$biotite ages of 1050-1250 and 400-500 Ma, and ε_{Nd} values ranging from -12.3 and -21.3 (Figure 3, 4, 7, Table 1). The age populations reflect the boundary between Grenville and Pan-African overprinting that occurs in Sector D [*Black et al.*, 1992; *Sheraton et al.*, 1992] (Figure 3). Marine sediment samples from Queen Mary Land are characterized by ε_{Nd} values of -11.9 (this study) and -21.4 [*Basile et al.*, 1997]. On-land measurements from moraines in the Bunger Hills span a range of 14 epsilon units and are hence very poorly constrained (ε_{Nd} = -9.0 and -23.0; [*Basile et al.*, 1997]).

5.2. Geochemical characterization of the Wilkes and Aurora Basins

Both the Wilkes and Aurora basins can be uniquely characterized based upon the combination of $^{40}Ar/^{39}Ar$ hornblende and biotite ages and neodymium isotope measurements from marine sediments cores located off the coast proximal to each of these basins. Terrigenous material shed from the margin of East Antarctica that coincides with the Aurora sub-glacial basin (~133˚E to ~ 105˚E, also Ice Drainage C) is characterized by $^{40}Ar/^{39}Ar$ hornblende and biotite ages of 1050-1200 Ma (Figure 6). These ages agree well with limited outcrops along the margin [*Post et al.*, 1996; *Fitzsimons*, 2000; *Post*, 2000].

Terrigenous material shed from the margin of East Antarctica that coincides with the Wilkes sub-glacial basin (~155˚E to ~135˚E, also Ice Drainage B) also has a distinct but mixed geochemical character. The detrital $^{40}Ar/^{39}Ar$ hornblende and biotite ages have a dominant population of 1500-1800 Ma (Figure 6), which is consistent with on-land ages [*Peucat et al.*,

1999; *Di Vincenzo et al.*, 2007; *Ménot et al.*, 2007]. In addition to this age population, there is also a significant 400-500 Ma population, mainly in the biotites. Thus, the signature for the Wilkes Basin consists of two $^{40}Ar/^{39}Ar$ age populations: 1500-1800 Ma for both biotites and hornblendes, and 450-500 Ma, dominated mainly by biotite ages but including some hornblende ages.

Given the physical characteristics of both of these basins, i.e. that the majority of the elevation lies more than 500 m below sea-level and that they contain reverse bed slopes (where the bed deepens inland), these areas might serve as zones of weakness to the East Antarctic Ice Sheet. *Schoof* [2007] showed that the flux of ice at the grounding line increases as the depth of the grounding line below sea-level increases. Where the grounding line rests on a reverse slope bed, retreat of the grounding line can set off a cycle of increased ice-discharge and further retreat, which will continue until a new equilibrium can be reached. It is plausible that such grounding line retreat and ice-discharge occurred on the Wilkes and Aurora subglacial basins in the past. An important outcome of this work is recognition that sediments being shed from the outlets of either of the basins are geochemically distinguishable from the other. This lays the foundations for future studies investigating the role of these basins in the evolution of the EAIS.

5.3. Comparison of IRD tracers

5.3.1. Individual Detrital Minerals

5.3.1.1 $^{40}Ar/^{39}Ar$ Hornblende and Biotite Ages

$^{40}Ar/^{39}Ar$ biotite ages from the >150 μm and 63-150 μm size fractions agree well with one another and can be treated as one population (Table 1, Figure 5). Because the $^{40}Ar/^{39}Ar$ biotite ages from these size fractions are in good agreement with each other, we restrict this part

of the discussion to a comparison of the $^{40}Ar/^{39}Ar$ hornblende ages to the biotite ages. $^{40}Ar/^{39}Ar$ biotite ages are mostly consistent with, although slightly younger than, the $^{40}Ar/^{39}Ar$ hornblende ages (Figure 6, Table 1). Given their respective closure temperatures of ~300˚C and ~500˚C, this observation indicates moderately fast cooling immediately following the most recent tectonothermal event.

We have calculated robust median ages for each of the $^{40}Ar/^{39}Ar$ age populations from all marine sediment cores in this study using ISOPLOT/Ex Program v. 3.00 (an Excel-powered program that allows for manipulation of radiogenic isotope data, [*Ludwig*, 2003]), in order to more closely compare the ages of these two thermochronometers (Table 2). As can be seen from Table 2, the age difference between the $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages is quite small at most sites (1 to 108 Myr), with almost all age differences less than 80 Myr.

The $^{40}Ar/^{39}Ar$ ages of individual minerals present a straightforward characterization of the East Antarctic margin between the Ross Sea and Prydz Bay (Figure 3), as discussed in 5.1. There is little overlap in age populations, and the comparison between what we have measured in the marine sediment cores matches well with available on-land measurements (Figure 3). Importantly, this agreement in $^{40}Ar/^{39}Ar$ ages indicates that where there is little or no outcrop data, the marine sediment $^{40}Ar/^{39}Ar$ provide robust information on the adjacent coast.

5.3.1.2. Decoupling of $^{40}Ar/^{39}Ar$ hornblende and biotite ages

While the $^{40}Ar/^{39}Ar$ hornblende and biotite age populations from the marine sediment cores generally agree with one another, differences may provide information about the composition and history of the onshore terranes. Two apparent mechanisms could serve to decouple the $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages, resulting in different populations

of ages between the two minerals. First, there is a lithological bias, as hornblendes tend to form in intermediate to mafic rocks, while biotites tend to form in felsic rocks. Both minerals are found in a range of metamorphic rocks. Thus, if a source area has a tendency towards the lithology favored by one mineral over the other, age populations would be biased to that source. A second mechanism for decoupling the $^{40}Ar/^{39}Ar$ ages is low-grade, greenschist facies metamorphism, which could re-set $^{40}Ar/^{39}Ar$ biotite ages (closure temperature of ~300˚C) without re-setting the hornblende ages (closure temperature of ~500˚C).

An apparent decoupling between the $^{40}Ar/^{39}Ar$ hornblende and biotite ages is found in several cores (Core 12: ELT37-09 (140-144 cm), Core 9: DF79-47 (563-567 cm), and Cores 5, 6 and 7. Figure 4; Table 1). First, the distribution of $^{40}Ar/^{39}Ar$ biotite ages in Core 12 (ELT37-09, 140-144 cm) reveals an age population of 450-550 Ma that is represented by only a few hornblendes ages; the dominant hornblende population for this sample is 1550-1800 Ma. To explore whether this ~500 Ma biotite age population is evidence of an ice-rafting event delivering ~500 Ma biotite grains from sources far from the core site (e.g. east of ~146˚E), or alternatively, a compositional bias in the two age provinces, we analyzed two other terrigenous-rich layers in Core ELT37-09 (92-93 cm and 137-139 cm). We found that the ~500 Ma biotite population exists in all three layers (Table 1), indicating that either this is a relatively local, previously unidentified, source or that this site is routinely the locus of deposition of similar far-traveled icebergs. We favor the local source due to the similar age distributions in the three samples. While no $^{40}Ar/^{39}Ar$ biotite ages of ~500 Ma have been reported west of the Mertz Glacier (~145˚E; Figure 6) [*Duclaux et al.*, 2008], we speculate that the $^{40}Ar/^{39}Ar$ biotite ages may reflect the ~500 Ma greenschist metamorphism recorded at Cape Denison and Cape Hunter (Adélie Land), described by *Stüwe and Oliver* [1989]. This type of metamorphism could

potentially reset biotite ages, without resetting amphibole ages. Furthermore the greenschist metamorphism at Cape Denison and Cape Hunter (~142˚E to ~143˚E) (*Stüwe and Oliver* [1989]'s M3 event) is expressed as assemblages primarily of epidote, lawsonite, biotite, chlorite and white mica, with very little hornblende.

The second example of contrast comes from Core 9 (DF79-47, 563-567 cm) where both biotites and hornblendes show a ~500 Ma age population consistent with on-land geology, but prominent ages of >1500 Ma consistent with the age of the Mertz Shear Zone (MSZ) [*Di Vincenzo et al.*, 2007] are found in the hornblendes, but not in the biotites. As with the case from ELT37-09, this is likely the result of a compositional bias, as the lithology of the rocks to the east of the Mertz Glacier that show Ross Orogen ages are biotite granites, granitoids and metasediments [*Di Vincenzo et al.*, 2007; *Duclaux et al.*, 2007], while the rocks to the west of the Mertz Glacier are a mixture of high-grade metamorphic rocks, such as amphibole-rich granulites, migmatites and various gneisses [*Duclaux et al.*, 2007]. It is important to note that Core 9 is ~100 km to the east of where the MSZ outcrops (Figure 6), and that the coastal current flows from east to west, making it unlikely grains would be delivered to Core 9 from this location. However, geophysical interpretations show that the MSZ extends into the continent to the southeast [*Ferraccioli et al.*, 2009] and so material may be sourced from the MSZ under the ice sheet, and to the east of where it outcrops.

In a third example of contrast, the difference between hornblende and biotite $^{40}Ar/^{39}Ar$ age populations in Cores 5, 6, and 7, appears to be the result of compositional bias, e.g. more mafic rocks contain hornblendes and not biotites, whereas more felsic rocks tend to contain more biotites than hornblendes. While hornblendes mostly show ages reflecting the Ross Orogen and

young volcanics from the western Ross Sea, the biotites show dominant ages in the 300-400 Ma range, reflecting the Bowers Terrane of Northern Victoria Land.

5.3.1.3. $^{40}Ar/^{39}Ar$ biotites as an IRD tracer at ODP Site 1165

The new $^{40}Ar/^{39}Ar$ biotite ages from ODP Site 1165 are consistent with the $^{40}Ar/^{39}Ar$ hornblende ages from *Williams et al.* [2010] (Figure 7), bearing in mind the lower closure temperature for biotite. Each of the four layers from Site 1165 contains a biotite age population of 450-550 Ma compared to $^{40}Ar/^{39}Ar$ hornblende ages of 450-600 Ma [*Williams et al.*, 2010]. *Williams et al.* [2010] attributed these ages to the local Prydz Bay area based upon both onshore evidence [*Tong et al.*, 1998; *Phillips et al.*, 2007; *Wilson et al.*, 2007] and evidence from $^{40}Ar/^{39}Ar$ measurements on detrital hornblendes from marine sediment core samples [*Roy et al.*, 2007; *van de Flierdt et al.*, 2008], all of which show a dominant ~500 Ma age. These $^{40}Ar/^{39}Ar$ biotite ages are also consistent with the peak $^{40}Ar/^{39}Ar$ biotite age (~502 Ma) measured from glacial-marine sediments in ODP Site 1166, located in Prydz Bay [*van de Flierdt et al.*, 2008], as well as onshore evidence [*Tong et al.*, 2002].

The three layers from ODP Site 1165 containing far-travelled hornblende grains from Wilkes Land (with a characteristic $^{40}Ar/^{39}Ar$ age of 1100-1200 Ma)) also contain biotite $^{40}Ar/^{39}Ar$ ages in the 1100-1200 Ma range. This typical Grenvillian age range is absent from rocks exposed in the Prydz Bay area and also has not been found in modern sediments (see *Williams et al.* [2010]).

These results indicate that the added use of $^{40}Ar/^{39}Ar$ biotite ages as a complement to $^{40}Ar/^{39}Ar$ hornblende ages for tracing IRD in the Southern Ocean is a useful approach, for two reasons. First, by analyzing both hornblendes and biotites, we reduce any lithological bias that

might occur by analyzing only hornblendes, and second, as we can measure $^{40}Ar/^{39}Ar$ biotite ages in the 63-150 μm fraction, this may provide the only viable option in samples with very low IRD concentrations.

5.3.2. ε_{Nd} values as a tracer of an integrated erosional signal

The ε_{Nd} values also provide characterization of the 4 drainage sectors. However, based on all of the ε_{Nd} values from this margin of East Antarctica (our new data, previous marine sediment cores studies and the on-land ε_{Nd} values, summarized in Figure 4) it is apparent that while each of the 4 sectors has a distinct range of values, there is some overlap between sectors. For example, ε_{Nd} values from marine sediment samples that characterize both ice-drainage *B* and *C* have ε_{Nd} values that fall in the -12 to -15 range. In addition, some on-land outcrop values do not agree with the values measured in marine sediment cores; a discrepancy that is the result of 1) the control that lithology has on a measured ε_{Nd} value (for example, mafic lithologies are expected to have more radiogenic (less negative) values than felsic lithologies) and 2) the fact that the ε_{Nd} value measured in the marine sediment cores represents an average of the proximal geology that is not necessarily evenly sampled.

It is interesting that the ε_{Nd} values measured in the marine sediment cores allow for a better division of this margin of East Antarctica than the on-land values. For example, in ice drainage *A* the majority of on-land ε_{Nd} values fall mostly in the -13 to -17 range, comparable to values obtained in the glacial-marine sediments in sectors *B* and *C*, while the marine sediment core ε_{Nd} values fall in the -3 to -10 range. This highlights an advantage of characterizing source areas by looking at proximal marine sediments, as these reveal a true average of the erosion

products being shed from under the ice sheet, and do overcome the sampling bias from on-land studies.

5.4. Pan-African and Ross Orogen Ages, and cooling history

The $^{40}Ar/^{39}Ar$ ages of the Pan-African orogeny (Prydz Bay, 600-500 Ma) and Ross Orogeny (Northern Victoria Land, 550-450 Ma) are known from relatively few onshore exposures, and the larger amount of offshore data present the opportunity to date the cooling phases of these orogenies more precisely. Additionally, information about the cooling rate can be determined from the difference in $^{40}Ar/^{39}Ar$ ages between hornblende (set at ~500°C) and biotite (set at ~300°C). To this end, In order to see if our data show distinguishable age peaks between sediments affected by either the Pan-African (650-500 Ma) or Ross (550-450 Ma) orogenies, we have calculated the robust median age of hornblende and biotite $^{40}Ar/^{39}Ar$ ages using the $^{40}Ar/^{39}Ar$ ages of grains from cores proximal to those areas of East Antarctica affected by Ross and Pan-African overprinting (Table 3). Ages reflecting the Ross Orogeny have robust median ages of 492.3 Ma (+5/-6.9 Ma) (hornblendes) and 492.1 Ma (+2.7/-7.0 Ma) (biotites), while ages reflecting the Pan-African orogeny have robust median ages of 517 Ma (+12/-6.8 Ma) (hornblendes) and 471 Ma (+23/-33 Ma) (biotites). Thus, while the hornblende $^{40}Ar/^{39}Ar$ ages reflecting the Pan-African orogeny are older than those reflecting the Ross orogeny, the opposite is true for the $^{40}Ar/^{39}Ar$ biotite ages. There is very little age difference between $^{40}Ar/^{39}Ar$ hornblende and biotite ages for the Ross orogeny, while there is nearly a 50 million year difference for the Pan-African Orogeny, indicating rapid cooling following the Ross Orogeny, and much slower cooling following the Pan-African. Using our peak age calculations, and assuming closure temperatures for $^{40}Ar/^{39}Ar$ hornblende (~500˚C) and $^{40}Ar/^{39}Ar$ biotite (~300˚C)

ages, the implied cooling rates for the Ross and Pan-African orogenies would be incredibly fast (due nearly identical $^{40}Ar/^{39}Ar$ hornblende and biotite ages), with ~ 4-5˚C Myr^{-1}, respectively.

Our data are consistent with previous studies, in that the Pan-African orogeny is slightly older than the Ross Orogeny. The onset of the Pan-African orogeny in the western Prydz Bay/Queen Mary Land area predated the onset of the Ross Orogeny, starting around 600 Ma [*Veevers*, 2003; *Veevers*, 2004], nearing completion around 500 Ma, and with peak ages of 550-500 Ma [*Meert*, 2003], based mostly on zircon U-Pb data. Subduction associated with the Ross Orogeny commenced ~ 550 Ma forming a convergent margin that lasted until 450 Ma [*Goodge*, 1997]. Ross Orogen ages found on-land in Oates Land and Northern Victoria land are younger than 530 Ma [*Adams*, 2006; *Di Vincenzo et al.*, 2007; *Goodge*, 2007], with peak Ross Orogen ages of 500 Ma [*Goodge*, 1997; 2007].

Our interpreted rapid cooling rate following the Ross Orogeny is compatible with some previous studies. While cooling rates from across Northern Victoria Land (NVL) range from 18˚ to 30˚Myr^{-1} [*Goodge and Dallmeyer*, 1996; *Schussler et al.*, 1999], both *Di Vincenzo et al.* [1997] and *Palmeri et al.* [2003] argue for very fast cooling in the NVL area based on overlapping ages in high-temperature thermochronometers (consistent with our near-identical $^{40}Ar/^{39}Ar$ hornblende and biotite age peaks).

Cooling rates for the Prydz Bay area also show a range. *Fitzsimons et al.* [1997] present data that supports a multi-stage cooling history from the eastern Prydz Bay area with initial cooling rates of 20˚myr^{-1} followed by cooling rates of 5˚myr^{-1}. However they also show that an average cooling rate of ~10˚myr^{-1} fits their data equally well. *Zhao et al.* [1997] inferred cooling rates of nearly 40˚Cmyr^{-1} from the same area. Slower cooling rates (3˚myr^{-1}) are reported from the northern Prince Charles mountains (western Prydz Bay), but these appear to be restricted to

this particular area [*Zhao et al.*, 2003]. Thus, it would appear that our ~4˚-5˚myr^{-1} cooling rate is anomalously low compared to measurements from outcrops. More data, and particularly more biotite data, from cores along this margin would provide more information. Using pairs of hornblende and biotite ages from pebbles and cobbles found in marine sediment cores along the margin would also offer more information as different sources of the two grain types can be excluded when derived from the same pebble.

While our data cannot definitively elucidate cooling rates for either of the orogenies at this point, it shows that the presented approach is a plausible method for estimating average cooling rates and exhumation histories for parts of Antarctica that are ice-covered, and thus inaccessible to direct study. Further studies should aim for a larger number of detrital thermochronometers in order to better constrain these rates.

6. Conclusions

We have performed an extensive survey of the $^{40}Ar/^{39}Ar$ ages of detrital hornblende and biotite grains in ice-rafted debris and Nd isotopes on the bulk <63 μm size fraction from marine sediment cores along the margin of East Antarctica from 94˚E to 165˚E. We measured an average of 78 (minimum of 29, maximum of 119) $^{40}Ar/^{39}Ar$ ages from 8 marine sediment cores for a total of 626 analyses. This large number of analyses provides robust statistics to formulate the following conclusions:

(1) The $^{40}Ar/^{39}Ar$ ages and neodymium isotope results obtained from marine sediment cores agree well with sparse outcrops and other marine sediment core data, both serving to better constrain our knowledge of provenance areas around Antarctica that could have been the loci of

iceberg calving and/or fine sediment discharge in the past. Our data improves the geological characterization for East Antarctic IRD source areas by quadrupling the number of $^{40}Ar/^{39}Ar$ analyses from detrital minerals and adding eight new Nd measurements of the bulk <63μm fraction from marine sediment cores along this margin, including areas that are ice-covered. With the Nd data, we have shown the importance of characterizing source areas around East Antarctica by looking at proximal glacial-marine sediments, as these measurements provide the integrated isotopic composition of the source areas. With the $^{40}Ar/^{39}Ar$ hornblende and biotite data, we have shown the advantage to measuring ages on the individual minerals, as such measurements allow for representation of all end-members (in contrast, bulk geochemical analyses are a mixture of the end-members).

(2) Sediments shed from along the continental margin where the Wilkes and Aurora sub-glacial basins terminate can be distinguished by a combination of their $^{40}Ar/^{39}Ar$ hornblende and biotite ages, in addition to the Nd isotopic composition of the bulk <63 μm fraction. The Wilkes Basin is characterized by $^{40}Ar/^{39}Ar$ hornblende and biotite ages of 1500-1800 Ma, with a significant biotite population of 450-550 Ma, and unradiogenic ε_{Nd}, values (mostly less than -16.1). The Aurora Basin is characterized by $^{40}Ar/^{39}Ar$ hornblende and biotite ages of 1100-1200 Ma, and more radiogenic ε_{Nd} values of -11.7 to -14.9. The ε_{Nd} values for both basins show some overlap, with the exception of the very unradiogenic values off the coast of Adélie Land that characterize part of the Wilkes Basin. The Aurora Basin is characterized by distinct Grenvillian $^{40}Ar/^{39}Ar$ ages of 1100 to 1200 Ma. The Wilkes basin drains an area affected by multiple tectonothermal events as reflected in multiple age polulations (Ross Orogeny ages of ~500 Ma and Adélie Land ages of 1500 to 1700 Ma). Our new data lend further support to the suggested instability of East

Antarctic subglacial basins during times of past warmth [*Williams et al.*, 2010] and should prove important to future provenance studies, aiming to improve our understanding of EAIS evolution and the role of the Wilkes and Aurora sub-glacial basins in ice instabilities in the past.

(3) We have characterized each of the four ice drainage divides (*A – D) [Vaughan et al., 1999]* that terminate along this margin of East Antarctica using a combination of $^{40}Ar/^{39}Ar$ hornblende and biotite ages of individual grains and bulk ε_{Nd} of the <63 μm fraction. Drainages *A* and *C* show a unique geochemical signature based upon these provenance tools. Drainages *B* and *D* have a mixed signal as they drain parts of the EAIS that cross major geologic boundaries; Drainage *B* drains over the divide between rocks affected by Ross-orogen overprinting and much older thermal events, while Drainage *D* drains over the boundary between Pan-African (range Ma) and Grenville (range Ma) overprinting.

(4) The use of $^{40}Ar/^{39}Ar$ dating of detrital hornblendes and biotites in marine sediments is a robust way to determine the provenance of ice-rafted debris around the East Antarctic perimeter. Given that both minerals are major rock-forming minerals it is reasonable to expect that they will be constituents in IRD; however this is dependent upon the source lithologies contributing to the sediment sample. $^{40}Ar/^{39}Ar$ ages of hornblendes can effectively be treated as crystallization ages (amphibolite-grade metamorphism), as the closure temperature for this system is ~500˚, thus allowing for inferences about the geology underlying the ice sheet to be made. While $^{40}Ar/^{39}Ar$ ages in biotites record cooling below ~300˚C, and thus are more susceptible to re-setting. Based on our data it is clear that the $^{40}Ar/^{39}Ar$ biotite ages can serve as a provenance tracer for IRD around East Antarctica.

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Table 1. Summary of $^{40}Ar/^{39}Ar$ ages and neodymium isotope measurements around the East Antarctic perimeter.

Sample Code	Sample	Lat.	Long.	Sector[1]/ Drainage[2]/ Basin[3]	Study*	Mineral+	Number of Grains in the Following Age Group (in Ma)**									ε_{Nd}[a]
							0-50	*300-400*	*400-550*	*1000-1300*	*1400-1500*	*1500-1800*	*2000-2500*	*Other*	*Total*	
1	ELT27-20	-71.96	178.60	NVL/***A***/ n	R[4]	Hb	1	1	7	-	-	-	-	5	14	-6.9
2	NBP9802-2H	-73.54	176.96	NVL/***A***/ n	R	Hb	-	-	4	1	-	-	-	-	5	-7.3
3	NBP9802-4H	-64.20	170.08	NVL/***A***/ n	R	Hb	-	1	-	-	-	-	-	3	4	-2.7
4	NBP9802-3H	-66.14	169.45	NVL/***A***/ n	R	Hb	-	-	1	-	-	-	-	2	3	~
5	DF80-35 (269-273)	-70.02	166.42	NVL/***A***/ n	P	Hb	14	2	3	-	-	-	-	2	21	~
						B (>150)	-	10	2	-	-	-	-	-	12	
						B (63-150)	-	9	1	-	-	-	-	1	11	
6	DF80-20 (160-164)	-69.78	163.68	NVL/***A***/ n	P	Hb	1	3	2	-	-	-	-	2	8	-10.3
						B (>150)	-	14	4	3	-	-	-	3	24	
						B (63-150)	-	8	3	-	-	-	-	3	14	
7	DF80-34 (222-226)	-69.92	162.83	NVL/***A***/ n	P	Hb	9	-	16	3	-	-	-	8	36	-3.5
						B (>150)	-	4	12	1	-	-	-	6	23	
						B (63-150)	-	3	6	-	-	-	-	1	10	
8	ELT37-04	-64.83	150.49	GVL, AL/ ***B*** / WSB	R[4]	Hb	~	~	~	~	~	~	~	~	~	-12.4
9	DF79-47 (563-567)	-66.67	148.73	GVL, AL/ ***B*** / WSB	P	Hb	1	-	15	4	7	8	-	11	46	-12.4
						B (63-150)	-	-	8	-	-	-	-	2	10	
10	ELT37-06	-66.08	145.02	GVL, AL/ ***B*** / WSB	R	Hb	2	-	2	-	-	3	-	1	8	-17.0
11	NBP0101 JPC11 2305-2310	-66.56	143.05	GVL, AL/ ***B*** / WSB	P[5]	Hb	-	-	-	1	2	11	1	-	15	-23.6
						B (>150)	-	-	-	-	-	14	-	-	14	
11	NBP0101 JPC11 2370-2375	-66.56	143.05	GVL, AL/ ***B*** / WSB	P	Hb	-	-	-	1	3	22	6	9	41	~
						B (>150)	-	-	-	-	-	15	-	-	15	
12	ELT37-09 (140-144)	-65.55	141.10	GVL, AL/ ***B*** / WSB	P	Hb	1	1	2	-	3	27	-	11	45	-21.1
						B (>150)	-	2	33	1	-	8	-	5	48	
						B (63-150)	-	-	3	1	-	6	-	-	10	
12	ELT37-09 A (137-139)	-65.55	141.10	GVL, AL/ ***B*** / WSB	P	B (>150)	-	-	6	-	2	5	-	1	14	~
12	ELT37-09 B (92-93)	-65.55	141.10	GVL, AL/ ***B*** / WSB	P	B (>150)	-	-	7	-	-	7	-	-	14	~
12	ELT37-09	-65.55	141.10	GVL, AL/ ***B*** / WSB	R[4]	Hb	2	-	4	1	4	24	1	6	42	-20.4
13	ELT37-10	-65.22	137.88	GVL, AL/ ***B*** / WSB	R	Hb	~	~	~	~	~	~	~	~	~	-16.1
14	ELT37-13	-64.67	132.98	WL / ***C*** / ASB	R	Hb	1	-	-	7	3	2	-	2	15	-14.9
14	ELT37-13 (113-120)	-64.67	132.98	WL / ***C*** / ASB	P	Hb	-	-	1	39	1	1	2	3	47	-14.7
						B (>150)	-	-	-	15	1	1	-	-	17	
						B (63-150)	-	-	-	11	-	-	-	1	12	
15	ELT37-16 (231-235)	-63.97	127.447	WL/ ***C*** / ASB	P	Hb	-	1	-	32	9	11	4	6	63	-13.4
						B (>150)	-	-	-	41	1	-	1	3	46	
						B (63-150)	-	1	-	8	1	-	-	-	10	
16	ELT50-18	-64.43	119.98	WL / ***C*** / ASB	R	Hb	~	~	~	~	~	~	~	~	~	-12.3
17	ELT50-16	-61.04	114.81	WL / ***C*** / ASB	R	Hb	-	-	1	6	-	1	-	1	9	-13.9
18	ELT50-13	-60.00	105.00	WL / ***C*** / ASB	R[4]	Hb	-	-	-	1	-	-	-	1	2	-14.8
19	DSDP 268	-63.9	105.2	WL / ***C*** / ASB	W	Hb	-	-	1	23	-	-	-	8	32	~
20	ELT49-30 (1698-1702)	-59.01	95.23	QML/***D***/ n	P	Hb	2	-	-	26	1	-	-	5	33	-12.3
						B (>150)	1	-	9	6	-	-	-	4	20	
						B (63-150)	-	-	3	4	-	-	-	3	10	
21	ELT47-07	-66.66	77.90	QML/***D***/ n	R[4]	Hb	-	-	32	3	-	1	-	18	54	-21.3

[1]Sectors refer to the geographic sectors that the core sample is located offshore from. NVL = Northern Victoria Land; GVL= George V Land; AL = Adélie Land; WL= Wilkes Land; QML=Queen Mary Land.

[2]Drainage divides (A: ~158°E to ~180°E, B: ~133°E to ~158°E), C: ~103°E to ~133°E, D: ~73°E to ~103°E) are based on the ice drainages from Vaughan et al., (1999). See Figure 1.

[3]Indicates which subglacial basin sediment in this core represents; WSB - Wilkes Subglacial Basin (~135°E to 155°E); ASB - Aurora Sublgacial Basin (~133°E to ~105°E); n = neither basin

[+]Mineral that $^{40}Ar/^{39}Ar$ age was measured on. Hb = hornblende; B (>150) = biotite >150μm; B (63-150) = biotite 63-150μm

[a] ε_{Nd} values were measured on the bulk <63μm fraction for this study and on the terrigenous <63μm fraction for studies labeled R and B. ε_{Nd} calculations are based on the chondritic values of $^{143}Nd/^{144}Nd$=0.512638 [*Jacobsen and Wasserburg,* 1980]; see Appendix C.

*Values are from the following studies (P - this study; R[4] - ε_{Nd} from *van de Flierdt et al.* [2007]; R - *Roy et al.* [2007]; B - *Brachfeld et al.* [2007].

**age ranges were determined based upon the dominant populations observed in the $^{40}Ar/^{39}Ar$ data; the 0-50 Ma (young volcanics from the Ross Sea/Victoria Land); 300-400 Ma (Bowers Mountain terrane); 400-550 Ma (the Ross orogeny); 1400-1500 Ma (Mertz Shear zone area); 1000-1300 Ma (Grenville Orogeny); 1500-1800 Ma and 2000-2500 Ma (thermal events in Adélie Land).

Table 2. Robust median ages of hornblende and biotite $^{40}Ar/^{39}Ar$ age populations by marine sediment core.

$^{40}Ar/^{39}Ar$ hornblende and biotite ages

		Hornblendes					Biotites				
Core#	**Site**	**# Grains**	**Robust Median Age (Ma)**	**±**	**% Error**	**Conf. Interval**	**# Grains**	**Robust Median Age (Ma)**	**±**	**% Error**	**Conf. Interval**
7	**DF80-34**	9	**8.8**	+1.9/-5.8	44	96.1	-	-	-	-	-
		-	**-**	-	-	-	7	**370**	+25/-67	12	98.4
			492	+9.5/-13	2.3	97.9	19	**491**	+20/-14	3.4	93.6
5	**DF80-35**	14	**7.6**	+2.8/-7.5	41	94.3	-	**-**	-	-	-
		-	**-**	-	-	-	19	**371.1**	+4/-9.9	1.9	93.6
6	**DF80-20**	5	**373**	13/-10	19	93.8	22	**368.2**	+2.2/-2.6	0.65	94.8
		-	**-**	-	-	-	7	**473**	+21/-61	8.6	98.4
9	**DF79-47**	18	**508.6**	+9.9/-18	2.8	96.9	8	**491**	+45/-54	10	93
		17	**1530**	+17/-6	7.5	95.1	-	**-**	-	-	-
11	**JPC11 2305**	13	**1651**	+79/-40	6.7	97.8	14	**1635**	+48/-27	2.3	94.3
11	**JPC11 2370**	31	**1690**	+63/-39	3	97	15	**1619**	+22/-20	1.5	96.5
12	**ELT37-09**	-	**-**	-	-	-	35	**494**	+10/-13	2.5	95
		33	**1693**	+68/-34	3	95	14	**1585**	+59/-23	2.6	94.3
14	**ELT37-13**	41	**1162**	+32/-31	2.7	95	26	**1117.3**	+4.2/-8.7	0.57	95
15	**ELT37-16**	35	**1165**	12	1.1	95	53	**1123.1**	+15/-17.8	1	95
20	**ELT49-30**	-	**-**	-	-	-	12	**471**	+24/-35	6	96.1
		27	**1164.5**	+8.2/-8.7	0.73	95	14	**1088**	+24/-22	2.1	94.5

Robust median age of hornblende and biotite $^{40}Ar/^{39}Ar$ age populations by marine sediment core. Robust median ages were calculated over the following age intervals, if they exist in the total population: 0-50 Ma, 300-400 Ma, 400-600 Ma, 900-1400 Ma, 1400-2000 Ma.

Table 3. Comparison of robust median Ross-Orogen and Pan-African Orogen ages

$^{40}Ar/^{39}Ar$ hornblende and biotite ages										
	$^{40}Ar/^{39}Ar$ Hornblende Ages					$^{40}Ar/^{39}Ar$ Biotite Ages				
Orogeny	# Grains	Robust Median Age (Ma)	±	% Error	Conf. Interval	# Grains	Robust Median Age (Ma)	±	% Error	Conf. Interval
Ross Orogeny	55	**492.3**	+5/-6.9	1.2	95	85	**492.1**	+2.7/-7.0	0.98	95
Pan-African	42	**517**	+12/-6.8	1.9	95	12	**471**	+24/-33	6	96.1

Comparison of Ross-Orogen (450-550 Ma) and Pan-African (450-600 Ma) robust median ages. Robust median ages calculated from hornblende and biotite data falling in the 400-600 Ma range. Hornblende ages from cores 1-9 and biotites from cores 1-12 were used to calculate the Ross Orogen ages. Hornblendes from cores 19-21 and biotites from core 20 were used to calculate the Pan-African ages.

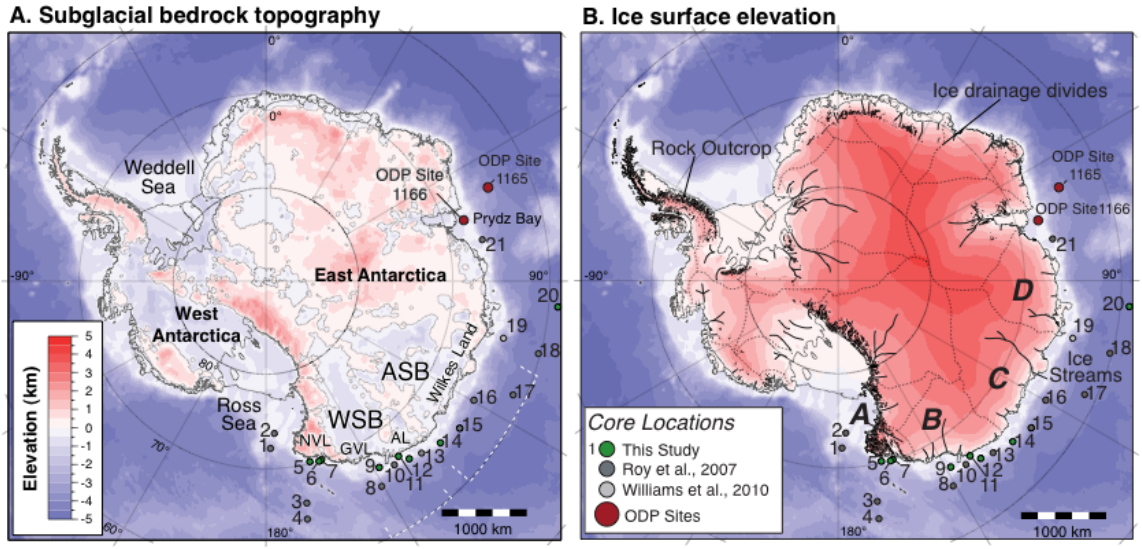


Figure 1. Map showing marine sediment core locations and sub-glacial bedrock elevation [*Lythe et al.*, 2001] with the location of East Antarctic sub-glacial basins and seabed bathymetry (ETOPO-5) (A). Map of ice surface elevation (ETOPO-5), rock outcrop (Antarctic Digital Database), ice drainage divides [*Vaughan et al.*, 1999], and the approximate extent of major ice streams [*Bamber et al.*, 2000](B). (Base map from *Williams et al.,* [2010]). NVL - Northern Victoria Land, GVL – George V Land, AL – Adélie Land, QML – Queen Mary Land.

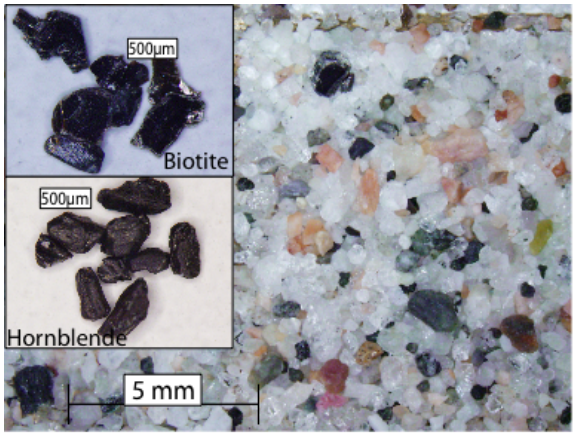


Figure 2. Photomicrograph of ice-rafted debris from the >150 µm size fraction in core ELT37-16. Inset: biotite and hornblende grains picked from the > 150 µm size fraction.

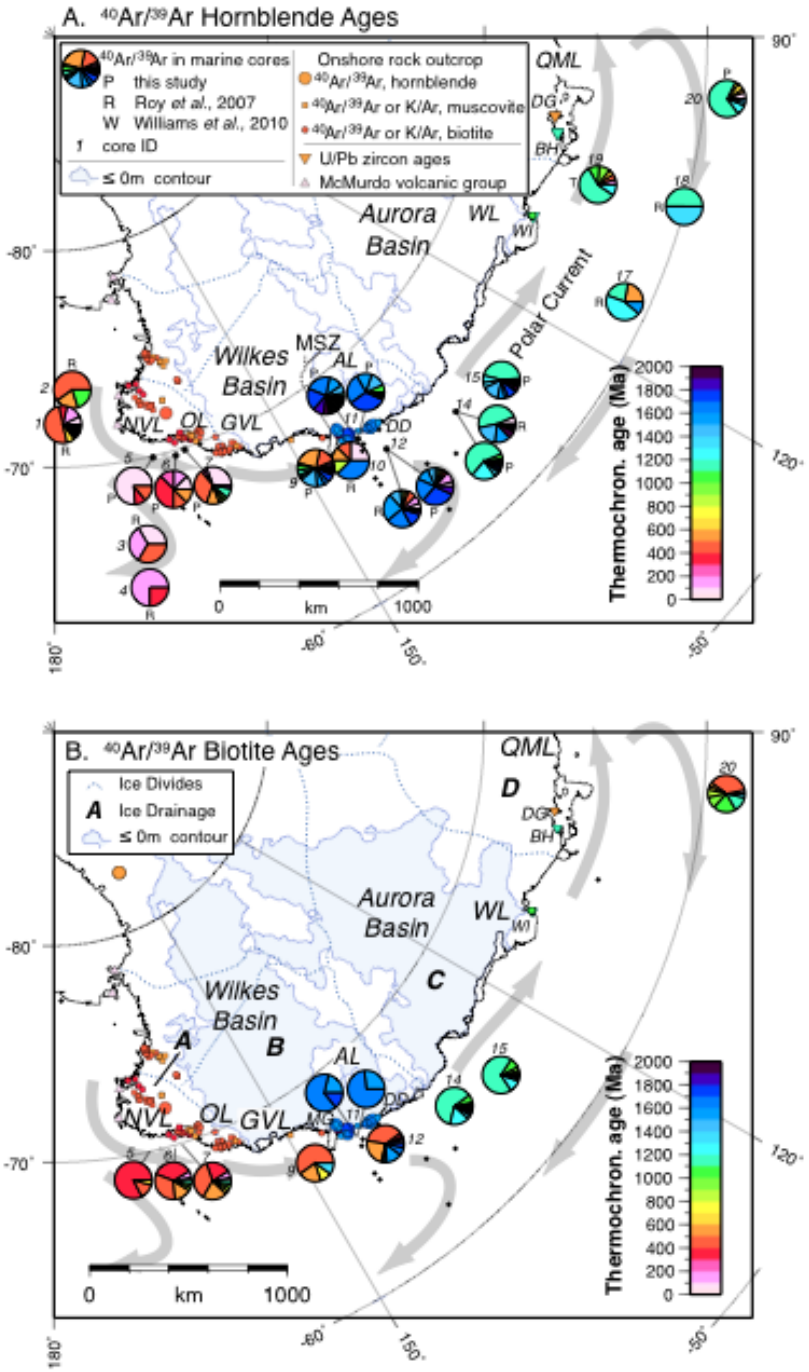


Figure 3. Map of thermochronologic data from marine sediment cores and on-land ages along the margin of East Antarctica (90˚E to 180˚) **(A)** $^{40}Ar/^{39}Ar$ hornblende ages from marine sediment cores **(B)** $^{40}Ar/^{39}Ar$ biotite ages from marine sediment cores. Each pie chart represents

the population of ages at that site with each equal-area wedge representing one analysis. The onshore $^{40}Ar/^{39}Ar$ hornblende thermochronology [*Tong et al.*, 1998; *Tong et al.*, 2002; *Di Vincenzo et al.*, 2007; *Duclaux et al.*, 2007; *Goodge*, 2007; *Phillips et al.*, 2007; *Wilson et al.*, 2007] is supplemented with $^{40}Ar/^{39}Ar$ biotite and muscovite data [*Adams*, 2006]. In areas lacking Ar data zircon U–Pb data are plotted [*Black et al.*, 1992; *Sheraton et al.*, 1992; *Boger et al.*, 2000; *Carson et al.*, 2000; *Post*, 2000; *Möller et al.*, 2002; *Liu et al.*, 2006; *Liu et al.*, 2007]. Diamond symbols mark DSDP and IODP sites. Ice-drainage divides [*Vaughan et al.*, 1999] and the 0 m sub-glacial contour line [*Lythe et al.*, 2001] outlining the Wilkes and Aurora basins are shown in light and dark blue, respectively. NVL -Victoria Land, OL - Oates Land, GVL - George V Land, AL - Adélie Land, DD - Dumont D'urville, MG - Mertz Glacier, WL - Wilkes Land; QML - Queen Mary Land, WI - Windmill Islands, BH - Bunger Hills, DG - Denman Glacier MSZ - Mertz Shear Zone (extent of MSZ from [*Ferraccioli et al.*, 2009]).

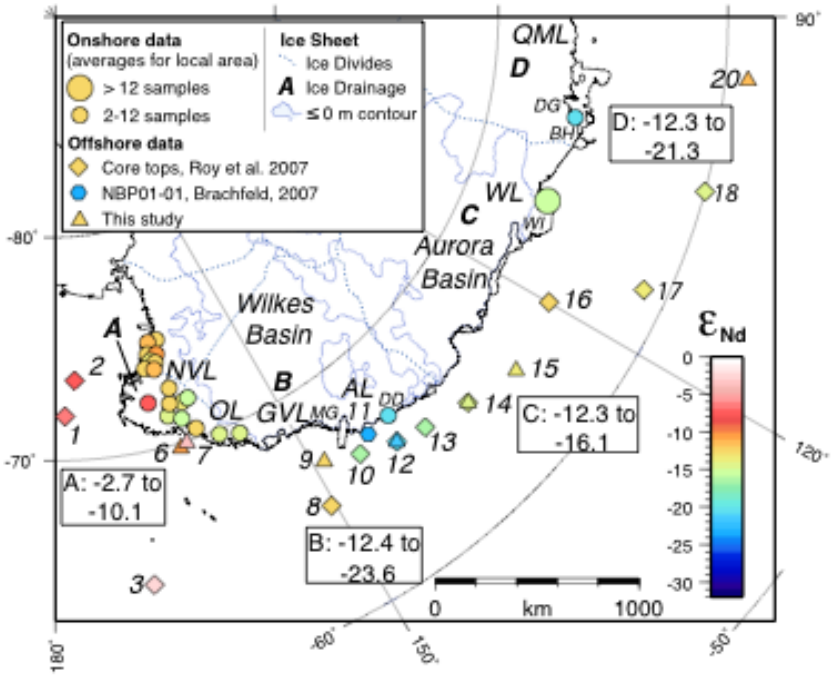


Figure 4. Epsilon neodymium (ε_{Nd}) values (T = 0 Ma) from marine cores and from on-land samples. Outcrop data from BH: [*Sheraton et al.*, 1990], WI: [*Möller et al.*, 2002], DD: [*Peucat et al.*, 1999], NVL/OL: [*Borg et al.*, 1987; *Rocchi et al.*, 1998; *Henjes-Kunst and Schussler*, 2003]. NVL -Victoria Land, OL - Oates Land, GVL - George V Land, AL - Adélie Land, DD - Dumont D'Urville, MG - Mertz Glacier, WL - Wilkes Land; QML - Queen Mary Land, WI - Windmill Islands, BH - Bunger Hills, DG - Denman Glacier. Ice-drainage divides [*Vaughan et al.*, 1999] and the 0 m sub-glacial contour line [*Lythe et al.*, 2001] outlining the Wilkes and Aurora basins are shown in light and dark blue, respectively.

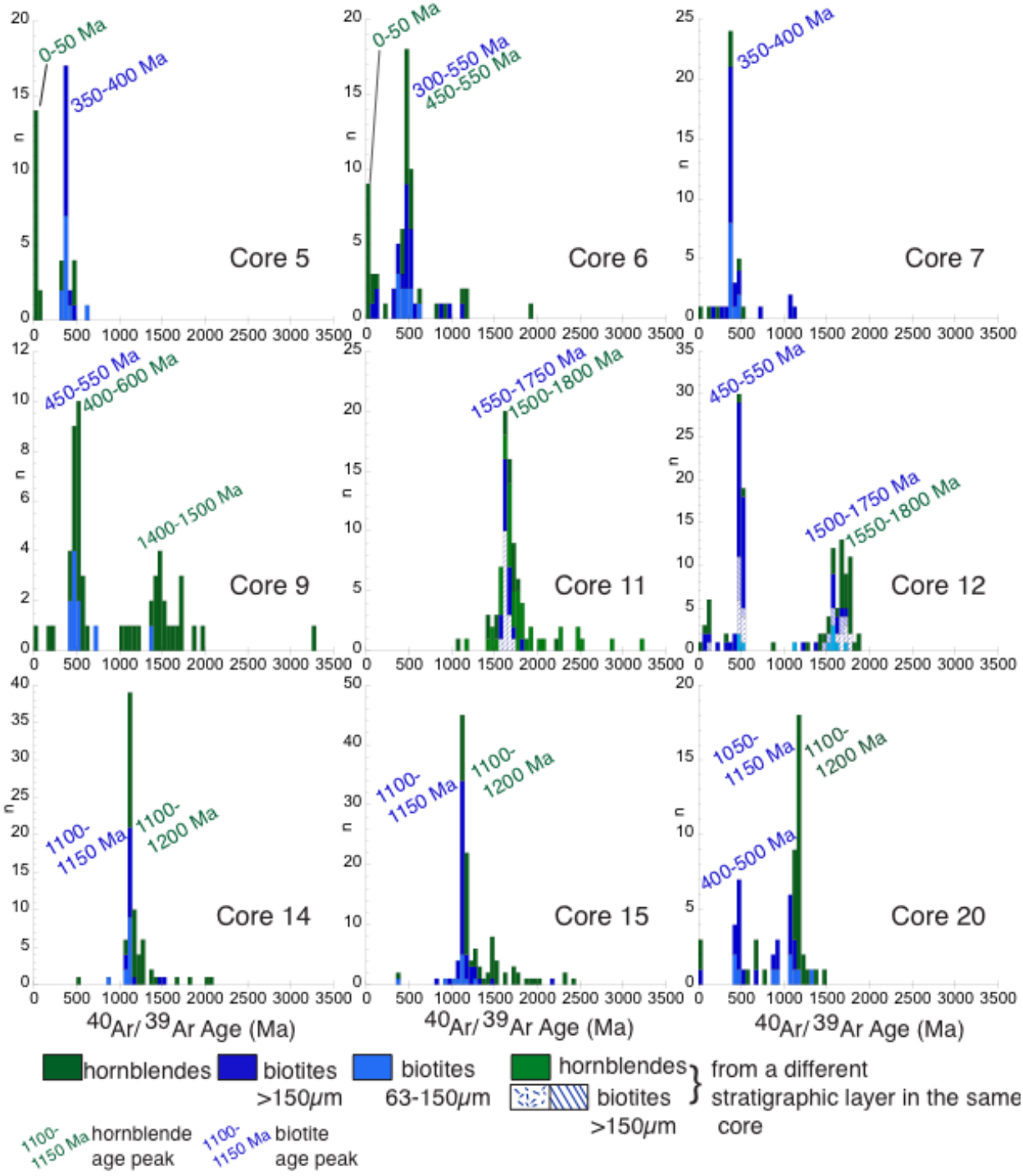


Figure 5. $^{40}Ar/^{39}Ar$ hornblende (green) and biotite (blue) ages from piston cores samples showing the general agreement in ages between hornblende (>150µm) and biotites (63-150µm and > 150µm). See text.

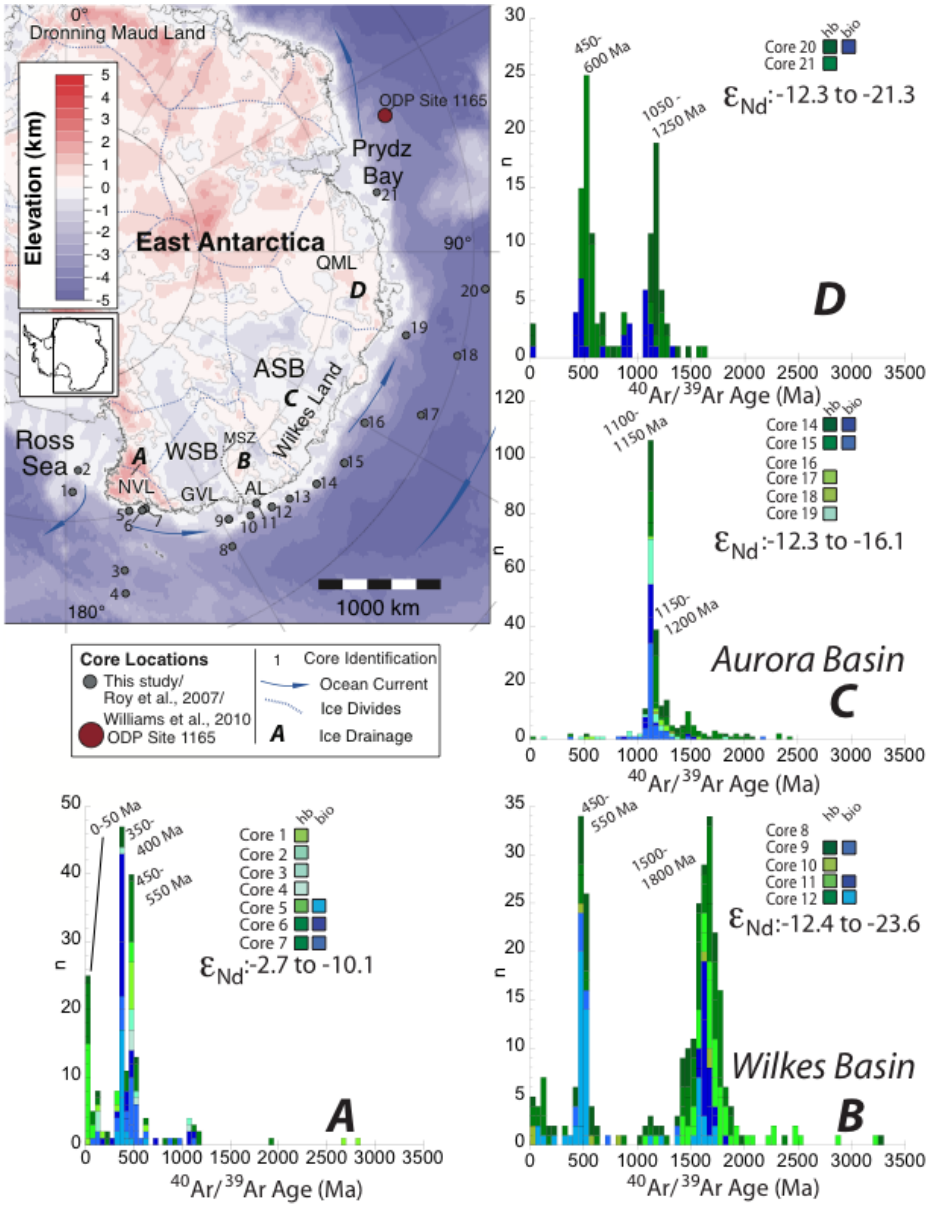


Figure 6. Geochemistry of ice-flow drainages and the Wilkes and Aurora basins based upon $^{40}Ar/^{39}Ar$ hornblende (>150 µm) ages, $^{40}Ar/^{39}Ar$ biotite (>150 µm and 63-150 µm) ages, and epsilon neodymium (e_{Nd}) values. The letters A-D signify divisions of the ice sheet drainage system; ice sheet drainage from *Vaughan et al.* [1999]. Histograms (50 Ma bins) show $^{40}Ar/^{39}Ar$ hornblende and biotites ages form samples grouped by the ice-drainage that is proximal to the cores. Map of bedrock topography modified from *Williams et al.* [2010]. NVL - Northern

Victoria Land; GVL - George V Land; AL - Adélie Land; MSZ - Mertz Shear Zone [*Ferraccioli et al.*, 2009] . Hb (green) = hornblende ages; Bio (blue) = biotite ages.

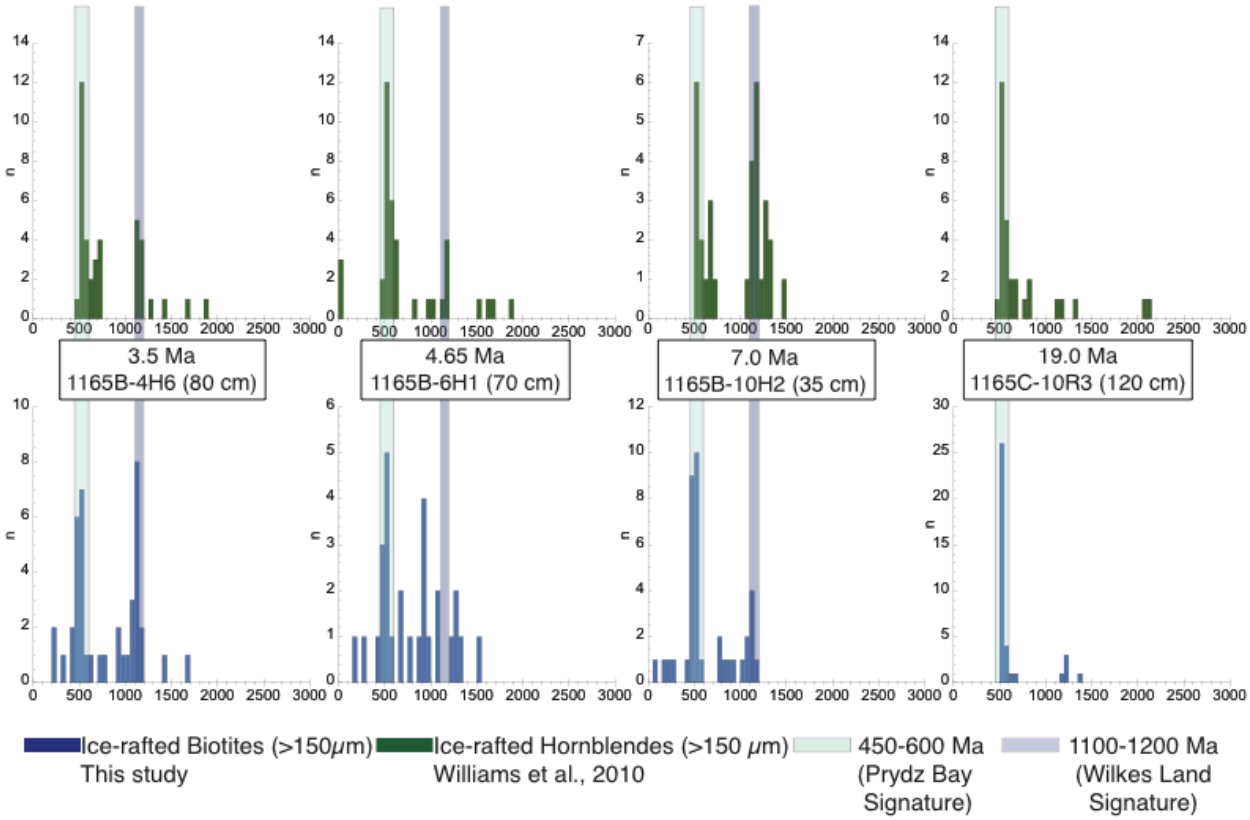


Figure 7. Histograms (50 Ma bins) comparing the $^{40}Ar/^{39}Ar$ hornblende ages [*Williams et al.*, 2010] and $^{40}Ar/^{39}Ar$ biotite ages from 4 ice-rafted debris-rich layers in ODP Site 1165. The blue and purple bands highlight the $^{40}Ar/^{39}Ar$ ages that fall in the 450-550 Ma and 1100-1200 Ma ranges, respectively.

Chapter 3: A mineral comparison from East Antarctica using detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende, and $^{40}Ar/^{39}Ar$ biotite ages: implications for the geology of subglacial terrains and provenance studies

Abstract

U-Pb ages of detrital zircon grains have provided an extraordinary tool for sedimentary provenance work, given that they are ubiquitous, resistant to damage and weathering, and that the U-Pb age records the crystallization age of the mineral. Although not as widely used, $^{40}Ar/^{39}Ar$ dating of detrital hornblende and biotite grains can also serve as a powerful sedimentary provenance tool, particularly in situations where chemical weathering is minor, e.g. Antarctica. Certain natural biases exist between these mineral chronometers (e.g., occurrence, abundance, resistance to weathering) that determine the extent to which they are found in sedimentary deposits. Additionally, the $^{40}Ar/^{39}Ar$ systems in hornblendes and biotites have lower closure temperatures (~500˚C and ~300˚C, respectively). Thus, for areas that have experienced a polymetamorphic history, such as East Antarctica, combining these approaches can provide added detail to provenance studies.

In this study we provide a comparison of the detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite age populations from 28 glacial-diamict and glacial-marine sediment core samples located around East Antarctica (55˚W to 163˚E). We present 3,284 new detrital age measurements of U-Pb zircon (n=1,840), $^{40}Ar/^{39}Ar$ hornblende (n=1,169), and $^{40}Ar/^{39}Ar$ biotite (n=275), in conjunction with previously published data from some of the same core sites (n = 232, 683, 494, respectively), as well as 78 U-Pb zircon ages taken from 5 ice-rafted debris layers recovered at ODP Site 1165. Our data indicate that 1) detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages faithfully record the geologic history of East Antarctica, as expressed

in their respective age populations 2) a number of previously unknown age populations have been identified with this method 3) there is an added layer of provenance characterization in combining the three chronometers, however the lower temperature thermochronometers provide the best characterization of source areas around East Antarctica, due to tectonothermal resetting of older, widespread ages present in the U-Pb zircon measurements.

1. Introduction

The U-Pb system in detrital zircons is a widely used and powerful tool for conducting sedimentary provenance studies (e.g., [*Ledent et al.*, 1964; *Tatsumoto and Patterson*, 1964; *Gaudette et al.*, 1981; *Gehrels et al.*, 2011], see Fedo *et al.* [2003] for a discussion of detrital U-Pb zircon studies). $^{40}Ar/^{39}Ar$ ages measured in detrital hornblende and biotite have not been exploited as much as a sedimentary provenance tool, but they are increasingly being used for studies of ice rafted detritus around Antarctica and other regions where glaciers end at the shore. In this study, we compare U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages measured on detritral grains from glacially-derived marine sediment samples taken from 28 marine sediment cores located around East Antarctica (Figure 1, 2).

The first objective is to provide a head-to-head comparison of detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite age populations. Given the natural biases that exist for each system (see discussion below), we are interested in which of the minerals are present, which age populations are present, if the age populations are present across all mineral systems, and how these ages relate to one another from a thermochronology point of view, and to what we know about East Antarctic geology. The findings should have broad implications for evaluating each of these chronometers as a provenance tracer around East Antarctica, and they will

particularly benefit the study of ice-rafted detritus (IRD). The provenance of IRD provides key information on ice sheet and ocean circulation dynamics, as glaciers that reach the edge of the continent can calve off icebergs that transport the detritus (IRD) from the continent to the open ocean; icebergs can then be carried with the ocean currents, melting as they travel causing entrained detritus to be rained out and deposited on the ocean floor.

The second objective for this study is to use this information to increase our understanding about East Antarctica's geology. As more than 98% of East Antarctica is covered by the thick East Antarctic ice sheet, relatively little outcrop is available for the direct study of East Antarctica's geology (Figure 2). Despite these challenges, much has been learned about the geologic history of East Antarctica. It is known to contain remnants of Archean cratons surrounded by metamorphic terranes that were formed or accreted during the Grenville (1330-900 Ma), Pan African (500-650 Ma) and Ross (400-550 Ma) orogenies (Figure 1) (e.g., [*Tingey*, 1991]). By examining the populations of U-Pb and $^{40}Ar/^{39}Ar$ ages of material that was derived from under the ice sheet in ice-covered areas, we will be able to make broad interpretations about the thermochronology of these areas (see section 2 for an overview of the thermochronometers discussed here).

2. Zircon, hornblende and biotite in provenance studies

There are some fundamental differences between zircon, hornblende and biotite, and the ages reflected by U-Pb measured in zircon and $^{40}Ar/^{39}Ar$ measurements in hornblende and biotite. Some of the basic advantages to using U-Pb zircon ages as a provenance tracer of terrestrial deposits do not hold true for provenance studies of marine sediments recovered in the polar regions, and vice-versa. Here we provide a brief description of these differences, in order to

highlight why the U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite age populations found in a sediment sample may not be the same.

2.1 Occurrence of zircon, hornblende and biotite in different rock types

Zircon, hornblende and biotite all occur in varying amounts in different rocks. Zircon ($ZrSiO_4$) is an accessory mineral found in trace amounts in most types of igneous and metamorphic rocks, with varying concentrations; zircon is most common in felsic crystalline rocks (e.g. granitoids) and orthogneisses, and is highly concentrated in mature sandstones (e.g. arkose) and (Table 1). Hornblende ($Ca_2Mg_4(Al,Fe^{3+})Si_7AlO_{22}(OH)_2$), a member of the amphibole group, is a major-rock forming mineral found in high concentrations in intermediate igneous rocks, e.g. diorite, as well as medium to high grade metamorphic rocks (e.g. amphibolite), especially those with a mafic/ultramafic protolith. Hornblende does not usually contribute as a major mineral in the sedimentary rock record, and if found is usually incorporated into the clasts in clastic sedimentary rocks, e.g. conglomerates. Biotite ($K(Mg,Fe)_3(AlSi_3O_{10})(OH_2)$), a mica, is a major rock-forming mineral found in high concentrations in felsic-intermediate igneous rocks, e.g. granitoids and diorite, low to medium grade metamorphic rocks, e.g, hornfels, phyllite and schist. Biotite does not contribute as a major mineral in the sedimentary rock record, though tends to be found in greater abundance than hornblende.

2.2 Weathering

In terms of relative susceptibility to weathering, zircon is most resistant, then biotite, then hornblende [*Goldich*, 1938; *Kowalewski and Rimstidt*, 2003]. Zircon is one of the most resilient

minerals, and is common in both modern and ancient sedimentary environments. It is incredibly resistant to weathering and damage during erosional processes [*Goldich*, 1938; *Morton*, 1984; *Bateman and Catt*, 1985; *Morton*, 1991], primarily due to its crystal structure with tightly bonded SiO_4 tetrahedra. Zircon not only survives sedimentary transport well, but also can survive through multiple cycles of burial, orogenesis, and erosion, which is why it is so prevalent in the rock record. Indeed, Kowalewski and Rimstidt [2003] have zircon ranked as the most durable mineral.

While both biotite and hornblende may also be found in modern and ancient sedimentary deposits, their susceptibility to weathering makes the occurrence of un-weathered/un-altered grain unusual, particularly in modern environments with high chemical weathering rates, or in the ancient sediments. Both hornblende and biotite are ferromagnesian silicates, and as such are more susceptible to chemical weathering via oxidation. Hornblende is, however slightly more susceptible to weathering than biotite, as discussed by Goldich [1938], and as explained by their relative placement on Bowen's reaction series [*Bowen*, 1922]; as hornblende forms at a higher temperature than biotite, its bonds are not as strong as those of biotite, and thus it breaks down more readily. Biotite can generally survive transport for long distances in modern sedimentary systems, as its elastic nature protects it from abrasion [*Kowalewski and Rimstidt*, 2003; *Hodges et al.*, 2005], however biotite is very susceptible to chemical dissolution.

As has been discussed before, (e.g., [*Thomas*, 2011]), the fact that zircon survives through many sedimentary cycles is an advantage, because a zircon population can record several tectonic events. However it is also a challenge when interpreting detrital zircon populations for provenance studies, because samples may contain recycled zircons that were transported from a previous location to a secondary location, and then eroded most recently from

the secondary location, but with a provenance signal indicating the first. Hornblende and biotite typically experience only one sedimentary cycle and are thus easier to interpret for provenance.

2.3 Geochronology and thermochronology

Zircons can retain their initial age through successive sedimentary cycles and orogenic events; while ages are rarely reset during successive tectonothermal events, rims can often grow around the original crystal during successive orogenies or later magma crystallization [*Silver and Deutsch*, 1963; *Bickford et al.*, 1981]. Conversely, zircons with high U concentrations can turn metamict, which can result in preferential destruction of this type of zircon.

$^{40}Ar/^{39}Ar$ ages measured in hornblende reflect the time since the hornblende grain cooled below ~500˚C [*McDougall and Harrison*, 1999]. This closure temperature allows for re-setting of the $^{40}Ar/^{39}Ar$ during major tectonothermal events. $^{40}Ar/^{39}Ar$ ages measured in biotite reflect the time since the biotite grain cooled below ~300˚C, which makes the $^{40}Ar/^{39}Ar$ biotite system more easily re-set during tectonothermal events than the hornblende system [*Reiners et al.*, 2005].

2.4 Transport mechanisms

2.4.1 Terrestrial sediment provenance studies

Previous detrital U-Pb zircon studies are too numerous to mention here as a comprehensive list, attesting to the strength of this tool as a provenance indicator from its earliest uses (e.g., [*Ledent et al.*, 1964; *Tatsumoto and Patterson*, 1964; *Gaudette et al.*, 1981]) to more recent studies (e.g., Gehrels *et al.* [2011]; see Fedo *et al.* [2003] for a discussion of detrital U-Pb zircon studies).

As discussed above, biotite and hornblende are not as resilient as zircon, and so the $^{40}Ar/^{39}Ar$ ages of biotite and hornblende have not been exploited as a provenance tool as much as U-Pb ages of zircons have been, particularly in areas where chemical weathering rates are high, and in ancient sediment deposits. For example, Aalto *et al.* [1998] found that the detrital $^{40}Ar/^{39}Ar$ biotite ages they measured did not yield meaningful ages, while Cohen *et al.* [1995] were successful in measuring the $^{40}Ar/^{39}Ar$ of detrital hornblende and biotite in volcaniclastic Jurassic sandstones in South Alaska, in order to determine the provenance of the Gravina Belt. Palmer *et al.* [2012] successfully applied $^{40}Ar/^{39}Ar$ dating to hornblendes in glacial till deposits from the Trans-Antarctic Mountains for constraining provenance, and Renne *et al.* [1990] were successful using detrital $^{40}Ar/^{39}Ar$ biotite ages to constrain the provenance of the Eocene Montgomery Creek Formation in northern California.

2.4.2. Marine sediment provenance studies

There are essentially two provenance components to this study. The first is making the connection between the samples taken from the shelf-sites to known outcrops on-land; the provenance of these samples should be more localized to the ice sheet drainage that delivers material to the core site, as subglacial till with some local ice-rafting (Figure 2). The second is to compare the provenance of ice-rafted grains from an open-ocean core site, located ~ 400 km away from the coast. The provenance of the ice-rafted material delivered to such a site has the potential to reflect sourcing form both local and distant sources, depending on past climatic conditions (e.g., sea-surface temperatures, ocean currents, wind and ice-sheet behavior).

Some of the basic advantages to using U-Pb zircon ages as a provenance tracer of terrestrial deposits do not hold true for provenance studies of marine sediments recovered from

the polar regions. In polar regions, and especially East Antarctica, the dominant transport mechanism is ice, and much of the sedimentary provenance studies conducted in these regions aim to determine the source of ice-rafted detritus (IRD). Ice is a transport mechanism that, unlike wind and water, does not sort the material that it is transporting. In glacial-fluvial settings, however, this may not be the case, as material comminuted by ice and subsequently entrained in water will undergo some sorting; this process seems to most affect biotite grains, and concentrates them in the finer sediment fractions [*Nesbitt and Young*, 1996]. In ice-dominated transport systems, the pairing with low amount of chemical weathering in polar regions means that there should be no preferential concentration of zircon relative to hornblende relative to biotite. Rather, the relative proportions of these minerals in a glacial deposit should be the result of the source lithologies that were eroded.

The $^{40}Ar/^{39}Ar$ ages of detrital hornblendes has been demonstrated to be a reliable provenance tool for IRD in the North Atlantic (e.g., [*Hemming et al.*, 1998; *Hemming et al.*, 2000; *Hemming et al.*, 2002]) and in the circum-Antarctic [*Roy et al.*, 2007; *van de Flierdt et al.*, 2008; *Williams et al.*, 2010; *Pierce et al.*, 2011]. Pierce *et al.* [2011] found that the $^{40}Ar/^{39}Ar$ ages of ice-rafted biotite grains worked well as a tracer of IRD provenance around the Wilkes and Adélie Land margins of East Antarctica.

2.5 Sample Size

Detrital zircon studies are most often applied to determining the provenance of sandstones, conglomerates etc., and it is general practice, and advisable, to take large samples; Gehrels *et al*. [2006] advocate taking 4.5 to 18 kilogram samples for detrital U-Pb zircon provenance studies, based on the maturity of the sandstone. It is important to note that for a terrestrial setting, sample

size is not restricted by the availability of the material. Typical sample sizes taken from marine sediment cores for the purpose of studying IRD are typically 10-20 cc, the bulk of which falls in the <63μm fraction. Because of this, and given the lack of sedimentary sorting done by the ice, there should be no preferential concentrating of any one mineral type in an IRD-rich layer. In such cases thermochronology of rock forming minerals may offer the advantage of more abundant grains for analysis.

3. Approach and Sampling Sites

For this study we are comparing U/Pb zircon, $^{40}Ar/^{39}Ar$ hornblende, and $^{40}Ar/^{39}Ar$ biotite ages from 28 marine sediment core sites (Figure 1, 2). Table 2 contains a full description of core site locations, water depth, sample type, and sampling depth. Twenty seven of the core sites are from the East Antarctic continental shelf, and the analyses were performed using each of the mineral systems, with the goal of studying subglacial geology. Duplicate layers were analyzed in several cores in order to try to increase the number of analyses for each mineral system. Samples from 26 of the core sites are from Florida State University's Antarctic Marine Geology Research Facility (FSU AMGRF), and consist of piston or jumbo piston cores samples, while samples from the remaining two core sites are from the Ocean Drilling Program. For the 26 piston or jumbo piston cores from the FSU AMGRF, we specifically targeted layers that had previously been identified as glacial diamict, or the sandy/gravel rich layers near the bottom of the piston cores, which are more likely to be till (perhaps representing LGM deposition), and thus be sourced form the proximal geology (see Pierce *et al.,* [2011]). (See Table 2 for description of samples). The Ocean Drilling Program provided the samples for one proximal site (ODP Site 1166) as well as the down-core samples from ODP Site 1165; from ODP Site 1165 we measured

the U-Pb zircon ages from 5 ice-rafted detritus (IRD) rich samples (spanning 3.5 to 19 Ma in depositional age) that had already been analyzed for $^{40}Ar/^{39}Ar$ hornblende [*Williams et al.*, 2010]and $^{40}Ar/^{39}Ar$ biotite [*Pierce et al.*, 2011], in order to compare the inferred provenance based on the different thermochronometers.

4. U-Pb and $^{40}Ar/^{39}Ar$ analyses

Bulk till and glacial-marine sediment samples (~20 cc) were dried, weighed, disaggregated in deionized water, and washed through 63 μm sieves with deionized water. Subsequent sieving was performed at 150μm and 1 mm. Size fractions > 63μm (63-150μm and 150μm to 1 mm) were passed under a hand magnet and then passed through a Frantz magnetic separator set to 0.8 Amps with a side-slope of 20˚.

Hornblendes and biotites were hand picked from the magnetic 150μm to 1mm fraction and subsequently irradiated either at the Cd-lined in-core facility (CLICIT) at the Oregon State rector, or (also with Cd shielding) at the U.S. Geological Survey (USGS) TRIGA reactor in Denver, CO. $^{40}Ar/^{39}Ar$ ages were obtained using single-step CO_2 laser fusion at the Lamont-Doherty Earth Observatory (L-DEO) argon geochronology lab (AGES: Argon Geochronology for the Earth Sciences). J values used to correct for neutron flux were calculated using the co-irradiated Mmhb-1 hornblende standard (525 Ma; [*Samson and Alexander*, 1987]).

The >150μm non-magnetic fraction was sieved at 250 μm, and combined with the 63-150μm non-magnetic fraction. The total 63-250 μm non-magnetic fraction was then passed through two density separations in order to concentrate the zircons in the sample. The first density separation was performed with LST (lithium heteropolytungstates) at a density of 2.85 g/cc. The fraction >2.85 g/cc was subsequently put through a density separation using MEI

(Methylene Iodide) at a density of 3.3 g/cc. Zircons were handpicked from the >3.3 g/cc fraction using light microscope with polarizing lens capabilities. Zircon morphologies included both euhedral and rounded grain shapes.

U-Pb zircon analyses were performed at the University of Arizona's LaserChron facility, using laser ablation MC-ICP-MS. Corrections for instrumental bias were applied based on the measurement of a Sri Lankan zircon standard that was measured throughout the analytical session. The full procedure for this lab is reported on their website (https://sites.google.com/a/laserchron.org/laserchron/home/) and in Gehrels *et al.* [2006].

5. Results of the U-Pb and $^{40}Ar/^{39}Ar$ analyses

5.1 Results from Source Area Characterization cores (Cores 1-15 &, 17-28)

A total of 1,840 U-Pb zircons ages, 1,169 $^{40}Ar/^{39}Ar$ hornblende ages, and 275 $^{40}Ar/^{39}Ar$ biotite ages were measured for this study (the total number of analyses for this study is 3,284), adding to 683 $^{40}Ar/^{39}Ar$ hornblende ages, 494 $^{40}Ar/^{39}Ar$ biotite ages, and 232 U/Pb zircon ages from previous studies [*van de Flierdt et al.*, 2008; *Williams et al.*, 2010; *Pierce et al.*, 2011] for a total of 2,072 U/Pb zircon ages, 1,863 $^{40}Ar/^{39}Ar$ hornblende ages, and 769 $^{40}Ar/^{39}Ar$ biotite ages (the total number of analyses discussed in this paper is 4,704**;** see Table 2). Twenty of the 27 piston jumbo core samples have measurements made on all three of the mineral systems (in 6 samples we did not find any zircons, and in 3 samples we did not find any biotites).

Dominant age populations present in each of the thermochronometers broadly include 400-600 Ma, 900-1200 Ma and 1400-1700 Ma, with minor Archean, other Proterozoic and Phanerozoic populations. Figure 3 A-D shows stacked histograms of each system (U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende, $^{40}Ar/^{39}Ar$ biotite) by geographic sector (A) Droning Maud Land (DML),

(B) Prydz Bay (PB), (C) Wilkes Land (WL) and (D) Adélie/George V/Northern Victoria Land (AL/GVL/NVL). Figures of stacked histograms of each system (U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende, $^{40}Ar/^{39}Ar$ biotite) by individual core site can be found in Appendix F. ISOPLOT/EX [*Ludwig*, 2003] was used for plotting relative probability plots of the data and used for determining the peak ages in the detrital data sets.

5.1.1 Weddell and Droning Maud Land Sector (Cores 1-14, 60˚ W to 15˚E**)**

Collective U-Pb zircon ages (n=754) from the core sites in the Droning Maud Land (DML) sector show dominant populations of 500-600 Ma (peak age 520 Ma) and 900-1200 Ma (peak ages 1068 and 1104), with additional small populations at ~108 Ma, ~180 Ma, ~764 Ma, ~1796 Ma and 2600 Ma. $^{40}Ar/^{39}Ar$ hornblende ages (n = 675) show dominant populations of 440-540 Ma (peak age 494 Ma), 960-1100 Ma (peak age ~1056 Ma), with smaller populations of ~92 Ma, ~174 Ma, ~1236 Ma, and ~2900 and ~3080 Ma. $^{40}Ar/^{39}Ar$ biotite ages (n = 186) show dominant populations of 400-500 Ma (peak age ~451 Ma) and 900-1100 Ma (peak ages 976 Ma and 1011 Ma), with smaller populations of ~ 200 Ma and ~2600-2700 Ma (Figure 3A).

5.1.2 Prydz Bay Sector (Cores 15, 17-19, 60˚E to 80˚E)

Collective U-Pb zircon ages (n=684) from cores in the Prydz Bay (PB) sector show dominant populations of 500-600 Ma (peak age 540 Ma) and 840-1040 Ma (peak age 932 Ma), with minor populations of ~2064 Ma and ~2766 Ma. $^{40}Ar/^{39}Ar$ hornblende ages (n=530) show dominant populations of 480-540 Ma (peak age ~500 Ma) and 860-1060 Ma (peak age ~ 932 Ma), with a small ~628 Ma population. $^{40}Ar/^{39}Ar$ biotite ages (n=105) show a dominant

population of 480-540 Ma (peak age ~501 Ma), with minor populations of ~ 455 Ma and ~561 Ma (Figure 3B).

5.1.3 Wilkes Land Sector (Cores 20-22, 90˚E to 135˚E)

Collective U-Pb zircon ages (n=302) from cores in the Wilkes Land (WL) sector show dominant populations of 1100-1200 Ma (peak ~ 1150 Ma) and 1480-1620 Ma (peak ~1562 Ma). $^{40}Ar/^{39}Ar$ hornblende ages (n=226) and show a dominant population of 1100-1200 Ma (peak age ~1152 Ma), and a small population ~ 1494 Ma. $^{40}Ar/^{39}Ar$ biotite ages (n=115) show a dominant population of 1080-1160 Ma (peak age ~1120 Ma) (Figure 3C).

5.1.4 Adélie Land / George V Land / Northern Victoria Land (Cores 23-28, 140˚E to 165˚E)

Collective U-Pb zircon ages (n=254) from cores in the Adélie/George V/Northern Victoria Land (AL/GVL/NVL) sector show dominant populations of 480-620 Ma (peak age ~502 and 579 Ma) and 380-400 Ma (peak age ~399 Ma), with small populations of ~ 1059 Ma, ~1236 Ma, ~1610 Ma, ~1795 Ma, ~2375 Ma and ~2518 Ma. $^{40}Ar/^{39}Ar$ hornblende ages (n=267) show dominant populations of 360-440 Ma (peak age ~ 493 Ma) and 0-20 Ma (peak age ~ 3 Ma), with small populations of ~1480 Ma, 1680 Ma and 1715 Ma. $^{40}Ar/^{39}Ar$ biotite ages (n=217) show dominant populations of 340-440 Ma (peak age ~369 Ma) and 460-540 Ma (peak age ~ 494 Ma), with a small population of ~1626 Ma (Figure 3D).

5.2 ODP Site 1165 (Core 16)

Sixty seven U-Pb zircon ages (average of 15 grains per sample) were measured from 5 depositional layers recovered from ODP Site 1165 for this study, to be compared with a total of

167 $^{40}Ar/^{39}Ar$ hornblende ages [*Williams et al.*, 2010] and 145 $^{40}Ar/^{39}Ar$ biotite ages [*Pierce et al.*, 2011]. Figure 4 shows stacked histograms of each mineral type for each of the IRD layers.

The U-Pb zircon age populations from each of the sampled layers contain an ~ 500-600 Ma age population. Three of the samples contain 1200-1300 Ma population, while the remaining two samples show small numbers of grains in this range ($n \leq 5$) (Figure 4). There are few U-Pb zircon analyses from the 3.0 Ma (n=10) and the first 4.65 Ma (n=3) and 19.0 Ma (n=13) samples, and all contain a mix of ~500 ma and 1000-1200 Ma grains. U-Pb zircon age populations from the 7.0 Ma sample (n=31) and the second 4.65 Ma sample (n=21) also show a mix of ~500 Ma and 1000-1200 Ma ages.

6. Discussion and comparison of the thermochronometers

6.1. Relationship between detrital ages and on-land geology

Figures 5A, 5B and 5C show the distribution of U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages as pie charts by core site, in addition to thermochronologic ages measured from outcrop samples (See Appendix E for table of on-land ages and references to published geological studies). In general, the detrital age populations are consistent with major known tectonothermal events, with overall age populations reflecting Archean and Paleoproterozoic terranes, the Grenville Orogeny (1330-900 Ma), the Pan-African Orogeny (650-500 Ma) and the Ross Orogeny (550-400 Ma) (e.g., [*Tingey*, 1991; *Anderson*, 1999].

Below we discuss the relationship between the detrtial U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages from the marine sediment core samples to previously published on-land ages; we do this starting with the oldest events (e.g., the Archean) to the youngest, and in the context of the major orogenies that certain age populations are known to reflect. The major

orogenies to leave their imprint on East Antarctica are the Grenville, the Pan-African and the Ross orogenies. The Grenville Orogeny represents the amalgamation of continental blocks during a series of collision events to form the supercontinent Rodinia ~ 1100 Ma, and led to the widespread occurrence of terranes with approximately Grenville (900-1300 Ma) ages (e.g., Fitzsimons, 2000). Below we use the term 'Grenville' to refer to ages that fall withint the 900-1300 Ma age range. The Pan-African Orogeny is yet another collision event, occurring ~650-500 Ma as the result of the Gondwana blocks (Antarctica, Australia, South America, India, Madagascar) colliding to form Gondwana, while the Ross orogeny (~400-550 Ma) was the result of collision between Gondwana and what would become the Pacific plate [*Tingey*, 1991]. Below, given the lower closure temperatures of $^{40}Ar/^{39}Ar$ hornblende and biotite ages, we refer to grains in the 400-600 Ma range as either 'Pan-African' or 'Ross', depending on the location.

6.1.1 Droning Maud Land Sector (Cores 1-14, 60˚ W to 15˚E)

Droning Maud Land (DML) is comprised of the Archean Grunehogna Craton, an expansive Grenville terrane with isolated areas of Pan-African and/or Ross signatures, and intrusions related to mid-Jurassic rifting [*Pasteels and Michot*, 1970; *Craddock*, 1972; *Millar and Pankhurst*, 1987; *Arndt et al.*, 1991; *Harris et al.*, 1995; *Jacobs et al.*, 1995; *Jacobs et al.*, 1996; *Gose et al.*, 1997; *Jacobs et al.*, 1997; *Mikhalsky et al.*, 1997; *Minor and Muakas*, 1997; *Zeh et al.*, 1999; *Vaughan et al.*, 2002; *Jacobs et al.*, 2003a; *Jacobs et al.*, 2003b; *Jacobs et al.*, 2003c; *Paulsson and Austrheim*, 2003; *Shiraishi et al.*, 2003; *Curtis et al.*, 2004; *Board et al.*, 2005; *Bisnath et al.*, 2006; *Verma et al.*, 2006; *Jacobs et al.*, 2008; *Shiraishi et al.*, 2008; *Marschall et al.*, 2010; *Flowerdew et al.*, 2012]. Detrital grains from core sites in DML sector

are dominated by Grenville and Pan-African ages, with minor Archean and 0-200 Ma populations (Figure 3A, 5A-C)

6.1.1.1 Archean and Proterozoic Terranes

Archean grains comprise a small population of the total analyses made on cores off the coast of Droning Maud Land. The majority (76%) of the Archean grains found in the cores off the coast of DML are either hornblendes or biotites, and are from cores sites 10-12, located directly offshore of the Archean Grunehoga Craton. The Grunehoga Craton is a continuation of South Africa's Kalahari Craton in East Antarctica (e.g., Marschall *et al.* [2010]), and, though only exposed in a few nunataks, has been interpreted to extend from ~2˚ to 15˚W, at ~ 72˚S based on geophysical surveying [*Jacobs et al.*, 1996].

Overall, Archean zircons (n=30) are scattered in the 2500-3700 Ma range, with minor populations of ~2600 Ma and ~2728 Ma. Marschall *et al.* [2010] measured U-Pb ages in zircons recovered from the Annandagstoppane granite, which outcrops in the Grunehoga Craton, and determined the crystallization age of the granite to be 3067±8 Ma, with evidence of inherited zircon ages ranging from 3175±8 to 3433±7 Ma. The low abundance of zircon in this granite, in addition to the lack of sorting during ice transport, is likely why there is no distinct population of U-Pb ages in the zircons measured in these cores. The spread of ages between 3100 Ma and 3700 Ma, however, is consistent with the inherited U-Pb zircon ages measured in the Annandagstoppane granite by Marschall *et al.* [2010], and with ages of tectono-magmatic events measured in the Kapvaal Craton, thus lending support to the conclusion of Marschall et al. (2010) that the Grunehogna craton was an extension of Africa's Kapvaal Craton.

Archean hornblendes (n = 71) form two a broad population of ~ 2800-3200 Ma. The older ages in this population are consistent with the U-Pb zircon age of 3067 ± 8 Ma obtained by of Marschall *et al.* [2010] for the crystallization age of the Annandagstoppane granite. However, no hornblende is reported in the petrographic descriptions of the Annandagstoppane granite (Barton et al., 1987). We suggest therefore that the hornblende-rich Archean basement lithologies may be obscured by the ice.

The ~ 2900 Ma $^{40}Ar/^{39}Ar$ hornblende population cannot be tied to known ages measured in outcrops; we speculate that it could be the result of cooling following emplacement of lithologies adjacent to the Annandagstoppane granite, or it could reflect East Antarctic bedrock that is previously un-sampled.

Archean biotites contain a population of ~2602 to 2716 Ma, indicating the GC as a source, and indeed the Annandagstoppane granite contains accessory (<5%) amounts of biotite [*Barton et al.*, 1987]. These younger $^{40}Ar/^{39}Ar$ biotite ages may reflect cooling following a resetting event at 2800 Ma [*Barton et al.*, 1987]. However, Barton *et al.* [1987] also report on an ~1200 Ma event (intrusion of the Annandagstoppane Gabbro) which reset the Rb-Sr bioite ages in the Annandagstoppane granite. It may be that with these biotite grains, we are tapping a previously unstudied part of the GC, containing biotites not reset during Grenville or Pan-African metamorphism.

6.1.1.2. Grenville Orogeny

Based on previous data, Fitzsimons [2000] divided Grenville U-Pb zircon ages in the DML area into those older than 1100 Ma, reflecting igneous crystallization of orthogneisses and metavolcanic precursors, and those 1090-1030 Ma, reflecting high-grade Grenville aged

tectonism. Grenville populations appear in each of the mineral systems, with peak ages of ~1068 Ma ~1104 Ma (U-Pb zircon), ~1056 Ma ($^{40}Ar/^{39}Ar$ hornblende) and ~ 1011 Ma and ~ 976 Ma ($^{40}Ar/^{39}Ar$ biotite).

The range of Grenville ages we have measured is consistent with Fitzsimons' [2000] survey, as well as with measured on-land ages that fall in the 1090 – 1030 Ma range [*Harris et al.*, 1995; *Jacobs et al.*, 1996; *Jacobs et al.*, 2003a; *Jacobs et al.*, 2003b; *Jacobs et al.*, 2003c; *Board et al.*, 2005; *Bisnath et al.*, 2006; *Jacobs et al.*, 2008] and the greater than 1100 Ma range [*Arndt et al.*, 1991; *Harris et al.*, 1995; *Gose et al.*, 1997; *Jackson*, 1999; *Board et al.*, 2005; *Bisnath et al.*, 2006; *Flowerdew et al.*, 2012]. Both the ~ 1104 Ma and 1068 Ma U-Pb zircon peaks are consistent with U-Pb zircon ages of 1104 ±8 and 1070 Ma measured by Bisnath *et al.* [2006] in Gjelsvikfjella. The Grenville ages found in Core 1 (Western Weddell Sea, Figure 5A-C) likely reflect sourcing from the Haag Nunatak area, which has been shown to contain Grenville ages ~1000-1180 Ma Rb-Sr whole rock ages [*Millar and Pankhurst*, 1987], and 991-1031 K-Ar hornblende and biotite ages [*Clarkson and Brook*, 1977]. There is also a 1200-1300 Ma population in the $^{40}Ar/^{39}Ar$ hornblende ages from Core 1, in the western Weddell Sea. While these ages may indicate a precursor to the Grenville Orogeny, they are significantly older than the detrital U-Pb zircon, additional $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages from this entire sector and may reflect an previously unstudied event.

There are no reported Grenville $^{40}Ar/^{39}Ar$ hornblende ages from outcrops in DML, though K-Ar dates for hornblende and biotite from the Haag Nunatak (West Antarctica) have been reported; the presence of Grenville-aged detrital $^{40}Ar/^{39}Ar$ hornblende populations from the marine sediment samples (Primarily cores 1, 4, 5 and 6) show hornblendes with this age are present in DML. Similarly, only one Grenville $^{40}Ar/^{39}Ar$ biotite age (974 Ma; Jacobs *et al.*

[1995]) is reported from outcrops in DML, though these ages are found in many of the core sites in DML (Figure 5 A-C).

6.1.1.3 Pan-African/Ross Orogeny

The ~ 500 Ma populations found in each of the detrtial thermochronomters from this area reflect a mix of Pan-African and Ross signatures from the bedrock source. Reconstructions of Gondwana (e.g., Harley and Kelly [2007]; Kleinshmidt [2007]; Figure 1), project the Ross Orogen all the way from Northern Victoria Land through to Coats Land, in addition to having Pan-African rocks potentially projected from Enderby Land (EL) along a continuation of the Lützow-Holm Belt (to the Coats Land area as well (see Figure 1). Given the close temporal overlap between these orogenies, we may not be able to tease apart, based on the detrital populations, which orogenies these reflect. However, based on the reconstructions mentioned above, we tentatively assign the ~500 Ma grain in cores 1-3 as having a 'Ross' Orogen source, while the ~500 Ma grains in cores 5 -14 are assigned a 'Pan-African' source. Additionally, there is an older tail age in the Pan-African age ages, less so than in the Ross.

Pan-African/Ross populations appear in each of the thermochronometeric ages, with peak ages of ~ 520 Ma, ~ 494 Ma, and ~451 Ma for U-Pb zircon, $^{40}Ar/^{39}$ hornblende and $^{40}Ar/^{39}Ar$ biotite, respectively, and are consistent with Pan-African ages measured on-land [*Jacobs et al.*, 1995; *Jacobs et al.*, 1996; *Jacobs et al.*, 1997; *Mikhalsky et al.*, 1997; *Harris*, 1999; *Zeh et al.*, 1999; *Jacobs et al.*, 2003a; *Jacobs et al.*, 2003b; *Jacobs et al.*, 2003c; *Paulsson and Austrheim*, 2003; *Curtis et al.*, 2004; *Board et al.*, 2005; *Bisnath et al.*, 2006; *Flowerdew et al.*, 2012], however the bulk of these onland measurements are U-Pb zircon ages [*Mikhalsky et al.*, 1997; *Harris*, 1999; *Zeh et al.*, 1999; *Jacobs et al.*, 2003a; *Jacobs et al.*, 2003b; *Jacobs et al.*, 2003c;

Paulsson and Austrheim, 2003; *Curtis et al.*, 2004; *Board et al.*, 2005; *Bisnath et al.*, 2006; *Flowerdew et al.*, 2012], with only a few $^{40}Ar/^{39}Ar$ hornblende [*Jacobs et al.*, 1995; *Jacobs et al.*, 1996; *Jacobs et al.*, 1997; *Board et al.*, 2005] and one $^{40}Ar/^{39}Ar$ biotite age [*Board et al.*, 2005] falling in this range. Again, we are seeing that Pan-African ages are well represented in the detrital lower-temperature thermochronometers.

The pattern that emerges from the age distribution in the thermochronometers in this area may reflect a division between Pan-African overprinting of Grenville-aged rocks, Ross overprinting of Grenville-aged belts, and an area of Grenville-aged rocks that did not undergo resetting during the Pan-African or Ross Orogenies. Core 4, which consists purely of Grenville age populations in each of the thermochronometers, is located adjacent to Bertrab-Littlewood-Moltke nunataks (see Figure 5), which have U-Pb zircon ages of 1000-1100 Ma [*Gose et al.*, 1997; *Storey et al.*, 2004], and which did not undergo any metamorphism during the Pan-African/Ross Orogenies. To the east of Core 4, Cores 5 and 6 contain bimodal populations of Pan-African/Ross and Grenville Ages in each of the chronometers. To the east of Core 6, and of the cores that contain all thermochronometers, Cores 7,8,11,12 and 14 contain Grenville and Pan-African U-Pb zircon age populations, while the $^{40}Ar/^{39}Ar$ hornblende and biotite age populations are dominated by Pan-African ages, with few to no Grenville ages (Figure 5, Table 4); this finding argues for significant resetting during the Pan-African Orogeny in locations onshore of these cores sites.

6.1.1.4 Jurassic Rifting

Grains 0-200 Ma in age are present in the U-Pb zircon and $^{40}Ar/^{39}Ar$ hornblende and biotite populations, though as a very small percentage (Figure 3A, 5A-C). Zircons and

hornblendes both contain populations of ~ 180 and ~100 Ma, while the biotite ages are more scattered from 160 to 211 Ma. The small population of ~ 100 Ma and younger ages are consistent with measured on-land ages south of the Ronne-Filchner Ice Shelf [*Gose et al.*, 1997; *Vaughan and Storey*, 2000; *Flowerdew et al.*, 2012], and are characteristic of the Antarctic Peninsula and West Antarctica (indeed, these ages are predominantly found in the cores located closest to the Antarctic Peninsula).

The small age peak at ~180 Ma and ~174 Ma in the U-Pb zircon and $^{40}Ar/^{39}Ar$ hornblende ages, respectively, from cores located off the coast of Coats Land; these likely reflect sourcing from the Dufek-Ferrar-Karoo volcanics. U-Pb zircon dates of ~183 Ma have been measured in the Sonora Bluffs and surrounding area [*Minor and Muakas*, 1997; *Flowerdew et al.*, 2012], while slightly younger $^{40}Ar/^{39}Ar$ hornblende ages of 179 Ma and 175 Ma have been measured in the same areas (Figure 5A-C). Hornblendes with these ages are additionally found farther along the coast to the east (Cores 7-9), and reflect sourcing from the extension of the Karoo flood basalts in the Vestfjella region, which have whole rock K-Ar ages of 160-230 Ma [*Furnes and Mitchell*, 1978; *Furnes et al.*, 1987; *Peters et al.*, 1991], and a palgioclase K-Ar age of 180 Ma [*Peters et al.*, 1991]. $^{40}Ar/^{39}Ar$ ages measured on the lavas in adjacent Kirwanveggan have an age of 183 ± 1 Ma [*Duncan et al.*, 1997], consistent with ages further to the south in Coats Land, while $^{40}Ar/^{39}Ar$ ages from the Ferrar doloerite in Transantarctic Mountains yield an age of ~ 176 Ma [*Flemming et al.*, 1995].

6.1.2 Prydz Bay (Cores 15, 17-19, 60˚E to 80˚E)

The Prydz Bay sector is dominated by Pan-African with subordinate populations of Grenville ages (Figure 5 A-C). Detrital U-Pb zircon ages from the Prydz Bay samples show a

bimodal population of ~540 Ma and ~932 Ma, with a minor spread of Archean grains. Detrital $^{40}Ar/^{39}Ar$ hornblende and biotite ages are both dominated by ~ 500 Ma ages, with essentially no Grenville or Archean grains.

6.1.2.1 Grenville Orogeny

The ~932 Ma U-Pb zircon ages agree well with Grenville ages of 990-900 Ma attributed to this area by Fitzsimmons [2000], as well as additional on-land studies [*Kinny et al.*, 1993; *Boger et al.*, 2000; *Carson et al.*, 2000; *Liu et al.*, 2007].

6.1.2.3 ~ 700 Ma Event?

The presence of a small ~698 Ma and ~628 Ma populations in the zircons, and hornblendes, respectively, may reflect a possible ~ 700 Ma metamorphic event (and subsequent cooling) recorded in the Prince Charles Mountains [*Tong et al.*, 2002].

6.1.2.4. Pan-African Orogeny

The dominant U-Pb zircon (~540 Ma) and $^{40}Ar/^{39}Ar$ hornblende and biotite (~500) age populations are consistent with the pervasive Pan-African (650-500 Ma) overprinting found in outcrops in the area [*Stüwe and Oliver*, 1989; *Zhao et al.*, 1992; *Fitzsimons et al.*, 1997; *Zhao et al.*, 1997; *Tong et al.*, 1998; *Tong et al.*, 2002; *Meert*, 2003; *Veevers*, 2003; *Veevers*, 2004; *Liu et al.*, 2006; *Liu et al.*, 2007; *Wang et al.*, 2007; *Veevers and Saeed*, 2011; *Veevers*, 2012], as well as in Eocene fluvial sediments from ODP site 1166 [*van de Flierdt et al.*, 2008]. Onshore $^{40}Ar/^{39}Ar$ dates only show ages consistent with Pan-African over-printing, and complete

resetting, of hornblende and biotites during the Pan-African orogeny, with no Grenville-aged hornblendes or biotites reported [*Tong*, 2004; *Phillips et al.*, 2007; *Wilson et al.*, 2007].

6.1.3 Wilkes Land (Cores 20-22, 90˚E to 135˚E)

Wilkes Land has very few accessible outcrops ([*Tingey*, 1991; *Anderson*, 1999]; Fig 2, 5 A-C), with on-land thermochronologic measurements coming only from the Denman Glacier/Bunger Hills locale [*Black et al.*, 1992; *Fitzsimons*, 2000], and the Windmill Islands [*Post et al.*, 1996; *Post*, 2000; *Möller et al.*, 2002; *Fitzsimons*, 2003](Figure 2, 5 A-C). The detrital samples from this sector are dominated by Grenville age populations in the lower temperature thermochronometers, while U-Pb zircon ages are divided between and ~1560 ma population in addition to the Grenville population.

6.1.3.1. ~1560 Ma U-Pb Zircons

Our detrital U-Pb zircon results from cores 21 and 22 show that half of the zircon population falls in the 1500-1600 ma range, with a peak age of ~ 1560 Ma. Just to the west of Wilkes Land, outcrops in the Bunger Hills area (~100˚E) consist of granulite-facies metamorphic rocks. The emplacement age of granodioritic orthogneisses in the Bunger Hills areas is dated at ~1521±29 Ma (Thomas Island) and ~1700 (southwest Bunger hills) Ma by U-Pb zircon (Sheraton et al., 1992, 1993). Additionally, Fitzsimons [2003] reported on a 1500-1600 Ma population of inherited U-Pb zircon ages from a psammittic gneiss in the Windmill Island area. The presence of ~1562 Ma U-Pb zircon ages from cores 21 and 22 could require an extension of this granodioritic orthogneiss or associated units over 1000 km to the east; however without more detrital U-Pb zircon analyses from marine sediment cores samples between these cores and

the Windmill Islands, this is entirely speculative. Veevers and Saeed [2011] measured detrital U-Pb zircon ages from Miocene-Oligocene samples recovered at DSDP Site 269 (Figure 5), off the coast of East Antarctica near the boundary between Wilkes and Adélie land, and just to the west of Core 21; their analyses revealed two minor peaks at ~1166 Ma and ~1570 Ma. These two age peaks are consistent with the U-Pb zircon ages we have for both of these cores, and Veevers and Saeed [2011] attribute these to 'ice covered gaps' in the data are available from outcrops.

There is a small $^{40}Ar/^{39}Ar$ hornblende peak at ~ 1494 Ma (mostly found in core 21), which could be associated with cooling following the older ~ 1520 Ma event recorded by the U-Pb zircon ages, and indeed the granodioritic gneiss does contain hornblende. While this would require the hornblendes to have withstood resetting during the intense metamorphism associated with the Grenville orogeny in this sector (see below), it is possible if they were sourced from far inside the East Antarctic craton, given that we could be tapping grains shed from a large, ice-covered, previously unstudied part of Wilkes Land.

6.1.3.2 Grenville Orogeny

Detrital $^{40}Ar/^{39}Ar$ hornblende and biotite ages from this sector are dominated by Grenville ages (1152 Ma and 1120 Ma peak ages, respectively), while the U-Pb zircon ages show two peaks at ~1150 Ma and ~1562 Ma (discussed above). The Grenville ages agree well with reports from Fitzsimmons [2000] and Sheraton *et al*. [1992; 1993], which conclude that high-grade metamorphism affected the Wilkes Land sector from 1130-1200 Ma. Given the dearth of outcrops along this part of East Antarctica, more studies utilizing this approach and sampling proximal glacial marine sediments would doubtless yield further important clues about the geology along this margin.

6.1.4 Adélie Land / George V Land / Northern Victoria Land (Cores 23-28, 140˚E to 165˚E)

Adélie Land is comprised of two terranes, identified by U-Pb zircon age, rock type, and structure. The two high-grade thermal events occurred in the Adélie craton ~1700 and ~2500 Ma [*Peucat et al.*, 1999; *Di Vincenzo et al.*, 2007; *Ménot et al.*, 2007] Grenville, Pan-African and Ross ages and overprinting are notably absent from outcrops in Adélie Land. Northern Victoria Land, Oats Land and Goerge V land to the east of the Mertz Shear Zone are dominated by Ross Orogen (550-400 Ma) ages [*Black and Sheraton*, 1990; *Tingey*, 1991; *Tessensohn and Henjes-Kunst*, 2005; *Di Vincenzo et al.*, 2007; *Tribuzio et al.*, 2008] (Figure 5 A-C).

6.1.4.1 Archean and Proterozoic Terranes

U-Pb zircon ages from the Adélie/George V/Northern Victoria Land sector show age populations of ~2373 to ~2518 Ma, consistent with onshore ages [*Oliver and Fanning*, 1997; *Peucat et al.*, 1999; *Fitzsimons*, 2003; *Ménot et al.*, 2007; *Duclaux et al.*, 2008; *Veevers and Saeed*, 2011] and offshore ages from marine sediments [*Goodge and Fanning*, 2010].

There is a broad 1600-1800 Ma population in the U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages. U-Pb zircon ages within this range show small peaks at ~1795 Ma, ~1723 Ma, and ~1610 Ma, which are also consistent with onshore ages in Adélie Land. Ménot *et al.* [2007] reported on U-Pb zircon ages of ~1600 Ma in western Adélie Land, while Peucat *et al.* [1999] obtained U-Pb ages on zircons from the Pointe Géologie Archipelago of 2800 Ma, 2600 Ma and 1730-1760 Ma. Peucat *et al.* [2002] measured U-Pb ages of ~1600 Ma on detrital zircons collected for moraines exposed in Adélie Land, which they interpreted to have been connected to the Gawler Craton Volcanics and Hiltuba Suite Granites of the Gawler Cratwon in Australia; the

Gawler Craton Volcanics and Hiltuba Suite Granites have U-Pb zircon ages of 1600-1580 Ma [*Fanning et al.*, 1988; *Creaser and Fanning*, 1993].

$^{40}Ar/^{39}Ar$ hornblende ages show peaks at ~1608 Ma and 1715 Ma, and $^{40}Ar/^{39}Ar$ biotite ages show a peak at ~1626 Ma. These ages are consistent with $^{40}Ar/^{39}Ar$ hornblende (~1700) and biotite outcrop ages from Adélie Land (Figure 5 A-C; DiVincenzo *et al*. [2007]). An additional but small ~ 1480 Ma peak in the $^{40}Ar/^{39}Ar$ hornblende ages has previously been attributed to the Mertz Shear Zone area [*Pierce et al.,* 2011], as these ages are from a core site (Core 22) directly off the coast from this feature. The shear zone is dated at ~1500 Ma via $^{40}Ar/^{39}Ar$ biotite ages [DiVincenzo *et al.,* 2007], and Pierce *et al.* [2011] concluded that since the shear zone extends far inland [*Ferraccioli et al.*, 2009], it is likely that interior rocks were affected by this event. This means that $^{40}Ar/^{39}Ar$ hornblende ages from the interior could have been reset, thus explaining the ~1480 peak in the $^{40}Ar/^{39}Ar$ hornblende ages.

6.1.4.2 Grenville Orogeny

There is a small spread of 1000-1200 Ma Grenville ages in the Adélie/George V/Northern Victoria Land sector samples, with no apparent age peaks in the U-Pb zircon ages and with a smaller comparable population in the $^{40}Ar/^{39}Ar$ hornblende an biotite ages. While no outcrops in the AL/GVL/NVL sector have reported Grenville ages, Goodge and Fanning [2010] also found a small number of detrital U-Pb zircon ages from marine sediment samples in this area, consistent with our finding. Goodge and Fanning [2010] proposed that the presence of these ages are the result of either Grenville-aged basement extending to this part of the craton under the ice sheet, or the result of zircon recycling into sedimentary rocks present in the area; given the presence of Grenville $^{40}Ar/^{39}Ar$ hornblende and biotite ages, however, it is more likely that

there is in fact Grenville-aged basement under the ice sheet in this part of Antarctica, as hornblende and biotite grains would not have survived sedimentary recycling.

6.1.4.3 Ross Orogeny

U-Pb zircon ages from the Adélie/George V/Northern Victoria Land detritus have two peaks, ~579 Ma and ~502 Ma. While the younger ~502 Ma age peak is consistent with typical Ross Orogen ages in this area of 544 -490 Ma (e.g., Veevers [2012]), the ~579 Ma peak is significantly older than what is typically ascribed to Ross Orogen ages based upon outcrop data. Goodge and Fanning [2010], who also measured detrital U-Pb zircon ages from marine sediment cores off the coast of George V and Adélie Land, found older age population of ~580 Ma in cores east of the Mertz shear zone, consistent with our findings. Goodge and Fanning [2010] attribute these older ages to the likely fact that the Ross Orogeny began earlier than what has been recorded in the limited outcrops in this area. $^{40}Ar/^{39}Ar$ hornblende and biotite ages have a single peak at ~493 Ma and ~494 Ma, respectively; these ages are consistent with Ross Orogen ages found in on-land sites to the east of the Mertz Shear Zone (Figure 5 A-C; [*Adams*, 2006; *Di Vincenzo et al.*, 2007; *Goodge*, 2007]).

Core 23, located at the western edge of Adélie Land is characterized by >1400 Ma $^{40}Ar/^{39}Ar$ hornblende ages, which is consistent with the proximal on-land geology, yet both the U-Pb zircon and $^{40}Ar/^{39}Ar$ biotite populations contain the >1400 Ma population in addition to a population of grains with Ross Orogen ages. Pierce *et al.* [2011] reported hornblende and biotite $^{40}Ar/^{39}Ar$ ages from this core, and attributed the ~500 Ma biotite population to possible low-temperature re-setting in western Adélie Land. The presence of U-Pb zircon ages with Ross ages implies that wether this population is the result of ice-rafting from east of the Mertz Shear Zone,

or alternatively that bedrock affected by the Ross Orogen is more extensive than previously thought. We consider the latter explanation highly unlikely, given the distance between Core 23 and outcrops affected by the Ross Orogen, as well as the absence of known Ross overprinting west of the Mertz Shear Zone.

6.1.4.4. Bowers Terrane

U-Pb zircon and $^{40}Ar/^{39}Ar$ biotite ages have population of ~ 389 Ma and ~369 Ma, respectively; this age population is notably absent from the hornblende grains. These ages most likely reflect sourcing from the Bowers Mountain range, which has K-Ar dates of this age [*Adams*, 2006]. The absence of hornblende grains in this age range is likely a lithological bias.

6.1.4.5 McMurdo Volcanics.

$^{40}Ar/^{39}Ar$ hornblende grains from cores off the coast of NVL contain a population of young grains, with a peak age of 2.3 Ma; these ages are not present in either the U-Pb zircon or $^{40}Ar/^{39}Ar$ biotite age populations. A likely source for these young grains is the extremely young volcanic rocks found off the coast of Victoria Land in the western Ross Sea. Cooper *et al*. [2007] dated volcanism associated with White Island at ~5 – 7 Ma, while Rilling *et al*. [2007] dated volcanism associated with the Terror Rift at < ~ 4 Ma.

6.2 Implications for Provenance Studies

6.2.1 Source area characterization

The general division of provenance sectors around East Antarctica that emerges from this study is consistent with previous work based on $^{40}Ar/^{39}Ar$ hornblende and biotite ages [*Roy et*

al., 2007; *Williams et al.,* 2010; *Pierce et al.,* 2011] as pertains to the Prydz Bay, Wilkes Land and Adélie/George V/Northern Victoria land sectors. Figures 3 A-D, Figures 5 A-C and Table 3 A and B illustrate the combined provenance signature for sectors around East Antarctica using each of the three mineral systems in this study.

The power in using U-Pb zircon ages in addition to the $^{40}Ar/^{39}Ar$ thermochronometers is that it adds another level of characterization, given the resilient nature of the U-Pb system in zircon, and zircon itself; additional age populations not present in the $^{40}Ar/^{39}Ar$ hornblende and biotite ages of the source areas can then be paired with these lower-temperature ages to better tease out source areas. Both Pan-African and Grenville overprinting are pervasive around East Antarctica, however the peak ages of these orogenies is variable, allowing for the potential to still differentiate between broad areas affected by these events. Grenville ages in each of the mineral systems is generally consistent (allowing for cooling following the event, as discussed above), with the division of Fitzsimons [2000], with the oldest peak Grenville ages found in Wilkes Land, then Droning Maud Land, then Prydz Bay. Pan-African and Ross overprinting as recorded by $^{40}Ar/^{39}Ar$ hornblende and biotite ages around East Antarctica generally show more overlap than what we see with the Grenville Orogeny (Table 3A), however peak ages within these populations (Table 3B) show subtle variations that may be applied to distinguish between these sectors.

The DML can be further refined as more than just a mix of Pan-African, Ross and Grenville Ages, largely by the $^{40}Ar/^{39}Ar$ hornblende and biotite ages. First, Archean grains sourced from the Grunehogna Craton stands out as distinct provenance signal in both the $^{40}Ar/^{39}Ar$ hornblende and biotite ages. Second, there appears to be an area in Coats Land with Grenville ages represented in all thermochronometers, and which were not reset during the

subsequent Pan-African and Ross orogenies. Thus, while Grenville U-Pb zircon ages are prevalent in most core sites along this margin, the $^{40}Ar/^{39}Ar$ hornblende and biotite ages with this signature are restricted to an area along the Coats Land Coast, and likely reflect sourcing from the Bertrab-Littlewood-Moltke nunataks (see Figure 5 A-C), which have U-Pb zircon ages of 1000-1100 Ma [*Gose et al.*, 1997; *Storey et al.*, 2004], This is likely due to re-setting of the lower-temperature thermochronomters during the Pan-African and Ross orogenies.

Overall, the U-Pb zircon and $^{40}Ar/^{39}Ar$ hornblende and biotite ages that we have measured and discussed in this study faithfully reflect known proximal on-land ages, and combined they offer ways to distinguish areas of East Antarctica.

6.2.2 ODP Site 1165B (Core 16)

We also report U-Pb ages on zircons from 5 IRD-rich layers recovered from ODP Site 1165; these IRD layers were originally part of a study by Williams *et al.* [2010], and demonstrated evidence for massive ice-berg armadas originating from Adélie Land and Wilkes Land during the Pliocene. The purpose of this data is to examine the application of U-Pb zircon ages for determining the provenance of IRD. The U-Pb zircon ages from the 3.0 Ma, 7.0 Ma and 19.0 Ma samples are consistent with the $^{40}Ar/^{39}Ar$ hornblende ages of Williams *et al.* [2010] and biotite ages of Pierce *at al.* [2011] (Figure 4). Figure 5 (A- C) shows pie-charts of the U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende, and $^{40}Ar/^{39}Ar$ biotite ages, respectively, for each of the IRD layers analyzed from ODP Site 1165. Based the characterization of source areas through our U-Pb data from the core sites, we would expect the local Prydz Bay signature for the U-Pb zircons to include a 500-600 Ma population, potentially a small ~700 Ma population, and a Grenville population dominated by 900-1000 Ma ages; the Wilkes Land signature should contain age

populations of ~1560 Ma and 1150 Ma, and the Adélie Land signature should contain age populations of >1600 Ma.

Williams *et al.* [2010] interpreted the source of IRD in the 19.0 Ma event as a dominantly local Prydz Bay source, based on the ~500 Ma population of $^{40}Ar/^{39}Ar$ hornblende ages. The U-Pb zircon ages from this sample show a bimodal distribution, with two populations, ~ 500 Ma, and a spread of Grenville ages (980-1300). The presence of Grenville-aged zircons, while different than the distribution of the $^{40}Ar/^{39}Ar$ hornblende ages, is still consistent with a local Prydz Bay source, as shown by the U-Pb analyses in Cores 15, and 17-19 [this study; *Fitzsimons* 2000, *van de Flierdt et al.,* 2008; *Veevers and Saeed*, 2011; *Veevers* 2012].

The source of the IRD in the 3.0 Ma and 7.0 Ma events was interpreted as a combination of the local ~ 500 Ma age signature, in addition to a significant contribution from the Wilkes Land Coast, based on the 1100-1200 Ma $^{40}Ar/^{39}Ar$ hornblende age population in both samples [*Williams et al.,* 2010]. The U-Pb zircon ages from the 3.0 Ma and 7.0 Ma show both of these age populations (~500 Ma and 1100-1200 Ma), which is also consistent with the 1100-1200 Ma U-Pb zircon ages found in proximal cores 21 and 22, off the coast of Wilkes Land. What is surprising, however, is the lack of 1500-1600 Ma U-Pb zircons; an age population that is present in the zircons from cores 21 and 22. It may be that our proximal core sites are tapping a larger area than the ice streams that produced the iceberg armadas; further characterization along the Wilkes Land margin would be beneficial for provenance studies as well as for further investigating the geologic history of this margin.

There are too few (n=3) U-Pb zircon ages to comment on the 4.65 Ma (70 cm) layer, however the 3 ages obtained are consistent with the $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages.

The 4.65 Ma (100 cm) event sample is intriguing, as it indicates sourcing of IRD from ~ 3000 km to the east of ODP Site 1165; $^{40}Ar/^{39}Ar$ hornblende ages reported in Williams *et al.* [2010] show an ~ 500 Ma population (local Prydz Bay signal) and a second $^{40}Ar/^{39}Ar$ hornblende age population of ~1500 Ma, interpreted as being sourced from the Adélie Land coast (Figure 5 A-C). U-Pb zircon and $^{40}Ar/^{39}Ar$ hornblende ages from cores near Adélie Land (Cores 23-25) contain an ~500 Ma population, a 1000-1200 Ma population, and a 1400-1600 Ma population, with 2 grains 2600-2700 Ma (Figure 5A, 5B, Figure 6). In comparing the zircon and hornblende age populations (Figure 6), we see that 9% and 20% of the hornblende grains fall in the 1000-1200 Ma and 1400-1600 Ma rage, respectively. Conversely, 10% and 4% of the zircon ages fall in the 1000-1200 Ma and 1400-1600 Ma populations. As more zircons fall in the 1000-1200 Ma range, while more hornblendes fall in the 1400-1600 Ma range, this may be an explanation for the apparent disparity in the zircon and hornblende age populations found in the 4.65 Ma (100 cm) layer.

7. Interesting Findings and Unexpected Detrtial Age Populations

This circum-East Antarctic detrital mineral comparison has revealed age populations from the detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite measurements which have not been reported from on-shore studies. These 'unexpected' age populations reflect either a bias in the types of measurements made from on-land samples (U-Pb zircon ages dominate the on-land record) or the presence of ice-covered terranes that are not, and never have been, accessible for direct study. Here we provide a brief overview of these findings:

First, Archean populations of $^{40}Ar/^{39}Ar$ hornblende and biotite ages are found in core samples from offshore of the Grunehogna Craton in the Droning Maud Land sector. There are

no-onland measurements of $^{40}Ar/^{39}Ar$ hornblende and biotite reflecting these Archean populations, however the granitic bedrock that makeas up the Grunehogna Craton has been determined to have a crystillization age 3067±8 Ma, based on the U/Pb zircon ages, with evidence of inherited zircon ages ranging from 3175±8 to 3433±7 Ma [*Marschall et al.,* 2010]. We propose that hornblende and biotite-rich rocks associated with the Grunehogna Craton are likely obscured by the ice sheet.

Second**,** a small but notable ~ 1230 Ma $^{40}Ar/^{39}Ar$ hornblende age population in Core 1, from the western Weddell Sea, perhaps reflects an early precursor to Grenville Orogeny in this part of East Antarctica. These $^{40}Ar/^{39}Ar$ hornblende ages are significantly older than the detrital U/Pb zircon, additional $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages from not only this core site, but from this entire sector, and may reflect an previously unstudied event.

Third, an ~ 580 Ma population of U-Pb zircons off the coast of George V Land and Northern Victoria Land indicates an older precursor to the Ross Orogeny than previously thought; this is consistent with the findings of a similar study by Goodge and Fanning [2010], which reported U-Pb zircon ages form glacial-marine sediments.

Fourth, a small but notable ~1000 to 1300 Ma (Grenville-aged) population in all three thermochronometers in the Adélie/George V/Northern Victoria Land sector, which is not seen in outcrops, may reflect an extension of Grenville-aged rocks far into East Antarctica's interior, or recycling of Grenville-aged minerals; Goodge and Fanning [2010] noted the presence of similar U/Pb zircon ages from glacial-marine sediment samples in this area, and hypothesized that they reflected either extension of Grenville-aged rocks to this are, or zircon recycling. Given that recycling is highly unlikely for hornblende and biotite grains, our data lend support to the idea that a Grenville-aged terrane does in fact extend into East Antarctica's interior.

Finally, we observe a dominant population of ~1562 Ma U-Pb zircons from core locations off the eastern most part of Wilkes Land (Cores 21 and 22), which falls just outside of error of the ~1521 ±2 0 U=Pb zircon ages measured by Sheraton et al. (1992, 1993) in the Bunger Hills, over 1000 km to the west. We can speculate that these ages require further extension of the granitoids from the Bunger Hills area, however we need more data from addition marine sediment core samples to validate this idea.

8. Conclusions

In this paper we have performed a circum-East Antarctic comparison of detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende, $^{40}Ar/^{39}Ar$ biotite ages from 27 marine sediment core around East Antarctica, adding a total of 3,284 new analyses to a growing data set of detrital thermochronologic ages from glacial-marine sediments around East Antarctica. Included in this is the analysis ice-rafted U-Pb zircon ages from a down-core record of IRD in ODP Site 1165. Our results lead us to reach the following conclusions:

1. Detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages faithfully record the geologic history of East Antarctica, as expressed in their respective age populations. Measured ages match well with known outcrops, while also providing information about ice covered areas; major populations present in our measurements include Archean ages reflecting the Grunehogna and Terre Adélie Cratons, Paleoproterozoic ages (~1500 -1700 Ma) reflecting thermal events in Wilkes and Adélie Land, Grenville (1330-900 Ma), Pan-African (600-550 Ma) and Ross (550-400 Ma) ages reflecting three major orogenies in East Antarctica's history, an ~380 Ma population reflecting volcanic activity in the Bowers Terrane of Northern Victoria land, a ~180

Ma population of grains reflecting Ferrar-Karoo magmatism associated with Jurassic rifting and separation of Gondwanaland, and a 0-20 Ma population reflecting the McMurdo volcanics in the Ross Sea.

2. Our results reveal age populations from the detrital U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite measurements which have not been reported from on-shore studies, reflecting either a bias in the types of measurements made from on-land samples (U-Pb zircon ages dominate the on-land record) or the presence of ice-covered terranes that are not accessible for direct study.

3. Zircons, hornblendes and biotites were found in variable amounts, as expected, in each of the core samples, reflecting differences in the lithologies of the bedrock eroded by the ice sheet. Age populations were found to not always be consistent between each of the U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite ages from individual samples. In some cases, this can be attributed to lithologic bias, while in many it is more likely the result of resetting of the $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite systems.

4. As has been shown with previous work (Roy et al., 2007, Williams et al., 2010, Pierce et al., 2011), East Antarctica can be broadly divided by the lower-temperature chronomters into source areas with distinctive ages; Northern Victoria Land/George V Land, Adélie Land, Wilkes Land, and Prydz Bay each have a unique signature. Droning Maud Land as a whole is a mix of Grenville and Pan-African/Ross-orogen ages, however within this sector divisions can be made to determine source areas.

5. U-Pb zircon measurements made on ice-rafted deposits from ODP Site 1165 highlight both the potential and disadvantage for using this approach to trace the provenance of IRD from deep-sea core sites. The low abundance of zircons in each of the IRD layers is most likely because the transporting mechanism (ice) does not sort or concentrate zircons, and thus the low zircon yield reflects the fact that zircon is an accessory mineral; from the 5 samples we studied, a minimum of 3 grains was found in the least enriched sample and a maximum of 31 grains in the most enriched. In comparison, hornblendes averaged 33 grains per sample [*Williams et al.,* 2010], and biotites averaged 36 grains per sample [*Pierce et al.,* 2011].

6. The results of this comparative approach are promising, and we recommend that further application of this combined approach is likely to improve our understanding of East Antarctic geology, particularly in areas that are ice covered. While the cores in this study were chosen so as to characterize major crustal elements of East Antarctica, more detailed work in specific study areas, combined with other types of zircon analyses, e.g. zircon grain morphology, fission track and (U-Th)/He, will undoubtedly prove more insights to East Antarctica's geologic history.

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Table 1: Relative concentrations of zircon, hornblende and biotite in major lithologies [*Poldervaart*, 1955; *Poldervaart*, 1956; *Deer et al.*, 1992; *Nesse*, 2000; *Reiners et al.*, 2005].

ZIRCON	***High***	***Medium***	***Low to none***
Igneous	Felsic crystalline (granite, granodiorite, tonalite)	Rhyolite, ignimbrite	Gabbro, basalt, ultramafic
Metamorphic	Orthogneiss	Pargneiss, metarhyolite, metasandstone, phyllite	Marble, eclogite, schist
Sedimentary	Arkose	Conglomerate, quartz-arenite, litharenite	Claystone, dolomite, carbonate rocks
HORNBLENDE	***High***	***Medium***	***Low to none***
Igneous	Intermediate rocks; granodiorite, diorite	Granite, gabbro	Ultramafic,
Metamorphic	Medium to high-grade; mafic/ultramafic protolith	medium grade	Marble, carbonate protolith
Sedimentary	None	None	Clastics
BIOTITE	***High***	***Medium***	***Low to none***
Igneous	Felsic rocks; granite, rhyolite	Intermediate and mafic rocks, diorite, andesite	ultramafic
Metamorphic	Low to intermediate grade; hornfels, phyllites, schists and gneisses	High grade; migmatites	Mafic protolith
Sedimentary	None	None	Clastics, immature sediments

Table 2: Samples and analyses made for this study. Columns headings form left to right: ID number assigned to cores for this study; Name of the core from which the sample was taken; Location of core in degrees latitude; Location of core in degrees longitude; Type of sample (SRL – sand rich layer; IRD – Ice rafted debris); Depth of sample in the core; Water depth of drill site; Geographical sector assigned to core based on relative position of the core to East Antarctica; DML - Dronning Maud Land; PB - Prydz Bay; WL- Wilkes Land; Al - Adélie Land; GVL - George V Land; NVL - Northern Victoria Land, Study in which U/Pb zircon data was collected, Number of zircon grains measured for U/Pb from sample, Study in which $^{40}Ar/^{39}Ar$ hornblende data was collected, Number of hornblende grains measured for $^{40}Ar/^{39}Ar$ from sample, Study in which $^{40}Ar/^{39}Ar$ biotite data was collected, Number of biotite grains measured for $^{40}Ar/^{39}Ar$ from sample.

Site ID	Site Name	Latidude (˚)	Longitude (˚)	Sample Type	Sampling Depth	Water Depth (m)	Sector	**Zircon** (U/Pb)	**n**	**Hornblende** (40Ar/39Ar)	**n**	**Biotite** (40Ar/39Ar)	**n**
1	IWSOE 68-11	-74.017	-54.75	SRL	11-18 cm	459	DML	This Study	0	This Study	67	This Study	11
2	IWSOE 68 G8	-76.833	-40.917	SRL	10-17 cm		DML	This Study	0	This Study	6	This Study	0
3	IWSOE 70 2-22-1	-77.533	-37.967	SRL	22-27 cm	1054	DML	This Study	137	This Study	71	This Study	0
4	IWSOE 69 G17	-76.883	-32.833	SRL	158-162 cm	341	DML	This Study	15	This Study	96	This Study	13
5	IWSOE69 G21	-72.8	-29.367	SRL	79-82 cm	3964	DML	This Study	60	This Study	55	This Study	9
6	IWSOE 68 13	-75.45	-26.55	SRL	8-14 cm	507	DML	This Study	42	This Study	46	This Study	17
7	IWSOE70 03-11-03	-73.983	-23.65	SRL	228-230cm	260	DML	This Study	102	This Study	20	This Study	4
8	IO 1578-27	-72.408	-19.418	SRL	735.5-737	3274	DML	This Study	20	This Study	39	This Study	19
9	IO 1578-28	-72.19	-15.305	SRL	235.5-237	58	DML	This Study	77	This Study	23	This Study	8
10	IWSOE 70 3-17-2	-71.167	-12.367	SRL	55-59 cm	418	DML	This Study	53	This Study	97	This Study	27
11	IO 1578-16	-70.612	-10.063	SRL	128-130 cm	366	DML	This Study	77	This Study	29	This Study	22
12	IWSOE 70 3-18-1	-70.3	-6.807	SRL	31-33 cm	713	DML	this stud	46	This Study	46	This Study	27
13	IO 1277-41	-69.998	-5.077	SRL	1161-1173	1173	DML	This Study	0	This Study	23	This Study	0

					cm								
14	IO 1277-23	-67.897	14.58	SRL	887-889; 889-891	924	DML	This Study	125	This Study	57	This Study	*29*
15	NBP01-01 JPC40	-67.176	65.737	diamict	2370, 2245, 2280 cm	750	PB	B/this study	95	this study	13	this study	25
16	ODP Site 1165B	-64.371	67.219	IRD	(see below)	3537	PB	This Study	78	Williams et al. (2010)	167	Pierce et al. (2011)	145
17	NBP01-01 JPC34	-68.251	72.730	diamict	70, 292, 345	754	PB	B/this study	231	this study	318	this study	50
18	ODP Site 1166A	-67.696	74.787	diamict and fluvial	60, 80, 100 cm	475	PB	vdF et al. (2008)	232	vdF et al. (2008)	160	vdF et al. (2008)	16
19	NBP01-01 JPC25	-68.752	76.703	diamict	1305, 1503 cm	848	PB	B/this study	126	this study	37	this study	14
20	ELT49-30	-59.005	95.23	SRL	1698-1702 cm	4276	WL	This Study	0	Pierce et al. (2011)	34	Pierce et al. (2011)	30
	ELT49-30 A			SRL	1276-1280 cm	4276		This Study	0	this study	nm	this study	nm
21	ELT37-16	-63.97	127.447	SRL	231-235 cm	3840	WL	This Study	0	Pierce et al. (2011)	63	Pierce et al. (2011)	57
	ELT37-16 A			SRL	228-233 cm	3840		This Study	143	this study	38	this study	nm
22	ELT37-13	-64.672	132.977	SRL	113-120 cm	1333	WL	This Study	33	Pierce et al. (2011)	47	Pierce et al. (2011)	29
	ELT37-13 A			SRL	112-117 cm	1333		This Study	126	this study	44	this study	nm
23	ELT37-09	-65.552	141.095	SRL	140-144 cm	1308	AL	This Study	10	Pierce et al. (2011)	45	Pierce et al. (2011)	28
	ELT37-09 A			SRL	137-139 cm	1308		This Study	34	this study	16	Pierce et al. (2011)	59
24	NBP 01-01JPC11	-66.563	143.052	diamict	2305-2310 cm	870	AL	This Study	10	Pierce et al. (2011)	15	Pierce et al. (2011)	14
	NBP 01-01JPC11			diamict	2370-2375 cm	870		This Study	8	Pierce et al. (2011)	41	Pierce et al. (2011)	15
25	DF79-47	-66.667	148.733	SRL	563-567 cm	476	GVL	This Study	17	Pierce et al. (2011)	46	Pierce et al. (2011)	10
	DF79-47 A			SRL	568.5 -576 cm	476		This Study	87	this study	18	this study	nm
26	DF80-34	-69.917	162.83	SRL	222-226 cm	805	NVL	This Study	17	Pierce et al. (2011)	36	Pierce et al. (2011)	33
	DF80-34 A			SRL	213-222 cm	805		This Study	71	this study	10	this study	nm
27	DF80-35	-70.017	166.417	SRL	269-273 cm	490	NVL	This Study	0	Pierce et al. (2011)	21	Pierce et al. (2011)	23
	DF80-35 A			SRL	264-269 cm	490		This Study	0	this study	11	this study	nm

28	DF80-20	-69.783	163.683	SRL	160-164 cm	475	NVL	This Study	0	Pierce et al. (2011)	8	Pierce et al. (2011)	35
	DF80-20 A			SRL	152-160 cm	475		This Study	0	this study	nm	this study	nm
Downcore Record ODP Site 1165B:													
		-64.371	67.219				PB						
16	ODP Site 1165	3.5 Ma		IRD	1165B-4H-6 (80)			This Study	10	Williams et al. (2010)	40	Pierce et al. (2011)	41
16	ODP Site 1165	4.65 Ma		IRD	1165B-6H-1 (70)			This Study	3	Williams et al. (2010)	32	Pierce et al. (2011)	28
16	ODP Site 1165	7 Ma		IRD	1165B-10H-2 (35)			This Study	31	Williams et al. (2010)	31	Pierce et al. (2011)	39
16	ODP Site 1165	19 Ma		IRD	1165C-10R-3 (120)			This Study	13	Williams et al. (2010)	23	Pierce et al. (2011)	37
16	ODP Site 1165	4.65 Ma		IRD	1165B 6H-1 100/102			This Study	21	Williams et al. (2010)	41	Pierce et al. (2011)	-

Table 3. A) Distribution of *age ranges* represented by each of the thermochronometers by geographic sector, for the purpose of characterizing provenance sources. **B)** Table showing *peak ages* by geographic sector, indicating significant populations that could be used as sedimentary provenance tools. '*' indicates that this is not a large population.

A.

	Age Ranges (in Ma)				
Sector	**0-400**	**400-800**	**800-1400**	**1400-2000**	**> 2000**
DML					
U Pb Z	80-200*	480-680	1000-1130	1600-1900*	2600-2800*
ArAr Hb	80-200*	460-520	980-1080	-	2800-3200
ArAr Bio	80-200*	400-500	900-1100	-	2600-2700
PB					
U Pb Z	-	520 - 700	880-1000	-	~2000*, ~2600*
ArAr Hb	-	460-540	-	-	-
ArAr Bio	-	460-540	-	-	-
WL					
U Pb Z	-	-	1100-1200	1500-1600	-
ArAr Hb	-	-	1100-1200	1400-1500*	-
ArAr Bio	-	-	1100-1200	-	-
AL					
U Pb Z	-	-	1000-1300*	1600-1800	2350-2550*
ArAr Hb	-	-	-	1400-1800	-
ArAr Bio	-	-	-	1500-1700	-
GVL/NVL					
U Pb Z	360-400	480-660	-	-	-
ArAr Hb	0-20	460-540	-	-	-
ArAr Bio	360-400	460-540	-	-	-

B.

	Age Ranges (in Ma)				
Sector	0-400	400-800	800-1400	1400-2000	> 2000
DML					
U Pb Z	168*, 189*	520, 760*	1068, 1104	1796	2588*,2736*
ArAr Hb	92*, 174*	494	1056	-	2890, 3080
ArAr Bio	160*, 211*	451	976, 1011, 1071	-	2550, 2600, 2644
PB					
U Pb Z	-	540, 698*	932	-	2064, 2766
ArAr Hb	-	500, 628*	-	-	-
ArAr Bio	-	501	-	-	-
WL					
U Pb Z	-	-	1150	1562	-
ArAr Hb	-	-	1152	1494	-
ArAr Bio	-	440	1120	-	-
AL/GVL/NVL					
U Pb Z	389	502, 579	1059-1236*	1610	2373-2518
ArAr Hb	2	493	-	1480, 1609, 1715	-
ArAr Bio	369	494	-	1626	-

Table 4. Peak ages for each thermochronometer by individual core site (see **Appendix F** for histograms). '*' indicates that this is not a large populations; bold-faced ages represent dominant population. U PB Z – U-Pb zircon; ArAr Hb - $^{40}Ar/^{39}Ar$ hornblende; ArAr Bio - $^{40}Ar/^{39}Ar$ biotite.)

Site ID	Age Ranges (in Ma):					
	0-400	400-800	800-1400	1400-2000	> 2000	*n*
1						
U Pb Z	-	-	-	-	-	*0*
ArAr Hb	90*, 366*	-	103, **1120**, 1220	-	-	*67*
ArAr Bio	190	-	975	-	-	*11*
2						
U Pb Z	-	-	-	-	-	*0*
ArAr Hb	-	488	-	-	-	*6*
ArAr Bio	-	-	-	-	-	*0*
3						
U Pb Z	**110**, 178	**542**, 658	1158*	1760	-	*137*
ArAr Hb	193*	**494**	-	-	-	*71*
ArAr Bio	-	-	-	-	-	*0*
4						
U Pb Z	-	-	1027	-	-	*15*
ArAr Hb	-	-	1060	-	-	*96*
ArAr Bio	-	-	1033, 1062	-	-	*13*
5						
U Pb Z	189	516, 652	1100	-	-	*60*
ArAr Hb	180	504	995	-	-	*55*
ArAr Bio	-	-	940	-	-	*9*
6						
U Pb Z	182	567	1111	-	-	*42*
ArAr Hb	-	**520,** 690, 732	998, **1050**	-	-	*46*
ArAr Bio	-	470	**973**, 1020	-	-	*17*
7						
U Pb Z	-	**529**, 568, 757	1050*, 1195*	-	-	*102*
ArAr Hb	174	474	-	-	-	*20*
ArAr Bio	-	484	-	-	-	*4*
8						
U Pb Z	-	482, 580	1090	-	-	*20*
ArAr Hb	184*	**483**	884*, 1014*	-	-	*39*
ArAr Bio	-	430	-	-	-	*19*
9						
U Pb Z	-	**508, 555**, 600	1066	-	-	*77*

ArAr Hb	60, 156	480	-	-	-	*23*
ArAr Bio	220	494	-	-	-	*8*
10						
U Pb Z	-	**522**, 570	-	-	3195*, 3525*, 3690*	*53*
ArAr Hb	62	**495**	-	-	3140	*97*
ArAr Bio	-	450	-	-	-	*27*
11						
U Pb Z	-	534, 614	1074	-	-	*77*
ArAr Hb	-	464	-	-	2908	*29*
ArAr Bio	-	465	-	-	-	*22*
12						
U Pb Z	-	518, 572, 642	957*, 1024*	-	-	*46*
ArAr Hb	-	474	-	-	2878, 3070	*46*
ArAr Bio	-	452	-	-	2600	*27*
13						
U Pb Z	-	-	-	-	-	*0*
ArAr Hb	-	472	-	-	-	*23*
ArAr Bio	-	-	-	-	-	*0*
14						
U Pb Z	-	**524,** 624	1040	-	-	*125*
ArAr Hb	-	466	-	-	-	*57*
ArAr Bio	-	430	-	-	-	*29*
15						
U Pb Z	-	699	**954,** 1010	-	-	*95*
ArAr Hb	-	540	-	-	-	*13*
ArAr Bio	-	528	-	-	-	*25*
17						
U Pb Z	-	550, 704*	**932,** 988	-	-	*231*
ArAr Hb	-	495, 625*		-	-	*318*
ArAr Bio	-	488	-	-	-	*50*
18						
U Pb Z	-	**532**; 630	900	-	-	*232*
ArAr Hb	-	**500**, 627	-	-	-	*160*
ArAr Bio	-	500	-	-	-	*15*
19						
U Pb Z	-	**538**, 566, 722	894	-	-	*126*
ArAr Hb	-	503, 545*,617*	-	-	-	*37*
ArAr Bio	-	500	-	-	-	*14*
20						
U Pb Z	-	-	-	-	-	*0*
ArAr Hb	-	-	1168	-	-	*34*
ArAr Bio	-	440*, 449*	1089	-	-	*30*
21						
U Pb Z	-	-	1151	**1512**, 1544, 1590	-	*143*
ArAr Hb	-	-	1155	1490	-	*101*
ArAr Bio	-	-	1120, 1240*	-	-	*57*

22						
U Pb Z	-	-	1145	1562	-	*159*
ArAr Hb	-	-	**1128**, 1264	-	-	*90*
ArAr Bio	-	-	1121	-	-	*29*
23						
U Pb Z	-	515, 581	1106, 1152	1638, 1794	2455	*44*
ArAr Hb	130*	537	-	1701, 1786	-	*61*
ArAr Bio	-	495	-	1580, 1690	-	*87*
24						
U Pb Z	-	-	-	1750	2440	*18*
ArAr Hb	-	-	-	1438, 1582, **1751**	2290*, 2460	*56*
ArAr Bio	-	-	-	1618	-	*29*
25						
U Pb Z	-	579	1055*	-	-	*104*
ArAr Hb	-	491, 515	1035-1230*	1470, 1710	-	*64*
ArAr Bio	-	490	-	-	-	*10*
26						
U Pb Z	388	500, 524, 576	1054-1240	-	-	*88*
ArAr Hb	3	495	1180	-	-	*36*
ArAr Bio	377	493	-	-	-	*33*
27						
U Pb Z	-	-	-	-	-	*0*
ArAr Hb	10	-	-	-	-	*32*
ArAr Bio	375	-	-	-	-	*23*
28						
U Pb Z	-	-	-	-	-	*0*
ArAr Hb	365	-	-	-	-	*8*
ArAr Bio	368	487*	-	-	-	*35*

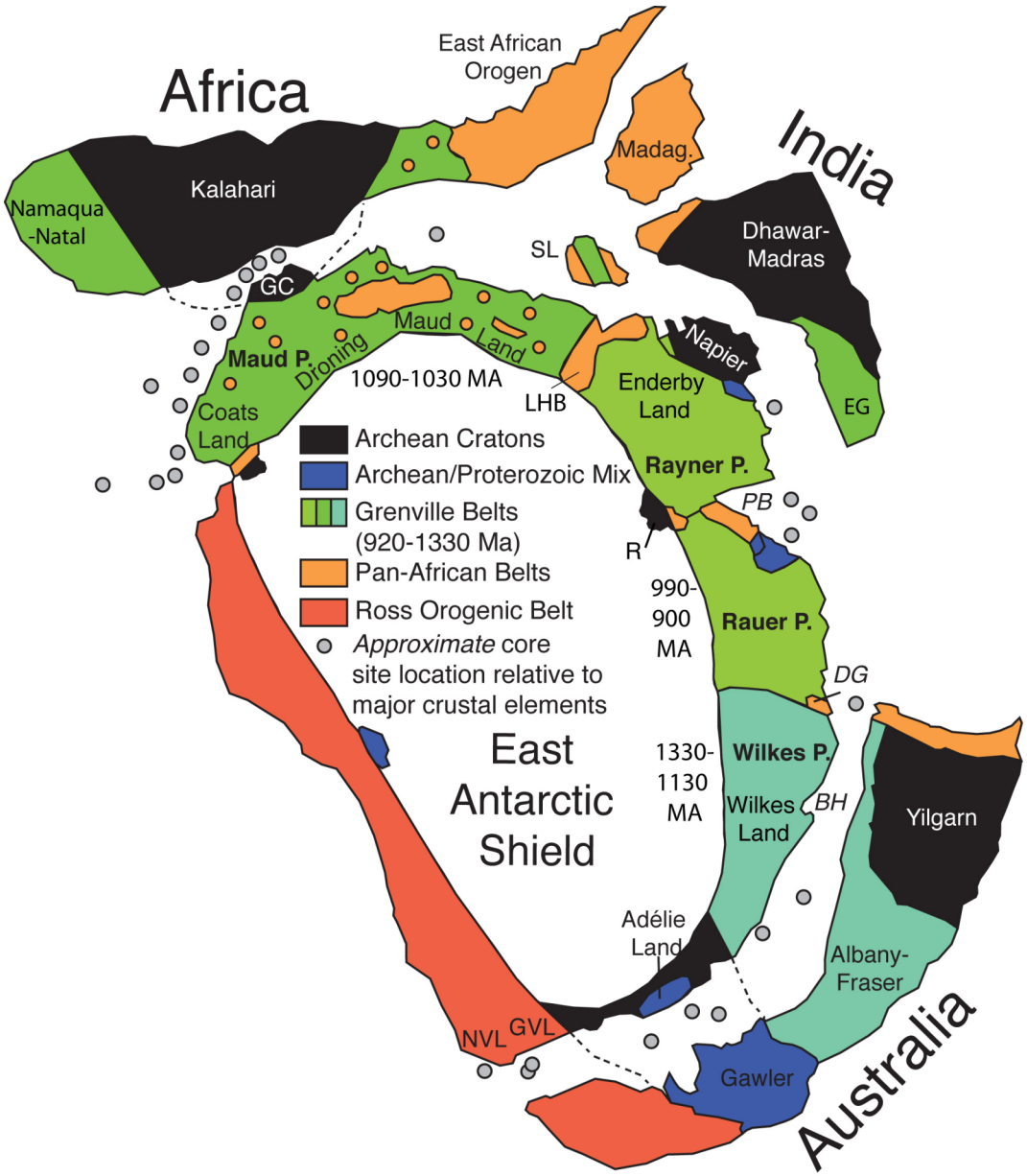


Figure 1. East Antarctic crustal terranes and approximate core sites. Map modified from Harley and Kelly [2007]; Grenville age ranges are as defined by Fitzsimons [2000]. BH – Bunger Hills, DG – Denman Glacier, EG – Eastern Ghats, GC- Grunehogna Craton, GVL – George V Land, LHN- Lützow-Holm Belt, Madag. – Madagascar- NVL – Northern Victoria Land, PB - Prydz Bay, R- Ruker Terrane, SL- Sri Lanka, WI – Windmill Islands.

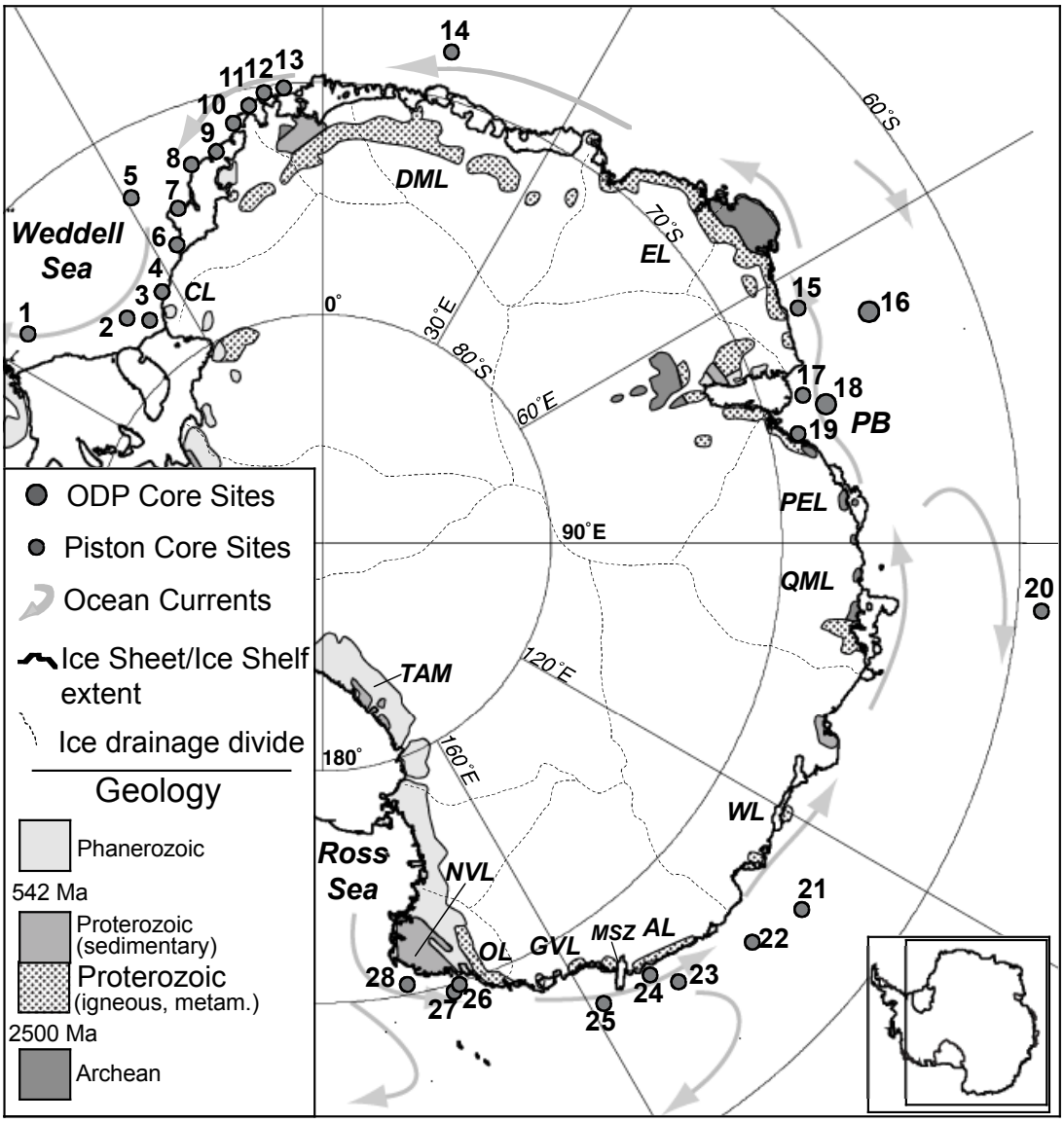


Figure 2. Location map of East Antarctica showing outcrops, basic geology, ocean currents and cores sites. Geology from Collins & Pisarevsky [2005]. AL – Adélie Land, CL- Coates Land, DML- Droning Maud Land, EL – Enderby Land, GVL – George V Land, MSZ – Mertz Zhear Zone, NVL –Northern Victoria Land, OL – Oates Land, PEL – Princess Elizabeth Land, PB – Prydz Bay, QML – Queen Mary Land, TAM –Transantarctic Mountains, WL – Wilkes Land.

Figure 3. A

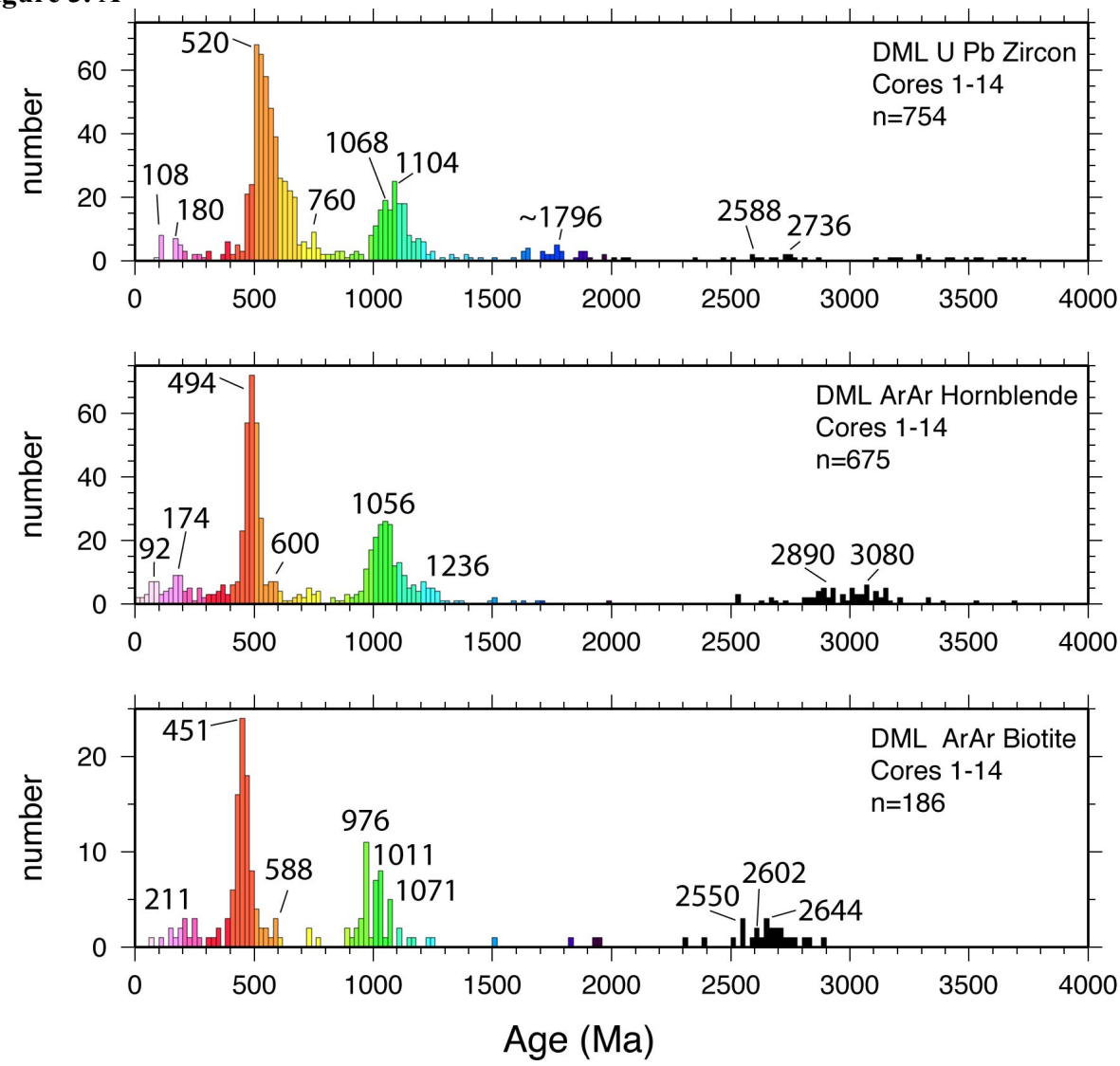

DML U Pb Zircon
Cores 1-14
n=754
520
108
180
760
1068
1104
~1796
2588
2736
DML ArAr Hornblende
Cores 1-14
n=675
494
92
174
600
1056
1236
2890
3080
DML ArAr Biotite
Cores 1-14
n=186
451
211
588
976
1011
1071
2550
2602
2644
number
Age (Ma)

Figure 3. B

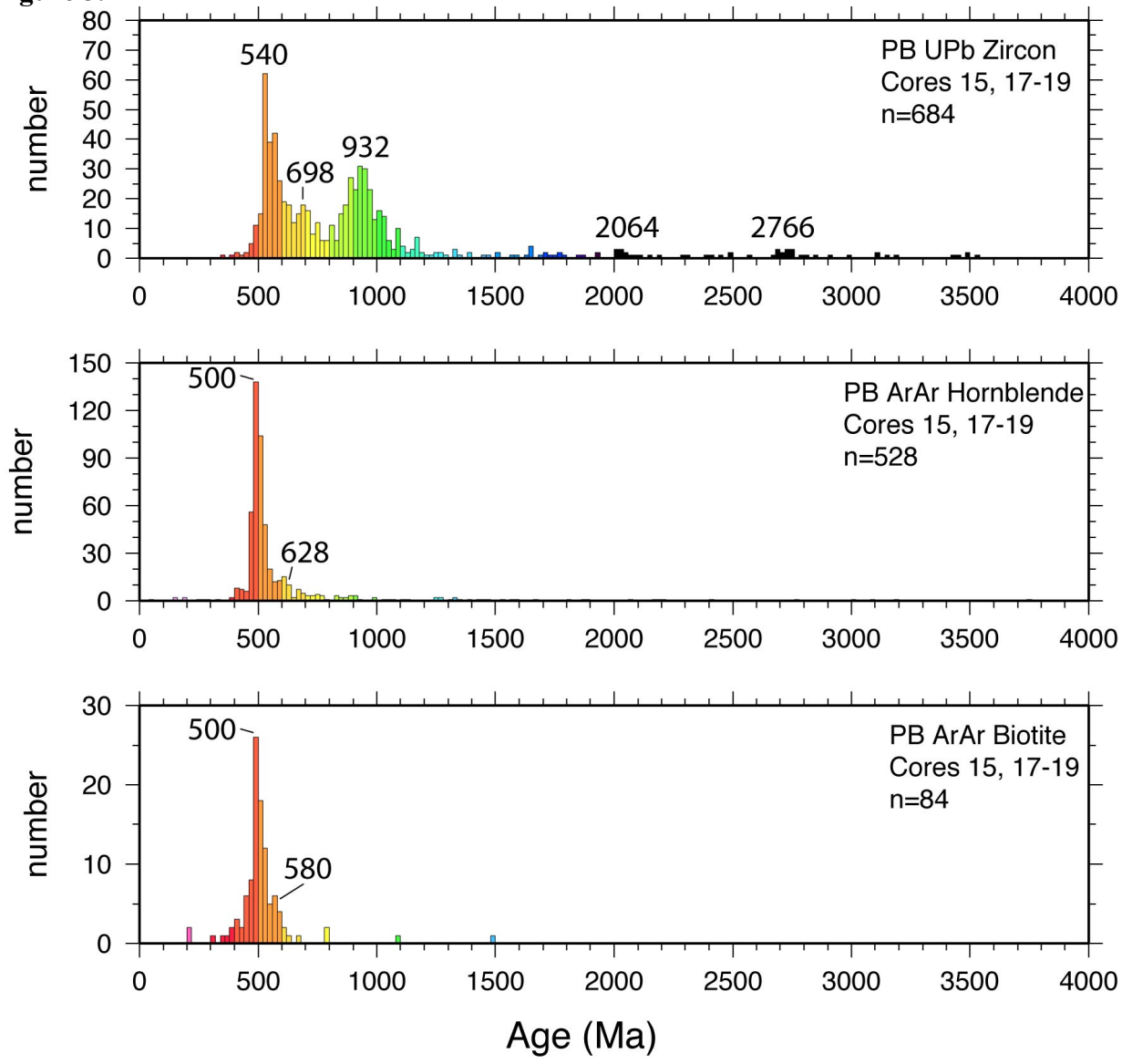

PB UPb Zircon
Cores 15, 17-19
n=684
540
698
932
2064
2766
number
PB ArAr Hornblende
Cores 15, 17-19
n=528
500
628
number
PB ArAr Biotite
Cores 15, 17-19
n=84
500
580
number
Age (Ma)

Figure 3.C

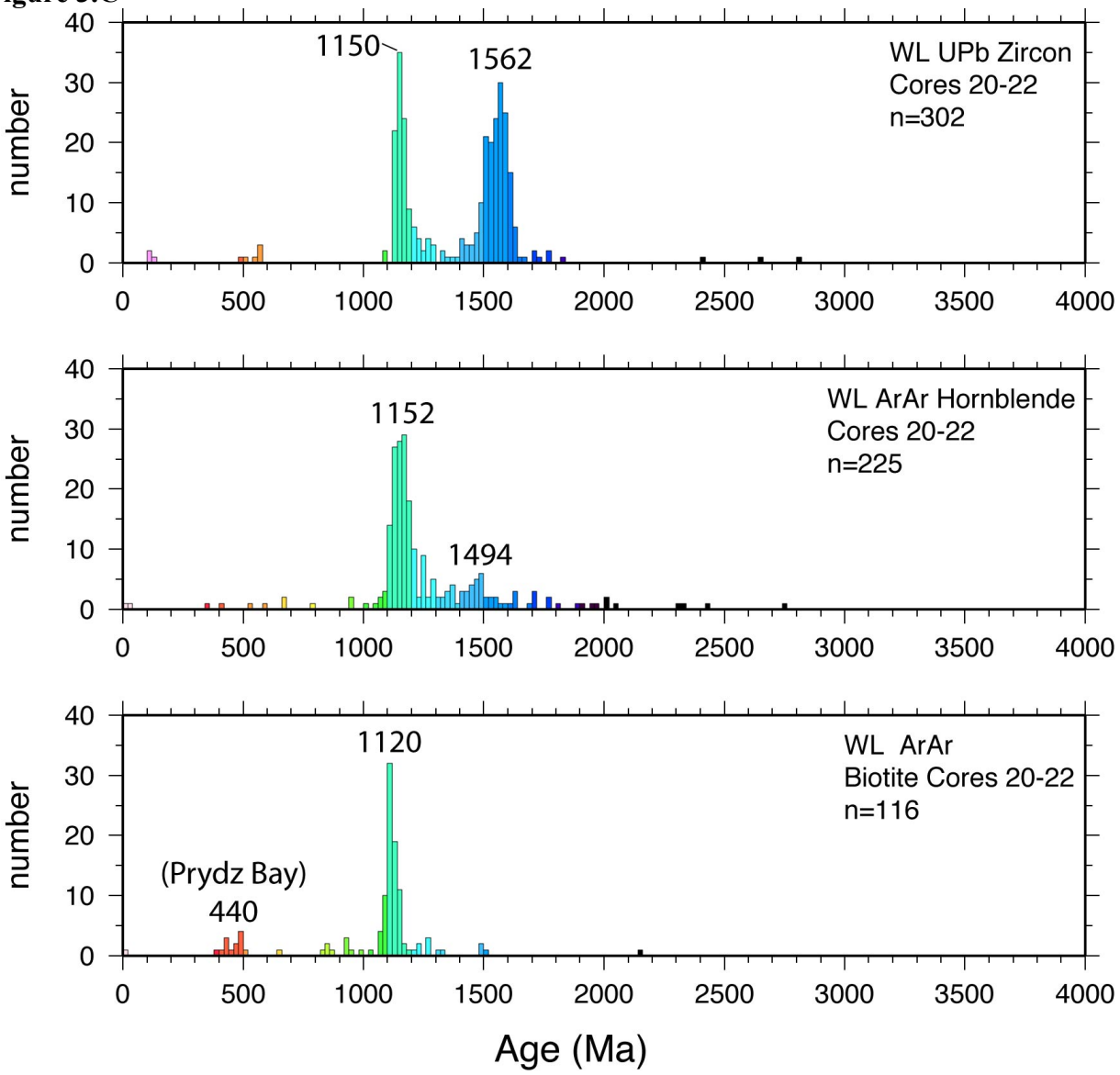

number
1150
1562
WL UPb Zircon
Cores 20-22
n=302
1152
1494
WL ArAr Hornblende
Cores 20-22
n=225
1120
(Prydz Bay)
440
WL ArAr
Biotite Cores 20-22
n=116
0
10
20
30
40
0
500
1000
1500
2000
2500
3000
3500
4000
Age (Ma)

Figure 3. D.

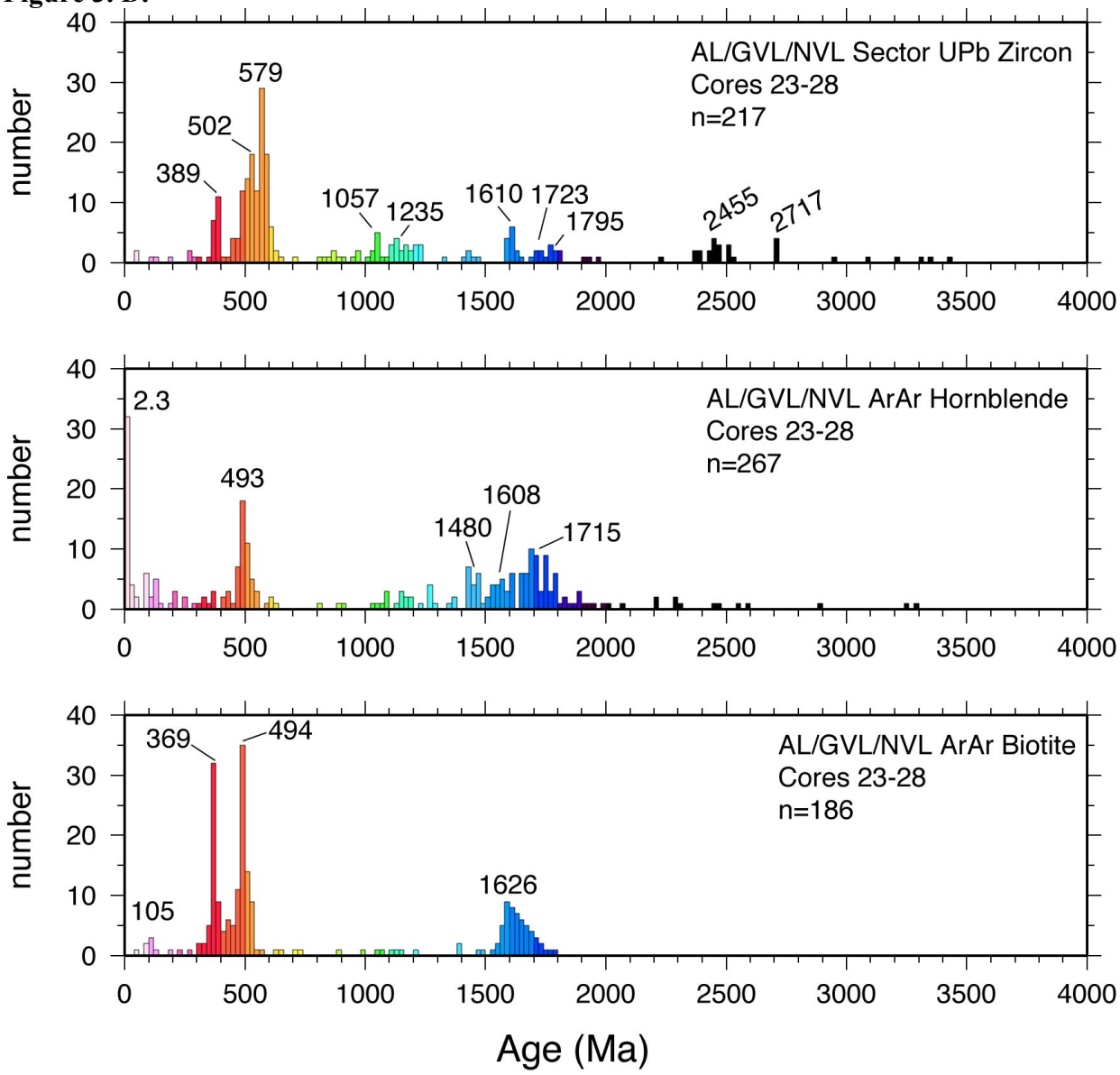


Figure 3. Histograms (20 Myr bins) of U-Pb zircon, $^{40}Ar/^{39}Ar$ hornblende and $^{40}Ar/^{39}Ar$ biotite by geographic sector. A) DML – Droning Maud Land B) PB – Prydz Bay C) WL – Wilkes Land and D) AL/GVL/NVL – Adélie Land, George V Land and Northern Victoria Land.

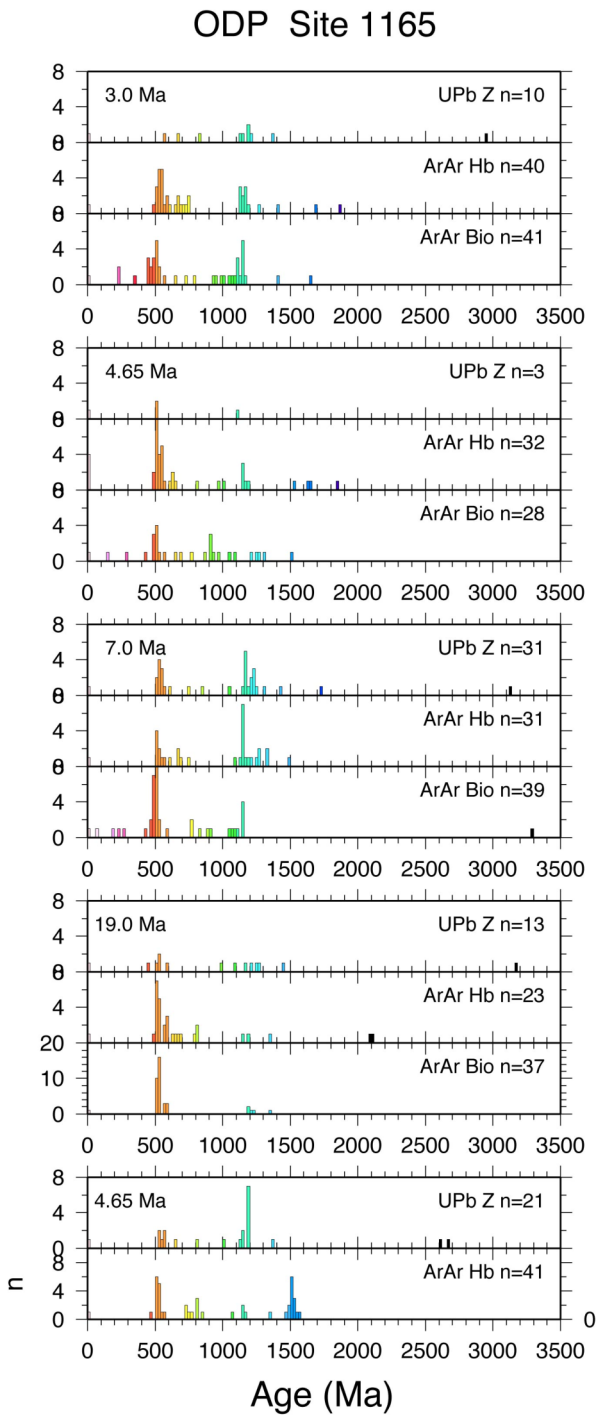


Figure 4. Stacked histograms (20 Myr bins) showing the U-Pb zircon (this study), $^{40}Ar/^{39}Ar$ hornblende [*Williams et al.,* 2010] and $^{40}Ar/^{39}Ar$ biotite [*Pierce et al.,* 2011] of the IRD layers from ODP Site 1165 record. The depositional age of each layer is in the top left corner of each

set of histograms (The 4.65 Ma layer is at the bottom since we did not measure biotites from this layer).

Figure 5. A.

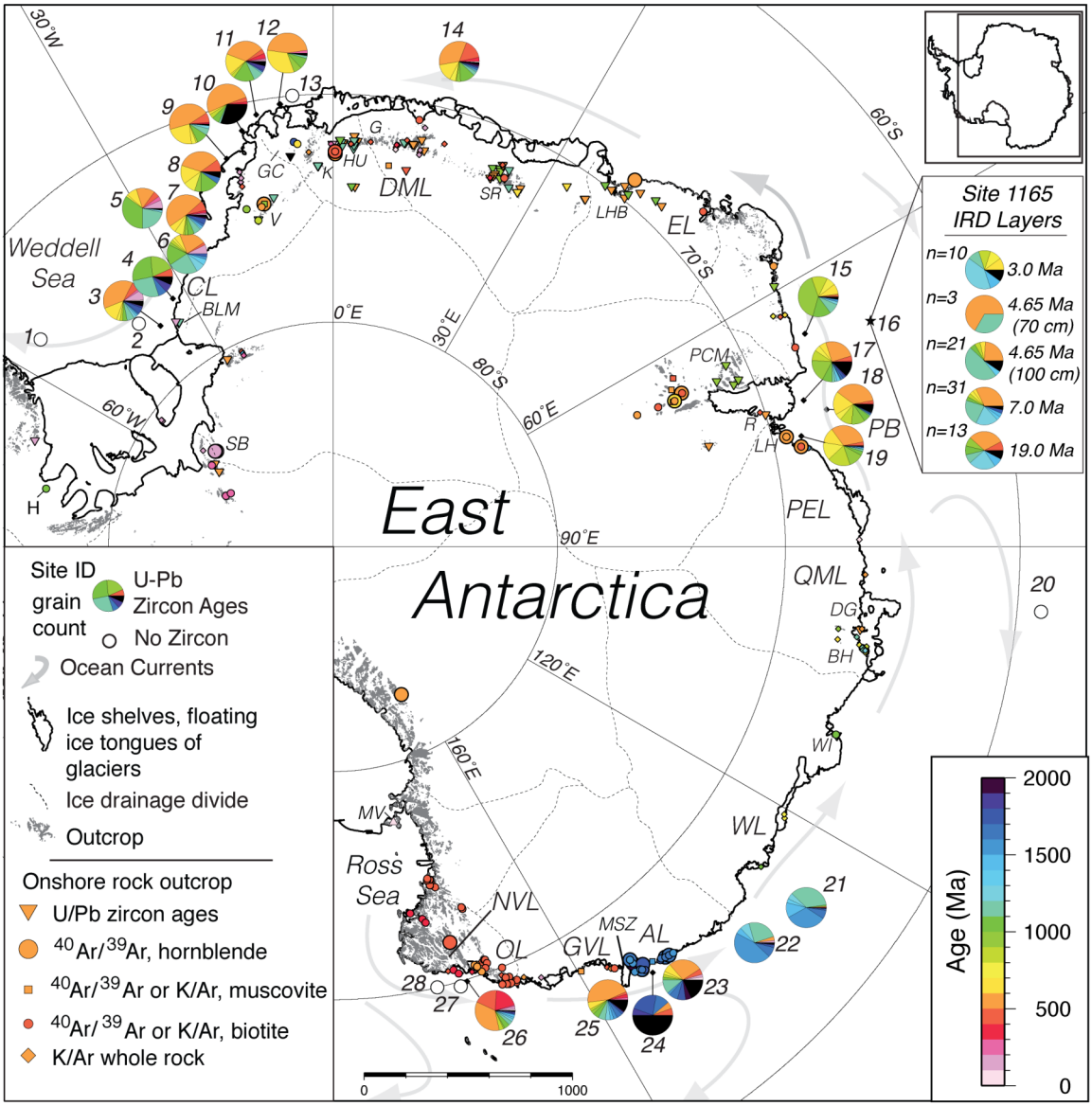

East Antarctica
Weddell Sea
Ross Sea
DML
CL
BLM
GC
HU
K
G
V
SR
LHB
EL
PCM
R
LH
PB
PEL
QML
DG
BH
WI
WL
MV
NVL
OL
GVL
MSZ
AL
SB
H
30°W
60°W
0°E
30°E
60°E
90°E
120°E
160°E
70°S
80°S
60°S
Site 1165
IRD Layers
n=10
3.0 Ma
n=3
4.65 Ma
(70 cm)
n=21
4.65 Ma
(100 cm)
n=31
7.0 Ma
n=13
19.0 Ma
Site ID
grain
count
U-Pb
Zircon Ages
No Zircon
Ocean Currents
Ice shelves, floating
ice tongues of
glaciers
Ice drainage divide
Outcrop
Onshore rock outcrop
U/Pb zircon ages
40Ar/39Ar, hornblende
40Ar/39Ar or K/Ar, muscovite
40Ar/39Ar or K/Ar, biotite
K/Ar whole rock
0
1000
Age (Ma)
2000
1500
1000
500
0

Figure 5. B.

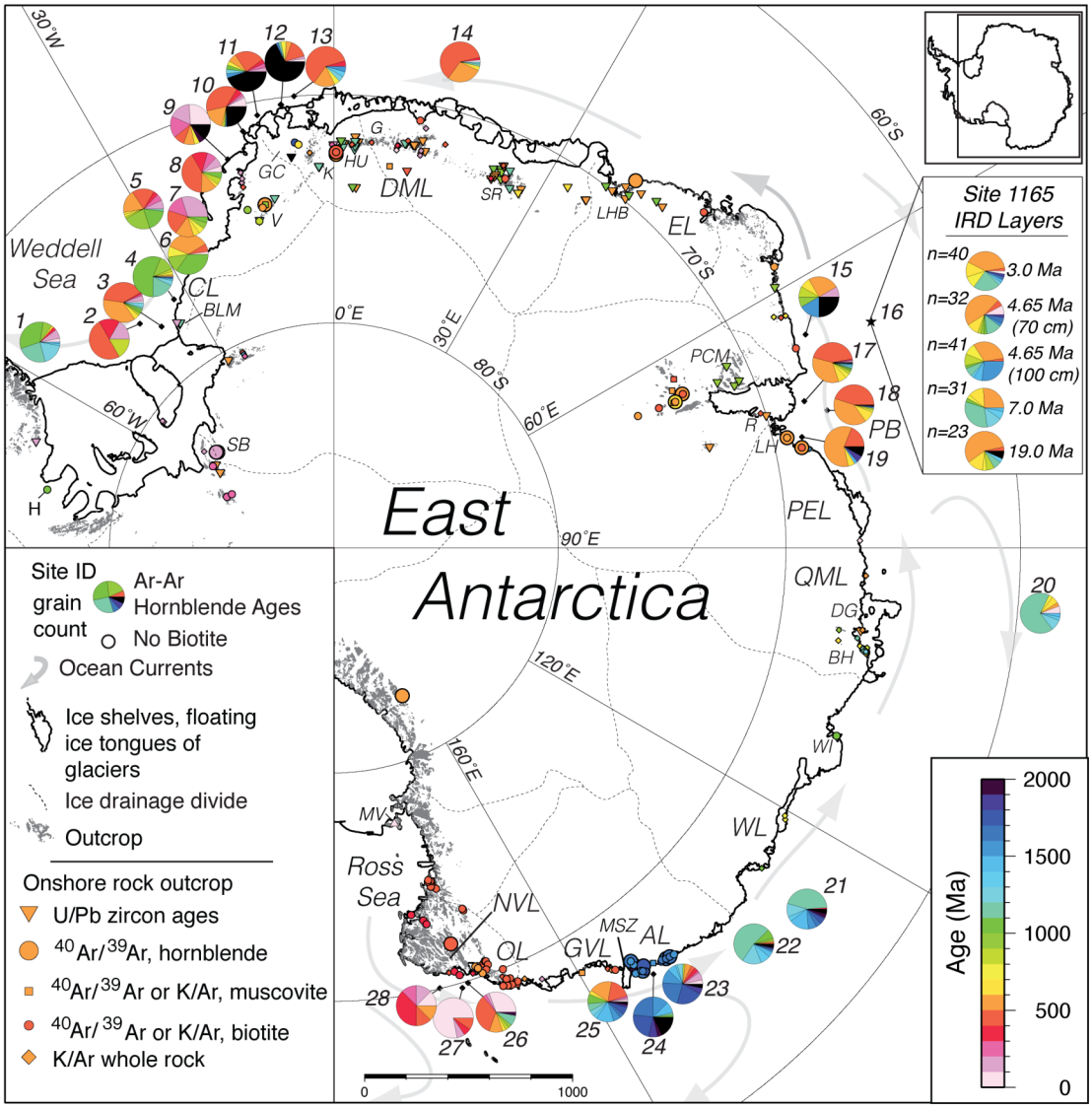

East
Antarctica
Weddell
Sea
Ross
Sea
DML
EL
PEL
QML
WL
WI
PB
CL
NVL
OL
GVL
AL
MSZ
SR
LHB
PCM
LH
R
HU
G
K
GC
V
BLM
SB
H
MV
BH
DG
30°W
60°W
0°E
30°E
60°E
90°E
120°E
160°E
70°S
80°S
60°S
Site ID
grain
count
Ar-Ar
Hornblende Ages
No Biotite
Ocean Currents
Ice shelves, floating
ice tongues of
glaciers
Ice drainage divide
Outcrop
Onshore rock outcrop
U/Pb zircon ages
40Ar/39Ar, hornblende
40Ar/39Ar or K/Ar, muscovite
40Ar/39Ar or K/Ar, biotite
K/Ar whole rock
0
1000
Site 1165
IRD Layers
n=40
3.0 Ma
n=32
4.65 Ma
(70 cm)
n=41
4.65 Ma
(100 cm)
n=31
7.0 Ma
n=23
19.0 Ma
Age (Ma)
2000
1500
1000
500
0

Figure 5. C.

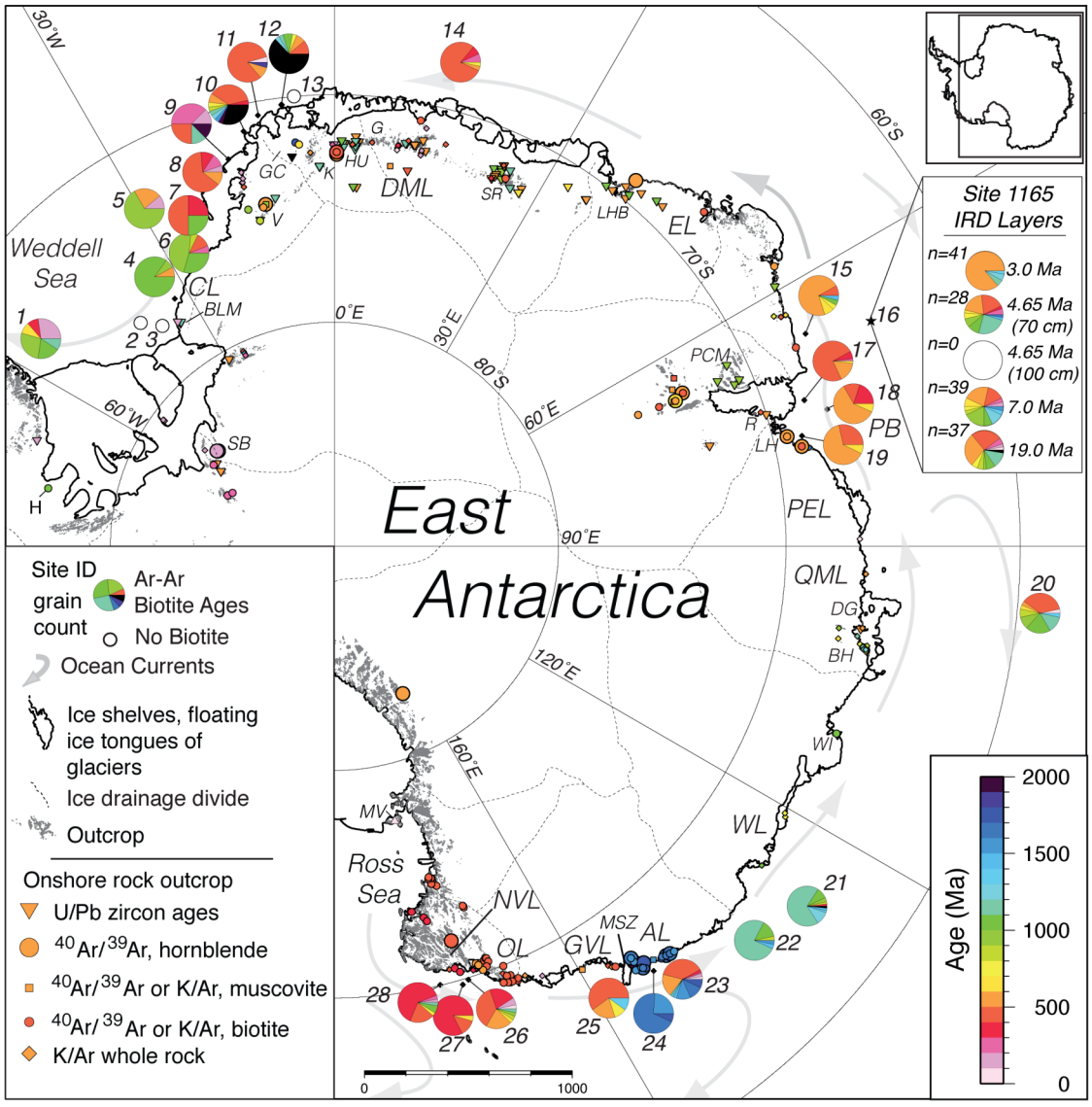


Figure 5. Maps of East Antarctica with pie charts showing the distribution of thermochonologic ages by site location and mineral type, the down-core ODP Site 1165 record of IRD, and known onland ages (see appendix E for onshore thermochonologic age references). **A**) Pie charts displaying U-Pb zircon results **B**) Pie charts displaying $^{40}Ar/^{39}Ar$ hornblende results **C**) Pie charts displaying $^{40}Ar/^{39}Ar$ biotite results. AL – Adélie Land, BH – Bunger Hills, BLM – Bertrab-Littlewood-Moltke Nunataks, CL- Coates Land, DG- Denman Glacier, DML- Droning

Maud Land, EL – Enderby Land, GC – Grunehogna Craton, GVL – George V Land, G-Gjelsvifjella, H – Haag Nunatak, HU- H.U. Sverdrupfjella, K – Kirwanveggan, LH- Larsemann Hills, LHB – Lützow-Holm Bay, MV- McMurdo Volcanics, MSZ – Mertz Zhear Zone, NVL – Northern Victoria Land, OL – Oates Land, PCM – Prince Charles Mountains, PEL – Princess Elizabeth Land, PB – Prydz Bay, QML – Queen Mary Land, R – Rauer Mountains, SB- Sonora Bluffs, SR – Sør Rondane, TAM –Transantarctic Mountains, WL – Wilkes Land, WI – Windmill Islands, V – Vestfjella.

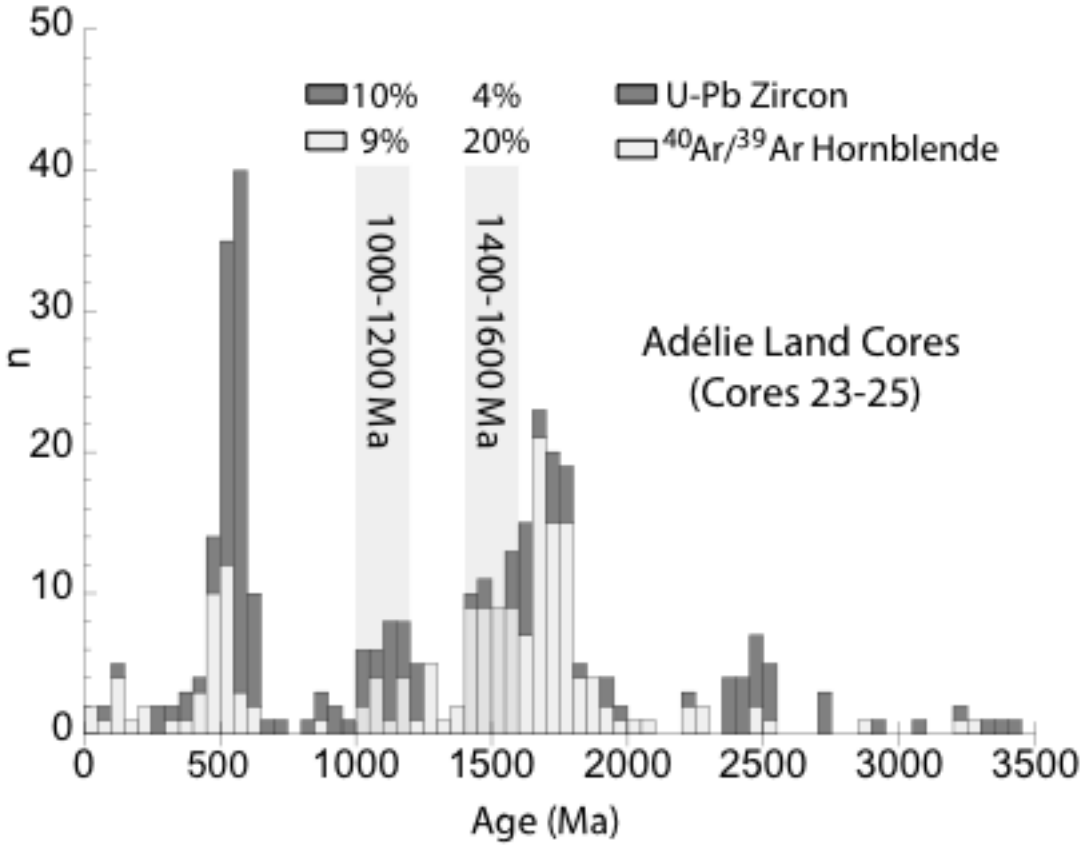


Figure 6. Histogram of Adélie Land (Cores 23 through 25) U-Pb zircon and $^{40}Ar/^{39}Ar$ hornblende ages measured, illustrating the difference in ~1000 Ma and ~1500 Ma populations by mineral type.

Chapter 4:

Sedimentary insights to East Antarctic Ice Sheet oscillations and growth during the mid-Miocene climate transition

Abstract

A major step in the evolution of the East Antarctic ice sheet (EAIS) occurred ~ 14 Ma during the Mid-Miocene Climate Transition (MMCT), a period with a global climatic shift that had a profound effect on many Earth systems, including terrestrial biota, ocean circulation, both ocean and terrestrial temperatures, sea-level, and ice volume. Of particular interest during this transition is the growth of the EAIS; despite inferences on the total amount of ice growth on Antarctica as a whole, little is known of the temporal and spatial evolution of the East Antarctic ice sheet at this time.

Here we apply isotopic provenance studies - $^{40}Ar/^{39}Ar$ ages of individual ice-rafted hornblendes and neodymium (Nd) measurements on the terrigenous < 63 μm fraction - in order to determine the source of glacially-derived sediments deposited ca. 14.7 to 12.6 Ma off the coast of East Antarctica at IODP Site U1356. A total of 672 hornblendes grains were measured from 40 samples, showing a dominant and unvarying age population of 1400-1550 Ma for all of the samples; Nd values show a range of 8 epsilon units (-8.4 to – 16.4), indicating an influx of sediment with a more radiogenic Nd composition than the local source area. Based on these results, we believe that the EAIS was greatly retreated in the Wilkes sub-glacial basin prior to and during the MMCT, and sat along the extension of the Mertz Shear Zone, at the western edge of the Wilkes Basin. Excursions to more radiogenic Nd values, 8 epsilon units higher than the local signal, reveals evidence for three events, which are correlated with periods of glacial outburst floods responsible for carving part of the spectacular scabland topography (the

Labyrinth) found in the Dry Valleys, and with provenance signals consistent with a significant sediment contribution from such a source.

These data add to our temporal and spatial knowledge of EAIS behavior across the MMCT by pinpointing dynamic areas of the ice sheet, and (tentatively) providing the first marine evidence for the glacial outburst floods observed in the Dry Valleys. The major pulse of IRD to IODP Site U1356 occurs between ~14.0 and ~13.7 Ma, and is in excellent agreement with both the timing of the major pulse of IRD at ODP Site 1165 in Prydz Bay, as well as previously published records of ice volume growth from oxygen isotope records and eustatic sea-level reconstructions, thus tying together direct evidence for EAIS growth from proximal glacial-marine sediments and results from far field proxies. Future work investigating the provenance of mid-Miocene, glacially-derived sediments from additional locations proximal to East Antarctica will help refine our understanding of the evolution of the EAIS during this major step in Cenozoic climate history.

1. The Mid-Miocene Climatic Transition and the East Antarctic Ice Sheet

The Mid-Miocene Climate Transition (MMCT) occurred ~ 14 million years ago (Ma), and marks a major step in the evolution of the East Antarctic ice sheet (EAIS); this period is inferred to mark a time of significant ice volume growth and the transition to a more stable ice sheet mode. The MMCT is characterized by a major increase in the $\delta^{18}O$ of both benthic and planktic foraminiferal shells, indicating both deep-sea and sea-surface cooling, as well as significant increases in ice volume [*Shackleton and Kennett*, 1975; *Miller et al.*, 1991; *Flower and Kennett*, 1994; *Lear et al.*, 2000; *Zachos et al.*, 2001; *Shevenell et al.*, 2004; *Holbourn et al.*, 2005; *Holbourn et al.*, 2007; *Shevenell et al.*, 2008; *Zachos et al.*, 2008](Figure 1). Additionally,

estimates of eustatic sea-level show a dramatic decrease across the MMCT [*Haq et al.*, 1987; *Bartek et al.*, 1991; *Miller et al.*, 1998; *John et al.*, 2011].

Many hypotheses about the cause of the MMCT have emerged over the years. Several studies have cited a permanent decrease in atmospheric carbon dioxide **(**CO_2**)** values coincident with the MMCT and EAIS growth ([*Berger and Vincent*, 1986; *Raymo and Ruddiman*, 1992; *Spivack et al.*, 1993]). Given the close link between global temperatures and CO_2 levels evidenced in much of the geologic record, this is an appealing idea. However, more recent studies investigating the role of CO_2 levels and the onset of the MMCT have shown that CO_2 levels dropped significantly many millions of years prior to the onset of the MMCT cooling and EAIS growth [*Pagani et al.*, 1999; *Pearson and Palmer*, 2000; *Royer et al.*, 2001]; while Pearson and Palmer [2000] observed a drop of ~160 ppm based on boron isotope measurements from foraminifera, it is a transient drop at ~14-15 Ma which quickly recovers to the ~300 ppm values observed before the MMCT. The role of Milankovitch cycles (eccentricity and obliquity forcing) has more recently emerged as a key player in the timing of the MMCT, with the idea that such forcing lead to changes in moisture transport and ocean-atmosphere circulation, allowing for the growth of the ice sheet at this time [*Shevenell et al.,* 2004, 2008; *Holbourn et al.,* 2005, 2008].

Regardless of the cause(s), the MMCT marks a period of major EAIS growth as indicated by significant increases in benthic $\delta^{18}O$; significant drops in global sea-level, and an overall increase in the abundance of IRD in the marine sediment record around East Antarctica. In order to gain a better understanding of the history of the EAIS, it is important to compare the timing and magnitude of these global records of ice sheet dynamics with the timing and spatial evolution of the EAIS through the study of proximal glacial-marine records. Few studies have been conducted that can attest to the temporal and spatial evolution of the EAIS over this

transition, due to the present-day ice cover (98%) in East Antarctica, the long time-scales involved, and a combination of poor recovery and difficulty of age determinations in sediments spanning this transition from previous drilling expeditions.

From studies based on terrestrial and proximal glacial-marine sediment records, it is clear that the EAIS advanced at different times in different locations throughout this climate transition. Existing terrestrial evidence for a major change in EAIS behavior mainly comes from the Transantarctic Mountain and Dry Valley regions. Pairing $^{40}Ar/^{39}Ar$ ages of ash-fall layers inter-bedded with glacial till deposits, several studies have argued for expansion of the EAIS and transition from a wet- to cold-based glacial regime contemporary to the MMCT [*Marchant et al.*, 1993; *Lewis et al.*, 2007; *Lewis et al.*, 2008]. Lewis *et al*. [2007] show evidence for the transition from a wet- to cold-based ice sheet at ~13.94 Ma in the Western Olympus Range of the Transantarctic Mountains (near the Dry Valleys)(Figure 1, 2), indicating a drop in mean annual temperatures of 25˚C to 35˚C, followed by major ice sheet expansion from 13.62 and 12.44 Ma; Lewis *et al.* [2008] presented evidence from the Dry Valleys for an abrupt drop in mean annual temperatures of 8˚ between 14.07±0.5 Ma and 13.85±.03 Ma. Evidence for tremendous sub-glacial outburst floods is recorded in incised channels in canyons in the Dry Valleys, and the last period of flooding is constrained by $^{40}Ar/^{39}Ar$ ages of ash layers to between 12.4 and 14.4 Ma [*Lewis et al.*, 2006].

From the glacial-marine record, Miocene sediments recovered from the ANDRILL (ANtarctic DRILLing Project) -2A drill site, located on the continental shelf in the Southern McMurdo Sound, show that glacial intensification occurs at ~15.4 Ma followed by major ice advance between ~14.7 and 14.3 Ma [*Passchier et al.*, 2011]. Flordino *et al.* [2003] remark on a

major lithological change in sediments recovered from ODP Site 1165, off of Prydz Bay (Figure 1, 2), at ~ 14.3 Ma, which they attribute to advance of the EAIS onto the shelf.

In this study we aim to contribute to better constraints on the spatial and temporal aspects of EAIS evolution across the MMCT by applying isotopic provenance studies to ice-rafted detritus layers deposited off of East Antarctica; as ice sheets tend to erode their own history, looking to the marine sediment record can offer a more complete history of ice dynamics. By determining the provenance of coarse (IRD) and fine (IRD plus other sources) grained sediments across this transition, we seek to identify how the ice sheet transitioned from a smaller, ephemeral ice sheet, to a much larger, more permanent ice sheet, and to compare our spatial and temporal record with other proximal and distal records of EAIS growth.

2. Methods to resolve Temporal and Spatial Evolution of EAIS over the MMCT

Given the challenge of reconstructing EAIS history prior to the Last Glacial Maximum, mainly due to the 98% ice cover in East Antarctica, and the fact that ice sheet behavior tends to erode away evidence of past behavior, it can be advantageous to turn to the glaciomarine sedimentary record. In this study we use the terrigenous record from marine sediment cores to further our understanding of EAIS behavior across the MMCT. IRD forms when continental glaciers reach the ocean and calve to form icebergs, subsequently melting out any terrigenous material that they have incorporated as the ice slides over the continent. Records of IRD deposition in the open ocean (often generated as a weight percent or number of lithics per gram of sediment count) can provide an overall picture of ice-sheet dynamics (e.g., [*Ruddiman*, 1977; *Kanfoush et al.*, 2000; *Ó Cofaigh et al.*, 2001; *Teitler et al.*, 2010; *Passchier*, 2011]), but these records can not be used to identify which parts of the vast East Antarctic ice sheet sourced the

IRD, and thus can not specify which parts of the ice sheet are behaving dynamically; i.e. which parts are retreating or advancing. IRD records paired with isotopic provenance studies can be incredibly helpful in elucidating the particular areas of an ice sheet that is behaving dynamically, as has been shown in studies on Northern Hemisphere ice sheet behavior [*Grousset et al.*, 1993; *Gwiazda et al.*, 1996; *Hemming et al.*, 1998; *Farmer et al.*, 2003] as well as around Antarctica [*Williams et al.,* 2010; *Pierce et al.,* 2011; *Cook et al.* (in prep)].

In this study we report $^{40}Ar/^{39}Ar$ ages of individual hornblende grains and the εNd in the terrigneous fine (< 63 μm) fraction. Both of these isotopic tracers have been shown to be robust tracers of provenance around East Antarctica [*Roy et al.*, 2007; *van de Flierdt et al.*, 2008; *Williams et al.*, 2010; *Pierce et al.*, 2011; *Cook et al.*, in prep], with the individual $^{40}Ar/^{39}Ar$ ages solely reflecting IRD provenance, and the Nd isotopes reflecting a combination of ice-rafting and erosional processes. By tracing the source of sediments deposited across the MMCT, we can develop a more detailed history of the EAIS as it grew through this climate transition.

3. IODP Site U1356

3.1. Site Selection

A survey of the marine sediments recovered from the 46 Deep - (DSDP), Ocean – (ODP) and Integrated Ocean - (IODP) Drilling Program sites located off the coast of East Antarctica in the Southern Ocean (Weddell Sea east to the Ross Sea, and south of 50˚S, with the exception of ODP Site 1140) (Figure 2, 3) revealed that, of these sites, 30 recovered Miocene-aged material. Of these 30 sites, 14 contain ice-rafted detritus, and of these sites 4 (DSDP Site 272, ODP Sites 744 and 1165, and IODP Site U1356) contain material deposited both during 15-12 Ma and

during the Mid-Miocene climate transition (14.2 to 13.8 Ma), contain ice-rafted detritus, and have good core recovery (Figure 2, 3, 4).

A study on pebbles contained in DSDP Sites 270-274 and 268 [*Barrett*, 1973], gives a relative record of the pebble count at DSDP Site 272, as the pebble counts were not consistently made throughout the core (Figure 4); however the magnetic susceptibility and clast count records are not available from the shipboard report for DSDP Site 272 [*Hayes et al.*, 1975]. These records show an overall increase in the abundance of pebbles from the early through middle Pliocene, however the age model is not sufficiently developed to pin-point the MMCT in these records. Clast count and magnetic susceptibility measurements from ODP Site 1165 and IODP Site U1356 show striking increases in the amount of course ice-rafted material to the core sites across the MMCT. ODP Site 744 does not contain ice-rafted detritus in the sand or gravel sized fraction [*Barron et al.*, 1991], however Ehrmann [1991] shows a large spike in non-biogenic silt fraction in the lower middle Miocene (Figure 4**)**.

For this study we examine marine sediment samples with depositional ages spanning ca. 14.7 - 12.6 Ma, which were recovered from IODP Site U1356 (Expedition 318), located off Adélie Land, East Antarctica (Figure 2). This site was chosen primarily because of its location close to the low-lying Wilkes subglacial basin, and the recovery of sediment deposited during the MMCT.

3.2 IODP Site U1356 and Sample Selection

IODP Site U1356A (63˚18.61'S, 135˚59.93'E) is located at 4003 m water depth, at the transition between the continental rise and abyssal plain off the Adélie Land Coast, East Antarctica (Figure 2) [*Escutia et al.*, 2011]. Samples for this study were taken from Site

U1356A, which had a 35% overall core recovery, and ~ 40% recovery across the MMCT. The lithology of the sampled interval consists of diatom ooze interbedded with and silt-laminated diatom-rich silty clay, with intervals of dispersed to common gravel sized clasts (Unit II; 0-278.4 mbsf), and is interpreted as a period of hemipelagic sedimentation with ice rafting events. The underlying unit, Unit III (278.4 - 459.4 mbsf) consists of interbedded bioturbated claystones and brown laminated claystones, with rare gravel-sized clasts and dispersed sand, serving as evidence for minimal ice-rafting during this interval [*Escutia et al.,* 2011].

Between ca. 15-12 Ma, there are 8 depositional periods with evidence for delivery of coarse-grained material, based upon the clast count greater than 2 mm and magnetic susceptibility records [*Escutia et al.*, 2011]. The first appears at ~14.7 Ma (~258.5 meters below surface (mbsf)). The next event occurred between 14.1 Ma and 13.8 (~ 205 to 170 mbsf, [*Escutia et al.*, 2011; *Tauxe et al.*, 2012]) with 6 apparent peaks. Based on the magneto-bio-stratigraphy reported in Tauxe *et al.* [2012], we have assigned ages of ~14.1 and ~14.0 to the first two peaks, ~13.9 Ma to the largest and third peak in this interval, and ~13.8 Ma to the following three peaks. Additional increases in clast counts and magnetic susceptibility occurred at ~13.5 Ma (~141 mbsf), ~13.0 Ma (~105-110 mbsf) and ~12.6 Ma (~97 mbsf). In order to make the above age determinations**,** we made two sets of age determinations based on the linear sedimentation rates between 1) paleomagnetic data and 2) biostratigraph data. The average difference between age assignments is 0.1 myr (range of 0 to 0.2 myr difference). For this study we have used the former.

Samples were selected from each of the intervals described above and based upon the age model for Site U1356, in an attempt to sample ice-rafted material from before, during and after the MMCT. Samples were additionally selected to represent low, medium and high ice-rafting

intensity, so that we could establish a background provenance signal during times of low ice-rafting intensity. For this study, a total of 39 samples were examined, spanning ~14.7 to ~12.6 Ma, in addition to a core-top sample from IODP Site U1356 (See Appendix A for a list of sampling depths and measurements).

4. Sample preparation and Isotope measurements: $^{40}Ar/^{39}Ar$ Dating and Neodymium Isotope Analyses

4.1 Bulk sample processing

Bulk samples were dried, disaggregated and dispersed in de-ionized water, and sieved into the following size fractions: <63 μm, 63 to 150 μm, 150 μm to 1 mm, and > 1 mm. The bulk sample and size fraction weights were recorded in order to calculate the weight percent for each of the size fractions.

4.2 $^{40}Ar/^{39}Ar$ Dating

Following magnetic separations, all hornblendes found in the > 150μm fraction were handpicked. Hornblendes and standards were irradiated at the U.S. Geological Survey (USGS) TRIGA reactor (with Cd shielding) in Denver, CO. $^{40}Ar/^{39}Ar$ ages were obtained using single-step CO_2 laser fusion at the Lamont-Doherty Earth Observatory (L-DEO) argon geochronology lab (AGES: Argon Geochronology for the Earth Sciences). J values used to correct for neutron flux were calculated using the co-irradiated Mmhb-1 hornblende standard (525 Ma; [*Samson and Alexander*, 1987]. $^{40}Ar/^{39}Ar$ ages were calculated following corrections for the neutron flux (J value), for mass discrimination, and for background values for each of the Ar isotopes. $^{40}Ar/^{39}Ar$ data are listed in Appendix B.

4.3. $^{143}Nd/^{144}Nd$ Analyses

Neodymium (Nd) isotopes were measured on the terrigenous <63 μm size fraction. Bulk <63μm samples were leached overnight in hydroxylamine hydrochloride to remove authigenic phases from the material. Nd data are listed in Appendix C.

Approximately 0.1g ± 0.5% of sample and 0.4g ± 0.5% of lithium metaborate flux were weighed and mixed, and samples were fused at 1050˚C for 30 minutes. The molten sample was then dropped into 50 mL of 10% HNO_3 in a Teflon beaker and placed on a stir plate for 15 minutes to ensure dissolution. The pH of the samples was adjusted to 8 (using ammonium hydroxide) to precipitate iron, and co-precipitate the rare earth elements (REE). This approach leaves soluble elements such as boron and lithium from the flux and sodium, potassium and calcium from the sample in solution and thus reduces the ion load on the cation exchange column. Precipitates were rinsed with de-ionized water, and re-dissolved in 2N HCl. Neodymium was subsequently separated from the matrix by a two-step ion chromatography. Seven mL columns filled with AG50W-8X cation resin were used to separate the REE from the matrix. The columns were cleaned with 10 mL of 4N HNO_3, equilibrated with 5 mL of 2N HCl, and the REEs were eluted with 15 mL of 4N HNO_3.

The REE aliquot was dried down, taken up in 0.22N HCl, and then passed through 800 μL columns filled with Eichrom Ln-Spec resin to isolate the Nd from the other REEs. The columns were first cleaned with 5 mL of 6 N HCl, conditioned twice with 1 mL 0.22N HCl, and the Nd was eluted with 5 mL of 0.22N HCl.

Neodymium isotope measurements were performed on the Nu Plasma MC-ICP-MS at Imperial College London. All reported $^{143}Nd/^{144}Nd$ ratios are corrected to a JNdi value of

0.512115 (Tanaka et al., 2000), and all ε_{Nd} values were calculated using a present day $^{143}Nd/^{144}Nd$ (CHUR) of 0.512638 [*Jacobsen and Wasserberg*, 1980]. A $^{146}Nd/^{144}Nd$ ratio of 0.7219 was applied to correct for instrumental mass bias following the exponential law. Tests with doped standards showed that interferences from ^{144}Sm are adequately corrected, if the ^{144}Sm contribution is less than 0.1% of the ^{144}Nd signal. Samarium contributions of all our samples were significantly below that level.

40 samples were analyzed over 8 analytical sessions. Repeated analyses of the JNdi standard during the analytical sessions yielded average $^{143}Nd/^{144}Nd$ ratios 0.511948 ± 0.000018 (2s S.D, n=27) and 0.512122 ± 0.000016 (2σ S.D, n=13), 0.512081 ± 0.000012 (2σ S.D , n=23) and 0.512150 ± 0.000012 (2σ S.D, n=7), 0.512079 ± 0.000011 (2σ S.D, n=16), and 0.512185 ± 0.000018 (2σ S.D., n=22) (see Appendix C).

Repeated analyses of the JNdi standard showed a drift over the last two analytical sessions, so we bracketed sample runs by standards on each side. Average JNdi values over these two sessions yielded $^{143}Nd/^{144}Nd$ ratios of 0.512191 ± 0.000035 (2σ S.D., n=25) and 0.512153 ± 0.000019 (2σ S.D., n=26). Blank values associated with the samples from these two analytical session samples were found to be in excess of 1% (24 ng and 45 ng of Nd) of the total sample (and no more than 5%). We subsequently tested the possible sources of the blank (lithium metaborate flux, Fe solution used in the blank preparation, and the columns used for the column chronotography), and found that the source was the lithium metaborate flux (~60 ng of Nd). Based on this, we have applied a full blank correction to our samples including the measured $^{143}Nd/^{144}Nd$ ratio of the blank. We have confidence that this approach is reasonable as the two BCR-2 rock standards that we measured in this session are in accord with published values once the blank correction was applied. All raw and corrected Nd data are listed in Appendix C.

5. Results of IRD Provenance Work

5.1 Weight % > 150μm, pebble lithologies, sample descriptions

5.1.1 Weight % and grain size distributions

A total of 40 samples, spanning ~14.7 to ~12.6 Ma and the core-top sample, from IODP Site U1356 were processed for this study. Grain-size analyses performed across each of our sampled intervals in the ~14.7 Ma to ~12.6 Ma range indicate that each of the increases in clast count and magnetic susceptibility, which we used for choosing samples, is due to an ice-rafting event, with the exception of the ~14.7 Ma event (Core 28RCC), which is likely the result of a turbidity current.

The > 150 μm fraction for all of the samples typically consisted of sand and granules, with occasional clasts > 1mm; the core top sample contained very little terrigenous material in the > 150 μm fraction. Weight % >150 μm varies from 0 % to 40 % throughout our Miocene record (core top value is < 1%). A decrease in both weight % > 150μm and clast counts occurs in core 12 (12R3). Prior to this core section the weight % > 150μm varies from 0 to 40%, while afterwards it stays below 5%; the clast count record (>2 mm, including granules and pebbles) also shows a decrease to 1 clast at most for the remainder of our record (Appendix F).

5.1.2 Ice-rafted clasts

Clasts from the > 1 mm were characterized using a light microscope, following the classification outlined in Licht *et al*. [2005]. Clasts from all of the samples are a mix of dominantly metamorphic or igneous rocks, consistent with the local geology. The metamorphic clasts are mostly foliated gneisses and schists, with minor metasediments. The igneous rocks are

felsic-intermediate intrusive lithologies (no mafic igneous clasts are present). Some clasts could not be distinguished between igneous intermediate and metamorphic, and are dominantly hornblende-plagioclase-quartz with minor biotite in some; we have given this lithology its own characterization and refer to it as HPQ in our Appendices E and F.

5.2. $^{40}Ar/^{39}Ar$ Analyses

Of the 40 samples (39 Miocene samples and the U1356 core-top sample) that were processed for this study, 28 contained hornblende grains in the > 150 μm fraction, while 12 did not. Every hornblende from the >150μm fraction was picked for $^{40}Ar/^{39}Ar$ analyses, with a total of 672 $^{40}Ar/^{39}Ar$ hornblende ages measured.

Overall, $^{40}Ar/^{39}Ar$ hornblende ages from IODP Site U1356 sample show a dominant age population of 1400-1550 Ma in each of the samples, with very small populations of < 200 Ma, 400-600 Ma 900-1300 Ma and >1600 Ma (Figure 5). Individual samples are dominated by the 1400-1550 Ma $^{40}Ar/^{39}Ar$ hornblende population throughout the record, although the oldest sample (~14.7 Ma, Core 28RCC) shows a slightly older population with most grains > 1500 Ma. There were no hornblende grains in the core top sample, which generally lacked terrigenous material.

5.3 ε_{Nd} values

Neodymium isotope values show an 8 epsilon unit (εNd) range from -16.4 to –8.4. The average ε_{Nd} value for all samples is -13.6, the median is -14.1, with a standard deviation of ± 2. The core top ε_{Nd} value is -14.5. The overall record is one dominated by the less radiogenic values

(-14 to -16), with significant excursion to more radiogenic values (-10 to -8) ca. 14.1 Ma, 13.8 Ma and 13.1 Ma (Figure 6).

6. Implications for EAIS dynamics over the MMCT

6.1 Relationship between provenance tracers

Based on previous work that delineates source area characterization based on $^{40}Ar/^{39}Ar$ hornblende ages and εNd from this part of the East Antarctic margin (Roy et al., 2007; Pierce et al., 2011), we can pair expected $^{40}Ar/^{39}Ar$ hornblende and εNd values from particular source areas (Figure 6), and so might expect a given $^{40}Ar/^{39}Ar$ hornblende age population for a given εNd value. This, of course, relies on the transport mechanisms delivering both the hornblende grains and the < 63μm fraction. In the case of the turbidite sample (~14.7 Ma, 28RCC), we see low εNd values, consistent with the local source areas, as well as a population of $^{40}Ar/^{39}Ar$ hornblende ages > 1500 Ma, also consistent with local sources; this is consistent with much of the material from this sample being delivered to the core site by the same mechanism.

We have looked at the relationship between the εNd values and the $^{40}Ar/^{39}Ar$ hornblende age populations (where present), and have been unable to establish a coherent relationship between the presence or lack of hornblende grains and εNd, the total number of hornblende grains and εNd values, or the percentage of hornblende grains in particular age bins (e..g, <200 Ma; 400-600 Ma, etc.) that reflect possible source areas and εNd values. There are hints that some of the more radiogenic εNd values contain more far-travelled IRD components, i.e. from George V Land, based on hornblende grains with $^{40}Ar/^{39}Ar$ ages of ~500 Ma (see Figure 6), however the most radiogenic εNd values (> -9) contain no grains of this age, and an overall

relationship between the $^{40}Ar/^{39}Ar$ hornblende ages and εNd values can be established in the ways described above.

There are at least two ways to explain this decoupling between our chosen provenance tracers. First, the influx of radiogenic εNd reflects significant ice-rafting sourced from an area with radiogenic εNd and lithologies which do not contain hornblendes**.** The second option is that the <63μm fraction is not entirely dominated by ice-rafting processes, which we might expect given the ability of ice-rafting, melt-water pulse, turbid plumes, and local erosional proceses to transport terrigenous material <63 μm in size.

6.2. Excavation along the Mertz Shear Zone in the East Antarctic Interior based on $^{40}Ar/^{39}Ar$ hornblende ages

The unvarying $^{40}Ar/^{39}Ar$ hornblende age populations dominated by a 1400-1550 Ma signal point to a single source for ice-rafted detritus. These grains are most likely sourced from along the Mertz Shear Zone (MSZ), which extends at least 900 km under the East Antarctic ice sheet to the south [*Ferraccioli et al.*, 2009], ~ 600 km east of IODP U1356, and which bounds a topographic low (200 km below sea-level) in the Wilkes subglacial basin (the Western Basin) (**Figure 5**).

Though there are no outcrops along the coast of East Antarctica with 1400-1550 $^{40}Ar/^{39}Ar$ hornblende ages, the MSZ has been dated via $^{40}Ar/^{39}Ar$ biotite as having an age of 1550 Ma [*Di Vincenzo et al.*, 2007]. This geologic boundary divides bedrock with ages > 1600 Ma to the west of the MSZ, from bedrock with Ross Orogen ages of 400-600 Ma in age to the east of the MSZ. $^{40}Ar/^{39}Ar$ ages from a core located just to the east of where the Mertz Shear show a mix of the 400-600 Ma ages, reflecting the terrane to the east of the MSZ, in addition to a

population of ~ 1400-1550 Ma ages; these ages are not seen in other core-top samples used for characterizing the $^{40}Ar/^{39}Ar$ hornblende ages of source areas [*Roy et al.*, 2007; *Pierce et al.*, 2011]. Given the extent of the MSZ into the interior of East Antarctica, we believe that these ages reflect sourcing from along the MSZ or adjacent bedrock terranes effected by activation of the shear zone ~1550 Ma.

There are several arguments supporting the idea that the margin of the mid-Miocene EAIS rested along the MSZ. First, we see negligible contributions to the overall population of $^{40}Ar/^{39}Ar$ hornblende grains with ages 400-600 Ma; if the ice margin were resting farther to the east, we would expect to see these ages. Second, the ice would be more stable on the high ground to the east, and unstable on the subglacial basin to the east. The Western Basins (Figure 6), a topographic low, lie just to the east of the MSZ, extending along the axis of the MSZ out towards the edge of the Wilkes Basin and the coast; the Western Basin are structurally controlled sedimentary basin, ~ 300 km long, with up to 2 km of sedimentary infill [*Ferraccioli et al.,* 2009]. Additional large sedimentary basins within the area are located at the tectonic boundary (the MSZ) between an inferred Precambrian craton and the Ross Orogen [*Ferraccioli et al*., 2009]. Furthermore, as ice streams are fastest and most erosive close to their outlets, the provenance signal that we are seeing lends support to the interpretation of a retreated position of the ice margin along the MSZ.

6.3 Evidence for sub-glacial outburst floods sourced from the Dry Valleys?

Delivery of terrigneous material to IODP Site U1356 must have been via ice-rafting for the course material (>150 μm), whose provenance is determined by individual $^{40}Ar/^{39}Ar$ hornblende ages. For the fine grained (<63 μm) sediment, the sediment transport processes

potentially include a mix of ice-rafting, as well as contributions from bottom and surface currents, as discussed above (section 6.1). Based on our $^{40}Ar/^{39}Ar$ hornblende and ε_{Nd} data it would appear that the two signals are consistent with a single source terrane throughout much of the record, but are decoupled, with the $^{40}Ar/^{39}Ar$ hornblende ages indicating a dominant and unvarying, single source, while the ε_{Nd} show dramatic swings of ~8 epsilon units. Below we outline an argument for the sourcing and transport mechanism for the radiogenic ε_{Nd} values that we see at ~14.1 Ma, ~13.8 Ma and ~13.0 Ma, and invoke glacial outburst floods to deliver sediment with such a radiogenic ε_{Nd} signature.

6.3.1 The Ferrar Group

Adélie Land onland and marine sediment core values used for characterizing source areas are dominated by unradiogenic Nd values, of -23.6 to -14 [*Brachfeld et al.*, 2007; *Roy et al.*, 2007; *Pierce et al.*, 2011]. The local ε_{Nd} signature from core-top samples close to IODP Site U1356 is characterized by unradiogenic values (-14 to -19), while on-land and Last Glacial Maximum diamict samples show values less than -20 epsilon units (Figure 6). We interpret much of our down-core ε_{Nd} record spanning the mid-Miocene as showing a sourcing of fine grained (<63μm) material from the adjacent coastline (Figure 6). Significant excursions to ε_{Nd} values < -9 occur at ca. 14.1 and 13.0 Ma, with a smaller excursion to -11 epsilon units occurring at ca. 13.8 Ma. These excursions require a significant input from a sediment source with more radiogenic ε_{Nd} values (the closer to -8, the greater the fraction required).

Two potential sources for radiogenic εNd values exist, based on outcrop information. The Cenozoic McMurdo volcanic group, which is found along the eastern coast of Victoria Land in the Ross Sea has ε_{Nd} values ranging from +3 to +8 [*Stuckless and Ericksen*, 1976; *Wörner et*

al., 1976] (see Figure 6 for locations of the McMurdo Volcanics); however these volcanics do not cover an extensive area as a single body and were mostly erupted after the mid Miocene [*Cooper et al.*, 2007; *Rilling et al.*, 2007].

The second potential source for sediment with radiogenic ε_{Nd} is the Ferrar Group (Figure 6, 7); the Ferrar Group consists of Kirpatrick Basalt lavas, sills of Ferrar dolerite, and mafic intrusions of the Duke Gabbro, is up to 780 m thick in some locations, and extends from northern Victoria Land to Coats Land (Weddell Sea). ε_{Nd} values measured from samples of the Ferrar Group in Victoria Land range from -4.8 to -6.1 [*Kyle et al.*, 1987; *Flemming et al.*, 1995], while measurements on sills in the area have values of -4.5 to -3.8 [*Hergt et al.*, 1989] and -5.9 to -5.1 [*Brotzu et al.*, 1992]. In addition to the numerous outcrops along the TransAntarctic Mountains, there is also a small outcrop of Beacon Sandstone rocks intruded by Ferrar Dolerite at Horn Bluff (Figure 6; [*Goodge and Fanning*, 2010]). The Beacon Sandstone is comprised of a 2.5 to 3.5 km thick Devonian to Jurassic dequence containing fluvial, glacial and shallow marine sediment [*Barrett et al.*, 1986; *Collinson et al.*, 1986; *Barrett*, 1991], and is found throughout both Northern and Southern Victoria Land. Airborne radar data collected from over the Wilkes subglacial basin reveals intrusions of Ferrar Group rocks, based on high frequency magnetic anomalies [*Ferraciolli et al.,* 2009], particularly concentrated around the Central Basin, and not present in the Western Basins; however the full extent of the Ferrar cannot be determined as the mapping did not cover the full area of the Wilkes basin, though it likely extends outside of the mapped area (F. Ferraciolli*, pers. comm*.).

6.3.2 Subglacial outburst floods from the Central Basin?

Several studies support the idea of the sudden drainage of sub- or pro-glacial lakes, and subsequent outburst flooding in East Antarctica. Bed morphology characteristics interpreted from airborne radar data over the Central Basin (up to 1.5 km below sea-level and located ~ 300 km inland within the Wilkes Basin, and approximately 600 km to the east of IODP U1356) has been hypothesized to be evidence of paleo-mega outburst floods originating from a paleo-subglacial lake, estimated to be one-sixth the size of Lake Vostok (~ 850 km^3); outburst flood features cover an area 70 km wide and 100 km long, and contain incised channels up to 5 km wide and 200 m deep, consistent with subglacial flood geomorphology from other parts of the world (e.g., the Dry Valleys (see section 6.2.3), the Amunsden Sea and South-East Alberta) [*Jordan et al.*, 2010].

The model hypothesized by Jordan *et al.* [2010] invokes the growth of the paleo-lake as the ice sheet over-rides the basin, with the outburst flood occurring as the ice sheet retreats at the end of glacial periods (in contrast to the models of Alley *et al*. [2006] and Erlingsson *et al.,* [1994], which argue for outburst flooding occurring when an ice-sheet overrides pro-glacial lakes during ice-sheet expansion). Though there are no age constraints on these geomorphic features, Jordan *et al.* [2010] hypothesize that this hydrologic system is likely to have evolved after the mid-Miocene growth of the then much warmer and wetter wet-based, East Antarctic ice sheet. Erosion of material due to subglacial outburst floods from this paleo-subglacial lake could explain the shift to more radiogenic values in our ε_{Nd} record, given the presence of Ferrar Group intrusions into Beacon Sandstone Rocks contained within the Central Basin and immediate surrounding.

6.3.3 Subglacial outburst floods from the Labyrinth (Dry Valleys)?

The spectacular geomorphologic features contained within the Dry Valleys [*Denton and Sugden*, 2005], and particularly the Labyrinth, a network of channels over 50 km long, with individual channels up to 600 m wide and 250 m deep, located in the western Dry Valleys [*Lewis et al.* 2006], are evidence for mega-outburst floods originating from subglacial and/or ice dammed lakes in East Antarctica during the mid-Miocene climate transition.

Subglacial lakes under the East Antarctic ice sheet are inferred as the source of the outburst floods, as these sources (i.e. non-local) are required in order to supply enough water to form these features. Estimates for total water availability from subglacial lakes present today under the EAIS, and which discharge into the Ross Sea, range from 4,000 km^3 to 10,000 km^3 [*Lewis et al.,* 2006]. Alternatively, ice-dammed lakes could have formed at this time as well, leading to catastrophic discharges as the these lakes filled and drained repeatedly [*Lewis et al.,* 2006]. The lower age limit on these mega-erosional features in the Labyrinth, 12.4-14.4 Ma, is constrained by the $^{40}Ar/^{39}Ar$ age of volcanic ash that is draped over these channels [*Lewis et al.*, 2006].

The compelling arguments for the Labyrinth outburst floods as the source of our radiogenic ε_{Nd} peaks are two-fold. First, the age constraints provided by the $^{40}Ar/^{39}Ar$ ages of volcanic ash in the Labyrinth are 14.4 to 12.4 Ma, while our peaks in radiogenic ε_{Nd} values occur at ca. 14.1 Ma, 13.8 Ma and 13.0 Ma. Second, the channels and incised valleys are cutting into a 300 m thick sill of Ferrar Dolerite, and thus would supply a tremendous amount of water and sediment to the Southern Ocean, with a radiogenic ε_{Nd} signature. Future work will better evaluate the validity of this connection.

6.3.4 Transport of fine-grained sediment to IODP U1356

Delivery of this radiogenic terrigenous material to IODP Site U1356 requires a transport distance of ~ 2500 km if sourced from the Dry Valleys, and ~ 900 km (300km to the present-day coast and 600 km in the ocean) if sourced from the Central Basin (Figure 6). Discharge calculations for the floods that carved out the Labyrinth range from 1.6 to 2.2 Sverdrups (10^6 m^3/s), while discharge calculations based on geomorphic features from the Central Basin indicate a peak discharge rate of ~ 5 Sverdrups. As a comparison, the catastrophic drainage of Lake Agassiz in North America during the late deglacial period at ~8.2 kyr is estimated to be 5 Sverdrups [*Teller et al.*, 2002]; calculations for sediment transport distances following this glacial outburst flood show significant transport distances (> 1600 km) of fine-grained sediment (clay and silt) following the outburst [*Clarke et al.*, 2009]. Indeed, hyperpycnal floods laden with sediment have the potential to travel 1000s of kilometers from their source, and mud from the mouth of Amazon River forms a plume that spans 2000 km [*Geyer et al.*, 2004]. Future work modeling sediment transport following such outburst floods will better evaluate the possibility of outburst floods delivering sediment to IODP Site U1356.

6.3.5 Implications of glacial outburst floods and our εNd data

Even if we cannot definitively assign the sediment with a radiogenic Nd signature to a Labyrinth source, and rather the source lies deep within the Wilkes subglacial basin, it points to an analagous process (glacial outburst flooding) occurring in the East Antarctic ice sheet at the same time as the floods that created the Labyrinth. This in keeping with previous studies [*Marchant et al.*, 1993; *Denton and Sugden*, 2005; *Leventer et al.*, 2006; *Lewis et al.*, 2008] which infer a significantly wetter-based EAIS with significant potential for melting and water

storage prior to the MMCT. Potential mechanisms for creating floods at this time include the over-riding of proglacial lakes, leading to changes in surface slope and subsequent flooding [*Erlingsson et al.,* 1994; *Alley et al.,* 2006]; the retreat of the ice sheet margin over ponded sub-glacial water, also leading to changes in surface slope and subsequent flooding [*Jordan et al.,* 2010]; or the catastrophic failure of ice-dammed lakes, as seen in the Missoula Flood records of the northwest United States (e.g., Waitt, [1980]) and Lake Agassiz (e.g. Clarke *at al.* [2004]) during the last deglacial period. Given the rapid cooling associated with the MMCT, it is highly likely that subglacial meltwater could pond and then be trapped by the ice sheet as it grew and transitioned to a cold-based ice sheet frozen to the bedrock (e.g., Lewis *et al.* [2006]). These floods would happen on a timescale too fast for Site U1356 to record discrete flood events; rather the times of peak radiogenic εNd data would reflect periods of episodic outburst flooding. Again as a comparison, over the last deglacial period the ice-dammed Lake Agassiz experienced failure (leading to flooding) five times [*Teller et al.,* [2002].

6.4 Ice-rafted pebbles

An interesting aspect of the marine sedimentary record at IODP Site U1356 and ODP Site 1165 during the MMCT is the dramatic onset and delivery of clasts > 2 mm to the depositional site via ice-rafting (Figure 1, 4). Entrainment of terrigenous material by ice can occur sub-, intra, and supra-glacially; material can fall on top of glaciers as they cut through rock, and subglacial material can freeze on to the bottom of ice and become incorporated in that way. The examination of the nature of ice-rafted material in the marine sedimentary record, in the context of how material is incorporated into the ice, is important for determining past ice-sheet behavior, yet it is also complicated. In order to entrain a lot of material, it is apparent that

significant sediment and water must be present, however specific mechanisms can be hard to identify. One mechanism for creating significant amounts of intraglacial sediment, which would survive transport by long distances well during ice-berg discharges, is glaciohydraulic supercooling [*Alley et al.*, 1998; *Roberts et al.*, 2002]. *Roberts et al.* [2002] show that jökulhlaup (outburst flood) conditions can result in particularly high concentrations of englacial sediment entrainment by supercooling, a method that shuld be considered when thinking about the behavior of the EAIS during the MMCT, in the context of entraining large amounts of debris.

6.5 Relationship between IODP U1356 and other records of the mid-Miocene climate transition

As discussed above, IODP U1356 record shows simultaneous increases in clast counts >2 mm and magnetic susceptibility at ~14.7 Ma, 14.1 Ma, 14.0 Ma, 13.9 Ma, 13.8 Ma, 13.5 Ma, 13.0 Ma and 12.6 Ma; the coarse terrigenous fraction in each of these samples was deposited via ice-rafting (mostly), or turbidity current (~14.7 Ma). As discussed above, the $^{40}Ar/^{39}Ar$ hornblende age population for this sample is skewed older than the rest of the (ice-rafted) samples, and better reflect local, on-land ages, as would be expected from a turbidity current. The fine-grain (<63 μm) terrigenous fraction reflects a combination of ice-rafting, and ocean current transport. Below we compare and contrast our record from IODP U1356 with other East-Antarctic proximal mid-Miocene records (e.g. ANDRILL) as well as with far-field proxies such as sea-level records, oxygen isotopes and sea-surface temperature reconstructions (Figure 1).

6.5.1 17 Ma to 15 Ma

IODP U1356 shows no bursts of terrigneous material as indicated by the clast > 2 mm record between 17 and 15 Ma (Figure 1; *Escutia et al.,* 2011). This period, the Miocene climatic optimum, was a time of relative warmth and greatly-reduced ice volume, as evidenced by oxygen isotope records [*Holbourn et al.,* 2005; *Shevenell et al.,* 2008], and high eustatic sea-level [*Haq et al.* 1987; *Pekar and Christie-Blick,* 2008*John et al.,* 2010;], and ice-volume estimates ranging between ~25% to 75% of the present day EAIS from 17 to 16 Ma [*Pekar and Christie-Blick* 2006], and ~5% of the full Pleistocene ice volume [*Lear et al.,* 2000]. Paschier *et al.* [2011] found evidence from the ANDRILL-2A core in the Ross Sea for ice sheet and sea-ice minima ~15.6-15.7 and ~16.3-16.5. Evidence for abrupt warming during middle Miocene climatic optimum at 15.7-15.5 Ma is based on palynological assemblages recovered at the AND-2A site [*Warny et al.*, 2009], and consistent with additional evidence for peak warmth ~15.7 Ma based on the deuterium isotope composition of plant waxes (also recovered from the AND-2A core) and model simulations, which indicate significantly higher precipitation, and warmer (11˚C warmer summer temperatures than today) at this time [*Feakins et al.*, 2012].

6.5.2 15.0 Ma to ~14.7 Ma

The Passchier *et al.* [2011] record from ANDRILL-2A shows glacial intensification ~15.4 Ma, followed by a major ice advance between 14.7 and 14.3 Ma. An increase in the $\delta^{18}O$ of sea-water indicates glacial advance at 14.9 Ma [*Shevenell et al.,* 2008]. The glacial advance starting at 14.7 Ma is coincident with a drop in eustatic sea-level of ~33 m [*John et al.,* 2010], and is also coincident with the deposition of the turbidite sample from IODP U1356 that was noted above. Given that the ANDRILL-2A site is quite far south and close to the Transtantarctic

mountains, this may reflect an early response to the cooling trend observed during the MMCT. Interestingly, the evidence indicating glacial advance listed above coincides temporally with a decrease in the $\delta^{18}O$ of sea-water record, which has been interpreted to represent a glacial retreat [*Shevenell et al.,* 2004].

6.5.3 ~14.2 to ~13.8 Ma

The period between 14.2 and 13.8 Ma marks an important period during the MMCT; at IODP U1356 we observed an initial small pulse of ice-rafted material at ~14.1 Ma, a second, large pulse at 14.0 Ma, followed by 4 even larger pulses at ~13.9-13.8 Ma. A contemporaneous pulse of terrigenous material was also deposited at ODP Site 1165 ~ 13.8 Ma. Just prior to the dramatic increases in IRD delivery to IODP Site U1356 and ODP Site 1165, evidence for cooling and ice advance onto the shelf in the Prydz Bay region is marked by a change in sedimentary facies in ODP Site 1165, ~14.3 Ma.

Far-field proxies of EAIS behavior include a dramatic eustatic drop in sea-level of ~60 m at 13.9 Ma [*John et al.*, 2004; *John et al.*, 2011]; sea-surfaces temperatures, as recorded by Mg/Ca records in foraminifera from the Southern Ocean indicate drop 6-7˚C between 14.2 and 13.8 Ma [*Shevenell et al.,* 2004]; evidence from the $\delta^{18}O$ of sea-water indicates major expansion of the East Antarctic ice sheet between 13.91 and 13.84 Ma (Holbourn et al., 2005), with a glacial retreat (14.0 Ma) followed by a glacial advance (13.8 Ma) indicated by the $\delta^{18}O$ of sea-water record from Shevenell *et al.* [2008]. Estimates of ice volume based on the $\delta^{18}O$ of sea-water indicate ice growth to ~30% of full Pleistocene values [*Lear et al.,* 2000]. Evidence from the Dry Valleys in the Transantarctic Mountains indicate a transition from wet- to cold-based glaciation at ~ 13.94 Ma, reflecting a drop in mean annual air temperature (MAT) of 25˚C to

30˚C (Lewis et al., 2007), while a nearby study by Lewis *et al.* [2008] indicated a drop in mean summer temperatures of 8˚C between 14.07±0.05 Ma and 13.85±0.03 Ma.

It is during this period that we have observed evidence for two possible glacial ouburst floods, reflected by high εNd values, at ~ 14.1 Ma and ~ 13.8 Ma. It is interesting that these swings towards more radiogenic Nd values in the <63 μm fraction coincide with pulses of ice-rafted material with an entirely different provenance source indicated by the $^{40}Ar/^{39}Ar$ hornblende ages, as it indicates an overall dynamic behavior of the East Antarctic ice sheet at this time. The timing of these events at Site U1356 falls within the age constraints from Lewis *et al.* [2006] for the last set of floods to carve part of the Labyrinth.

6.5.4. ~13.5 to 12.6 Ma

Following the largest pulse of material at ~13.8 Ma, minor ice-rafting events occurred at ~13.5 Ma, ~13.0 Ma and ~12.6 Ma. Clasts counts from ODP Site 1165 reveal a pulse of IRD at ~ 13.6 Ma (O'Brien et al., 2001). The **ε**Nd of the < 63 μm fraction deposited ~ 13.0 Ma indicate the possibility of another glacial outburst flood event, based upon the excursion towards radiogenic Nd isotope values. The **ε**Nd record could also reflect the basic possibility that the area of glacial erosion moved from one place to another because of a change in the ice sheet extent; however this change is not reflected in the record of coarse-grained IRD (e.g., the $^{40}Ar/^{39}Ar$ hornblende ages). Coincident with this timing, Lewis *et al.* [2007] indicate significant expansion of the EAIS between ~13.62 and 12.44 Ma in the Olympus Range of the Transantarctic mountains.

7. Conclusions

1. Eight significant bursts of coarse-grained (> 150μm) terrigenous material were deposited at IODP Site U1356 during the mid-Miocene Climate transition between ca. 14.7 and 12.0 Ma. The first burst (14.7 Ma) was deposited in a turbidity current, while the remaining 7 depositional events are due to ice-rafting.
2. In general, we see excellent agreement between the sedimentary record recovered at IODP Site U1356, additional sedimentary records proximal to East Antarctica (e.g., ODP Site 1165, ANDRILL-2A), terrestrial records (e.g., from the Dry Valleys in the Transantarctic Mountains), and far-field proxy records (eustatic sea-level drops, declines in sea-surface, terrestrial and deep sea temperatures, and increases in the $\delta^{18}O$ of sea-water) as regards a significant event – major growth of the East Antarctic ice sheet - between ~ 13.8-13.9 Ma. Nuanced differences in the timing and spatial relationships of smaller, yet crucial, steps before and after major ice sheet growth highlight the importance of future studies comparing and contrasting the spatial and temporal evolution of the EAIS over this transition.
3. The provenance of the ice-rafted hornblende grains across the MMCT indicates an un-varying source (1400-1550 Ma) related to the Mertz Shear Zone area; the Mertz Shear Zone extends at least 900 km under the East Antarctic ice sheet to the south, is ~ 600 km east of IODP U1356 where it outcrops on the coast, and marks the western edge of basins contained in the Wilks subglacial basin. These data indicate that this was likely an active margin of the East Antarctic ice sheet during the Mid-Miocene (ca. 14.1-12 Ma).
4. **ε**Nd in the fine fraction, reflecting a combination of ice-rafting, and fine grained sediment transport by ocean currents, are mostly -16.5 to -14, reflecting relatively local

sourcing of fine-grained material. Pulses of sediment with a significantly higher εNd source are required to explain excursions at ca. 14.1, 13.8 and 13.0 Ma, and are tentatively inferred to be evidence for periods of glacial outburst flooding during the Mid-Miocene expansion of the East Antarctic ice sheet.

The εNd data likely point to sourcing from either 1) the glacial outburst floods at that occurred in the Labyrinth area of the Dry Valleys between 14.4 and 12.4 Ma or 2) subglacial outburst floods from the Central Basin, located within the Wilkes subglacial Basin. Though we cannot definitively confirm or rule out either of these sources, the fact that 1) the geomorphologic evidence in the Labyrinth shows dramatic incision (hundreds of meters deep and wide) into a 300 m thick Ferarr Dolerite sill, and 2) the age constraints on the last of these flood events perfectly bracket our samples, make it the most likely candidate. To our knowledge this is the first documentation of outbursts floods during this time interval in the marine record. Furthermore, this is a hypothesis that further work on additional cores, with additional sediment provenance tracers, should be able to test.

8. Future Work

1. Future sampling will be conducted at a higher temporal resolution on the terrigenous <63 μm fraction of samples from IODP site U1356, with the goal of further refining the history of outburst floods. εNd and K-Ar measurements on the terrigenous < 2 μm, 2-20μm and 20-63μm fraction, in addition to measurements on the overall

terrigenous < 63 μm fraction should further illuminate EAIS behavior across the MMCT.

For this study we were trying to target ice-rafting events, and so chose samples based on coincident peaks in the clast counts > 2mm and the magnetic susceptibility. There are additional peaks in the magnetic susceptibility record across this period that we have yet to sample, and which would be ideal targets for future work, in an effort to further investigate the connection between glacial outburst floods and the sediment record from IODP U1356.

2. Marine sediments from ANDRILL cores are located just offshore of the Dry Valleys in Southern Victoria Land; future studies of middle Miocene-aged recovered from this core location and potentially DSDP Site 272 in the Ross Sea could provide additional evidence and age constraints on glacial outburst flood history from the Dry Valleys (particularly AND-2A).

3. Additional core-top samples from along the margin of the Wilkes subglacial basin will be processed for $^{40}Ar/^{39}Ar$ hornblende ages as well as Nd isotopes, in order to further characterize the isotopic signal from this region.

4. Future work characterizing the MMCT in the cores we identified (DSDP Site 272 and ODP Site 744 and 1165) should help to further elucidate East Antarctic ice sheet behavior across this important transition. Ongoing work in a parallel study is

investigating the provenance of the IRD pulse at ODP Site 1165. Previous IRD provenance studies at ODP Site 1165 (Prydz Bay) have indicated a switch from locally sourced IRD during 19-14 Ma to distally sourced IRD (coming from the Wilkes and Adélie Land margins) at 3.5, 4.65 and 7.5 Ma [*Williams et al.,* 2010; *Pierce et al.,* 2011], potentially indicating a switch in EAIS dynamics ~14 Ma.

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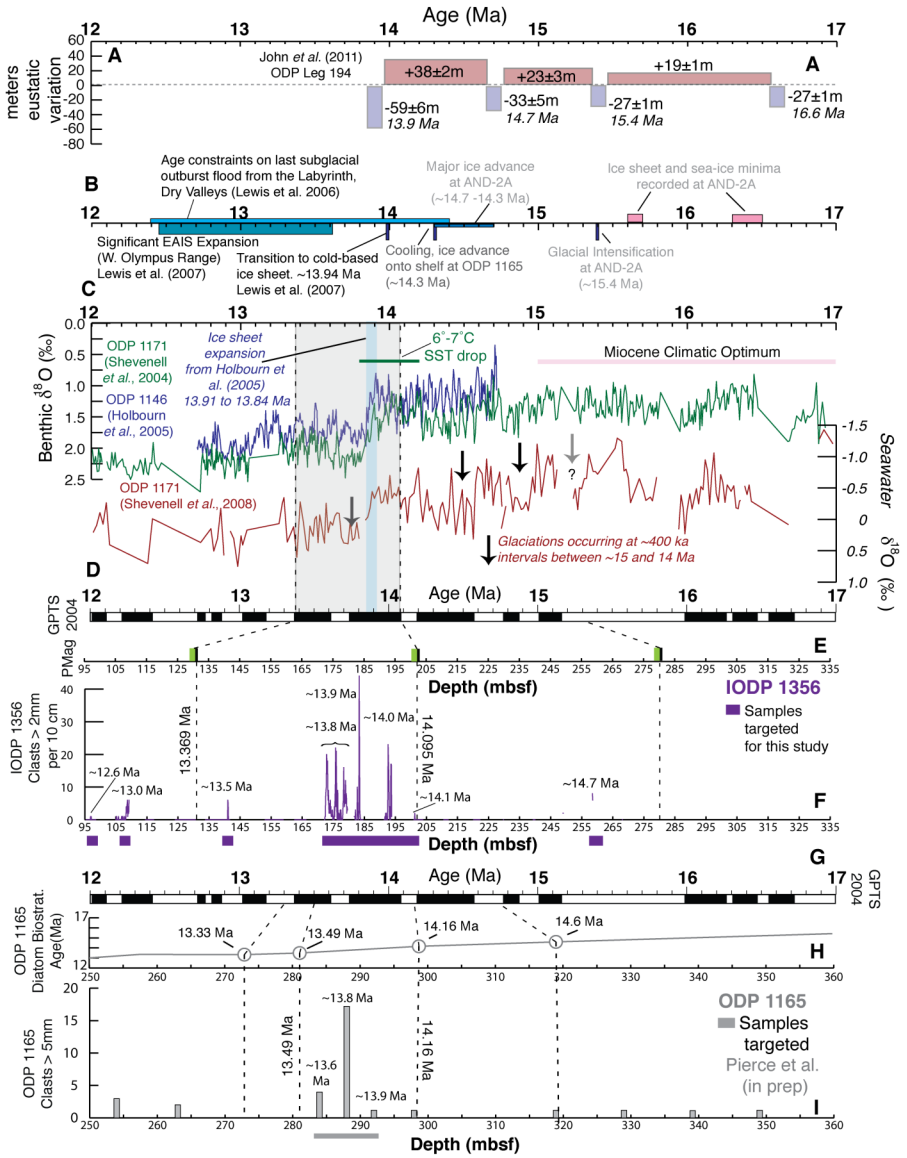


Figure 1. Compilation of records from across the mid-Miocene climate transition. **A**) Eustatic sea-level variations based on backstripped sediments from ODP Leg 194 (Marion Plateau, off the northwestern coast of Australia). Sea-level changes are the 'best combined estimates' from Fig. 7 in John *et al.* [2011]. The observed overall eustatic sea-level drop of 53-69m between 16.5 Ma and 13.9 Ma implies growth of > 90% of the East Antarctic ice sheet. **B**) EAIS behavior from ANDRILL-2A [*Passhier et al.,* 2011], from ODP Site 1165 [*Florindo et al.*, 2003] and from the Dry Valleys [Lewis *et al.,* 2006; 2007]. **C**) Benthic oxygen isotope records from ODP Site 1171 [*Shevenell et al.,* 2004; *C. mundulus*] and ODP Site 1146 [*Holbourn et al.,* 2005], in addition to

the sea-water oxygen isotope record from ODP Site 1171 [*Shevenell et al., 2008*]. **D**) Geomagentic Polarity Time Scale (GPTS) from Gradstein and Ogg (2004). **E**) Paleomagentic recovery in IODP Site U1356 [*Tauxe et al.,* 2012]. **F**) Counts of clasts > 2 mm per 10 cm of core for IODP Site U1356 [*Escutia et al.,* 2011]. **G**) GPTS. **H**) Diatom biostratigraphy for this section of ODP Site 1165. Depths and diatom species are from Florindo *et al*. [2003]; we have applied the revised diatom age assignments from Cody et al. [*Cody et al.*, 2008]. **I**) Counts of clasts > 5 mm from ODP Site 1165 [*O'Brien et al.*, 2001].

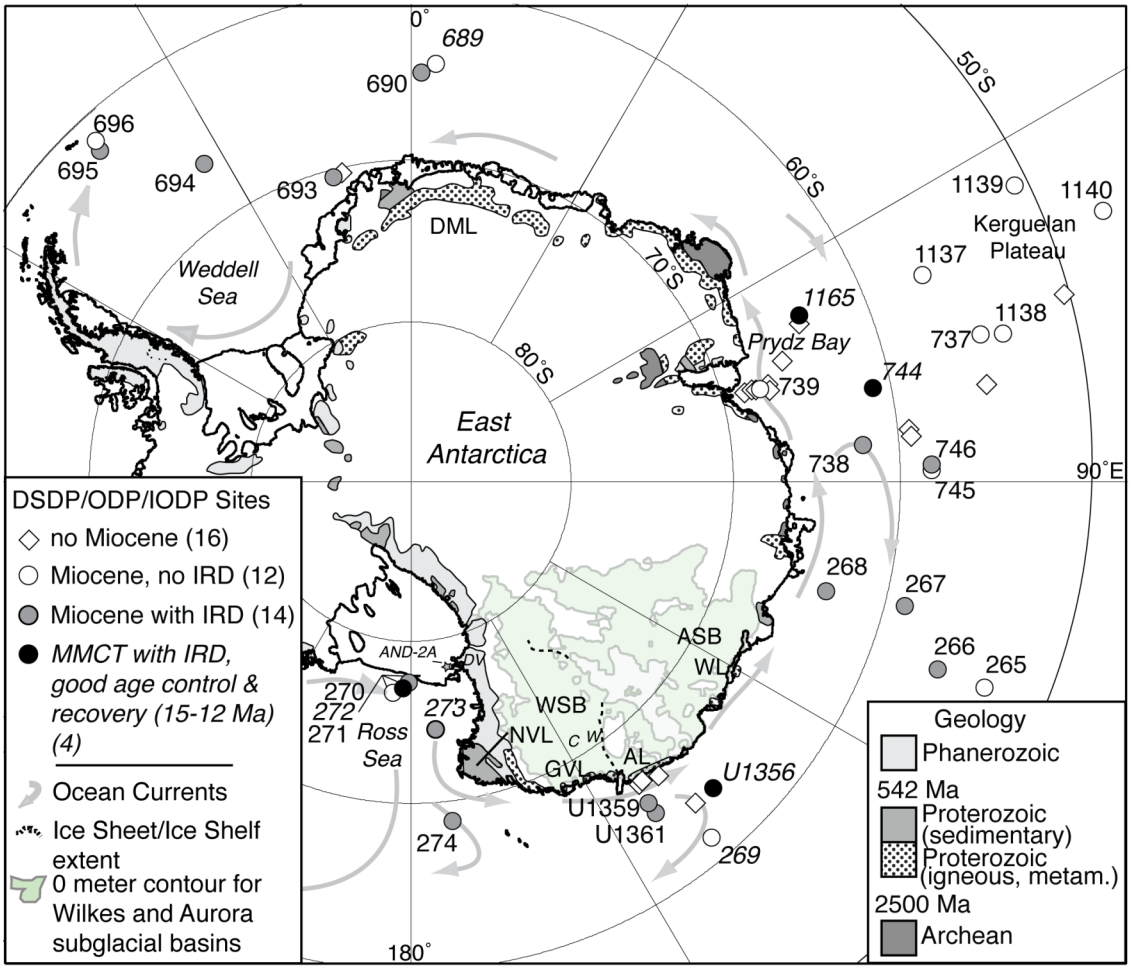


Figure 2. Location map of DSDP, ODP and IODP locations in the Southern Ocean, ocean currents, and the Wilkes and Aurora subglacial basins. DSDP, ODP and IODP sites are divided into four categories: 1) sites that did not recover Miocene aged sediments 2) sites that recovered Miocene sediments, but which do not contain IRD in the Miocene 3) sites that recovered Miocene sediments which contain IRD and 4) sites that recovered Miocene sediments which span the MMCT, contain IRD, and have good age control and sediment recovery (see Figure 3 for site descriptions, and Appendix G). AL- Adélie Land; ASB – Aurora Subglacial Basin; C-Cenral Basin; DML – Dronning Maud Land; DV – Dry Valleys; GVL – George V Land; NVL-Northern Victoria Land; W – Western Basins; WL- Wilkes Land; WSB – Wilkes Subglacial

Basin. Dashed line = subglacial extent of the Mertz Shear Zone [*Ferraccioli et al.,* 2009]. Geology and outcrops from Collins and Pisarevsky [2005].

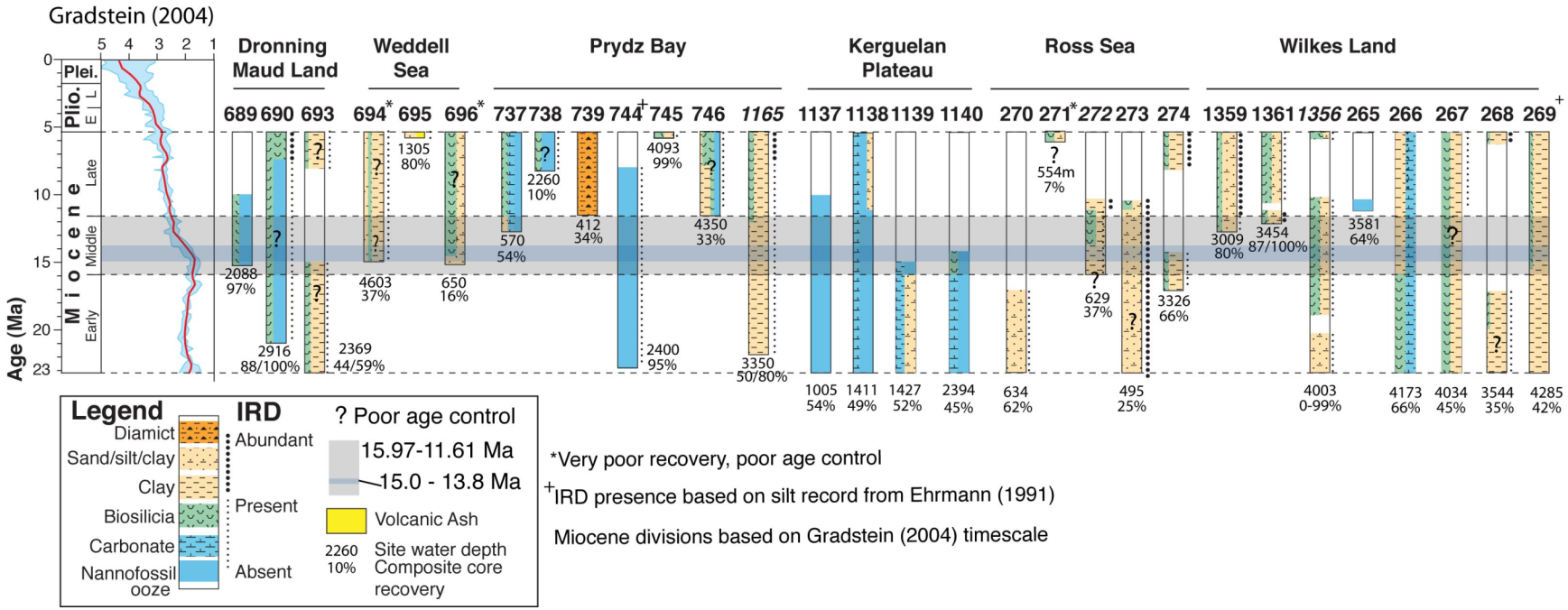


Figure 3. DSDP/ODP/IODP cores for MMCT and core lithologies. Lithostratigraphy, presence of ice-rafted detritus, water depth, and composite core recovery (%) of Miocene-aged sediments recovered at 25 DSDP/ODP/IODP Sites (of 47 considered south of 50˚S around East Antarctica). *Zachos et al.* [2008] benthic oxygen isotope curve is plotted on the left as a reference. Data for each of the sites was taken from the initial shipboard reports for DSDP Leg 28, ODP Legs 113, 119, 120, 183, 188 and IODP Expedition 318. The presence/duration of Miocene sediment deposition at each core site is based on unit descriptions and age models from the shipboard reports. The presence or lack of IRD is based on unit descriptions or gravel/sand/clast counts, if available.

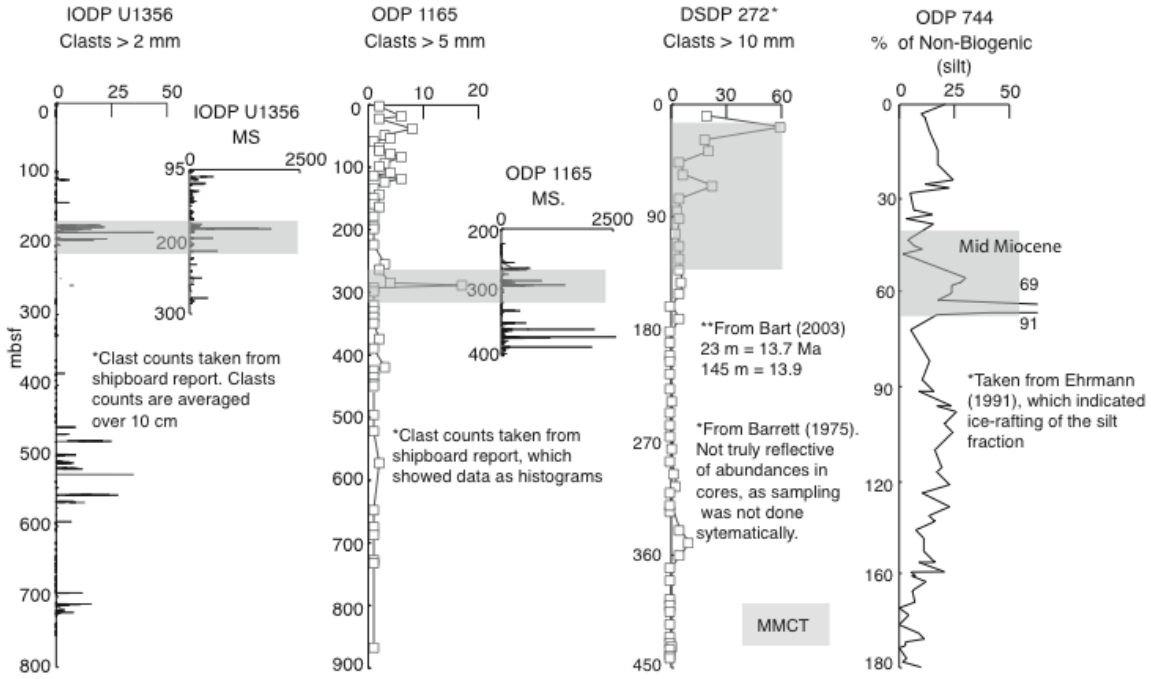


Figure 4. MS/Clast counts from IODP U1356, ODP 744 and 1165, and DSDP 278 showing pulses of course-grained material during the mid-Miocene climate transition.

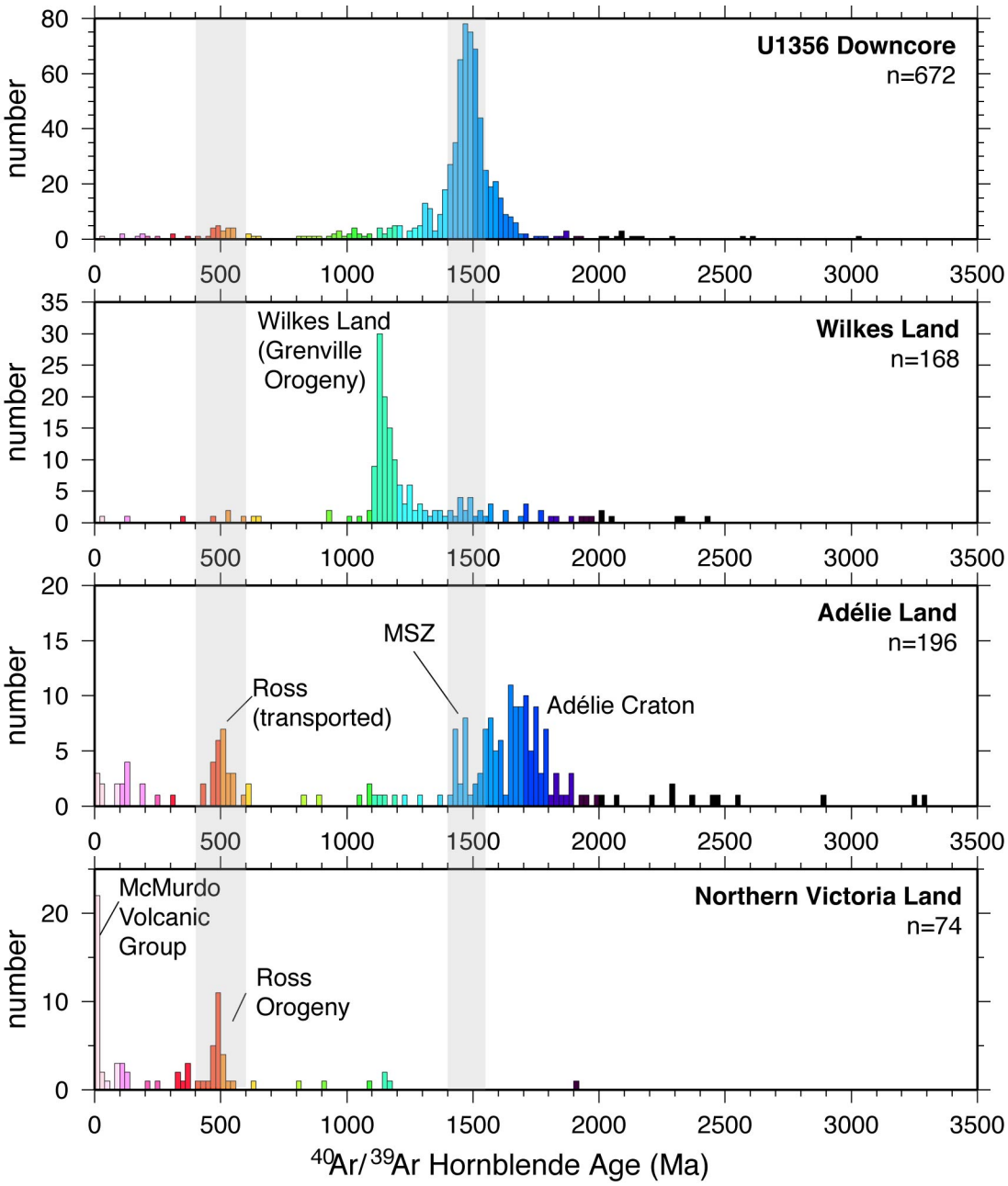


Figure 5. Histograms (20 myr bins) of $^{40}Ar/^{39}Ar$ hornblende ages from sources areas around this part of East Antarctica and the total population of $^{40}Ar/^{39}Ar$ hornblende ages from IODP U1356 samples deposited during the mid-Miocene. The 1400-1550 Ma ages that dominate the ice-rafted hornblendes from IODP U1356 are predominantly found from a piston-core sample located proximal to the Mertz Shear Zone.

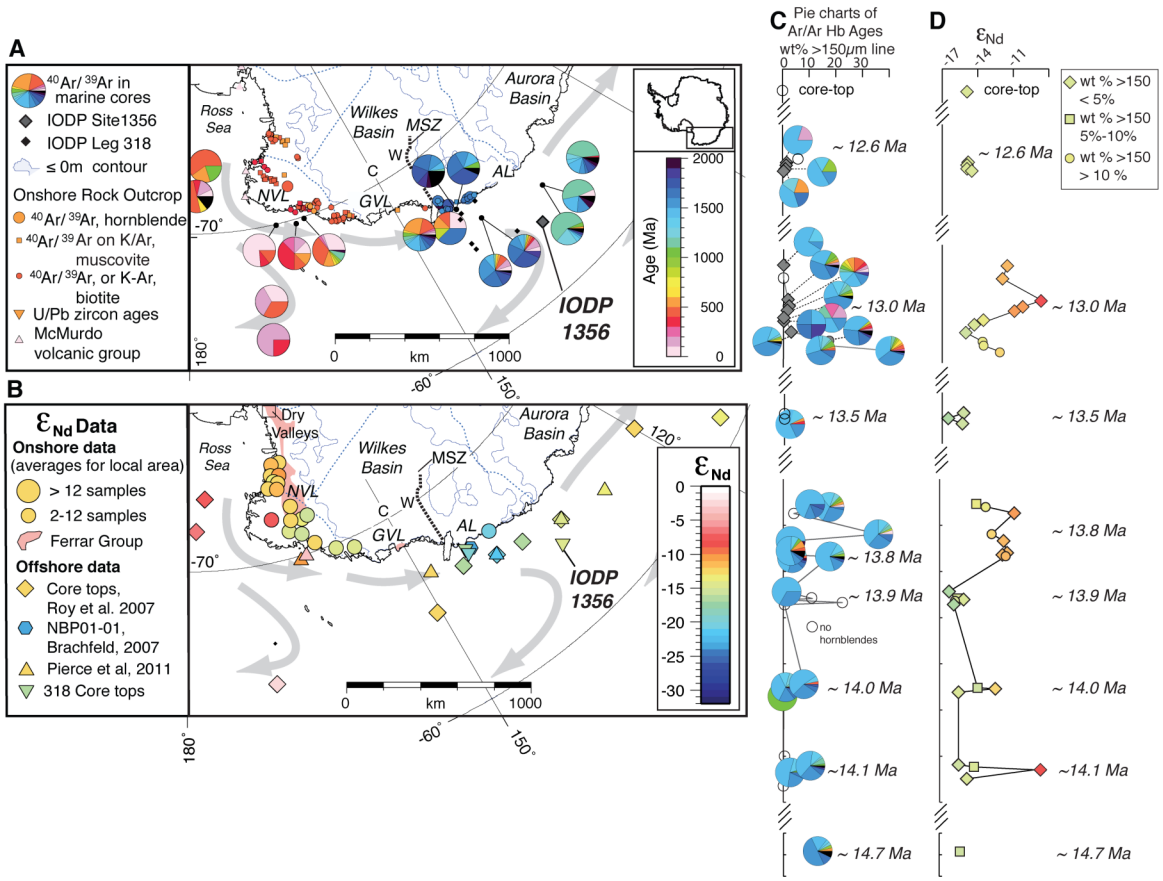


Figure 6. Down-core records from IODP U1356 and source area characterization (**A**) $^{40}Ar/^{39}Ar$ hornblende characterization for source areas [*Roy et al.,* 2007; *Pierce et al.,* 2011] (**B**) Nd data characterization for source areas [*Roy et al.,* 2007; *Brachfeld et al*., 2007; *Pierce et al.,* 2011; see Pierce *et al.* [2011] and Williams *et al.* [2010] for a summary of the on-land geology plotted in plotted in A and B) (**C**) Downcore $^{40}Ar/^{39}Ar$ hornblende data from IODP U1356 expressed as pie-charts and plotted vs. depth on a scale reflecting

weight % > 150μm (**D**) Down-core Nd data (plotted as ε_{Nd}) vs. depth with symbols reflecting the weight % > 150μm. AL- Adélie Land; C- Central Basin; GVL – George V Land; NVL- Northern Victoria Land; W – Western Basins; WL- Wilkes Land; Dashed line - subglacial extent of the Mertz Shear Zone [*Ferraccioli et al.,* 2009].

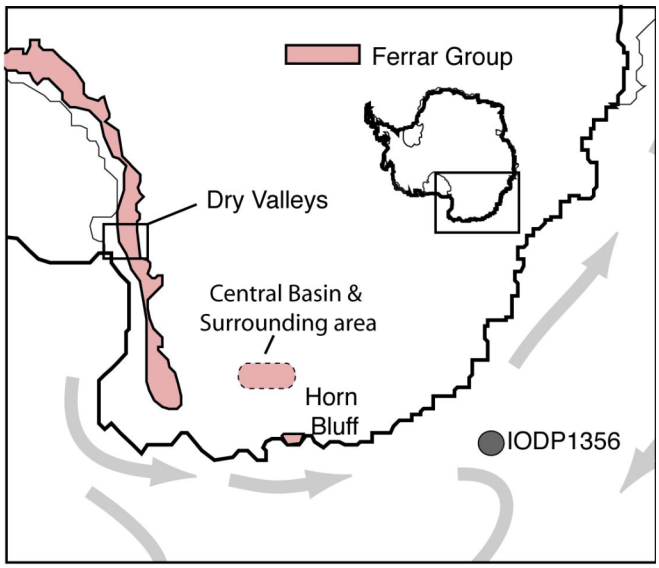


Figure 7. Known locations of the Ferrar Group, which consists of the Ferrar Dolerite, the Kirkpatrick Basalt and the Dufek Gabbro, and has ε_{Nd} values ranging from -4.8 to -6.9 [*Flemming et al.,* 1995; *Kyle et al.,* 1987]. The extent of the Ferrar Group mapped in the Transantarctic Mountains is from *Flemming et al.* [1997], and outcrops of Ferrar intruding into Beacon Sandstone Group rocks at Horn Bluff is from *Goodge and Fanning* [2010]. Airborne radar surveys over parts of the Wilkes subglacial basin indicate the presence of Ferrar rocks intruding into Beacon Sandstone Group rocks, mostly grouped around the Central Basin [*Ferraccioli et al.,* 2009]. Note, the full extent of the Ferrar Group intrusions in the Wilkes subglacial basin is unknown as the full extent of the basin was not surveyed.

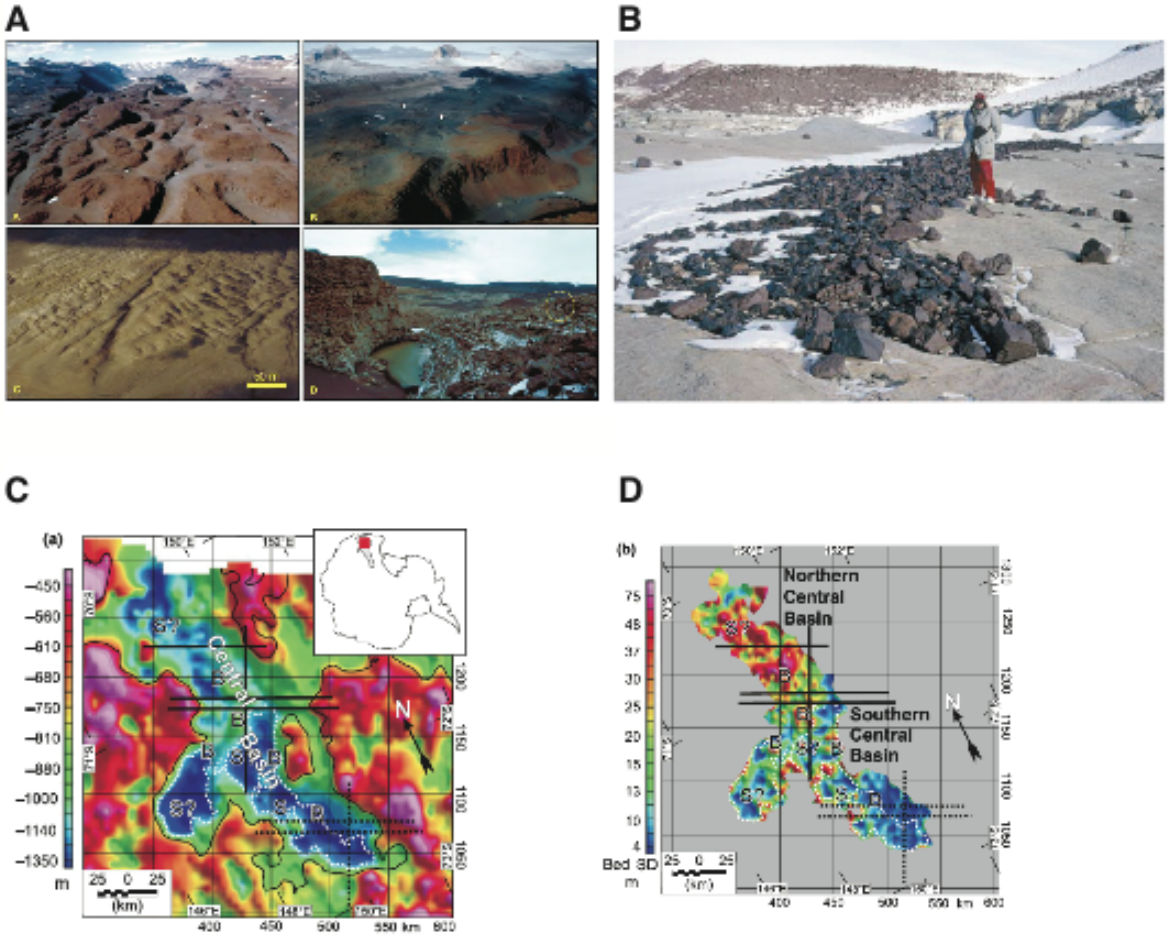


Figure 8. Two locations with geomorphologic evidence outburst floods in East Antarctica. (**A**) Incised channels, canyons and erosional surfaces cutting into Ferrar Dolerite in the Labyrinth (Dry Valleys) (from *Lewis et al.,* [2006]) (**B**) Ripple of Dolerite blocks in the Labyrinth (from *Denton and Sugden* [2005]). (**C**) subglacial topography of the Central Basin (from *Jordan et al.,* [2010]) and (**D**) and bed roughness map of the Central Basin (from *Jordan et al.,* [2010]). The paleo-subglacial lake is outlined in white dashed line; and bed roughness is smooth to the south (lake) and exhibits topography consistent with subglacial flooding to the north [*Jordan et al.,* 2010]. B = Beacon Sandstone intruded by Ferrar Dolerite.

Appendices

Chapter 2. Appendix A. Cores from the Antarctic Marine Geology Research Facility (AMGRF) at Florida State University and IODP.

Appendix A. Cores from the Antarctic Marine Geology Research Facility (AMGRF) at Florida State University and IODP

Core	Core Type	Sample Depth (cm)	Latitude (°)	Longitude (°)	Water Depth (m)
DF79-47	Piston Core	563-567	-66.667	148.733	476
DF80-20	Piston Core	160-164	-69.783	163.683	490
DF80-34	Piston Core	222-226	-69.917	162.83	805
DF80-35	Piston Core	269-273	-70.017	166.417	475
ELT37-09	Piston Core	140-144	-65.552	141.095	1308
ELT37-09 A	Piston Core	137-139	-65.552	141.095	1308
ELT37-09 B	Piston Core	92-93	-65.552	141.095	1308
ELT37-13	Piston Core	113-120	-64.672	132.977	1333
ELT37-16	Piston Core	231-235	-63.97	127.447	3840
ELT49-30	Piston Core	1698-1702	-59.005	95.23	4276
NBP01-01 2305	Jumbo Piston Core	2305-2310	-66.563	143.052	870
NBP01-01 2370	Jumbo Piston Core	2370-2375	-66.563	143.052	870

Below samples contained no terrigenous material

Core	Core Type	Sample Depth (cm)	Latitude (°)	Longitude (°)	Water Depth (m)
ELT49-32	Piston Core	1190-1192	-58.368	98.468	4137
ELT50-14	Piston Core	21-23	-61.373	105.632	4279
ELT45-49	Piston Core	428-430	-61.352	113.748	4234
ELT50-18	Piston Core	1021-1023	-64.425	119.977	3120
ELT37-15	Piston Core	280-282	-64.048	130.258	3274
DF80-27	Piston Core	510-514	-69.333	163.533	2121
DF80-29	Piston Core	587-590	-69.2	165.6	2251

Samples from the Integrated Ocean Drilling Program
Leg 188 Site ODP 1165

Sampe Name	Hole-Core-Section (depth in section, cm)	Approximate Age (Ma)	Latitude (°)	Longitude (°)
ELP-01	**1165B-4H-6 (80)**	**3.5**	-64.366	67.2
ELP-02	**1165B-6H-1 (70)**	**4.65**		
ELP-06	**1165B-10H-2 (35)**	**7.0**		
ELP-09	**1165C-10R-3 (120)**	**19.0**		

Chapter 2. Appendix B. $^{40}Ar/^{39}Ar$ hornblende and biotite data. $^{40}Ar/^{39}Ar$ dating was performed at the L-DEO AGES (Argon Geochronology for the Earth Sciences) laboratory.

Sample Name	Run ID Number	Ca/K	Cl/K	Mol 39Ar	%40Ar*	Age	Internal Error	± Age	Size Fraction
DF79-47 hb	12685-05	2.37059	0.01687	0.122	38	180.01	3.56	3.99	> 150
DF79-47 hb	12685-14	4.70811	-0.22949	0.001	34.4	431.69	66.38	66.52	> 150
DF79-47 hb	12685-15	6.2587	-0.00347	0.056	50.4	494.82	6.11	7.86	> 150
DF79-47 hb	12685-02	9.54973	0.00617	0.05	95.6	514.84	3.31	6.12	> 150
DF79-47 hb	12685-04	4.47714	0.00486	0.15	84.6	517.76	2.44	5.72	> 150
DF79-47 hb	12685-10	7.5997	-0.20608	0.003	86.6	599.15	35.33	35.83	> 150
DF79-47 hb	12685-09	12.6577	-0.00277	0.05	85.2	613.47	3.76	7.19	> 150
DF79-47 hb	12685-13	8.40591	0.0116	0.049	71.3	1041.39	7.05	12.58	> 150
DF79-47 hb	12685-01	7.79916	0.01699	0.145	98.4	1474.84	3.85	15.24	> 150
DF79-47 hb	12685-21	10.15418	0.01739	0.022	8.1	4.97	4.76	4.76	> 150
DF79-47 hb	12685-22	66.89985	0.21874	0.003	9.9	247.33	47.36	47.42	> 150
DF79-47 hb	12685-16	7.68478	0.0062	0.064	94.9	490.53	2.74	5.62	> 150
DF79-47 hb	12685-18	5.60775	0.03088	0.008	55.5	1520.61	22.74	27.35	> 150
DF79-47 hb	12685-26	7.0264	0.02002	0.029	98	1649.56	8.44	18.53	> 150
DF79-47 hb	12977-23	0.98964	0.00916	0.05	90.4	485.65	2.35	5.40	> 150
DF79-47 hb	12977-17	0.03839	0.00271	0.142	96.6	557.22	1.56	5.79	> 150
DF79-47 hb	12977-07	7.01002	0.00451	0.283	94.9	1089.09	2.61	11.20	> 150
DF79-47 hb	12977-16	7.78879	0.00331	0.143	99.3	1129.54	2.65	11.60	> 150
DF79-47 hb	12977-22	7.28079	0.01717	0.056	97.9	1231.46	3.80	12.89	> 150
DF79-47 hb	12977-09	7.97982	0.00244	0.098	99	1426.46	3.85	14.77	> 150
DF79-47 hb	12977-14	8.75023	0.01878	0.07	99.5	1435.37	3.63	14.80	> 150
DF79-47 hb	12977-11	8.86541	0.02355	0.033	98.3	1460.30	5.74	15.69	> 150
DF79-47 hb	12977-18	8.67059	0.00769	0.076	94.6	1476.42	4.28	15.37	> 150

DF79-47 hb	12977-12	11.00843	0.01091	0.029	96.2	1555.43	5.62	16.54	> 150
DF79-47 hb	12977-02	6.59405	0.04518	5.173	99.7	1741.76	4.68	18.04	> 150
DF79-47 hb	12977-03	25.3946	0.00984	0.037	99.9	1881.66	6.63	19.95	> 150
DF79-47 hb	12977-01	4.55152	0.14329	0.003	82.7	3299.22	34.73	47.90	> 150
DF79-47 hb	13185-01A	16.99535	-0.04916	0.059	94.6	529.71	8.47	9.99	> 150
DF79-47 hb	13185-02A	26.32185	-0.15503	0.023	92.3	1430.01	18.15	23.11	> 150
DF79-47 hb	13185-03A	4.94522	0.02011	0.136	99.3	1191.49	11.86	16.81	> 150
DF79-47 hb	13185-04A	7.07881	0.02905	0.187	95.2	505.74	6.77	8.45	> 150
DF79-47 hb	13185-06A	6.29252	-0.0043	0.113	100	477.10	5.79	7.50	> 150
DF79-47 hb	13185-07A	9.29667	-0.02644	0.062	95.2	556.63	8.38	10.06	> 150
DF79-47 hb	13185-08A	5.99902	-0.03114	0.101	92.7	492.11	7.87	9.28	> 150
DF79-47 hb	13185-09A	4.29808	-0.04074	0.137	97.6	500.63	6.50	8.20	> 150
DF79-47 hb	13185-10A	15.47538	-0.02376	0.077	99.8	1530.10	14.58	21.13	> 150
DF79-47 hb	13185-12A	77.98733	-0.30772	0.02	104.5	1708.85	21.67	27.60	> 150
DF79-47 hb	13185-13A	7.02658	0.00032	0.106	94	511.54	7.62	9.18	> 150
DF79-47 hb	13185-14A	7.01443	0.08374	0.121	98.1	1700.70	14.83	22.56	> 150
DF79-47 hb	13185-16A	6.72283	0.0232	0.052	97.6	1378.56	13.94	19.61	> 150
DF79-47 hb	13185-17A	5.72914	-0.00319	0.163	99.1	1682.18	14.06	21.93	> 150
DF79-47 hb	13185-19A	9.88904	0.03419	0.047	94.4	517.35	8.95	10.34	> 150
DF79-47 hb	13185-20A	16.16265	-0.03808	0.048	92.5	518.58	9.13	10.50	> 150
DF79-47 hb	13185-21A	4.5758	-0.12897	0.053	101.2	1469.94	12.44	19.26	> 150
DF79-47 hb	13185-22A	6.15686	0.01124	0.152	91.1	423.21	6.78	7.99	> 150
DF79-47 hb	13185-23A	8.36834	0.00017	0.13	98.2	1988.63	17.03	26.18	> 150
DF79-47 bio 63-150	13463-08	-0.05594	0.02097	0.037	72.3	429.50	8.73	9.73	63-150
DF79-47 bio 63-150	13463-07	-0.11661	0.01615	0.032	90	436.90	9.86	10.78	63-150
DF79-47 bio 63-150	13463-06	-0.0795	-0.03976	0.033	98.6	462.78	9.83	10.87	63-150

DF79-47 bio 63-150	13463-10	0.01295	0.00709	0.116	100.2	488.27	4.57	6.69	63-150
DF79-47 bio 63-150	13463-05	-0.27545	0.01802	0.028	82.3	492.83	11.40	12.42	63-150
DF79-47 bio 63-150	13463-11	-0.0352	0.00581	0.027	98.7	495.08	11.58	12.59	63-150
DF79-47 bio 63-150	13463-09	-0.19732	-0.05853	0.014	100.3	535.89	17.17	17.99	63-150
DF79-47 bio 63-150	13463-02	-0.02851	0.02942	0.051	99.3	547.15	7.63	9.39	63-150
DF79-47 bio 63-150	13463-01	0.75776	0.06774	0.02	98.6	712.11	16.22	17.72	63-150
DF79-47 bio 63-150	13463-03	-0.18376	0.04029	0.011	99.9	1385.58	24.76	28.37	63-150
DF80-20 hb	12686-11	9.25028	-0.14469	0.01	10	31.00	13.91	13.92	> 150
DF80-20 hb	12686-08	13.68731	0.09943	0.036	56.9	126.15	4.61	4.78	> 150
DF80-20 hb	12686-14	5.45543	-0.05761	0.009	31.3	243.96	15.50	15.69	> 150
DF80-20 hb	12686-04	18.01687	0.00466	0.091	97.1	476.95	2.33	5.31	> 150
DF80-20 hb	12686-13	14.61673	-0.07042	0.019	71.3	504.20	7.36	8.92	> 150
DF80-20 hb	12686-16	13.10768	0.02205	0.042	72.2	372.94	4.31	5.70	> 150
DF80-20 hb	12686-19	25.01592	-0.05136	0.016	78.1	362.89	6.95	7.84	> 150
DF80-20 hb	12686-22	23.52487	0.04813	0.052	92.2	363.12	2.93	4.67	> 150
DF80-20 bio	12745-01	0.12716	0.0002	5.663	99.3	365.60	0.83	3.75	> 150
DF80-20 bio	12745-03	0.01529	0.00218	1.823	99.6	367.49	0.90	3.78	> 150
DF80-20 bio	12745-04	-0.00396	0.00072	0.442	96.9	373.81	1.16	3.91	> 150
DF80-20 bio	12745-05	0.10674	0.00313	0.705	99.1	481.18	1.17	4.95	> 150
DF80-20 bio	12745-06	-0.01116	0.00077	0.179	91.8	369.93	1.52	4.00	> 150
DF80-20 bio	12745-07	0.13353	0.00216	0.497	98.9	364.13	1.04	3.79	> 150
DF80-20 bio	12745-08	0.028	0.00303	3.33	98.6	484.77	1.13	4.98	> 150

DF80-20 bio	12745-10	0.01783	0.00506	0.249	97.2	365.50	1.33	3.89	> 150
DF80-20 bio	12745-11	0.00252	0.00246	0.778	98.1	367.67	0.83	3.77	> 150
DF80-20 bio	12745-12	0.11154	0.00552	0.096	81	370.11	1.95	4.18	> 150
DF80-20 bio	12745-13	0.18232	0.00191	0.425	79.2	335.96	1.15	3.55	> 150
DF80-20 bio	12745-14	0.01903	-0.0012	0.268	94.4	360.51	1.16	3.79	> 150
DF80-20 bio	12745-15	0.21791	0.0011	0.349	97.2	365.59	1.05	3.80	> 150
DF80-20 bio	12745-16	0.05227	0.00349	0.128	93.2	367.53	1.48	3.96	> 150
DF80-20 bio	12745-17	-0.00165	-0.00206	0.087	90.2	370.24	1.73	4.09	> 150
DF80-20 bio	12745-18	0.36028	0.01837	0.104	43.6	277.74	2.64	3.83	> 150
DF80-20 Bio	13193-01A	0.72396	0.01092	0.169	96.5	444.88	7.33	8.57	> 150
DF80-20 Bio	13193-02A	0.27769	0.00334	0.726	100.2	1144.21	13.20	17.47	> 150
DF80-20 Bio	13193-03A	0.07753	0.00055	4.713	99	412.01	6.16	7.41	> 150
DF80-20 Bio	13193-04A	0.10887	-0.00425	0.749	100.1	738.92	9.45	12.00	> 150
DF80-20 Bio	13193-05A	24.90623	0.51976	0.005	37.8	185.52	62.19	62.22	> 150
DF80-20 Bio	13193-06A	0.0401	-0.01163	0.489	99.8	1061.70	12.77	16.61	> 150
DF80-20 Bio	13193-07A	0.20474	0.00128	0.255	100.7	1058.20	12.42	16.31	> 150
DF80-20 Bio	13193-08A	0.68414	0.0176	0.148	99.7	361.98	5.72	6.77	> 150
DF80-20 Bio 63-150	13464-07	-0.04341	0.00273	0.104	100.5	363.21	3.12	4.79	63-150
DF80-20 Bio 63-150	13464-08	0.01315	-0.00203	0.086	99.2	368.80	3.33	4.97	63-150
DF80-20 Bio 63-150	13464-11	-0.05927	0.00642	0.075	97.7	370.39	4.58	5.89	63-150
DF80-20 Bio 63-150	13464-01	0.21493	0.00822	0.042	94	370.43	8.22	9.02	63-150
DF80-20 Bio 63-150	13464-05	-0.06679	0.00573	0.066	101.7	376.43	5.42	6.60	63-150
DF80-20 Bio 63-150	13464-03	-0.07409	0.00346	0.056	94.1	376.55	4.74	6.06	63-150
DF80-20 Bio 63-150	13464-09	-0.03871	0.00704	0.064	98.4	380.43	5.49	6.68	63-150

DF80-20 Bio 63-150	13464-10	0.04895	-0.00785	0.05	98.1	386.85	6.23	7.34	63-150
DF80-20 Bio 63-150	13464-02	0.15531	0.00044	0.027	85.5	429.77	11.07	11.87	63-150
DF80-20 Bio 63-150	13464-04	-0.06367	0.05084	0.009	80.3	472.63	29.75	30.12	63-150
DF80-20 Bio 63-150	13464-06	-0.05728	0.01483	0.083	96	493.56	5.04	7.06	63-150
DF80-34 bio	12747-04	0.01568	0.00148	0.997	79.1	105.20	0.41	1.13	> 150
DF80-34 bio	12747-11	0.04545	-0.00278	0.203	77.5	127.39	0.76	1.48	> 150
DF80-34 bio	12747-15	-0.00291	0.00203	0.313	89.7	303.00	1.10	3.22	> 150
DF80-34 bio	12747-08	0.02562	0.00191	0.969	98.2	376.73	0.87	3.87	> 150
DF80-34 bio	12747-16	0.00396	0.00197	0.148	95	446.65	1.75	4.80	> 150
DF80-34 bio	12747-10	0.03041	0.00033	1.156	99	473.08	0.94	4.82	> 150
DF80-34 bio	12747-07	0.03605	0.00105	0.942	98	483.97	0.98	4.94	> 150
DF80-34 bio	12747-05	0.01834	0.00149	0.847	98.1	488.76	1.03	4.99	> 150
DF80-34 bio	12747-17	-0.00309	0.00813	0.048	81	491.19	2.65	5.58	> 150
DF80-34 bio	12747-02	0.02864	0.00014	1.554	98.2	497.64	0.89	5.06	> 150
DF80-34 bio	12747-06	0.01838	0.00295	0.713	99.3	501.15	1.00	5.11	> 150
DF80-34 bio	12747-03	0.00892	0.01229	0.707	96.2	521.42	1.19	5.35	> 150
DF80-34 bio	12747-01	0.02569	0.00055	0.275	96.7	523.60	1.60	5.48	> 150
DF80-34 bio	12747-13	0.01228	0.00148	0.754	98.1	561.69	1.22	5.75	> 150
DF80-34 bio	12747-14	0.00873	0.00038	0.269	97.5	895.14	1.85	9.14	> 150
DF80-34 bio	12747-12	0.05921	0.00449	0.167	93.6	1126.86	3.01	11.66	> 150
DF80-34 Bio	13194-01A	0.55561	0.00798	0.078	94.2	516.23	9.63	10.93	> 150
DF80-34 Bio	13194-02A	-0.00284	0.00592	0.301	97.8	367.34	5.78	6.85	> 150
DF80-34 Bio	13194-03A	-0.09566	-0.02616	0.048	86.9	489.12	12.34	13.28	> 150
DF80-34 Bio	13194-04A	1.98383	0.03908	0.088	71.5	84.99	4.65	4.73	> 150

DF80-34 Bio	13194-06A	12.42474	-0.14798	0.02	66.5	345.38	19.82	20.11	> 150
DF80-34 Bio	13194-07A	4.28675	0.05706	0.046	92	477.01	10.51	11.54	> 150
DF80-34 Bio	13194-08A	0.8706	-0.02724	0.127	98.6	983.84	13.01	16.31	> 150
DF80-34 bio 63-150	13465-05	0.02056	0.00807	0.048	98.7	369.83	5.44	6.57	63-150
DF80-34 bio 63-150	13465-07	-0.02467	0.00439	0.058	96.8	389.56	5.39	6.65	63-150
DF80-34 bio 63-150	13465-06	-0.02448	-0.00952	0.06	88.8	394.96	5.88	7.08	63-150
DF80-34 bio 63-150	13465-01	-0.0043	0.01043	0.228	99.6	401.24	2.59	4.77	63-150
DF80-34 bio 63-150	13465-08	-0.66651	0.00339	0.011	105.8	428.89	23.51	23.90	63-150
DF80-34 bio 63-150	13465-04	-0.04155	0.00485	0.136	98.9	466.90	3.74	5.98	63-150
DF80-34 bio 63-150	13465-03	-0.16039	-0.02773	0.023	103.2	496.42	14.39	15.22	63-150
DF80-34 bio 63-150	13465-02	-0.13884	0.01224	0.027	98.8	510.72	11.97	13.01	63-150
DF80-34 bio 63-150	13465-11	0.03057	0.00711	0.055	90.3	527.16	7.52	9.18	63-150
DF80-34 bio 63-150	13465-10	-0.0305	0.01055	0.024	97.9	633.15	10.05	11.88	63-150
DF80-34 hb	12691-09	5.27409	0.01901	0.123	2.7	0.79	1.01	1.01	> 150
DF80-34 hb	12691-14	7.63484	0.01068	0.193	5.4	6.28	1.78	1.78	> 150
DF80-34 hb	12691-11	7.39049	-0.01169	0.014	5.6	8.75	7.71	7.71	> 150
DF80-34 hb	12691-13	5.75784	0.02763	0.088	45.3	8.89	1.25	1.26	> 150
DF80-34 hb	12691-07	8.57737	-0.00076	0.066	4.3	10.69	4.06	4.06	> 150
DF80-34 hb	12691-05	3.20515	0.00144	0.002	0.1	12.02	164.97	164.97	> 150
DF80-34 hb	12691-02	42.12188	-0.07207	0.014	32.8	57.63	7.32	7.34	> 150
DF80-34 hb	12691-06	22.24842	-0.12419	0.005	2.8	205.65	103.32	103.34	> 150

DF80-34 hb	12691-04	1.52704	0.02669	0.003	38.3	817.50	43.53	44.29	> 150
DF80-34 hb	12691-01	8.15435	0.02906	0.096	92.1	1141.44	5.63	12.73	> 150
DF80-34 hb	12691-08	8.89858	0.00134	0.128	96.2	1159.74	4.86	12.57	> 150
DF80-34 hb	12691-22	4.56073	0.01848	0.667	9.3	2.92	0.21	0.21	> 150
DF80-34 hb	12691-16	8.66996	0.00471	0.6	26.2	3.75	0.26	0.27	> 150
DF80-34 hb	12691-17	2.6199	0.01184	0.609	8.7	9.40	0.91	0.92	> 150
DF80-34 hb	12691-18	7.22599	0.00678	0.059	93.4	497.37	3.02	5.82	> 150
DF80-34 hb	12691-23	7.62276	0.0168	0.038	77.4	499.14	2.97	5.81	> 150
DF80-34 hb	12923-30	14.06459	0.00649	0.006	34.4	83.48	5.52	5.59	> 150
DF80-34 hb	12923-25	17.16385	0.02666	0.016	18.1	125.18	5.60	5.74	> 150
DF80-34 hb	12923-12	9.09137	0.01322	0.035	89.2	416.98	2.07	4.65	> 150
DF80-34 hb	12923-16	11.16042	0.02308	0.019	91.7	478.95	3.30	5.82	> 150
DF80-34 hb	12923-10	32.58829	0.02237	0.013	93	482.47	3.65	6.05	> 150
DF80-34 hb	12923-14	8.3821	0.03515	0.039	94	483.71	2.24	5.33	> 150
DF80-34 hb	12923-23	8.76369	-0.00213	0.022	92.7	489.74	2.85	5.67	> 150
DF80-34 hb	12923-07	70.02775	0.00342	0.019	501	491.64	3.99	6.33	> 150
DF80-34 hb	12923-28	25.76539	0.04864	0.013	81.9	492.43	4.37	6.58	> 150
DF80-34 hb	12923-26	17.08506	0.01008	0.092	91.2	502.77	1.77	5.33	> 150
DF80-34 hb	12923-27	9.58465	0.01833	0.045	92	528.24	2.42	5.81	> 150
DF80-34 hb	12923-24	13.99904	0.13357	0.001	13	628.91	43.84	44.29	> 150
DF80-34 hb	12923-20	6.75473	0.05353	0.002	16.6	914.75	39.94	40.98	> 150
DF80-34 hb	12923-13	8.70245	0.02108	0.075	97.1	1179.68	3.23	12.23	> 150
DF80-34 hb	13186-02A	15.18334	0.00073	0.045	100.8	1901.25	14.79	24.09	> 150
DF80-34 hb	13186-03A	9.09946	0.03828	0.171	92.5	501.30	7.55	9.06	> 150
DF80-34 hb	13186-04A	9.43369	-0.01149	0.214	99.4	541.80	6.35	8.35	> 150
DF80-34 hb	13186-06A	3.31287	0.07895	0.047	83.4	495.14	11.65	12.66	> 150
DF80-34 hb	13186-09A	18.02137	0.03191	0.02	101.8	447.92	13.82	14.53	> 150
DF80-34 hb	13186-10A	12.28013	0.03566	0.042	105.6	439.83	8.53	9.60	> 150

DF80-35 bio	12746-02	0.02073	0.00213	0.296	94	374.14	1.04	3.88	> 150
DF80-35 bio	12746-03	0.01921	0.00625	0.285	97.5	372.74	0.92	3.84	> 150
DF80-35 bio	12746-04	0.01787	0.00101	0.7	98.3	363.41	0.83	3.73	> 150
DF80-35 bio	12746-05	0.89522	0.00141	0.277	80.2	474.86	1.61	5.02	> 150
DF80-35 bio	12746-06	0.09196	-0.00061	0.203	91.2	374.94	1.23	3.95	> 150
DF80-35 bio	12746-07	0.03854	-0.00047	0.216	84.6	414.16	1.48	4.40	> 150
DF80-35 bio	12746-08	0.06551	-0.00057	0.087	88.3	352.13	1.58	3.86	> 150
DF80-35 bio	12746-09	0.0223	0.00622	0.356	83.6	355.18	1.20	3.75	> 150
DF80-35 bio	12746-10	0.04457	0.00725	0.087	87	362.41	1.97	4.13	> 150
DF80-35 bio	12746-11	0.14178	0.00382	0.268	94.1	356.48	1.16	3.75	> 150
DF80-35 bio	12746-12	0.01067	0.0043	0.132	81	375.11	1.71	4.12	> 150
DF80-35 bio	12746-13	0.00152	0.00657	0.072	89.1	380.48	1.99	4.29	> 150
DF80-35 bio 63-150	13468-09	-0.04147	-0.00941	0.059	98.8	310.44	5.48	6.30	63-150
DF80-35 bio 63-150	13468-10	0.00686	0.00039	0.037	90.7	348.52	7.89	8.62	63-150
DF80-35 bio 63-150	13468-01	-0.13959	-0.03687	0.028	101.1	361.24	8.79	9.50	63-150
DF80-35 bio 63-150	13468-03	0.03628	-0.03175	0.049	96.6	362.98	6.34	7.30	63-150
DF80-35 bio 63-150	13468-08	0.06789	-0.03439	0.008	94	371.12	31.67	31.88	63-150
DF80-35 bio 63-150	13468-02	-0.02335	0.02344	0.1	96	376.06	3.68	5.26	63-150
DF80-35 bio 63-150	13468-11	0.00995	0.00995	0.04	97.9	381.01	7.92	8.79	63-150
DF80-35 bio 63-150	13468-04	0.12259	-0.02227	0.039	88.7	385.70	7.88	8.78	63-150
DF80-35 bio 63-150	13468-07	-0.05939	-0.01053	0.023	87.3	394.80	12.08	12.71	63-150

DF80-35 bio 63-150	13468-05	-0.05792	-0.01416	0.025	91.4	407.21	12.02	12.69	63-150
DF80-35 bio 63-150	13468-06	-0.06813	0.02582	0.036	84.2	647.68	6.95	9.50	63-150
DF80-35 hb	12690-02	3.02673	0.01617	0.109	0.4	3.03	11.28	11.28	> 150
DF80-35 hb	12690-03	9.57969	0.00182	0.083	20.1	5.71	1.45	1.45	> 150
DF80-35 hb	12690-05	4.42151	0.0158	0.319	15.3	16.08	1.45	1.46	> 150
DF80-35 hb	12690-01	48.81312	0.02183	0.2	26.3	23.15	1.22	1.24	> 150
DF80-35 hb	12690-07	3.30523	0.00801	6.417	42.9	9.63	0.08	0.13	> 150
DF80-35 hb	12690-09	5.59235	0.01844	0.579	1.3	0.77	0.35	0.35	> 150
DF80-35 hb	12690-16	7.49857	0.0241	0.108	4.3	2.69	0.76	0.76	> 150
DF80-35 hb	12690-15	10.10302	0.00588	0.445	12.6	4.10	0.25	0.25	> 150
DF80-35 hb	12690-14	3.06318	0.02173	0.92	1.5	6.78	2.03	2.03	> 150
DF80-35 hb	12690-08	3.33203	0.00529	0.097	9.4	11.44	1.03	1.04	> 150
DF80-35 hb	12690-19	1.57053	0.01704	0.709	85.1	98.78	0.39	1.06	> 150
DF80-35 hb	12922-06	7.46521	0.00815	0.07	12.1	6.80	0.69	0.69	> 150
DF80-35 hb	12922-07	7.44774	0.01847	0.016	18.2	8.37	1.97	1.97	> 150
DF80-35 hb	12922-12	10.81235	-0.00027	0.02	13.7	10.13	1.82	1.82	> 150
DF80-35 hb	12922-18	10.0335	0.01517	0.158	47.6	10.38	0.25	0.27	> 150
DF80-35 hb	12922-14	1.44238	0.00571	0.003	18.7	83.57	12.21	12.23	> 150
DF80-35 hb	12922-10	3.08324	0.00691	0.083	68.1	330.55	2.18	3.96	> 150
DF80-35 hb	12922-08	6.07094	0.19473	0.002	29.8	333.58	18.30	18.60	> 150
DF80-35 hb	12922-15	6.82018	0.03076	0.028	95.7	476.50	2.40	5.34	> 150
DF80-35 hb	12922-17	16.69373	0.03804	0.013	35.1	477.86	8.90	10.10	> 150
DF80-35 hb	12922-09	6.86422	0.03355	0.027	78.6	485.42	3.09	5.75	> 150
ELT37-09 A bio	13577-05	0.62766	0.00038	0.371	76	111.29	0.78	1.36	> 150

ELT37-09 A bio	13577-01	0.01798	0.00209	2.435	99.5	459.80	1.53	4.84	> 150
ELT37-09 A bio	13577-11	0.01207	0.00149	2.293	99.7	487.55	1.53	5.11	> 150
ELT37-09 A bio	13577-15	0.003	0.00755	0.644	99.6	489.99	1.82	5.23	> 150
ELT37-09 A bio	13577-10	0.00985	0.00244	0.603	99.1	490.03	1.58	5.15	> 150
ELT37-09 A bio	13577-02	0.00079	0.01853	1.005	99.5	495.06	0.65	4.99	> 150
ELT37-09 A bio	13577-04	0.11152	0.0008	0.706	99.9	499.77	0.80	5.06	> 150
ELT37-09 A bio	13577-12	0.00194	0.00514	0.472	98	1479.01	2.06	14.93	> 150
ELT37-09 A bio	13577-06	0.0352	-0.0059	0.379	72.1	1493.07	6.86	16.43	> 150
ELT37-09 A bio	13577-07	0.13469	-0.00064	0.732	99.3	1559.09	2.21	15.75	> 150
ELT37-09 A bio	13577-14	0.01444	0.00664	0.762	99.8	1590.40	5.24	16.75	> 150
ELT37-09 A bio	13577-09	0.0173	0.00401	0.87	99.7	1647.52	4.93	17.20	> 150
ELT37-09 A bio	13577-13	-0.00237	0.00173	1.831	99.9	1670.83	5.65	17.64	> 150
ELT37-09 A bio	13577-03	0.00553	0.00239	4.186	100	1698.71	7.59	18.61	> 150
ELT37-09 B bio	13578-06	0.0064	0.00058	3.085	99	481.45	1.66	5.09	> 150
ELT37-09 B bio	13578-03	0.00039	0.00309	2.538	99.5	491.55	1.64	5.18	> 150
ELT37-09 B bio	13578-08	-0.0051	-0.00135	0.415	99.8	493.08	1.86	5.27	> 150
ELT37-09 B bio	13578-15	0.14303	0.00297	3.384	99.7	493.11	1.94	5.30	> 150
ELT37-09 B bio	13578-09	-0.00514	0.00264	1.597	99.8	496.37	1.39	5.15	> 150
ELT37-09 B bio	13578-07	-0.0101	0.00352	0.445	99.7	500.73	1.03	5.11	> 150
ELT37-09 B bio	13578-12	-0.00043	0.00547	1.905	99.5	512.22	1.37	5.30	> 150
ELT37-09 B bio	13578-14	0.06627	0.00054	7.264	99.9	1628.08	10.78	19.52	> 150
ELT37-09 B bio	13578-11	-0.00036	0.00119	3.257	99.9	1668.48	7.26	18.19	> 150
ELT37-09 B bio	13578-02	0.1212	0.00376	6.915	99.8	1679.27	8.75	18.94	> 150
ELT37-09 B bio	13578-04	-0.00068	0.00185	2.315	99.8	1707.45	6.58	18.30	> 150
ELT37-09 B bio	13578-01	0.00004	0.00093	6.957	99.7	1734.03	9.02	19.55	> 150
ELT37-09 B bio	13578-10	0.0796	0.00227	3.799	99.8	1744.95	7.83	19.12	> 150
ELT37-09 B bio	13578-05	0.00028	-0.00272	0.212	99.9	1767.14	7.80	19.31	> 150

ELT37-09 bio	12742-01	0.61397	0.00556	1.581	23.3	53.63	1.46	1.55	> 150
ELT37-09 bio	12742-06	0.03209	0.00359	0.895	87.6	97.64	0.49	1.09	> 150
ELT37-09 bio	12742-13	0.0125	-0.00327	0.207	88.3	438.55	1.91	4.78	> 150
ELT37-09 bio	12742-09	0.00815	0.0092	0.137	82	457.01	2.43	5.17	> 150
ELT37-09 bio	12742-07	0.0737	0.00354	0.994	80.2	463.15	1.72	4.94	> 150
ELT37-09 bio	12742-12	0.00863	-0.00059	0.486	95.8	466.83	1.35	4.86	> 150
ELT37-09 bio	12742-04	0.0122	0.0135	0.782	98	492.55	1.23	5.08	> 150
ELT37-09 bio	12742-02	0.00138	0.01062	3.721	99.1	493.67	1.19	5.08	> 150
ELT37-09 bio	12742-08	0.11794	0.00094	4.695	98	494.76	1.18	5.09	> 150
ELT37-09 bio	12742-05	0.05914	0.00476	0.622	93.4	1393.71	3.13	14.28	> 150
ELT37-09 bio	12742-03	0.01303	0.00282	6.055	99.1	1554.62	3.71	15.98	> 150
ELT37-09 bio	12742-10	0.0505	0.00172	0.666	98.9	1575.93	2.93	16.03	> 150
ELT37-09 bio	12742-11	0.01059	0.00368	0.535	98.5	1604.52	3.31	16.38	> 150
ELT37-09 bio	12862-01	0.00371	0.002	1.24	98.3	1630.59	4.27	16.86	> 150
ELT37-09 bio	12862-02	0.00956	0.00411	0.877	96.9	1562.81	4.49	16.26	> 150
ELT37-09 bio	12862-03	0.01627	0.00436	1.909	94.5	459.54	1.96	5.00	> 150
ELT37-09 bio	12862-04	0.00423	0.00543	14.288	99	517.58	2.12	5.59	> 150
ELT37-09 bio	12862-05	0.00669	0.00375	2.765	95.3	481.12	1.74	5.12	> 150
ELT37-09 bio	12862-06	0.0423	0.01204	4.945	98.1	493.42	1.81	5.26	> 150
ELT37-09 bio	12862-07	0.00548	0.00356	0.864	90.7	489.41	2.38	5.44	> 150
ELT37-09 bio	12862-08	0.02137	0.00232	1.136	93.8	474.51	1.90	5.11	> 150
ELT37-09 bio	12862-09	0.00606	0.01182	4.794	99.7	1706.73	5.66	17.98	> 150
ELT37-09 bio	12862-10	0.00724	0.00217	2.135	96.4	485.08	1.65	5.12	> 150
ELT37-09 bio	12862-11	0.00883	0.00478	0.309	98.9	495.55	1.83	5.28	> 150
ELT37-09 bio	12862-12	0.003	0.00398	1.178	99.3	493.63	1.67	5.21	> 150
ELT37-09 bio	12862-13	0.1604	0.00136	5.647	99.1	399.55	1.33	4.21	> 150
ELT37-09 bio	12862-14	0.01683	0.01965	0.186	94.1	526.54	2.31	5.75	> 150

ELT37-09 bio	12862-15	0.01916	0.01067	1.789	97.8	328.27	1.18	3.49	> 150
ELT37-09 bio	12862-16	0.00123	0.0088	3.544	93.9	523.64	2.01	5.61	> 150
ELT37-09 bio	12862-17	0.00253	0.01242	0.837	96.1	504.53	1.99	5.42	> 150
ELT37-09 bio	12862-18	0.17598	0.00533	1.499	98.9	1666.70	4.91	17.38	> 150
ELT37-09 bio	12862-19	-0.0037	0.01227	0.326	95.4	512.56	1.90	5.47	> 150
ELT37-09 bio	12862-23	0.01161	0.00202	3.669	94.3	102.08	0.44	1.11	> 150
ELT37-09 bio	13192-01A	0.35185	0.01495	0.409	101.6	510.09	6.65	8.38	> 150
ELT37-09 bio	13192-02A	0.05144	0.00283	1.434	100.4	503.95	6.76	8.43	> 150
ELT37-09 bio	13192-03A	0.11267	0.00565	1.353	100.7	480.57	6.41	8.01	> 150
ELT37-09 bio	13192-04A	0.12603	-0.02221	0.266	103.2	479.72	6.08	7.75	> 150
ELT37-09 bio	13192-05A	-0.17184	-0.01029	0.174	104	526.71	6.52	8.38	> 150
ELT37-09 bio	13192-07A	1.01977	0.02026	0.116	100.2	512.89	7.62	9.19	> 150
ELT37-09 bio	13192-08A	0.3162	-0.01373	0.27	100.5	527.97	7.23	8.96	> 150
ELT37-09 bio	13192-10A	0.09734	0.0068	0.219	97.3	427.28	6.72	7.96	> 150
ELT37-09 bio	13192-11A	0.11974	-0.00204	1.068	99.8	493.31	6.82	8.42	> 150
ELT37-09 bio	13192-12A	1.03728	-0.01794	0.117	99.7	1204.77	14.99	19.23	> 150
ELT37-09 bio	13192-13A	0.09573	0.01496	0.979	100.5	531.87	7.10	8.87	> 150
ELT37-09 bio	13192-15A	6.09615	-0.0727	0.032	97.8	503.22	11.93	12.95	> 150
ELT37-09 bio	13192-16A	18.01166	0.13756	0.02	101.5	1595.01	19.60	25.27	> 150
ELT37-09 bio	13192-17A	0.04384	0.01561	0.428	101.4	505.16	6.65	8.35	> 150
ELT37-09 bio	13192-18A	0.02743	0.0268	0.648	100.5	497.00	6.72	8.36	> 150
ELT37-09 bio	13192-19A	1.0176	0.00253	0.136	93.9	229.49	4.92	5.43	> 150
ELT37-09 bio 63-150	13460-04	-0.01645	0.00799	0.064	95.9	475.27	6.15	7.77	63-150
ELT37-09 bio 63-150	13460-02	-0.02178	-0.07665	0.018	94.9	481.87	15.50	16.23	63-150
ELT37-09 bio 63-150	13460-01	0.03363	0.01959	0.057	94.8	501.05	7.29	8.84	63-150
ELT37-09 bio	13460-03	-0.07072	-0.01991	0.077	100.4	1113.04	8.47	13.99	63-150

63-150									
ELT37-09 bio 63-150	13460-11	-0.09499	0.12157	0.011	100.7	1527.53	25.07	29.36	63-150
ELT37-09 bio 63-150	13460-08	-0.08241	0.02505	0.057	99.7	1560.71	12.98	20.30	63-150
ELT37-09 bio 63-150	13460-06	-0.11719	-0.01054	0.049	99.7	1567.05	16.00	22.40	63-150
ELT37-09 bio 63-150	13460-10	-0.05406	0.00487	0.108	100.1	1568.10	12.59	20.11	63-150
ELT37-09 bio 63-150	13460-09	-0.09124	-0.01119	0.044	98.9	1644.10	18.00	24.38	63-150
ELT37-09 bio 63-150	13460-07	-0.19651	-0.05173	0.025	97.8	1733.04	22.16	28.14	63-150
ELT37-09 hb	12674-03	7.33485	0.01013	0.605	99.9	1715.69	6.60	18.38	>150
ELT37-09 hb	12674-04	5.77156	0.00455	0.267	94.4	1429.27	6.09	15.53	>150
ELT37-09 hb	12674-05	2.23335	0.00177	0.273	97.1	1287.67	4.85	13.76	>150
ELT37-09 hb	12674-07	8.83598	0.01678	0.213	99.4	1609.36	5.57	17.03	>150
ELT37-09 hb	12674-09	17.96544	0.05361	0.048	100	1660.62	8.27	18.55	>150
ELT37-09 hb	12674-10	32.73616	0.05953	0.082	98.5	1874.23	6.07	19.70	>150
ELT37-09 hb	12674-12	9.25045	0.0063	0.273	99.5	1547.56	5.26	16.34	>150
ELT37-09 hb	12674-15	11.3095	0.01995	0.338	72.2	98.82	1.22	1.57	>150
ELT37-09 hb	12978-16	6.99763	0.0674	0.103	52.5	4.25	0.35	0.36	> 150
ELT37-09 hb	12978-04	9.25228	0.01717	0.078	36.7	127.65	2.25	2.59	> 150
ELT37-09 hb	12978-12	15.08758	0.01268	0.034	50.4	132.07	1.91	2.32	> 150
ELT37-09 hb	12978-08	22.81568	0.19692	0.027	30.7	301.62	6.49	7.16	> 150
ELT37-09 hb	12978-15	12.27431	0.0313	0.034	61.9	894.37	6.21	10.89	> 150
ELT37-09 hb	12978-01	10.72956	0.02691	0.029	98.1	1448.51	5.14	15.37	> 150
ELT37-09 hb	12978-22	10.98124	0.00939	0.052	95	1495.99	4.45	15.61	> 150
ELT37-09 hb	12978-11	16.19903	-0.00731	0.029	92.3	1583.04	6.36	17.06	> 150
ELT37-09 hb	12978-17	28.99154	0.01266	0.161	98.7	1681.20	3.33	17.14	> 150

ELT37-09 hb	12978-10	7.51069	0.09332	0.049	94.7	1690.03	4.55	17.50	> 150
ELT37-09 hb	12978-18	51.14565	-0.00654	0.026	98.2	1748.56	7.80	19.15	> 150
ELT37-09 hb	12978-23	12.41936	0.04783	0.027	92.5	1755.44	7.68	19.16	> 150
ELT37-09 hb	12978-19	6.3361	0.02429	0.067	98.1	1768.87	4.49	18.25	> 150
ELT37-09 hb	12978-07	9.20599	0.03506	0.16	98.8	1785.31	3.58	18.21	> 150
ELT37-09 hb	12978-03	43.39233	0.04073	0.036	95.1	1841.73	6.55	19.55	> 150
ELT37-09 hb	12978-06	4.32943	0.2495	0.002	62.7	4063.12	50.82	65.06	> 150
ELT37-09 hb	13184-01A	12.85272	0.03557	0.387	95.1	115.51	1.86	2.19	> 150
ELT37-09 hb	13184-02A	5.23818	0.04189	0.28	97.3	539.00	6.54	8.47	> 150
ELT37-09 hb	13184-03A	11.00415	0.09016	0.091	73.9	128.60	5.08	5.24	> 150
ELT37-09 hb	13184-04A	13.30093	0.04127	0.207	98.4	1659.30	14.15	21.81	> 150
ELT37-09 hb	13184-06A	5.5894	0.26071	0.027	78.1	1531.21	28.58	32.42	> 150
ELT37-09 hb	13184-08A	12.87927	0.03868	0.209	99.5	1693.48	13.68	21.77	> 150
ELT37-09 hb	13184-09A	11.61379	0.06003	0.099	98.1	1789.98	15.27	23.53	> 150
ELT37-09 hb	13184-10A	1.03142	-0.10265	0.023	92.6	1651.45	22.86	28.20	> 150
ELT37-09 hb	13184-11A	7.22988	0.00636	0.108	98.3	1707.68	15.37	22.97	> 150
ELT37-09 hb	13184-12A	7.61725	-0.01503	0.075	97.8	1785.69	17.32	24.88	> 150
ELT37-09 hb	13184-13A	9.85743	-0.15889	0.025	100.6	1778.57	15.96	23.90	> 150
ELT37-09 hb	13184-14A	7.00821	-0.08373	0.045	99.7	1794.48	18.16	25.53	> 150
ELT37-09 hb	13184-15A	9.03718	0.13751	0.035	99.4	1676.81	15.29	22.69	> 150
ELT37-09 hb	13184-17A	13.79903	-0.06219	0.031	96.8	1687.60	16.94	23.91	> 150
ELT37-09 hb	13184-18A	6.78487	0.12474	0.038	101	1783.25	17.78	25.18	> 150
ELT37-09 hb	13184-19A	8.57142	0.05666	0.101	99.2	1894.38	16.37	25.04	> 150
ELT37-09 hb	13184-20A	8.29247	0.00917	0.051	96.3	1592.35	17.73	23.83	> 150
ELT37-09 hb	13184-21A	6.35906	0.01968	0.173	97.9	493.27	6.20	7.92	> 150
ELT37-09 hb	13184-22A	19.66375	-0.01066	0.045	98.6	1712.31	18.17	24.97	> 150
ELT37-09 hb	13184-23A	3.32213	-0.0331	0.044	97.1	1761.06	16.47	24.11	> 150
ELT37-09 hb	13184-25A	7.77236	0.27625	0.028	97.4	1595.23	16.68	23.08	> 150

ELT37-13 bio	12743-01	0.03879	0.0005	3.204	99.8	1118.64	2.08	11.38	> 150
ELT37-13 bio	12743-02	0.01056	0.00281	0.644	99.7	1123.23	2.42	11.49	> 150
ELT37-13 bio	12743-03	0.01104	0.00099	0.976	99.7	1493.72	2.99	15.23	> 150
ELT37-13 bio	12743-04	0.01585	0.00115	0.876	98.6	1076.41	2.70	11.10	> 150
ELT37-13 bio	12743-05	0.0076	0.0004	1.184	99.3	1115.44	2.63	11.46	> 150
ELT37-13 bio	12743-06	-0.0111	0.00194	0.266	99.2	1126.72	2.67	11.58	> 150
ELT37-13 bio	12743-07	0.00756	0.00082	1.164	99.6	1128.97	2.36	11.53	> 150
ELT37-13 bio	12743-08	0.01184	-0.00005	5.553	99.7	1115.94	2.66	11.47	> 150
ELT37-13 bio	12743-09	0.05785	-0.00021	5.629	99.5	1139.43	2.47	11.66	> 150
ELT37-13 bio	12743-10	0.01957	0.00095	0.491	98.5	1119.73	2.53	11.48	> 150
ELT37-13 bio	12743-11	0.02869	-0.00175	0.187	98.9	1157.96	2.85	11.92	> 150
ELT37-13 bio	12743-12	0.0056	0.00003	1.709	99.8	1128.95	2.29	11.52	> 150
ELT37-13 bio	12743-13	0.03264	0.00366	0.217	89	1112.16	3.59	11.69	> 150
ELT37-13 bio	12743-14	0.01	0.00094	0.901	99.4	1121.64	2.33	11.46	> 150
ELT37-13 bio	12743-15	0.00394	0.00132	0.871	99.2	1121.45	2.83	11.56	> 150
ELT37-13 bio	12743-16	3.63879	-0.00011	0.432	97.5	1097.12	2.73	11.31	> 150
ELT37-13 bio	12743-17	0.02214	0.00103	0.38	99.2	1514.11	3.26	15.49	> 150
ELT37-13 bio 63-150	13470-07	0.0205	-0.01823	0.099	96.1	861.02	5.76	10.36	63-150
ELT37-13 bio 63-150	13470-09	0.00727	-0.01929	0.055	100.3	1087.61	6.29	12.56	63-150
ELT37-13 bio 63-150	13470-12	-0.0658	-0.00607	0.106	99.4	1091.56	4.12	11.67	63-150
ELT37-13 bio 63-150	13470-03	-0.02421	0.00296	0.155	99.9	1100.04	3.22	11.46	63-150
ELT37-13 bio 63-150	13470-06	-0.05397	-0.013	0.039	97.9	1101.33	15.07	18.67	63-150
ELT37-13 bio	13470-10	-0.06375	0.00089	0.065	100	1104.58	9.78	14.75	63-150

63-150									
ELT37-13 bio 63-150	13470-01	-0.04538	-0.00798	0.068	97.9	1105.80	9.35	14.48	63-150
ELT37-13 bio 63-150	13470-02	-0.12526	-0.01857	0.052	100.1	1108.61	12.35	16.60	63-150
ELT37-13 bio 63-150	13470-08	-0.03341	0.00898	0.121	99.7	1111.74	7.67	13.51	63-150
ELT37-13 bio 63-150	13470-04	-0.0772	0.00113	0.09	100	1119.46	7.68	13.57	63-150
ELT37-13 bio 63-150	13470-05	-0.09897	0.01371	0.066	99.9	1121.06	8.88	14.30	63-150
ELT37-13 bio 63-150	13470-11	0.00695	-0.01869	0.056	100.3	1132.90	9.70	14.92	63-150
ELT37-13 hb	12979-05	9.76933	0.00931	0.187	99.5	1121.27	2.77	11.55	> 150
ELT37-13 hb	12979-04	12.97786	0.00414	0.176	99.3	1128.57	2.60	11.58	> 150
ELT37-13 hb	12979-02	5.41983	0.00322	3.264	99.8	1139.19	2.86	11.74	> 150
ELT37-13 hb	12979-06	13.56411	-0.00181	0.1	99.1	1179.44	3.00	12.17	> 150
ELT37-13 hb	12979-01	9.73409	0.01426	0.777	96.9	1257.95	2.72	12.87	> 150
ELT37-13 hb	12679-01	12.89935	0.00386	0.266	99	1114.88	3.03	11.55	> 150
ELT37-13 hb	12679-03	7.88209	0.00944	0.302	98.4	1205.27	2.99	12.42	> 150
ELT37-13 hb	12679-05	6.22964	0.00819	0.273	99.7	1128.56	2.97	11.67	> 150
ELT37-13 hb	12679-06	13.99852	0.00232	0.252	99.3	1447.51	3.65	14.93	> 150
ELT37-13 hb	12679-07	9.51268	0.00768	0.089	99.4	1363.31	4.46	14.34	> 150
ELT37-13 hb	12679-08	57.05087	0.12589	0.004	79.7	2055.67	39.84	44.83	> 150
ELT37-13 hb	12679-09	24.51428	-0.00126	0.246	92.9	1225.68	3.92	12.87	> 150
ELT37-13 hb	12679-11	8.36614	0.00112	0.757	99.7	1125.53	2.54	11.54	> 150
ELT37-13 hb	12679-12	5.23601	0.01991	0.005	75.1	1293.45	41.29	43.27	> 150
ELT37-13 hb	12679-13	11.34937	-0.01701	0.049	97.3	1216.49	6.48	13.79	> 150
ELT37-13 hb	12679-14	6.35363	0.00332	0.134	99.7	1127.20	3.56	11.82	> 150
ELT37-13 hb	12679-15	28.40905	-0.01991	0.04	97.7	1386.57	7.14	15.59	> 150

ELT37-13 hb	12679-18	1.86986	0.01586	0.078	95.6	538.86	2.51	5.94	> 150
ELT37-13 hb	12679-22	2.3292	-0.01879	0.01	94.3	1089.91	15.96	19.32	> 150
ELT37-13 hb	12679-23	12.24865	-0.00425	0.099	93.7	1110.61	3.99	11.80	> 150
ELT37-13 hb	12679-19	9.72061	-0.00327	0.174	97.5	1117.64	2.99	11.57	> 150
ELT37-13 hb	12679-16	6.94007	0.00339	0.167	98.7	1120.72	3.09	11.63	> 150
ELT37-13 hb	12679-28	10.79683	0.02475	0.064	97.3	1123.22	4.35	12.05	> 150
ELT37-13 hb	12679-25	6.46002	0.01184	0.043	98.1	1131.44	5.89	12.76	> 150
ELT37-13 hb	12679-20	11.49504	0.02549	0.067	97.8	1132.86	4.70	12.26	> 150
ELT37-13 hb	12679-29	9.39301	0.00329	0.318	97	1136.59	2.70	11.68	> 150
ELT37-13 hb	12679-17	8.8582	0.00523	0.506	98.7	1137.47	2.43	11.63	> 150
ELT37-13 hb	12679-30	10.79568	0.00104	0.125	97	1138.27	3.41	11.88	> 150
ELT37-13 hb	12679-27	18.06721	0.01886	0.043	96.5	1162.46	5.44	12.83	> 150
ELT37-13 hb	12679-24	7.20951	-0.00042	0.127	95.7	1181.73	3.51	12.33	> 150
ELT37-13 hb	12679-26	41.25096	0.00777	0.054	98.9	2013.32	7.51	21.49	> 150
ELT37-13 hb	12979-24	14.50738	0.00258	0.135	96.9	1080.87	2.99	11.22	> 150
ELT37-13 hb	12979-33	15.07214	0.00427	0.258	97.6	1101.66	2.84	11.38	> 150
ELT37-13 hb	12979-28	18.77428	0.00296	0.03	96.2	1110.77	4.38	11.94	> 150
ELT37-13 hb	12979-34	7.61102	0.00986	0.254	85.7	1162.06	3.76	12.21	> 150
ELT37-13 hb	12979-29	7.81791	0.00548	0.46	98.8	1172.56	2.46	11.98	> 150
ELT37-13 hb	12979-25	8.02304	-0.00925	0.031	98.5	1175.81	4.78	12.69	> 150
ELT37-13 hb	12979-32	38.23289	-0.03684	0.009	77.4	1193.63	11.79	16.78	> 150
ELT37-13 hb	12979-26	8.97237	0.00801	0.045	96.3	1198.64	4.66	12.86	> 150
ELT37-13 hb	12979-35	10.06447	0.00949	0.081	92.1	1199.20	3.51	12.49	> 150
ELT37-13 hb	12979-30	17.86613	0.00615	0.095	97.4	1215.28	3.61	12.68	> 150
ELT37-13 hb	12979-27	19.34789	0.00775	0.068	80.3	1255.46	5.20	13.59	> 150
ELT37-13 hb	12979-37	14.54053	0.00046	0.025	85.8	1257.53	5.72	13.82	> 150
ELT37-13 hb	12979-31	37.91826	0.01815	0.027	96.8	1283.92	6.26	14.28	> 150
ELT37-13 hb	12979-23	13.88472	0.01894	0.047	59.3	1288.17	8.96	15.69	> 150

ELT37-13 hb	12979-36	36.54656	0.02633	0.019	46.1	1684.36	16.45	23.54	> 150
ELT37-13 hb	12979-22	9.45756	0.02063	0.907	97.8	1815.36	3.55	18.50	> 150
ELT37-16 bio	12744-01	0.78351	-0.00007	2.901	99.1	1109.10	2.64	11.40	> 150
ELT37-16 bio	12744-02	0.19596	-0.00013	6.294	99.6	1115.09	3.09	11.57	> 150
ELT37-16 bio	12744-03	0.00718	-0.00133	0.26	99.6	1137.77	2.37	11.62	> 150
ELT37-16 bio	12744-04	0.00837	0.00057	2.255	99.8	1126.58	2.11	11.46	> 150
ELT37-16 bio	12744-05	0.03913	0.00384	1.088	99.1	1117.68	2.60	11.48	> 150
ELT37-16 bio	12744-06	0.06316	-0.00005	0.135	97.2	1126.77	3.56	11.82	> 150
ELT37-16 bio	12744-07	0.04303	0.00514	0.512	98.6	1120.47	3.26	11.67	> 150
ELT37-16 bio	12744-08	0.02158	0.00176	0.881	74.5	829.41	3.28	8.92	> 150
ELT37-16 bio	12744-09	0.02949	0.00103	3.131	99.7	1146.70	2.34	11.70	> 150
ELT37-16 bio	12744-10	0.03649	-0.00087	0.171	96.4	1119.21	3.16	11.63	> 150
ELT37-16 bio	12744-11	0.03032	0.00238	2.05	99.7	1146.40	2.35	11.70	> 150
ELT37-16 bio	12744-12	0.00762	0.00004	2.161	99.8	1141.36	2.28	11.64	> 150
ELT37-16 bio	12744-13	0.01553	0.00143	0.326	99.4	1224.60	3.27	12.68	> 150
ELT37-16 bio	12744-14	0.22075	0.00208	0.479	99.6	2156.93	3.82	21.90	> 150
ELT37-16 bio	12744-15	0.0366	0.00523	0.222	99.2	1144.79	2.68	11.76	> 150
ELT37-16 bio	12744-16	-0.013	0.00709	0.119	99.2	1106.67	3.32	11.55	> 150
ELT37-16 bio	12928-01	0.00991	0.00446	0.697	99	1094.77	1.88	11.11	> 150
ELT37-16 bio	12928-02	0.03699	0.00176	8.122	99.6	1144.80	3.42	11.95	> 150
ELT37-16 bio	12928-03	0.02334	0.00161	8.255	99.5	1167.45	3.57	12.21	> 150
ELT37-16 bio	12928-04	0.02066	0.00227	2.293	97.8	1107.49	2.56	11.37	> 150
ELT37-16 bio	12928-05	0.0019	0.00095	2.939	99.4	1123.87	2.85	11.59	> 150
ELT37-16 bio	12928-06	0.00294	0.00074	5.467	99.6	1102.29	4.02	11.73	> 150
ELT37-16 bio	12928-07	0.29245	0.00274	3.525	99.7	1490.83	3.68	15.35	> 150
ELT37-16 bio	12928-08	0.03367	0.00206	3.402	99.2	1141.51	2.93	11.79	> 150

ELT37-16 bio	12928-09	-0.1358	0.05578	0.004	57	1265.44	37.17	39.27	> 150
ELT37-16 bio	12928-10	0.01568	0.00235	2.992	98.9	1113.06	2.51	11.41	> 150
ELT37-16 bio	12928-11	0.01372	0.00064	0.05	47	1111.21	8.36	13.91	> 150
ELT37-16 bio	12928-12	48.9179	0.02073	0.083	89.3	1230.36	3.71	12.85	> 150
ELT37-16 bio	12928-13	0.00183	0.00193	11.52	99.8	1150.86	3.21	11.95	> 150
ELT37-16 bio	12928-14	0.18883	0.00087	10.913	99.8	1155.97	3.55	12.09	> 150
ELT37-16 bio	12928-27A	0.006463581	0.001779316	2.439310044	99.66797671	1115.91	11.41	15.96	> 150
ELT37-16 bio	12928-23A	0.013290906	0.004138215	1.219442274	99.47380107	1110.56	11.55	16.02	> 150
ELT37-16 bio	12928-24A	0.038886667	0.006524505	0.763936937	98.81441441	1161.58	12.11	16.78	> 150
ELT37-16 bio	12928-21A	0.062502313	0.003452412	4.08697505	95.32834342	1117.22	11.66	16.15	> 150
ELT37-16 bio	12928-22A	0.034473492	0.003327413	2.14866256	97.36341725	1304.94	13.34	18.66	> 150
ELT37-16 bio	12928-15A	0.429600842	0.00647603	0.155768421	66.52240602	1104.13	11.27	15.78	> 150
ELT37-16 bio	12928-16A	-0.00574721	0.001512196	0.45640683	97.85219072	1131.00	11.58	16.19	> 150
ELT37-16 bio	12928-29A	-0.026489965	-0.005505709	0.215329787	93.96489362	1261.66	12.88	18.03	> 150
ELT37-16 bio	12928-25A	-0.059429424	-0.013223609	0.265691729	85.52506266	1144.29	11.72	16.38	> 150
ELT37-16 bio	12928-18A	-0.38844719	0.236390886	0.784	201.3589873	1119.88	11.50	16.05	> 150
ELT37-16 bio	12928-31A	-0.591885172	0.11312092	0.01062069	48.86034483	987.44	10.15	14.16	> 150
ELT37-16 bio	12928-19A	0.177381518	0.105092768	0.1255625	61.459375	1097.45	11.22	15.70	> 150
ELT37-16 bio	12928-17A	0.001332859	0.003809676	1.022704225	99.23488722	1130.20	11.50	16.12	> 150
ELT37-16 bio	12928-28A	0.164655926	0.005271279	0.136828283	98.1952862	1106.18	11.38	15.87	> 150
ELT37-16 bio	12928-26A	3.376678516	0.016813355	0.054303226	97.55483871	1074.88	11.23	15.55	> 150
ELT37-16 bio	12928-20A	20.88569433	0.008987784	0.129536082	98.92938144	1208.59	12.69	17.52	> 150
ELT37-16 bio 63-150	13459-05	0.10938	-0.09873	0.015	96	387.36	16.74	17.18	63-150
ELT37-16 bio 63-150	13459-06	-0.2063	-0.04991	0.018	93.9	938.30	18.76	20.97	63-150
ELT37-16 bio 63-150	13459-04	-0.10684	-0.01023	0.032	99	1039.19	14.60	17.92	63-150
ELT37-16 bio	13459-09	-0.13782	0.00673	0.073	100.1	1098.66	10.63	15.29	63-150

63-150									
ELT37-16 bio 63-150	13459-01	-0.05007	-0.00496	0.057	100.3	1100.75	9.89	14.80	63-150
ELT37-16 bio 63-150	13459-03	-0.0369	-0.00419	0.136	100.2	1108.44	6.87	13.04	63-150
ELT37-16 bio 63-150	13459-02	0.00003	0.00588	0.136	100.3	1115.24	8.04	13.75	63-150
ELT37-16 bio 63-150	13459-10	0.18306	-0.00591	0.136	100.1	1123.05	7.53	13.52	63-150
ELT37-16 bio 63-150	13459-08	-0.08053	0.00029	0.115	99.9	1125.66	8.14	13.89	63-150
ELT37-16 bio 63-150	13459-11	-0.11938	-0.01516	0.072	100.2	1159.67	9.52	15.00	63-150
ELT37-16 bio 63-150	13459-07	-0.20122	-0.02043	0.046	100.6	1260.86	13.46	18.45	63-150
ELT37-16 hb	12680-01	3.17171	0.00165	1.28	99.7	1250.07	2.78	12.81	> 150
ELT37-16 hb	12680-02	11.44255	0.00421	0.411	99.4	1632.84	3.75	16.75	> 150
ELT37-16 hb	12680-03	7.54908	0.00233	0.166	98.8	1302.18	3.56	13.50	> 150
ELT37-16 hb	12680-04	21.44905	-0.0202	0.044	98.2	1194.11	6.31	13.51	> 150
ELT37-16 hb	12680-06	65.38187	0.03673	0.042	96.8	2017.55	8.55	21.91	> 150
ELT37-16 hb	12680-07	23.43376	0.00792	0.087	99.2	2309.63	6.32	23.94	> 150
ELT37-16 hb	12680-08	21.38554	0.04417	0.02	95.3	1143.85	10.03	15.21	> 150
ELT37-16 hb	12680-09	23.30239	0.03658	0.035	98.1	1497.16	8.69	17.31	> 150
ELT37-16 hb	12680-10	18.72199	0.01827	0.08	99.5	1171.64	4.50	12.55	> 150
ELT37-16 hb	12680-11	10.36479	0.00141	0.138	99.2	1197.80	3.35	12.44	> 150
ELT37-16 hb	12680-12	13.53421	0.00171	0.131	99.2	1152.30	3.70	12.10	> 150
ELT37-16 hb	12680-13	18.29366	0.00664	0.028	98.5	1250.00	9.41	15.64	> 150
ELT37-16 hb	12680-14	16.37397	-0.00089	0.051	99.5	1496.50	6.12	16.17	> 150
ELT37-16 hb	12680-15	9.96974	0.00496	0.193	98.3	1481.72	4.16	15.39	> 150
ELT37-16 hb	12680-16	10.46987	-0.01706	0.117	99.7	1149.73	3.27	11.95	> 150
ELT37-16 hb	12680-22	7.47265	0.00057	0.33	98.2	1155.49	2.86	11.90	> 150

ELT37-16 hb	12680-24	6.78632	0.00453	0.351	99	1195.63	2.66	12.25	> 150
ELT37-16 hb	12680-18	16.30465	0.03666	0.022	91.7	1330.53	7.71	15.38	> 150
ELT37-16 hb	12680-21	7.28225	0.00436	0.503	99	1489.89	2.63	15.13	> 150
ELT37-16 hb	12680-17	16.276	0.00607	0.25	99.1	1549.89	3.27	15.84	> 150
ELT37-16 hb	12680-23	23.38785	0.02168	0.118	98.1	2330.49	4.99	23.83	> 150
ELT37-16 hb	12980-16	2.48009	0.01677	0.14	49.9	354.21	3.87	5.24	> 150
ELT37-16 hb	12980-24	12.81148	0.01338	0.046	87.6	1128.40	5.16	12.41	> 150
ELT37-16 hb	12980-31	11.09251	0.00128	0.222	97.6	1131.54	2.85	11.67	> 150
ELT37-16 hb	12980-06	9.0119	0.00407	0.587	98.5	1131.66	2.68	11.63	> 150
ELT37-16 hb	12980-17	11.68396	0.00281	0.636	94.5	1132.31	2.85	11.68	> 150
ELT37-16 hb	12980-34	7.63834	0.00959	0.26	98.2	1136.43	3.03	11.76	> 150
ELT37-16 hb	12980-41	8.26589	0.0049	0.116	99.4	1141.05	3.29	11.87	> 150
ELT37-16 hb	12980-25	6.89157	0.00327	0.389	99.2	1144.09	2.44	11.70	> 150
ELT37-16 hb	12980-23	27.58413	0.00616	0.064	94.7	1145.53	3.87	12.09	> 150
ELT37-16 hb	12980-15	10.56146	0.00346	0.181	98.2	1147.65	3.24	11.92	> 150
ELT37-16 hb	12980-21	7.41926	0.01218	0.428	98.9	1156.84	2.74	11.89	> 150
ELT37-16 hb	12980-14	12.98396	0.00234	0.176	98.8	1158.13	2.86	11.93	> 150
ELT37-16 hb	12980-22	16.64825	0.01027	0.065	92.8	1160.66	4.06	12.30	> 150
ELT37-16 hb	12980-01	22.5215	0.00035	0.216	98.2	1162.95	2.79	11.96	> 150
ELT37-16 hb	12980-37	8.16526	0.00618	0.082	97.9	1164.69	3.30	12.10	> 150
ELT37-16 hb	12980-08	7.47336	0.00264	2.722	99.3	1167.60	3.02	12.06	> 150
ELT37-16 hb	12980-40	8.4108	0.00375	0.174	98.8	1167.65	3.40	12.16	> 150
ELT37-16 hb	12980-42	5.87249	0.00775	0.499	96.7	1169.02	2.92	12.05	> 150
ELT37-16 hb	12980-32	17.95697	0.01917	0.058	95.6	1174.08	4.45	12.56	> 150
ELT37-16 hb	12980-36	5.24229	0.0085	0.458	98.9	1176.90	2.66	12.07	> 150
ELT37-16 hb	12980-12	11.21189	0.00305	0.45	98.5	1199.60	2.63	12.28	> 150
ELT37-16 hb	12980-30	7.3083	0.0076	0.225	96.9	1215.96	3.16	12.56	> 150
ELT37-16 hb	12980-28	7.54955	0.00708	0.171	94.1	1273.31	3.44	13.19	> 150

ELT37-16 hb	12980-02	25.34668	-0.01483	0.03	78.2	1351.98	6.61	15.05	> 150
ELT37-16 hb	12980-09	35.53666	0.01381	0.174	97.3	1405.44	3.54	14.49	> 150
ELT37-16 hb	12980-19	40.67461	0.01279	0.112	96.7	1433.47	3.83	14.84	> 150
ELT37-16 hb	12980-18	9.02436	0.00831	0.346	99.4	1456.67	3.25	14.93	> 150
ELT37-16 hb	12980-11	16.6597	0.00555	0.212	92.9	1463.81	4.04	15.19	> 150
ELT37-16 hb	12980-35	28.48244	0.00329	0.056	96.6	1479.88	5.19	15.68	> 150
ELT37-16 hb	12980-04	19.58876	0.01614	0.078	83.9	1519.52	5.18	16.06	> 150
ELT37-16 hb	12980-13	25.0238	0.02902	0.038	92.1	1528.19	6.05	16.44	> 150
ELT37-16 hb	12980-10	10.1525	0.01218	0.046	99.1	1528.79	4.67	15.99	> 150
ELT37-16 hb	12980-05	32.69251	0.00081	0.276	87	1634.40	4.47	16.95	> 150
ELT37-16 hb	12980-07	28.2396	0.01027	0.053	88.7	1705.84	5.88	18.04	> 150
ELT37-16 hb	12980-26	14.11781	0.0053	0.664	93.1	1709.72	4.22	17.61	> 150
ELT37-16 hb	12980-27	35.17421	0.0042	0.102	95.5	1711.30	4.65	17.73	> 150
ELT37-16 hb	12980-29	11.40088	0.00924	0.2	99.1	1765.31	3.42	17.98	> 150
ELT37-16 hb	12980-03	48.05452	-0.00219	0.045	86.9	1777.05	6.84	19.04	> 150
ELT37-16 hb	12980-33	13.38322	0.00773	0.252	99	1881.16	3.82	19.20	> 150
ELT37-16 hb	12980-38	15.26778	-0.00288	0.121	97.8	1941.65	4.54	19.94	> 150
ELT37-16 hb	12980-39	27.5257	0.01323	0.049	98.6	1967.55	6.13	20.61	> 150
ELT37-16 hb	12980-20	45.47058	0.00682	0.118	93.7	2421.16	5.32	24.79	> 150
ELT49-30 bio	12674-27	0.0191	0.00411	3.2	87.6	499.54	1.38	5.18	> 150
ELT49-30 bio	12674-29	0.00812	0.00719	1.637	98.2	510.41	1.29	5.27	> 150
ELT49-30 bio	12674-28	0.01694	0.00451	1.677	94.2	854.75	2.03	8.79	> 150
ELT49-30 bio	12674-31	0.1078	0.00026	2.784	98.8	1075.20	2.45	11.03	> 150
ELT49-30 bio	12674-30	0.03331	-0.00068	1.427	99.6	1091.06	2.46	11.18	> 150
ELT49-30 bio	12927-10	-0.0573	-0.01131	0.027	2	11.35	4.34	4.34	> 150
ELT49-30 bio	12927-06	0.01065	0.0015	0.129	89.7	456.19	1.52	4.81	> 150
ELT49-30 bio	12927-08	0.06087	0.0002	0.151	75.6	463.47	1.99	5.04	> 150

ELT49-30 bio	12927-09	0.90698	0.01931	0.081	59.6	652.15	3.96	7.63	> 150
ELT49-30 bio	12927-01	0.20779	0.0061	2.198	89.2	935.01	2.44	9.66	> 150
ELT49-30 bio	12927-04	0.0014	0.0064	0.367	95.6	1085.08	2.25	11.08	> 150
ELT49-30 bio	12927-02	0.0045	0.00142	2.803	96.9	1104.12	2.97	11.43	> 150
ELT49-30 bio	12927-05	0.12393	0.00147	0.286	92.7	1111.97	2.58	11.41	> 150
ELT49-30 Bio	13195-03A	0.2678	0.00404	0.644	97.5	480.13	7.30	8.73	> 150
ELT49-30 Bio	13195-04A	0.57563	-0.00665	0.214	99.9	487.90	6.96	8.50	> 150
ELT49-30 Bio	13195-05A	3.18496	0.03092	0.056	98.5	921.00	14.24	16.96	> 150
ELT49-30 Bio	13195-06A	1.51149	0.07848	0.044	92.3	400.31	10.47	11.21	> 150
ELT49-30 Bio	13195-07A	4.19708	0.00882	0.051	92.3	478.21	10.80	11.81	> 150
ELT49-30 Bio	13195-08A	1.52924	0.01458	0.117	94.3	428.01	8.01	9.08	> 150
ELT49-30 Bio	13195-09A	1.86067	0.03671	0.102	97.7	1065.65	14.75	18.20	> 150
ELT49-30 bio 63-150	13469-10	-0.01363	0.00509	0.169	99.4	438.12	3.10	5.37	63-150
ELT49-30 bio 63-150	13469-04	0.03295	0.00417	0.186	96	438.41	2.85	5.23	63-150
ELT49-30 bio 63-150	13469-01	-0.19803	-0.00407	0.027	98.5	494.56	12.59	13.53	63-150
ELT49-30 bio 63-150	13469-06	-0.10724	0.00632	0.071	86.3	855.80	8.22	11.87	63-150
ELT49-30 bio 63-150	13469-03	4.23465	-0.1576	0.006	89.2	943.56	44.04	45.04	63-150
ELT49-30 bio 63-150	13469-11	-0.03363	-0.0051	0.101	100.1	1083.44	3.93	11.52	63-150
ELT49-30 bio 63-150	13469-07	-0.01664	-0.00336	0.014	100.1	1090.93	25.44	27.68	63-150
ELT49-30 bio 63-150	13469-02	0.07033	0.01733	0.023	96.3	1138.72	19.30	22.40	63-150
ELT49-30 bio 63-150	13469-05	-0.3537	0.01548	0.023	99.2	1195.70	20.73	23.93	63-150
ELT49-30 bio 63-150	13469-09	-0.07478	-0.00133	0.092	100.2	1339.83	8.67	15.96	63-150

ELT49-30 hb	12673-22	8.17817	-0.00747	0.122	98.7	661.15	2.37	7.02	> 150
ELT49-30 hb	12673-26	20.22232	-0.02419	0.029	97.3	1135.28	7.21	13.45	> 150
ELT49-30 hb	12673-19	6.49868	-0.00009	0.159	99.2	1150.81	3.00	11.89	> 150
ELT49-30 hb	12673-23	6.15927	-0.00243	0.164	99.2	1155.78	2.83	11.90	> 150
ELT49-30 hb	12673-25	7.94718	0.00198	0.113	95.8	1164.09	3.31	12.10	> 150
ELT49-30 hb	12673-20	6.04748	0.0077	0.571	99.5	1172.68	2.30	11.95	> 150
ELT49-30 hb	12673-18	6.80707	0.02547	0.375	99	1364.59	2.66	13.90	> 150
ELT49-30 hb	12673-21	6.30127	-0.0089	0.048	97.9	1477.64	6.83	16.28	> 150
ELT49-30 hb	12673-02	6.59551	0.01079	0.392	99.1	1164.88	4.39	12.45	>150
ELT49-30 hb	12673-03	5.1076	0.05835	2.302	1.2	3.49	5.20	5.20	>150
ELT49-30 hb	12673-06	10.97325	0.02388	0.563	99.3	1203.83	4.76	12.95	>150
ELT49-30 hb	12673-07	5.57445	0.02019	0.435	96.1	1163.85	4.70	12.55	>150
ELT49-30 hb	12673-08	6.35349	-0.00045	0.602	78.7	582.21	4.77	7.53	>150
ELT49-30 hb	12673-09	16.0711	0.01649	0.487	98.8	1113.89	4.14	11.89	>150
ELT49-30 hb	12673-10	6.98301	0.00532	0.341	85.7	671.18	4.34	7.99	>150
ELT49-30 hb	12673-13	9.35143	0.02165	0.834	92.5	1242.90	6.40	13.98	>150
ELT49-30 hb	12673-14	5.14668	-0.00115	0.209	99.4	798.07	3.22	8.61	>150
ELT49-30 hb	12673-15	7.04795	-0.00584	0.07	98.6	1152.40	4.34	12.31	>150
ELT49-30 hb	12932-18	3.75189	0.00886	0.01	5.4	23.52	5.89	5.90	> 150
ELT49-30 hb	12932-11	7.20778	0.01187	0.083	90	1135.87	3.64	11.93	> 150
ELT49-30 hb	12932-10	7.22154	0.01193	0.07	99.4	1138.62	3.25	11.84	> 150
ELT49-30 hb	12932-09	7.26258	0.013	0.231	99.4	1164.48	2.55	11.92	> 150
ELT49-30 hb	12932-08	6.39021	0.00772	0.115	99.2	1172.05	2.71	12.03	> 150
ELT49-30 hb	12932-22	6.42643	0.00548	0.09	99.1	1172.70	3.09	12.13	> 150
ELT49-30 hb	12932-13	7.46358	0.01648	0.248	96.6	1180.25	2.69	12.10	> 150
ELT49-30 hb	12932-17	6.92773	0.01582	0.017	97.4	1189.16	6.59	13.60	> 150
ELT49-30 hb	13187-02A	12.55072	-0.01178	0.09	98.1	1169.11	12.39	17.03	> 150

ELT49-30 hb	13187-03A	5.8936	0.01523	0.128	97.9	1133.51	11.90	16.43	> 150
ELT49-30 hb	13187-04A	15.02749	-0.04135	0.053	101.4	1190.81	13.10	17.71	> 150
ELT49-30 hb	13187-05A	4.86782	0.04463	0.099	99.4	1162.95	12.15	16.82	> 150
ELT49-30 hb	13187-06A	6.87292	-0.01099	0.091	98.9	1147.23	12.34	16.85	> 150
ELT49-30 hb	13187-07A	3.83124	0.01209	0.063	97.6	1157.32	13.41	17.71	> 150
ELT49-30 hb	13187-08A	5.01837	-0.00791	0.071	99.6	1265.49	13.01	18.15	> 150
ELT49-30 hb	13187-09A	3.53255	0.01527	0.117	98.3	1190.66	12.22	17.06	> 150
JPC11 2305-2310 bio	13575-01	-0.02704	-0.00185	0.236	99.9	1683.21	6.40	18.01	> 150
JPC11 2305-2310 bio	13575-02	0.04358	0.00363	1.222	99.5	1594.16	5.12	16.74	> 150
JPC11 2305-2310 bio	13575-03	0.01262	0.00114	1.229	99.9	1709.11	2.55	17.28	> 150
JPC11 2305-2310 bio	13575-04	-0.09654	0.01972	0.093	97.4	1655.07	5.00	17.29	> 150
JPC11 2305-2310 bio	13575-06	0.01107	-0.00099	0.45	99.8	1634.58	5.76	17.33	> 150
JPC11 2305-2310 bio	13575-07	-0.00065	0.00413	0.874	100	1656.97	5.24	17.38	> 150
JPC11 2305-2310 bio	13575-08	0.00827	0.00165	0.226	99.2	1618.98	3.00	16.47	> 150
JPC11 2305-2310 bio	13575-09	-0.00282	0.00237	1.912	99.9	1608.34	6.08	17.19	> 150
JPC11 2305-2310 bio	13575-10	0.03228	-0.00018	1.237	99.9	1624.18	3.66	16.65	> 150
JPC11 2305-2310 bio	13575-11	0.00031	0.00082	1.524	99.9	1686.12	2.52	17.05	> 150
JPC11 2305-2310 bio	13575-12	-0.00132	0.00803	0.711	99.9	1635.44	2.15	16.50	> 150
JPC11 2305-2310 bio	13575-13	0.00579	0.00119	0.266	99.7	1580.25	2.95	16.08	> 150
JPC11 2305-	13575-14	0.0148	0.00071	0.486	99.9	1583.01	2.18	15.98	> 150

2310 bio									
JPC11 2305-2310 bio	13575-15	0.27267	0.00502	6.489	99.8	1799.91	9.74	20.47	> 150
JPC11 2305-2310 hb	12507-04	0.0078	0.0003	4.196	99.8	1611.75	3.72	16.54	> 150
JPC11 2305-2310 hb	12507-05	22.32632	0.00947	0.188	98.3	1668.36	3.33	17.01	> 150
JPC11 2305-2310 hb	12507-06	33.77635	0.00584	0.046	97.6	1650.51	6.70	17.81	> 150
JPC11 2305-2310 hb	12507-07	20.12419	0.00874	0.084	97.2	1729.90	5.55	18.17	> 150
JPC11 2305-2310 hb	12507-08	7.27876	0.00465	0.231	98.6	1704.86	2.96	17.30	> 150
JPC11 2305-2310 hb	12507-09	57.91119	0.06279	0.014	92	2212.65	12.90	25.61	> 150
JPC11 2305-2310 hb	12507-10	0.65296	0.04869	0.002	77.8	1506.80	35.56	38.62	> 150
JPC11 2305-2310 hb	12507-11	0.1759	-0.00017	0.63	99.3	1431.76	2.02	14.46	> 150
JPC11 2305-2310 hb	12507-12	0.59148	0.00244	0.172	83.2	1613.05	3.84	16.58	> 150
JPC11 2305-2310 hb	12507-13	0.66761	0.00098	0.418	93.7	1091.91	1.70	11.05	> 150
JPC11 2305-2310 hb	12507-14	30.50721	0.00838	0.051	96.5	1729.59	5.74	18.22	> 150
JPC11 2305-2310 hb	12507-15	11.93941	0.01859	0.126	97.4	1546.05	3.76	15.91	> 150
JPC11 2305-2310 hb	12507-16	36.24223	0.01438	0.029	93.6	1726.78	7.92	19.00	> 150
JPC11 2305-2310 hb	12507-17	14.07825	0.0045	0.095	99.2	1756.08	5.25	18.33	> 150
JPC11 2305-2310 hb	12507-18	7.85514	0.00682	0.078	97.8	1420.01	4.76	14.98	> 150

JPC11 2370-2375 bio	13574-01	-0.00093	-0.00258	0.407	99.7	1581.00	2.70	16.04	> 150
JPC11 2370-2375 bio	13574-03	0.43147	0.05247	0.016	83.5	1592.50	13.69	21.00	> 150
JPC11 2370-2375 bio	13574-15	-0.01546	0.00738	0.305	99.8	1594.74	3.43	16.31	> 150
JPC11 2370-2375 bio	13574-10	-0.00699	0.00444	0.39	99.9	1598.26	2.98	16.26	> 150
JPC11 2370-2375 bio	13574-04	0.01763	-0.00005	0.171	99.9	1602.40	3.73	16.45	> 150
JPC11 2370-2375 bio	13574-09	-0.00556	0.00878	0.276	99.9	1607.13	3.51	16.45	> 150
JPC11 2370-2375 bio	13574-08	0.00917	0.00372	0.279	99.9	1617.25	4.81	16.87	> 150
JPC11 2370-2375 bio	13574-06	0.01381	-0.00057	1.022	99.9	1618.66	5.45	17.08	> 150
JPC11 2370-2375 bio	13574-05	-0.02394	-0.0027	0.144	100	1619.78	4.79	16.89	> 150
JPC11 2370-2375 bio	13574-02	-0.03149	0.00426	0.188	99.8	1624.88	3.14	16.55	> 150
JPC11 2370-2375 bio	13574-12	-0.00595	0.00353	0.26	99.8	1635.41	3.56	16.74	> 150
JPC11 2370-2375 bio	13574-14	0.01228	0.00628	0.816	99.9	1640.17	4.93	17.13	> 150
JPC11 2370-2375 bio	13574-07	-0.00741	-0.00091	0.464	99.9	1659.98	5.12	17.37	> 150
JPC11 2370-2375 bio	13574-11	0.01619	0.00368	0.773	99.7	1674.24	4.98	17.47	> 150
JPC11 2370-2375 bio	13574-13	-0.00273	0.00835	0.298	99.2	1698.25	2.66	17.19	> 150
JPC11 2370-2375 hb	12635-01	26.70138	0.00972	0.591	94.5	1757.43	2.42	17.74	> 150
JPC11 2370-2375 hb	12635-02	17.22664	0.01241	0.436	96.2	1696.20	2.27	17.11	> 150
JPC11 2370-2375 hb	12635-03	53.70243	0.01856	0.151	90.1	3248.97	5.13	32.89	> 150

JPC11 2370-2375 hb	12635-04	6.78385	0.00613	1.23	94.3	1158.37	1.84	11.73	> 150
JPC11 2370-2375 hb	12635-05	6.94557	0.00458	0.686	98.7	1579.50	2.15	15.94	> 150
JPC11 2370-2375 hb	12635-06	33.79887	-0.00126	0.278	97.9	1929.63	3.25	19.57	> 150
JPC11 2370-2375 hb	12635-07	35.81388	0.00531	0.118	96.4	1708.95	3.82	17.51	> 150
JPC11 2370-2375 hb	12635-08	24.52023	0.00077	0.158	96.5	2002.07	4.45	20.51	> 150
JPC11 2370-2375 hb	12635-09	29.245	0.00201	0.183	95.8	1687.44	3.12	17.16	> 150
JPC11 2370-2375 hb	12635-10	19.68589	0.00559	0.246	95.7	1754.11	2.77	17.76	> 150
JPC11 2370-2375 hb	12635-11	31.57426	0.00733	0.151	96.6	1752.28	3.64	17.90	> 150
JPC11 2370-2375 hb	12635-12	0.51514	-0.00023	3.222	99.6	1613.82	2.86	16.39	> 150
JPC11 2370-2375 hb	12635-13	11.96913	0.02178	0.261	97.3	1743.42	2.88	17.67	> 150
JPC11 2370-2375 hb	12635-14	31.4551	0.01022	0.074	91.1	1829.16	5.56	19.12	> 150
JPC11 2370-2375 hb	12635-15	56.88529	0.02096	0.046	92.1	2282.94	8.20	24.26	> 150
JPC11 2370-2375 hb	12635-16	15.69341	0.01807	0.145	96.4	1895.70	4.05	19.38	> 150
JPC11 2370-2375 hb	12635-17	22.70609	0.02273	0.069	93.2	1651.09	4.55	17.13	> 150
JPC11 2370-2375 hb	12635-18	9.97799	0.01978	0.372	98.8	1578.70	2.45	15.98	> 150
JPC11 2370-2375 hb	12635-19	14.958	0.01835	0.166	95.7	1665.35	3.17	16.95	> 150
JPC11 2370-2375 hb	12635-20	12.43042	0.00786	0.145	97.5	1821.41	4.29	18.71	> 150
JPC11 2370-2375 hb	12635-21	22.59055	0.00869	0.217	97.3	1943.71	3.30	19.71	> 150
JPC11 2370-	12635-22	13.35981	0.01121	0.254	97.4	1754.90	2.95	17.80	> 150

2375 hb									
JPC11 2370-2375 hb	12635-23	2.14067	0.00044	0.61	97.3	1433.78	1.90	14.46	> 150
JPC11 2370-2375 hb	12635-24	0.35033	0.00051	1.32	99.5	1566.18	2.34	15.84	> 150
JPC11 2370-2375 hb	12635-25	64.47626	-0.00448	0.027	94	2888.19	14.12	32.15	> 150
JPC11 2370-2375 hb	12635-26	63.15348	-0.01328	0.042	96.1	2463.99	10.10	26.63	> 150
JPC11 2370-2375 hb	12635-27	20.67141	0.00186	0.256	96.7	1667.74	2.85	16.92	> 150
JPC11 2370-2375 hb	12635-28	19.35601	0.02118	0.143	95.4	1568.37	3.80	16.14	> 150
JPC11 2370-2375 hb	12635-29	48.21788	0.01108	0.039	96.6	2078.62	9.30	22.77	> 150
JPC11 2370-2375 hb	12635-30	0.54833	-0.00022	3.099	99.4	1477.08	2.72	15.02	> 150
JPC11 2370-2375 hb	12635-31	29.99707	-0.00135	0.172	95.1	1602.77	3.56	16.42	> 150
JPC11 2370-2375 hb	12635-32	12.56434	0.01097	0.231	98.3	1542.40	2.80	15.68	> 150
JPC11 2370-2375 hb	12635-33	13.40714	0.00366	0.259	96.6	1689.76	2.76	17.12	> 150
JPC11 2370-2375 hb	12635-34	18.91264	0.00687	0.195	97.6	1676.27	3.19	17.06	> 150
JPC11 2370-2375 hb	12635-35	28.09366	0.02987	0.042	93.9	2541.76	9.23	27.04	> 150
JPC11 2370-2375 hb	12635-36	24.33676	-0.01162	0.08	96.7	1712.19	5.54	18.00	> 150
JPC11 2370-2375 hb	12635-37	36.83839	-0.01923	0.072	96.2	2285.84	5.76	23.57	> 150
JPC11 2370-2375 hb	12635-38	14.96535	0.00951	0.201	98	1819.36	3.37	18.50	> 150
JPC11 2370-2375 hb	12635-39	34.11192	-0.01609	0.04	94.7	1784.25	6.73	19.07	> 150
JPC11 2370-2375 hb	12635-40	22.83852	-0.00735	0.116	97.4	2454.30	4.89	25.02	> 150

JPC11 2370-2375 hb	12635-41	16.06268	0.00814	0.067	96.8	1458.82	5.12	15.46	> 150

Leg 118 ODP Site 1165 Samples

Sample Name	Run ID Number	Ca/K	Cl/K	Mol 39Ar	%40Ar*	Age	Internal Error	± Age	Size Fraction
ELP-01 bio	13548-01	0.00086	-0.00003	0.691	99.5	507.43	3.82	6.35	> 150
ELP-01 bio	13548-02	-0.01341	-0.00039	0.385	99.4	1404.56	9.13	16.75	> 150
ELP-01 bio	13548-03	0.10925	0.00212	2.915	98.6	1072.45	8.27	13.54	> 150
ELP-01 bio	13548-04	0.00104	0.00033	3.249	99.8	1140.02	7.36	13.57	> 150
ELP-01 bio	13548-05	0.00413	0.00201	0.612	98.6	523.69	4.09	6.65	> 150
ELP-01 bio	13548-06	0.00293	0.01147	4.336	99.3	481.52	4.03	6.28	> 150
ELP-01 bio	13548-07	8.0996	0.03579	0.115	98	939.97	7.23	11.86	> 150
ELP-01 bio	13548-08	0.00167	0.0028	1.982	99.8	466.86	3.60	5.90	> 150
ELP-01 bio	13548-09	0.00266	0.01164	1.417	99.9	1659.91	10.54	19.66	> 150
ELP-01 bio	13548-10	0.02249	0.00555	0.972	98.3	722.00	5.69	9.19	> 150
ELP-01 bio	13548-11	-0.00793	0.00981	0.303	99.2	1110.88	8.65	14.08	> 150
ELP-01 bio	13548-12	0.00401	0.0035	0.602	98.4	1009.93	7.02	12.30	> 150
ELP-01 bio	13548-13	-0.0021	-0.01121	0.079	99.8	1156.17	8.18	14.17	> 150
ELP-01 bio	13548-14	0.01242	-0.00567	0.323	99.5	1058.82	7.05	12.72	> 150
ELP-01 bio	13548-15	1.35936	0.00457	1.315	95.3	798.25	6.68	10.41	> 150
ELP-01 bio	13548-16	0.00986	0.00399	0.892	99.5	447.27	2.19	4.98	> 150
ELP-01 bio	13548-17	0.01871	0.00469	1.076	64	224.86	3.63	4.27	> 150
ELP-01 bio	13548-18	0.00873	0.00452	0.401	99.4	997.12	4.35	10.88	> 150
ELP-01 bio	13548-19	0.00102	0.0102	0.438	99.4	568.87	3.22	6.54	> 150

ELP-01 bio	13548-20	0.04174	0.00276	3.493	99.3	454.85	2.70	5.29	> 150
ELP-01 bio	13548-21	0.04196	0.00618	1.336	99.1	506.50	2.73	5.75	> 150
ELP-01 bio	13548-22	-0.00127	0.00524	0.77	99.9	1130.45	4.72	12.25	> 150
ELP-01 bio	13548-23	0.00133	0.00219	0.449	99	475.73	3.00	5.62	> 150
ELP-01 bio	13548-24	0.01142	0.00526	0.204	99.4	1147.07	5.32	12.64	> 150
ELP-01 bio	13548-25	-0.00687	0.01097	0.952	99.6	503.33	2.47	5.61	> 150
ELP-01 bio	13548-26	-0.01343	0.00608	0.481	99.5	510.70	3.01	5.93	> 150
ELP-01 bio	13548-27	0.00243	0.00783	0.72	99.5	1144.37	5.10	12.53	> 150
ELP-01 bio	13548-28	-0.05043	0.01002	0.088	89.3	483.94	3.87	6.20	> 150
ELP-01 bio	13548-29	-0.00461	0.01168	0.358	99.8	1119.95	4.76	12.17	> 150
ELP-01 bio	13548-31	0.00989	0.00505	0.675	83.3	343.52	3.02	4.57	> 150
ELP-01 bio	13548-32	-0.01971	-0.00057	0.43	99.6	1100.16	5.91	12.49	> 150
ELP-01 bio	13548-33	0.01485	0.00384	0.759	98.1	444.15	2.33	5.02	> 150
ELP-01 bio	13548-34	-0.05278	0.00796	0.082	98.3	499.95	3.36	6.03	> 150
ELP-01 bio	13548-35	-0.15758	0.04274	0.03	100.2	503.45	7.29	8.86	> 150
ELP-01 bio	13548-36	0.00767	0.00334	1.67	98.1	944.34	5.29	10.82	> 150
ELP-01 bio	13548-37	-0.0484	0.02062	0.122	97.6	535.07	3.27	6.27	> 150
ELP-01 bio	13548-38	0.02875	-0.01284	0.054	97.7	1093.03	7.39	13.19	> 150
ELP-01 bio	13548-39	0.06853	0.00887	0.228	56.8	220.64	4.56	5.07	> 150
ELP-01 bio	13548-40	0.01417	0.00414	0.169	98.7	645.95	3.59	7.39	> 150
ELP-01 bio	13548-41	-0.01407	0.0064	0.475	99.8	1176.76	6.07	13.24	> 150
ELP-01 bio	13548-42	-0.02039	0.01221	0.286	99.7	1141.40	5.04	12.48	> 150
ELP-02 bio	13551-01	0.00287	0.00407	2.209	96.7	515.07	4.36	6.75	> 150
ELP-02 bio	13551-02	0.00349	0.00412	1.971	99.4	774.58	6.01	9.81	> 150
ELP-02 bio	13551-03	-0.0118	0.00431	0.358	98.7	509.64	3.99	6.47	> 150
ELP-02 bio	13551-04	-0.01112	0.00776	0.606	99.7	915.38	6.20	11.05	> 150
ELP-02 bio	13551-05	0.04628	0.00103	0.825	97.9	908.72	6.78	11.34	> 150

ELP-02 bio	13551-06	0.02234	0.01522	0.115	99.2	508.25	5.11	7.21	> 150
ELP-02 bio	13551-07	0.08201	0.00893	1.403	99.7	1217.39	8.37	14.77	> 150
ELP-02 bio	13551-08	0.10319	0.00383	1.182	98.6	911.62	6.57	11.24	> 150
ELP-02 bio	13551-09	0.0235	0.00385	0.734	98.5	482.90	4.05	6.30	> 150
ELP-02 bio	13551-10	0.05517	0.00226	0.374	99.6	1508.11	9.97	18.08	> 150
ELP-02 bio	13551-11	0.08023	0.00492	1.225	99.5	1273.00	8.19	15.14	> 150
ELP-02 bio	13551-12	0.07386	0.00445	0.136	93.2	286.27	3.22	4.31	> 150
ELP-02 bio	13551-13	0.01007	0.00197	0.315	84.8	568.12	6.98	9.00	> 150
ELP-02 bio	13551-14	0.01367	0.00382	0.43	99	1098.27	7.32	13.20	> 150
ELP-02 bio	13551-15	0.0072	0.01089	3.869	99.8	1313.26	9.69	16.32	> 150
ELP-02 bio	13551-16	-0.0127	0.00789	0.766	99.7	963.08	4.98	10.84	> 150
ELP-02 bio	13551-17	-0.00269	0.00408	0.347	99.3	939.48	4.27	10.32	> 150
ELP-02 bio	13551-18	0.05821	0.00176	0.685	99.2	513.42	3.01	5.95	> 150
ELP-02 bio	13551-19	0.00229	0.00689	1.553	98.1	656.73	3.47	7.43	> 150
ELP-02 bio	13551-20	0.02915	0.01087	0.62	95.2	486.57	3.06	5.75	> 150
ELP-02 bio	13551-21	0.32719	0.00107	0.22	91.4	1256.76	7.03	14.40	> 150
ELP-02 bio	13551-22	0.90027	0.02056	0.092	31.3	159.05	8.11	8.27	> 150
ELP-02 bio	13551-23	-0.01485	0.00868	0.709	99.8	878.47	4.62	9.93	> 150
ELP-02 bio	13551-24	0.19459	0.00825	0.103	69.2	683.86	8.64	11.02	> 150
ELP-02 bio	13551-25	-0.02315	0.00602	0.273	98.6	531.12	2.91	6.06	> 150
ELP-02 bio	13551-26	0.01576	0.01103	0.626	94.7	431.31	2.77	5.12	> 150
ELP-02 bio	13551-27	0.02383	0.00392	0.432	99.1	1059.35	5.77	12.06	> 150
ELP-02 bio	13551-28	-0.01071	0.00883	0.224	99	493.29	3.55	6.08	> 150
ELP-06 bio	13560-01	0.03579	0.00014	0.272	24.5	278.80	21.43	21.61	> 150
ELP-06 bio	13560-02	0.00975	0.0043	0.266	95.1	524.26	4.11	6.66	> 150
ELP-06 bio	13560-03	-0.00176	0.00175	0.72	99.4	1109.64	5.74	12.49	> 150
ELP-06 bio	13560-04	0.00223	0.00442	1.794	99.5	505.61	2.85	5.81	> 150

ELP-06 bio	13560-05	0.01338	0.01786	1.732	99.2	519.14	2.95	5.97	> 150
ELP-06 bio	13560-06	0.00046	0.00538	0.646	99.7	3285.22	13.67	35.58	> 150
ELP-06 bio	13560-07	0.01186	0.00451	1.172	99.2	1067.11	5.72	12.11	> 150
ELP-06 bio	13560-08	0.00433	0.00201	2.027	99.6	1145.89	5.65	12.78	> 150
ELP-06 bio	13560-09	0.52025	-0.00264	0.546	90.5	918.08	7.28	11.72	> 150
ELP-06 bio	13560-10	-0.0031	0.00481	0.371	99.9	1150.61	6.60	13.26	> 150
ELP-06 bio	13560-11	-0.02697	0.00946	0.294	98.9	493.52	3.52	6.06	> 150
ELP-06 bio	13560-12	0.01416	0.00083	0.39	95.2	499.80	3.40	6.05	> 150
ELP-06 bio	13560-13	-0.00335	0.01853	0.493	92.7	487.09	3.63	6.07	> 150
ELP-06 bio	13560-14	-0.00127	0.00226	1.083	99.7	1041.83	5.85	11.95	> 150
ELP-06 bio	13560-15	0.01073	0.01023	0.323	99.8	487.96	3.37	5.93	> 150
ELP-06 bio	13560-16	0.01635	0.00197	3.29	99.9	1147.82	6.86	13.37	> 150
ELP-06 bio	13560-17	0.05165	0.00248	2.084	80.3	426.66	4.42	6.15	> 150
ELP-06 bio	13560-18	-0.0076	0.00752	0.373	98.2	502.99	3.36	6.05	> 150
ELP-06 bio	13560-19	0.03065	0.00044	0.807	89.9	497.14	3.76	6.23	> 150
ELP-06 bio	13560-20	-0.00029	0.01169	1.659	99.6	500.10	2.81	5.74	> 150
ELP-06 bio	13560-21	-0.00611	0.01142	0.487	97.6	516.54	3.01	5.98	> 150
ELP-06 bio	13560-22	0.05987	0.00538	0.377	69.8	239.60	3.61	4.33	> 150
ELP-06 bio	13560-23	0.00452	0.00822	0.524	99.3	493.84	2.70	5.63	> 150
ELP-06 bio	13560-24	0.00388	0.00798	0.276	48.9	66.60	2.14	2.24	> 150
ELP-06 bio	13560-25	-0.0095	0.00014	0.322	97.7	498.27	2.99	5.81	> 150
ELP-06 bio	13560-26	0.02175	0.00968	2.543	99	518.59	3.00	5.99	> 150
ELP-06 bio	13560-27	0.0009	-0.01101	0.203	24.8	199.06	13.21	13.36	> 150
ELP-06 bio	13560-28	0.00449	0.00392	0.618	99.7	836.70	4.55	9.53	> 150
ELP-06 bio	13560-29	-0.11361	-0.00093	0.074	99.1	528.20	3.30	6.23	> 150
ELP-06 bio	13560-30	-0.01041	0.01398	0.33	93	509.93	3.69	6.30	> 150
ELP-06 bio	13560-31	0.01164	0.00208	1.426	99.6	775.77	3.80	8.64	> 150
ELP-06 bio	13560-33	-0.00704	-0.00016	0.535	99	1082.27	5.78	12.27	> 150

ELP-06 bio	13560-34	-0.00592	0.00911	0.621	99.3	764.52	3.68	8.48	> 150
ELP-06 bio	13560-35	-0.00169	0.00374	4.04	99.9	894.95	5.28	10.39	> 150
ELP-06 bio	13560-36	0.01968	0.01191	1.251	97.7	596.63	3.31	6.82	> 150
ELP-06 bio	13560-37	0.01224	-0.00004	0.772	90	479.10	3.61	6.00	> 150
ELP-06 bio	13560-38	-0.04828	0.01207	0.085	93.6	464.34	3.66	5.91	> 150
ELP-06 bio	13560-40	-0.00572	0.00938	0.326	98.4	501.91	2.66	5.68	> 150
ELP-06 bio	13560-41	0.02196	0.00518	0.542	99.8	1147.75	4.83	12.45	> 150
ELP-09 bio	13568-01	-0.01652	0.00225	0.221	99.9	1217.29	2.63	12.45	> 150
ELP-09 bio	13568-02	0.00354	-0.00403	0.232	99.5	1199.20	2.62	12.27	> 150
ELP-09 bio	13568-03	0.04906	-0.00244	0.448	99.8	1354.18	2.66	13.80	> 150
ELP-09 bio	13568-04	0.30181	0.00354	4.572	99.7	525.95	2.22	5.71	> 150
ELP-09 bio	13568-05	0.0088	-0.00017	0.137	99.7	1222.83	7.43	14.31	> 150
ELP-09 bio	13568-07	-0.00255	0.00434	2.336	99.2	599.14	2.10	6.35	> 150
ELP-09 bio	13568-08	0.01109	-0.00126	0.353	98.4	573.59	1.18	5.86	> 150
ELP-09 bio	13568-10	0.00487	0.00749	0.477	100.2	518.54	0.92	5.27	> 150
ELP-09 bio	13568-11	0.00367	0.00651	0.252	100.3	527.70	1.28	5.43	> 150
ELP-09 bio	13568-12	0.00471	0.00615	0.704	99.7	516.71	0.82	5.23	> 150
ELP-09 bio	13568-13	-0.00846	0.00746	0.835	99.7	513.97	0.73	5.19	> 150
ELP-09 bio	13568-14	0.00597	0.00647	0.677	99.9	518.57	1.66	5.45	> 150
ELP-09 bio	13568-15	0.08958	0.00607	1.709	99.7	561.51	1.24	5.75	> 150
ELP-09 bio	13568-16	-0.0163	0.01024	0.12	97.1	519.13	2.03	5.58	> 150
ELP-09 bio	13568-17	-0.05456	0.01474	0.166	100	528.46	1.79	5.58	> 150
ELP-09 bio	13568-18	-0.00778	0.00587	1.517	99.9	532.23	1.36	5.49	> 150
ELP-09 bio	13568-20	0.00413	0.01332	0.799	99.9	532.27	0.90	5.40	> 150
ELP-09 bio	13568-21	-0.0032	0.00741	0.879	99.6	519.12	0.79	5.25	> 150
ELP-09 bio	13568-22	-0.01333	0.03717	0.217	99.8	533.86	2.48	5.89	> 150
ELP-09 bio	13568-23	0.00325	0.00325	1.078	99.5	525.90	1.51	5.47	> 150

ELP-09 bio	13568-24	1.7496	0.00067	0.287	98.2	573.71	2.18	6.14	> 150
ELP-09 bio	13568-25	-0.03147	0.00544	0.236	99	528.01	1.37	5.46	> 150
ELP-09 bio	13568-26	-0.00009	0.01054	0.882	99.2	527.41	1.47	5.48	> 150
ELP-09 bio	13568-27	5.14894	0.08931	0.307	99.2	582.27	1.15	5.94	> 150
ELP-09 bio	13568-28	-0.01798	0.00685	0.33	99.6	521.87	1.14	5.34	> 150
ELP-09 bio	13568-29	-0.01345	0.00507	0.353	99.7	516.99	2.27	5.65	> 150
ELP-09 bio	13568-30	0.00708	0.00486	0.391	99.6	513.39	1.82	5.45	> 150
ELP-09 bio	13568-31	-0.01153	-0.00331	0.18	99.2	520.40	2.30	5.69	> 150
ELP-09 bio	13568-32	0.00287	0.02875	0.131	100.7	520.09	2.95	5.98	> 150
ELP-09 bio	13568-33	-0.00823	0.00428	0.389	99.7	1182.67	3.21	12.25	> 150
ELP-09 bio	13568-34	-0.01202	0.00281	0.443	97.2	522.18	1.04	5.32	> 150
ELP-09 bio	13568-35	-0.07805	-0.31715	0.002	56.4	580.68	37.19	37.65	> 150
ELP-09 bio	13568-36	-0.01713	0.00678	0.322	99.9	530.27	0.98	5.39	> 150
ELP-09 bio	13568-37	-0.03893	0.00697	0.306	98	523.43	0.96	5.32	> 150
ELP-09 bio	13568-38	-0.14468	0.01073	0.05	102	535.14	3.32	6.30	> 150
ELP-09 bio	13568-39	-0.11783	-0.0009	0.083	100.5	518.35	3.81	6.44	> 150
ELP-09 bio	13568-40	-0.52835	0.00516	0.019	102.7	515.50	11.16	12.29	> 150

Chapter 2. Appendix C. Neodymium Data.

Core ID	Sample	$^{143}Nd/^{144}Nd$[a] (corrected)	±2σ S.E.[b]	ε_{Nd}[c]
6	DF80-20	0.512110	0.000010	-10.3
7	DF80-34	0.512467	0.000010	-3.5
9	DF79-47	0.512012	0.000012	-12.4
12	ELT37-09	0.511556	0.000010	-21.1
14	ELT37-13	0.511884	0.000009	-14.7
15	ELT37-16	0.512080	0.000010	-13.4
20	ELT49-30	0.512025	0.000008	-12.3

[a] All reported $^{143}Nd/^{144}Nd$ ratios represent the average of two measurements and are corrected to a JNdi value of 0.512115, which equals a La Jolla value of 0.511858 (Tanaka *et al*., 2000). JNdi values on two separate measuring days were 0.512116 ± 0.000020 (2σ S.D., n =11and 0.512097 ± 0.000013 (2σ S.D., n =13). Since the standard data showed a clear trend throughout the day, we first detrended the standard values, to then correct the JNdi value.

[b] The 2σ S.E. reported is the larger of the two internal errors of the two sample runs that were averaged

[c] ε_{Nd} calculations are based on a $^{143}Nd/^{144}Nd$ chrondritic value of 0.512638 (Jacobsen and Wasserburg, 1980).

Chapter 2. Appendix D. Onshore εNd values used for making Figure 7.

Author	Longitude	Latitude	$\varepsilon_{Nd}(0)$	Geographic Location or Sample Description	Samples averaged to obtain ε_{Nd}	Minimum ε_{Nd} value	Maximum ε_{Nd} value	Standard Deviation	Median ε_{Nd} value
Brachfeld et al., (2007)	143.052	-66.563	-23.4	Mertz Drift	1				
Henjes-Kunst (2003)	164.2	-71.25	-14.1	Roberston Bay Group	13	-12.3	-15.6	0.9	-14.4
Henjes-Kunst (2003)	162.5	-71	-15.9	Bowers Terrane, Molnar Formation	13	-11.8	-19.9	3.1	-16.9
Henjes-Kunst (2003)	161.8	-71.7	-14.0	Wilson Terrane, Moruzumi Phyllites	10	-11.8	-17.2	1.7	-13.8
Henjes-Kunst (2003)	160.8	-71.8	-16.0	Wilson Terrane, Rennkick Schists	11	-11.8	-19.8	2.6	-15.2
Henjes-Kunst (2003)	156.0	-69.5	-14.8	Wilson Terrane, Berg group	6	-12.7	-17.9	2.3	-13.8
Henjes-Kunst (2003)	163.5	-71.8	-14.8	Wilson Terrane, Wilson Schists	4	-14.5	-15.3	0.4	-14.7
Henjes-Kunst (2003)	163.5	-71.8	-12.7	Wilson Terrane, Lanternann Metamorphics	6	-11.1	-15.0	1.9	-11.8
Henjes-Kunst (2003)	161.1	-70.4	-12.7	Wilson Terrane, Wilson Gneisses, Kavrayskiy Hills	4	-11.4	-13.8	1.3	-12.8
Henjes-Kunst (2003)	158.5	-69.8	-13.9	Willson Terrane, Wilson Gneisses, Wilson Hills	7	-12.8	-15.4	0.9	-13.7
Rocchi (1998)	162.6	-74.7	-12.7	Mountainer Range	10	-8.2	-14.8	2.0	-13.4
Rocchi (1998)	164.1	-74.7	-11.1	Southern Cross Mountains	5	-3.3	-16.3	5.2	-12.1
Rocchi (1998)	164.7	-74.2	-12.8	Southern Cross Mountains	3	-10.5	-13.4	1.7	-13.4
Rocchi (1998)	163.3	-74.1	-10.9	Peraluminous leucogranites	4	-10.3	-15.0	2.1	-13.9
Rocchi (1998)	164.6	-73.9	-13.3	Peraluminous leucogranites	3	-11.7	-14.0	1.2	-12.6
Rocchi (1998)	163.9	-73.8	-12.4	Deep Freeze Range	7	-6.6	-14.0	3.0	-11.9

Rocchi (1998)	165.8	-73.6	-12.5	Terra Nove Intrusives	2	-10.3	-11.9	1.1	-11.1
Rocchi (1998)	164.4	-73.4	-11.7	Prince Albert Mts	4	-12.3	-13.2	0.4	-12.6
Borg (1991)	167.0	-70.7	-16.11	Surgeon Island	2	-15.6	-16.6	0.7	-16.1
Borg (1991)	165.1	-70.6	-11.55	Cooper Spur	1				
Borg (1991)	157.1	-83.3	-24.11	Miller Range	6	-10.6	-33.3	9.0	-27.1
Borg (1991)	158.7	-80.8	0.21	Shackleton Coast	1				
Borg (1991)	139.8	-66.7	-23.23	Adelie Coast	1				
Borg (1991)	157.3	-80.2	-13.53	Byrd Glacier	4	-11.8	-15.4	1.6	-13.4
Borg (1991)	-124.9	-85.5	-6.78	Horlick Mountains	8	-3.3	-8.8	2.0	-7.2
Borg (1991)	162.0	-77.5	-8.61	Dry Valleys	4	-6.6	-10.8	2.1	-8.5
Borg (1991)	-103.9	-82.4	-4.12	Whitmore Mountains	1				
Borg (1987)	163.0	-72.5	-13.0	Granite Harbor Intrusives	5	-10.1	-14.2	-14.2	-13.5
Borg (1987)	166.5	-72.1	-7.5	Admiralty Intrusives	7	-4.4	-11.3	2.6	-7.9
Sheraton et al., (1990)	100.9	-66.2	-20.2	Bunger Hills	4	-14.8	-23.4	3.8	-21.3
Peucat et al., (1999)	140.0	-66.7	-20.6	Adélie Land	4	-19.6	-21.8	1.0	-20.4
Möller et al., (2002)	110.4	-66.4	-15.9	Windmill Islands	16	-1.6	-26.1	5.6	-15.7

εNd values represent an average from samples taken over a small geographic area.
* for data presented in original publications as εNd(t), we have used a CHUR value of 0.512638 to calculate εNd(0).

Chapter 3. Appendix A. U-Pb Zircon Analyses. U-Pb analyses were performed at the University of Arizona's LASERCHRON Lab. Sri Lanka zircon standards were analyzed throughout the sampling to account for mass fractionation.

Core ID	Core Name	Best Age (Ma)	± (Ma)		# *grains*
1	IWSOE 68-11			***n=***	***0***
2	IWSOE 68 G8			***n=***	***0***
3	IWSOE 70 2-22-2	98.9	16.7	***n=***	***137***
3	IWSOE 70 2-22-2	109.0	1.1		
3	IWSOE 70 2-22-2	109.0	1.1		
3	IWSOE 70 2-22-2	110.6	1.4		
3	IWSOE 70 2-22-2	110.9	5.5		
3	IWSOE 70 2-22-2	110.9	5.5		
3	IWSOE 70 2-22-2	112.3	5.8		
3	IWSOE 70 2-22-2	116.8	1.2		
3	IWSOE 70 2-22-2	117.8	1.2		
3	IWSOE 70 2-22-2	173.7	4.8		
3	IWSOE 70 2-22-2	173.9	1.9		
3	IWSOE 70 2-22-2	178.8	1.8		
3	IWSOE 70 2-22-2	216.8	6.0		
3	IWSOE 70 2-22-2	216.8	6.0		
3	IWSOE 70 2-22-2	279.6	9.6		
3	IWSOE 70 2-22-2	426.0	4.2		
3	IWSOE 70 2-22-2	426.0	4.2		
3	IWSOE 70 2-22-2	428.4	57.0		
3	IWSOE 70 2-22-2	474.1	20.4		
3	IWSOE 70 2-22-2	477.2	44.6		
3	IWSOE 70 2-22-2	477.2	44.6		
3	IWSOE 70 2-22-2	494.2	8.2		
3	IWSOE 70 2-22-2	494.2	8.2		
3	IWSOE 70 2-22-2	495.3	7.9		
3	IWSOE 70 2-22-2	500.1	4.8		
3	IWSOE 70 2-22-2	501.1	4.8		
3	IWSOE 70 2-22-2	509.7	4.9		
3	IWSOE 70 2-22-2	510.5	4.9		
3	IWSOE 70 2-22-2	510.5	4.9		
3	IWSOE 70 2-22-2	511.0	24.3		
3	IWSOE 70 2-22-2	511.0	24.3		
3	IWSOE 70 2-22-2	518.1	5.0		
3	IWSOE 70 2-22-2	518.1	5.0		
3	IWSOE 70 2-22-2	518.5	5.0		
3	IWSOE 70 2-22-2	518.5	5.0		
3	IWSOE 70 2-22-2	524.9	11.6		
3	IWSOE 70 2-22-2	524.9	11.6		
3	IWSOE 70 2-22-2	525.1	7.5		
3	IWSOE 70 2-22-2	526.8	64.1		
3	IWSOE 70 2-22-2	534.2	7.0		
3	IWSOE 70 2-22-2	534.5	10.7		
3	IWSOE 70 2-22-2	534.5	10.7		

3	IWSOE 70 2-22-2	535.3	21.6
3	IWSOE 70 2-22-2	536.6	9.0
3	IWSOE 70 2-22-2	537.5	5.2
3	IWSOE 70 2-22-2	539.2	25.5
3	IWSOE 70 2-22-2	540.3	6.0
3	IWSOE 70 2-22-2	540.3	6.0
3	IWSOE 70 2-22-2	540.9	12.9
3	IWSOE 70 2-22-2	543.4	5.2
3	IWSOE 70 2-22-2	544.4	8.2
3	IWSOE 70 2-22-2	544.4	8.2
3	IWSOE 70 2-22-2	545.5	10.5
3	IWSOE 70 2-22-2	545.5	10.5
3	IWSOE 70 2-22-2	548.0	5.3
3	IWSOE 70 2-22-2	548.4	20.8
3	IWSOE 70 2-22-2	550.7	11.8
3	IWSOE 70 2-22-2	552.3	6.6
3	IWSOE 70 2-22-2	557.2	5.3
3	IWSOE 70 2-22-2	564.5	26.0
3	IWSOE 70 2-22-2	565.5	17.6
3	IWSOE 70 2-22-2	565.6	9.2
3	IWSOE 70 2-22-2	565.6	9.2
3	IWSOE 70 2-22-2	567.5	5.4
3	IWSOE 70 2-22-2	567.5	5.4
3	IWSOE 70 2-22-2	567.9	40.7
3	IWSOE 70 2-22-2	567.9	40.7
3	IWSOE 70 2-22-2	574.0	5.5
3	IWSOE 70 2-22-2	577.5	10.6
3	IWSOE 70 2-22-2	580.1	7.7
3	IWSOE 70 2-22-2	582.9	7.7
3	IWSOE 70 2-22-2	589.4	12.3
3	IWSOE 70 2-22-2	589.4	12.3
3	IWSOE 70 2-22-2	591.5	5.7
3	IWSOE 70 2-22-2	591.5	5.7
3	IWSOE 70 2-22-2	593.3	5.7
3	IWSOE 70 2-22-2	593.3	5.7
3	IWSOE 70 2-22-2	606.4	5.8
3	IWSOE 70 2-22-2	609.4	57.9
3	IWSOE 70 2-22-2	612.3	18.4
3	IWSOE 70 2-22-2	612.3	18.4
3	IWSOE 70 2-22-2	614.7	82.7
3	IWSOE 70 2-22-2	624.5	9.5
3	IWSOE 70 2-22-2	626.8	15.2
3	IWSOE 70 2-22-2	630.8	9.6
3	IWSOE 70 2-22-2	644.5	6.1
3	IWSOE 70 2-22-2	652.9	8.3
3	IWSOE 70 2-22-2	653.0	8.2
3	IWSOE 70 2-22-2	653.5	11.8
3	IWSOE 70 2-22-2	656.9	6.2
3	IWSOE 70 2-22-2	660.0	14.9

3	IWSOE 70 2-22-2	663.6	18.9		
3	IWSOE 70 2-22-2	672.2	11.6		
3	IWSOE 70 2-22-2	675.9	6.5		
3	IWSOE 70 2-22-2	675.9	6.5		
3	IWSOE 70 2-22-2	707.6	9.2		
3	IWSOE 70 2-22-2	748.2	78.4		
3	IWSOE 70 2-22-2	754.2	7.1		
3	IWSOE 70 2-22-2	756.5	49.0		
3	IWSOE 70 2-22-2	830.6	88.8		
3	IWSOE 70 2-22-2	879.7	40.4		
3	IWSOE 70 2-22-2	879.7	40.4		
3	IWSOE 70 2-22-2	1048.5	122.1		
3	IWSOE 70 2-22-2	1048.7	71.6		
3	IWSOE 70 2-22-2	1060.5	45.3		
3	IWSOE 70 2-22-2	1092.9	70.2		
3	IWSOE 70 2-22-2	1092.9	70.2		
3	IWSOE 70 2-22-2	1103.7	38.4		
3	IWSOE 70 2-22-2	1110.5	120.6		
3	IWSOE 70 2-22-2	1124.0	66.2		
3	IWSOE 70 2-22-2	1124.0	66.2		
3	IWSOE 70 2-22-2	1149.7	49.5		
3	IWSOE 70 2-22-2	1170.3	70.3		
3	IWSOE 70 2-22-2	1170.3	70.3		
3	IWSOE 70 2-22-2	1198.1	34.1		
3	IWSOE 70 2-22-2	1219.1	120.7		
3	IWSOE 70 2-22-2	1219.1	120.7		
3	IWSOE 70 2-22-2	1226.6	70.3		
3	IWSOE 70 2-22-2	1323.6	83.7		
3	IWSOE 70 2-22-2	1385.2	65.9		
3	IWSOE 70 2-22-2	1513.7	61.6		
3	IWSOE 70 2-22-2	1621.9	47.3		
3	IWSOE 70 2-22-2	1702.8	739.7		
3	IWSOE 70 2-22-2	1718.7	49.4		
3	IWSOE 70 2-22-2	1737.2	49.6		
3	IWSOE 70 2-22-2	1748.4	43.6		
3	IWSOE 70 2-22-2	1748.4	43.6		
3	IWSOE 70 2-22-2	1772.5	96.3		
3	IWSOE 70 2-22-2	1777.4	96.2		
3	IWSOE 70 2-22-2	1891.7	65.3		
3	IWSOE 70 2-22-2	1891.7	65.3		
3	IWSOE 70 2-22-2	2673.2	64.6		
3	IWSOE 70 2-22-2	2681.0	36.7		
3	IWSOE 70 2-22-2	2754.1	47.0		
3	IWSOE 70 2-22-2	2758.1	47.0		
3	IWSOE 70 2-22-2	3294.8	189.1		
3	IWSOE 70 2-22-2	3294.8	189.1		
4	IWSOE 69 G17	457.7	5.2	***n=***	***15***
4	IWSOE 69 G17	985.8	50.1		
4	IWSOE 69 G17	992.5	100.4		

4	IWSOE 69 G17	998.9	78.5		
4	IWSOE 69 G17	1006.0	119.7		
4	IWSOE 69 G17	1022.4	77.0		
4	IWSOE 69 G17	1026.5	9.5		
4	IWSOE 69 G17	1046.6	97.8		
4	IWSOE 69 G17	1115.1	70.2		
4	IWSOE 69 G17	1139.3	149.7		
4	IWSOE 69 G17	1177.0	67.2		
4	IWSOE 69 G17	1181.2	42.2		
4	IWSOE 69 G17	1638.5	185.4		
4	IWSOE 69 G17	1864.3	145.4		
4	IWSOE 69 G17	2352.8	140.7		
5	IWSOE 69 G21	170.9	11.1	***n=***	***60***
5	IWSOE 69 G21	178.5	5.2		
5	IWSOE 69 G21	183.0	4.0		
5	IWSOE 69 G21	189.2	2.6		
5	IWSOE 69 G21	202.8	2.4		
5	IWSOE 69 G21	258.4	2.5		
5	IWSOE 69 G21	481.0	5.9		
5	IWSOE 69 G21	499.0	11.2		
5	IWSOE 69 G21	499.9	75.9		
5	IWSOE 69 G21	501.9	10.0		
5	IWSOE 69 G21	516.1	7.0		
5	IWSOE 69 G21	518.3	54.2		
5	IWSOE 69 G21	528.3	32.0		
5	IWSOE 69 G21	550.3	105.0		
5	IWSOE 69 G21	552.0	7.1		
5	IWSOE 69 G21	575.1	16.7		
5	IWSOE 69 G21	588.1	12.4		
5	IWSOE 69 G21	594.0	55.4		
5	IWSOE 69 G21	626.1	17.1		
5	IWSOE 69 G21	644.5	12.9		
5	IWSOE 69 G21	658.0	24.0		
5	IWSOE 69 G21	660.6	19.7		
5	IWSOE 69 G21	674.9	53.8		
5	IWSOE 69 G21	701.0	8.5		
5	IWSOE 69 G21	1029.4	13.6		
5	IWSOE 69 G21	1029.9	13.1		
5	IWSOE 69 G21	1030.8	15.1		
5	IWSOE 69 G21	1047.1	14.8		
5	IWSOE 69 G21	1053.2	10.5		
5	IWSOE 69 G21	1069.1	16.9		
5	IWSOE 69 G21	1071.8	88.0		
5	IWSOE 69 G21	1074.9	23.2		
5	IWSOE 69 G21	1078.2	19.0		
5	IWSOE 69 G21	1078.9	132.8		
5	IWSOE 69 G21	1079.8	37.3		
5	IWSOE 69 G21	1081.4	7.8		
5	IWSOE 69 G21	1085.5	20.2		

5	IWSOE 69 G21	1086.0	25.9		
5	IWSOE 69 G21	1086.0	39.9		
5	IWSOE 69 G21	1086.1	61.2		
5	IWSOE 69 G21	1086.2	67.1		
5	IWSOE 69 G21	1091.6	26.6		
5	IWSOE 69 G21	1091.8	17.0		
5	IWSOE 69 G21	1097.1	4.8		
5	IWSOE 69 G21	1098.7	8.2		
5	IWSOE 69 G21	1101.1	25.7		
5	IWSOE 69 G21	1102.2	31.7		
5	IWSOE 69 G21	1103.3	7.5		
5	IWSOE 69 G21	1105.3	42.4		
5	IWSOE 69 G21	1106.9	7.4		
5	IWSOE 69 G21	1109.8	10.8		
5	IWSOE 69 G21	1112.8	13.6		
5	IWSOE 69 G21	1124.7	26.5		
5	IWSOE 69 G21	1127.5	37.3		
5	IWSOE 69 G21	1129.9	16.7		
5	IWSOE 69 G21	1131.5	6.8		
5	IWSOE 69 G21	1144.2	12.3		
5	IWSOE 69 G21	1176.0	20.3		
5	IWSOE 69 G21	1216.8	160.5		
5	IWSOE 69 G21	2729.9	8.7		
6	IWSOE 68 13-18-1	168.7	1.7	***n=***	***42***
6	IWSOE 68 13-18-1	181.3	1.8		
6	IWSOE 68 13-18-1	183.9	2.5		
6	IWSOE 68 13-18-1	474.5	4.6		
6	IWSOE 68 13-18-1	509.4	4.9		
6	IWSOE 68 13-18-1	525.9	11.0		
6	IWSOE 68 13-18-1	527.8	13.2		
6	IWSOE 68 13-18-1	532.4	12.4		
6	IWSOE 68 13-18-1	551.8	5.3		
6	IWSOE 68 13-18-1	563.2	8.4		
6	IWSOE 68 13-18-1	567.3	5.5		
6	IWSOE 68 13-18-1	583.0	5.6		
6	IWSOE 68 13-18-1	594.7	8.1		
6	IWSOE 68 13-18-1	635.6	16.3		
6	IWSOE 68 13-18-1	647.6	8.0		
6	IWSOE 68 13-18-1	777.8	14.1		
6	IWSOE 68 13-18-1	882.4	8.2		
6	IWSOE 68 13-18-1	918.7	13.7		
6	IWSOE 68 13-18-1	1017.0	52.4		
6	IWSOE 68 13-18-1	1054.0	45.0		
6	IWSOE 68 13-18-1	1061.1	37.9		
6	IWSOE 68 13-18-1	1084.1	63.6		
6	IWSOE 68 13-18-1	1088.4	37.0		
6	IWSOE 68 13-18-1	1096.7	37.6		
6	IWSOE 68 13-18-1	1096.9	28.4		
6	IWSOE 68 13-18-1	1105.4	33.7		

6	IWSOE 68 13-18-1	1109.4	107.9		
6	IWSOE 68 13-18-1	1114.8	65.4		
6	IWSOE 68 13-18-1	1126.2	96.5		
6	IWSOE 68 13-18-1	1128.5	51.5		
6	IWSOE 68 13-18-1	1130.7	107.7		
6	IWSOE 68 13-18-1	1131.4	79.0		
6	IWSOE 68 13-18-1	1133.5	38.4		
6	IWSOE 68 13-18-1	1181.0	102.2		
6	IWSOE 68 13-18-1	1183.0	60.9		
6	IWSOE 68 13-18-1	1219.8	70.7		
6	IWSOE 68 13-18-1	1236.2	64.7		
6	IWSOE 68 13-18-1	1249.2	45.7		
6	IWSOE 68 13-18-1	1345.0	52.2		
6	IWSOE 68 13-18-1	1383.5	257.4		
6	IWSOE 68 13-18-1	1594.4	95.5		
6	IWSOE 68 13-18-1	1772.6	138.7		
7	IWSOE 70 03-11-03	198.3	11.9	***n=***	***102***
7	IWSOE 70 03-11-03	273.7	8.8		
7	IWSOE 70 03-11-03	374.5	50.8		
7	IWSOE 70 03-11-03	397.9	42.5		
7	IWSOE 70 03-11-03	428.8	24.5		
7	IWSOE 70 03-11-03	466.4	19.4		
7	IWSOE 70 03-11-03	467.3	82.0		
7	IWSOE 70 03-11-03	475.4	28.2		
7	IWSOE 70 03-11-03	481.2	61.9		
7	IWSOE 70 03-11-03	482.4	35.0		
7	IWSOE 70 03-11-03	486.2	22.7		
7	IWSOE 70 03-11-03	497.9	23.1		
7	IWSOE 70 03-11-03	500.7	75.0		
7	IWSOE 70 03-11-03	504.5	6.8		
7	IWSOE 70 03-11-03	509.3	5.0		
7	IWSOE 70 03-11-03	509.3	9.3		
7	IWSOE 70 03-11-03	511.5	12.1		
7	IWSOE 70 03-11-03	511.5	7.8		
7	IWSOE 70 03-11-03	512.6	7.7		
7	IWSOE 70 03-11-03	514.6	22.4		
7	IWSOE 70 03-11-03	515.7	23.1		
7	IWSOE 70 03-11-03	516.5	7.0		
7	IWSOE 70 03-11-03	517.0	35.7		
7	IWSOE 70 03-11-03	521.1	12.4		
7	IWSOE 70 03-11-03	521.7	6.8		
7	IWSOE 70 03-11-03	525.7	5.3		
7	IWSOE 70 03-11-03	525.7	7.5		
7	IWSOE 70 03-11-03	528.4	4.6		
7	IWSOE 70 03-11-03	528.4	7.5		
7	IWSOE 70 03-11-03	529.5	25.7		
7	IWSOE 70 03-11-03	530.9	5.8		
7	IWSOE 70 03-11-03	532.2	14.5		
7	IWSOE 70 03-11-03	533.9	52.0		

7	IWSOE 70 03-11-03	534.9	37.0
7	IWSOE 70 03-11-03	536.0	4.9
7	IWSOE 70 03-11-03	536.4	18.4
7	IWSOE 70 03-11-03	538.3	52.5
7	IWSOE 70 03-11-03	538.4	32.4
7	IWSOE 70 03-11-03	538.6	9.0
7	IWSOE 70 03-11-03	540.5	10.7
7	IWSOE 70 03-11-03	545.4	18.6
7	IWSOE 70 03-11-03	545.9	11.1
7	IWSOE 70 03-11-03	548.3	14.4
7	IWSOE 70 03-11-03	549.4	93.0
7	IWSOE 70 03-11-03	552.0	12.4
7	IWSOE 70 03-11-03	554.9	56.2
7	IWSOE 70 03-11-03	555.7	15.6
7	IWSOE 70 03-11-03	557.3	8.7
7	IWSOE 70 03-11-03	562.1	19.4
7	IWSOE 70 03-11-03	562.3	6.1
7	IWSOE 70 03-11-03	566.1	62.3
7	IWSOE 70 03-11-03	566.1	11.3
7	IWSOE 70 03-11-03	569.3	42.4
7	IWSOE 70 03-11-03	570.4	6.1
7	IWSOE 70 03-11-03	572.8	12.3
7	IWSOE 70 03-11-03	573.3	8.8
7	IWSOE 70 03-11-03	573.9	9.3
7	IWSOE 70 03-11-03	585.4	19.2
7	IWSOE 70 03-11-03	586.7	11.0
7	IWSOE 70 03-11-03	586.7	33.3
7	IWSOE 70 03-11-03	596.5	2.8
7	IWSOE 70 03-11-03	619.9	25.2
7	IWSOE 70 03-11-03	621.9	6.0
7	IWSOE 70 03-11-03	651.7	64.8
7	IWSOE 70 03-11-03	652.7	65.3
7	IWSOE 70 03-11-03	667.3	54.9
7	IWSOE 70 03-11-03	671.9	68.3
7	IWSOE 70 03-11-03	716.7	25.8
7	IWSOE 70 03-11-03	722.5	41.9
7	IWSOE 70 03-11-03	725.1	10.7
7	IWSOE 70 03-11-03	746.0	20.8
7	IWSOE 70 03-11-03	747.9	131.7
7	IWSOE 70 03-11-03	754.5	8.4
7	IWSOE 70 03-11-03	790.4	45.2
7	IWSOE 70 03-11-03	859.1	59.5
7	IWSOE 70 03-11-03	940.2	190.6
7	IWSOE 70 03-11-03	987.8	26.8
7	IWSOE 70 03-11-03	989.2	33.8
7	IWSOE 70 03-11-03	1011.3	14.4
7	IWSOE 70 03-11-03	1021.2	18.3
7	IWSOE 70 03-11-03	1044.3	12.5
7	IWSOE 70 03-11-03	1048.4	15.3

7	IWSOE 70 03-11-03	1089.9	14.8		
7	IWSOE 70 03-11-03	1111.6	18.6		
7	IWSOE 70 03-11-03	1122.9	47.1		
7	IWSOE 70 03-11-03	1140.4	69.0		
7	IWSOE 70 03-11-03	1155.2	34.3		
7	IWSOE 70 03-11-03	1162.6	111.5		
7	IWSOE 70 03-11-03	1188.5	8.3		
7	IWSOE 70 03-11-03	1291.9	173.5		
7	IWSOE 70 03-11-03	1402.8	13.3		
7	IWSOE 70 03-11-03	1458.5	15.0		
7	IWSOE 70 03-11-03	1647.0	9.7		
7	IWSOE 70 03-11-03	1656.2	23.3		
7	IWSOE 70 03-11-03	1700.7	22.2		
7	IWSOE 70 03-11-03	1735.1	12.9		
7	IWSOE 70 03-11-03	1781.3	19.6		
7	IWSOE 70 03-11-03	1792.7	20.5		
7	IWSOE 70 03-11-03	1792.8	4.9		
7	IWSOE 70 03-11-03	1963.7	68.7		
7	IWSOE 70 03-11-03	2469.1	19.9		
7	IWSOE 70 03-11-03	2617.4	4.5		
8	IO1578-27	1065.4	24.5	***n=***	***20***
8	IO1578-27	1654.6	132.9		
8	IO1578-27	698.5	24.5		
8	IO1578-27	565.8	18.3		
8	IO1578-27	548.3	14.0		
8	IO1578-27	590.4	25.9		
8	IO1578-27	2587.3	5.7		
8	IO1578-27	479.9	8.7		
8	IO1578-27	924.3	4.1		
8	IO1578-27	472.1	40.6		
8	IO1578-27	515.8	22.4		
8	IO1578-27	1074.7	23.2		
8	IO1578-27	754.5	105.2		
8	IO1578-27	630.3	10.0		
8	IO1578-27	586.6	8.5		
8	IO1578-27	1094.9	19.6		
8	IO1578-27	510.1	43.4		
8	IO1578-27	606.8	6.7		
8	IO1578-27	752.1	100.1		
8	IO1578-27	579.8	5.1		
9	IO1578-28	313.9	51.4	***n=***	***77***
9	IO1578-28	446.3	52.7		
9	IO1578-28	461.9	20.3		
9	IO1578-28	464.8	68.0		
9	IO1578-28	470.9	28.0		
9	IO1578-28	479.3	86.5		
9	IO1578-28	498.1	6.4		
9	IO1578-28	504.3	9.7		
9	IO1578-28	506.2	5.3		

9	IO1578-28	507.4	76.7
9	IO1578-28	509.5	3.2
9	IO1578-28	510.4	22.4
9	IO1578-28	511.3	6.9
9	IO1578-28	513.7	18.2
9	IO1578-28	517.3	20.4
9	IO1578-28	518.8	14.4
9	IO1578-28	519.2	69.5
9	IO1578-28	519.4	17.2
9	IO1578-28	524.3	19.8
9	IO1578-28	526.0	66.6
9	IO1578-28	526.8	20.9
9	IO1578-28	533.5	16.4
9	IO1578-28	542.0	36.4
9	IO1578-28	548.2	15.0
9	IO1578-28	549.4	11.2
9	IO1578-28	553.4	95.3
9	IO1578-28	554.0	6.0
9	IO1578-28	554.5	83.8
9	IO1578-28	554.8	7.3
9	IO1578-28	556.5	63.2
9	IO1578-28	558.6	58.4
9	IO1578-28	558.9	10.0
9	IO1578-28	563.9	26.1
9	IO1578-28	572.4	5.7
9	IO1578-28	579.2	20.8
9	IO1578-28	580.7	60.1
9	IO1578-28	581.6	38.2
9	IO1578-28	592.3	10.2
9	IO1578-28	593.5	5.4
9	IO1578-28	595.4	12.0
9	IO1578-28	595.6	13.9
9	IO1578-28	599.9	20.0
9	IO1578-28	602.1	8.5
9	IO1578-28	604.4	8.4
9	IO1578-28	609.3	11.6
9	IO1578-28	611.7	10.6
9	IO1578-28	620.3	10.1
9	IO1578-28	624.8	14.7
9	IO1578-28	628.4	34.2
9	IO1578-28	630.9	13.4
9	IO1578-28	646.2	18.1
9	IO1578-28	646.2	25.4
9	IO1578-28	646.7	27.7
9	IO1578-28	648.7	11.2
9	IO1578-28	658.3	39.6
9	IO1578-28	662.5	13.7
9	IO1578-28	670.9	72.6
9	IO1578-28	675.8	59.0

9	IO1578-28	681.3	26.3		
9	IO1578-28	706.9	51.1		
9	IO1578-28	757.6	53.8		
9	IO1578-28	779.2	58.5		
9	IO1578-28	813.5	55.0		
9	IO1578-28	1004.5	52.9		
9	IO1578-28	1007.2	31.9		
9	IO1578-28	1012.9	24.6		
9	IO1578-28	1016.8	70.0		
9	IO1578-28	1054.7	16.2		
9	IO1578-28	1059.7	24.5		
9	IO1578-28	1083.4	27.9		
9	IO1578-28	1111.8	16.5		
9	IO1578-28	1129.1	16.6		
9	IO1578-28	1145.9	13.9		
9	IO1578-28	1159.1	9.3		
9	IO1578-28	1202.8	39.3		
9	IO1578-28	1218.4	56.4		
9	IO1578-28	2503.9	9.7		
10	IWSOE 3-17-2	304.0	7.4	***n=***	***53***
10	IWSOE 3-17-2	461.6	19.6		
10	IWSOE 3-17-2	492.9	15.1		
10	IWSOE 3-17-2	507.5	5.7		
10	IWSOE 3-17-2	510.3	7.4		
10	IWSOE 3-17-2	511.9	36.6		
10	IWSOE 3-17-2	515.2	5.0		
10	IWSOE 3-17-2	517.6	15.5		
10	IWSOE 3-17-2	519.4	5.0		
10	IWSOE 3-17-2	520.1	7.9		
10	IWSOE 3-17-2	520.8	13.0		
10	IWSOE 3-17-2	528.0	5.1		
10	IWSOE 3-17-2	528.3	5.1		
10	IWSOE 3-17-2	532.3	9.3		
10	IWSOE 3-17-2	532.9	16.4		
10	IWSOE 3-17-2	541.3	28.1		
10	IWSOE 3-17-2	546.8	11.4		
10	IWSOE 3-17-2	547.6	7.1		
10	IWSOE 3-17-2	549.3	18.5		
10	IWSOE 3-17-2	553.6	11.1		
10	IWSOE 3-17-2	554.5	20.4		
10	IWSOE 3-17-2	561.6	11.0		
10	IWSOE 3-17-2	567.2	5.4		
10	IWSOE 3-17-2	568.8	6.5		
10	IWSOE 3-17-2	575.4	6.8		
10	IWSOE 3-17-2	582.4	9.2		
10	IWSOE 3-17-2	584.9	15.3		
10	IWSOE 3-17-2	585.1	10.0		
10	IWSOE 3-17-2	586.4	12.6		
10	IWSOE 3-17-2	593.5	8.0		

10	IWSOE 3-17-2	625.0	14.8		
10	IWSOE 3-17-2	814.7	64.1		
10	IWSOE 3-17-2	855.6	38.9		
10	IWSOE 3-17-2	1019.4	62.4		
10	IWSOE 3-17-2	1077.1	72.5		
10	IWSOE 3-17-2	1086.1	57.7		
10	IWSOE 3-17-2	1101.9	69.8		
10	IWSOE 3-17-2	2633.8	127.8		
10	IWSOE 3-17-2	2777.9	64.0		
10	IWSOE 3-17-2	2806.2	75.6		
10	IWSOE 3-17-2	2867.9	203.5		
10	IWSOE 3-17-2	3111.5	67.7		
10	IWSOE 3-17-2	3161.6	59.9		
10	IWSOE 3-17-2	3196.8	61.2		
10	IWSOE 3-17-2	3333.2	73.5		
10	IWSOE 3-17-2	3430.5	60.0		
10	IWSOE 3-17-2	3485.7	32.5		
10	IWSOE 3-17-2	3523.9	39.7		
10	IWSOE 3-17-2	3544.9	127.8		
10	IWSOE 3-17-2	3627.5	64.3		
10	IWSOE 3-17-2	3645.3	38.4		
10	IWSOE 3-17-2	3681.0	32.1		
10	IWSOE 3-17-2	3733.6	120.1		
11	IO1578-16 128-130	319.9	49.1	***n=***	***77***
11	IO1578-16 128-130	374.2	63.1		
11	IO1578-16 128-130	391.1	44.7		
11	IO1578-16 128-130	474.6	8.1		
11	IO1578-16 128-130	490.4	2.9		
11	IO1578-16 128-130	509.8	9.0		
11	IO1578-16 128-130	510.2	22.0		
11	IO1578-16 128-130	512.8	13.1		
11	IO1578-16 128-130	533.6	3.5		
11	IO1578-16 128-130	551.9	35.4		
11	IO1578-16 128-130	556.9	7.1		
11	IO1578-16 128-130	576.7	4.3		
11	IO1578-16 128-130	577.0	9.9		
11	IO1578-16 128-130	588.4	18.4		
11	IO1578-16 128-130	596.3	32.8		
11	IO1578-16 128-130	599.4	14.4		
11	IO1578-16 128-130	602.7	12.2		
11	IO1578-16 128-130	617.4	54.6		
11	IO1578-16 128-130	628.8	17.1		
11	IO1578-16 128-130	637.4	8.5		
11	IO1578-16 128-130	696.4	59.1		
11	IO1578-16 128-130	717.6	121.8		
11	IO1578-16 128-130	858.8	131.8		
11	IO1578-16 128-130	1008.9	29.8		
11	IO1578-16 128-130	1037.1	27.0		
11	IO1578-16 128-130	1039.1	38.6		

11	IO1578-16 128-130	1048.4	8.5
11	IO1578-16 128-130	1069.9	6.8
11	IO1578-16 128-130	1084.6	17.2
11	IO1578-16 128-130	1125.9	102.9
11	IO1578-16 128-130	1160.7	33.0
11	IO1578-16 128-130	1241.8	139.3
11	IO1578-16 128-130	1852.3	15.6
11	IO1578-16 128-130	1886.8	12.2
11	IO1578-16 128-130	2584.9	62.6
11	IO1578-16 128-130	2727.9	81.7
11	IO1578-16 130-132	177.2	15.9
11	IO1578-16 130-132	249.2	2.8
11	IO1578-16 130-132	473.5	27.2
11	IO1578-16 130-132	500.5	30.5
11	IO1578-16 130-132	504.2	20.9
11	IO1578-16 130-132	518.9	7.7
11	IO1578-16 130-132	519.3	41.5
11	IO1578-16 130-132	520.4	9.7
11	IO1578-16 130-132	526.5	7.0
11	IO1578-16 130-132	539.9	7.2
11	IO1578-16 130-132	545.9	20.2
11	IO1578-16 130-132	546.5	19.3
11	IO1578-16 130-132	554.6	12.8
11	IO1578-16 130-132	562.6	51.6
11	IO1578-16 130-132	568.0	56.6
11	IO1578-16 130-132	569.6	78.4
11	IO1578-16 130-132	593.7	19.8
11	IO1578-16 130-132	599.1	10.5
11	IO1578-16 130-132	604.4	71.2
11	IO1578-16 130-132	604.6	21.5
11	IO1578-16 130-132	613.9	58.7
11	IO1578-16 130-132	614.6	7.0
11	IO1578-16 130-132	615.2	56.6
11	IO1578-16 130-132	618.0	8.9
11	IO1578-16 130-132	637.2	23.9
11	IO1578-16 130-132	652.4	10.9
11	IO1578-16 130-132	824.3	17.4
11	IO1578-16 130-132	1043.3	30.3
11	IO1578-16 130-132	1059.0	52.6
11	IO1578-16 130-132	1062.5	43.9
11	IO1578-16 130-132	1069.2	11.8
11	IO1578-16 130-132	1082.9	16.6
11	IO1578-16 130-132	1091.5	9.1
11	IO1578-16 130-132	1091.5	20.6
11	IO1578-16 130-132	1132.6	62.4
11	IO1578-16 130-132	1148.7	29.9
11	IO1578-16 130-132	1188.4	78.0
11	IO1578-16 130-132	1195.4	95.6
11	IO1578-16 130-132	1761.4	8.2

11	IO1578-16 130-132	1874.3	7.8		
11	IO1578-16 130-132	2063.6	74.8		
12	IWSOE 70 3-18-01	284.7	6.4	***n=***	***46***
12	IWSOE 70 3-18-01	508.8	12.5		
12	IWSOE 70 3-18-01	511.9	8.6		
12	IWSOE 70 3-18-01	513.9	14.4		
12	IWSOE 70 3-18-01	514.1	6.2		
12	IWSOE 70 3-18-01	516.2	7.6		
12	IWSOE 70 3-18-01	519.2	11.3		
12	IWSOE 70 3-18-01	519.4	6.1		
12	IWSOE 70 3-18-01	525.4	16.8		
12	IWSOE 70 3-18-01	525.7	11.1		
12	IWSOE 70 3-18-01	529.0	33.1		
12	IWSOE 70 3-18-01	531.1	17.9		
12	IWSOE 70 3-18-01	533.9	12.6		
12	IWSOE 70 3-18-01	535.4	7.6		
12	IWSOE 70 3-18-01	544.1	59.3		
12	IWSOE 70 3-18-01	544.4	74.8		
12	IWSOE 70 3-18-01	553.0	10.0		
12	IWSOE 70 3-18-01	566.0	10.6		
12	IWSOE 70 3-18-01	570.0	7.9		
12	IWSOE 70 3-18-01	571.1	25.3		
12	IWSOE 70 3-18-01	572.3	5.4		
12	IWSOE 70 3-18-01	598.7	13.5		
12	IWSOE 70 3-18-01	605.6	17.9		
12	IWSOE 70 3-18-01	607.9	16.2		
12	IWSOE 70 3-18-01	610.2	11.8		
12	IWSOE 70 3-18-01	616.1	22.4		
12	IWSOE 70 3-18-01	626.6	33.6		
12	IWSOE 70 3-18-01	627.3	9.8		
12	IWSOE 70 3-18-01	634.4	12.7		
12	IWSOE 70 3-18-01	637.8	10.6		
12	IWSOE 70 3-18-01	642.5	4.7		
12	IWSOE 70 3-18-01	650.1	22.3		
12	IWSOE 70 3-18-01	654.3	8.4		
12	IWSOE 70 3-18-01	659.2	20.0		
12	IWSOE 70 3-18-01	665.1	6.7		
12	IWSOE 70 3-18-01	665.1	30.1		
12	IWSOE 70 3-18-01	679.8	26.5		
12	IWSOE 70 3-18-01	923.8	57.1		
12	IWSOE 70 3-18-01	945.2	12.6		
12	IWSOE 70 3-18-01	989.9	25.4		
12	IWSOE 70 3-18-01	1022.6	44.7		
12	IWSOE 70 3-18-01	1023.4	35.7		
12	IWSOE 70 3-18-01	1064.6	20.9		
12	IWSOE 70 3-18-01	1066.7	71.3		
12	IWSOE 70 3-18-01	1115.6	61.4		
12	IWSOE 70 3-18-01	3206.0	52.4		
13	IO1277-41			*n=*	*0*

14	IO1277-23	381.3	711.0	*n=*	*125*
14	IO1277-23	381.3	68.9		
14	IO1277-23	387.0	56.8		
14	IO1277-23	388.3	360.6		
14	IO1277-23	400.3	262.0		
14	IO1277-23	419.8	100.0		
14	IO1277-23	423.7	196.1		
14	IO1277-23	455.7	15.1		
14	IO1277-23	461.7	102.8		
14	IO1277-23	470.9	87.7		
14	IO1277-23	471.4	137.3		
14	IO1277-23	472.0	109.9		
14	IO1277-23	478.9	54.4		
14	IO1277-23	480.4	44.4		
14	IO1277-23	481.1	58.3		
14	IO1277-23	486.3	73.4		
14	IO1277-23	486.4	13.8		
14	IO1277-23	492.3	71.6		
14	IO1277-23	492.9	53.5		
14	IO1277-23	494.9	11.6		
14	IO1277-23	496.7	18.6		
14	IO1277-23	497.3	20.5		
14	IO1277-23	497.4	26.7		
14	IO1277-23	497.8	14.6		
14	IO1277-23	501.6	14.6		
14	IO1277-23	503.9	9.7		
14	IO1277-23	504.1	6.9		
14	IO1277-23	507.0	16.8		
14	IO1277-23	508.6	103.0		
14	IO1277-23	508.8	38.5		
14	IO1277-23	511.4	10.4		
14	IO1277-23	517.2	8.1		
14	IO1277-23	518.2	9.7		
14	IO1277-23	520.1	24.0		
14	IO1277-23	520.2	103.0		
14	IO1277-23	521.8	11.5		
14	IO1277-23	522.5	9.5		
14	IO1277-23	522.6	16.6		
14	IO1277-23	523.0	4.8		
14	IO1277-23	525.8	14.8		
14	IO1277-23	526.8	5.9		
14	IO1277-23	527.1	16.2		
14	IO1277-23	528.8	6.5		
14	IO1277-23	535.4	10.7		
14	IO1277-23	535.8	20.0		
14	IO1277-23	537.2	6.0		
14	IO1277-23	538.2	14.3		
14	IO1277-23	541.0	95.3		
14	IO1277-23	541.6	15.6		

14	IO1277-23	543.8	16.7
14	IO1277-23	544.5	14.0
14	IO1277-23	549.7	7.7
14	IO1277-23	551.2	9.2
14	IO1277-23	551.6	9.8
14	IO1277-23	558.8	11.8
14	IO1277-23	560.9	6.1
14	IO1277-23	562.1	11.0
14	IO1277-23	566.1	17.6
14	IO1277-23	569.1	19.4
14	IO1277-23	569.7	7.0
14	IO1277-23	570.4	8.2
14	IO1277-23	573.9	18.4
14	IO1277-23	575.7	10.1
14	IO1277-23	588.9	22.1
14	IO1277-23	589.4	7.5
14	IO1277-23	595.8	174.2
14	IO1277-23	603.6	33.5
14	IO1277-23	603.9	28.9
14	IO1277-23	609.9	13.8
14	IO1277-23	620.2	9.9
14	IO1277-23	620.5	89.9
14	IO1277-23	623.6	7.3
14	IO1277-23	626.8	94.6
14	IO1277-23	631.5	18.2
14	IO1277-23	639.5	36.8
14	IO1277-23	640.6	24.6
14	IO1277-23	658.2	18.2
14	IO1277-23	661.4	17.0
14	IO1277-23	667.0	8.0
14	IO1277-23	667.4	292.4
14	IO1277-23	667.5	233.6
14	IO1277-23	671.9	156.5
14	IO1277-23	683.8	5.5
14	IO1277-23	694.9	41.4
14	IO1277-23	703.4	22.3
14	IO1277-23	731.1	36.1
14	IO1277-23	739.6	104.7
14	IO1277-23	761.8	112.2
14	IO1277-23	769.5	44.4
14	IO1277-23	795.7	47.3
14	IO1277-23	866.5	52.1
14	IO1277-23	906.5	33.4
14	IO1277-23	925.9	22.2
14	IO1277-23	989.6	54.8
14	IO1277-23	994.3	24.5
14	IO1277-23	1009.1	39.7
14	IO1277-23	1018.6	35.4
14	IO1277-23	1023.8	17.3

14	IO1277-23	1031.0	10.7		
14	IO1277-23	1033.7	15.4		
14	IO1277-23	1035.3	34.0		
14	IO1277-23	1035.8	11.7		
14	IO1277-23	1036.9	7.0		
14	IO1277-23	1042.5	50.5		
14	IO1277-23	1044.0	48.9		
14	IO1277-23	1045.0	41.7		
14	IO1277-23	1045.3	37.5		
14	IO1277-23	1055.3	14.7		
14	IO1277-23	1055.8	7.4		
14	IO1277-23	1081.6	50.2		
14	IO1277-23	1116.6	14.7		
14	IO1277-23	1121.4	14.0		
14	IO1277-23	1124.4	30.1		
14	IO1277-23	1144.7	22.6		
14	IO1277-23	1244.7	686.1		
14	IO1277-23	1321.7	16.3		
14	IO1277-23	1630.9	674.5		
14	IO1277-23	1642.4	1491.9		
14	IO1277-23	1763.6	1143.3		
14	IO1277-23	1864.1	89.3		
14	IO1277-23	1909.1	475.6		
14	IO1277-23	1971.1	210.2		
14	IO1277-23	2015.5	39.1		
14	IO1277-23	3400.3	434.5		
14	IO1277-23	4404.7	970.0		
15	NBP 01-01 JPC 40	472.8	29.5	*n=*	*95*
15	NBP 01-01 JPC 40	556.7	11.5		
15	NBP 01-01 JPC 40	620.0	33.0		
15	NBP 01-01 JPC 40	649.3	41.7		
15	NBP 01-01 JPC 40	660.4	28.2		
15	NBP 01-01 JPC 40	661.8	20.3		
15	NBP 01-01 JPC 40	690.0	28.6		
15	NBP 01-01 JPC 40	693.1	9.4		
15	NBP 01-01 JPC 40	695.0	15.8		
15	NBP 01-01 JPC 40	696.5	12.5		
15	NBP 01-01 JPC 40	720.2	25.6		
15	NBP 01-01 JPC 40	735.8	24.9		
15	NBP 01-01 JPC 40	762.7	32.8		
15	NBP 01-01 JPC 40	771.4	20.7		
15	NBP 01-01 JPC 40	773.2	16.2		
15	NBP 01-01 JPC 40	785.0	21.3		
15	NBP 01-01 JPC 40	794.0	23.5		
15	NBP 01-01 JPC 40	800.3	10.5		
15	NBP 01-01 JPC 40	816.6	28.3		
15	NBP 01-01 JPC 40	816.7	15.6		
15	NBP 01-01 JPC 40	852.8	44.7		
15	NBP 01-01 JPC 40	859.2	23.8		

15	NBP 01-01 JPC 40	861.6	19.1
15	NBP 01-01 JPC 40	864.7	9.2
15	NBP 01-01 JPC 40	881.8	21.2
15	NBP 01-01 JPC 40	887.5	34.1
15	NBP 01-01 JPC 40	897.2	48.7
15	NBP 01-01 JPC 40	898.5	17.8
15	NBP 01-01 JPC 40	899.6	17.0
15	NBP 01-01 JPC 40	901.9	29.3
15	NBP 01-01 JPC 40	903.5	18.7
15	NBP 01-01 JPC 40	904.8	8.9
15	NBP 01-01 JPC 40	914.8	13.2
15	NBP 01-01 JPC 40	915.0	16.4
15	NBP 01-01 JPC 40	917.7	19.3
15	NBP 01-01 JPC 40	920.5	28.5
15	NBP 01-01 JPC 40	923.6	32.0
15	NBP 01-01 JPC 40	928.4	70.7
15	NBP 01-01 JPC 40	931.6	41.7
15	NBP 01-01 JPC 40	932.3	18.1
15	NBP 01-01 JPC 40	934.1	26.5
15	NBP 01-01 JPC 40	939.5	40.9
15	NBP 01-01 JPC 40	940.5	70.5
15	NBP 01-01 JPC 40	942.9	12.3
15	NBP 01-01 JPC 40	943.1	53.8
15	NBP 01-01 JPC 40	944.3	40.8
15	NBP 01-01 JPC 40	944.9	25.5
15	NBP 01-01 JPC 40	946.7	8.8
15	NBP 01-01 JPC 40	946.8	19.4
15	NBP 01-01 JPC 40	949.5	35.6
15	NBP 01-01 JPC 40	950.9	19.7
15	NBP 01-01 JPC 40	951.2	69.8
15	NBP 01-01 JPC 40	956.0	18.5
15	NBP 01-01 JPC 40	956.2	41.6
15	NBP 01-01 JPC 40	957.0	18.7
15	NBP 01-01 JPC 40	962.2	36.1
15	NBP 01-01 JPC 40	963.0	30.2
15	NBP 01-01 JPC 40	964.8	12.2
15	NBP 01-01 JPC 40	966.1	53.9
15	NBP 01-01 JPC 40	969.0	9.0
15	NBP 01-01 JPC 40	971.0	15.4
15	NBP 01-01 JPC 40	971.3	30.8
15	NBP 01-01 JPC 40	982.5	67.9
15	NBP 01-01 JPC 40	982.6	20.4
15	NBP 01-01 JPC 40	982.8	67.2
15	NBP 01-01 JPC 40	986.7	51.3
15	NBP 01-01 JPC 40	992.7	21.8
15	NBP 01-01 JPC 40	1000.1	15.1
15	NBP 01-01 JPC 40	1004.7	17.2
15	NBP 01-01 JPC 40	1008.7	16.2
15	NBP 01-01 JPC 40	1009.3	21.0

15	NBP 01-01 JPC 40	1009.6	17.8		
15	NBP 01-01 JPC 40	1010.6	16.9		
15	NBP 01-01 JPC 40	1024.0	22.4		
15	NBP 01-01 JPC 40	1026.0	64.3		
15	NBP 01-01 JPC 40	1029.5	25.7		
15	NBP 01-01 JPC 40	1030.3	17.2		
15	NBP 01-01 JPC 40	1035.3	58.6		
15	NBP 01-01 JPC 40	1039.5	25.1		
15	NBP 01-01 JPC 40	1057.3	34.1		
15	NBP 01-01 JPC 40	1063.0	27.5		
15	NBP 01-01 JPC 40	1100.1	46.0		
15	NBP 01-01 JPC 40	1103.5	95.0		
15	NBP 01-01 JPC 40	1120.4	59.3		
15	NBP 01-01 JPC 40	1149.8	67.4		
15	NBP 01-01 JPC 40	1162.0	44.1		
15	NBP 01-01 JPC 40	1170.8	114.9		
15	NBP 01-01 JPC 40	1174.2	71.8		
15	NBP 01-01 JPC 40	1180.5	63.2		
15	NBP 01-01 JPC 40	1201.6	81.1		
15	NBP 01-01 JPC 40	1258.5	60.2		
15	NBP 01-01 JPC 40	1509.8	70.1		
15	NBP 01-01 JPC 40	1563.2	40.1		
15	NBP 01-01 JPC 40	2001.5	58.3		
15	NBP 01-01 JPC 40	2444.1	45.5		
16	ODP Site 1165	670.6	20.3	***n=***	***10***
16	ODP Site 1165	1136.2	5.3		
16	ODP Site 1165	1377.7	27.4		
16	ODP Site 1165	1212.8	13.1		
16	ODP Site 1165	566.7	14.6		
16	ODP Site 1165	1155.7	23.7		
16	ODP Site 1165	828.2	24.9		
16	ODP Site 1165	1180.6	20.6		
16	ODP Site 1165	2948.8	14.6		
16	ODP Site 1165	1194.2	45.5		
16	ODP Site 1165	1103.3	23.1	***n=***	***3***
16	ODP Site 1165	502.5	11.0		
16	ODP Site 1165	514.5	6.5		
16	ODP Site 1165	1244.3	30.4	***n=***	***31***
16	ODP Site 1165	3139.5	155.5		
16	ODP Site 1165	1154.5	32.0		
16	ODP Site 1165	1173.6	11.5		
16	ODP Site 1165	1176.6	7.0		
16	ODP Site 1165	1435.0	68.7		
16	ODP Site 1165	1730.6	39.1		
16	ODP Site 1165	1174.4	22.2		
16	ODP Site 1165	1228.5	24.1		
16	ODP Site 1165	1315.7	19.5		
16	ODP Site 1165	524.0	12.5		
16	ODP Site 1165	517.8	8.7		

16	ODP Site 1165	1208.1	8.2		
16	ODP Site 1165	1170.2	8.4		
16	ODP Site 1165	1224.3	93.4		
16	ODP Site 1165	522.4	11.8		
16	ODP Site 1165	574.7	16.9		
16	ODP Site 1165	1201.9	10.3		
16	ODP Site 1165	504.0	18.1		
16	ODP Site 1165	609.2	17.7		
16	ODP Site 1165	1185.5	6.0		
16	ODP Site 1165	548.7	26.6		
16	ODP Site 1165	538.4	7.3		
16	ODP Site 1165	1047.0	20.1		
16	ODP Site 1165	1225.0	44.9		
16	ODP Site 1165	557.9	29.8		
16	ODP Site 1165	521.0	21.2		
16	ODP Site 1165	554.9	15.1		
16	ODP Site 1165	851.1	18.9		
16	ODP Site 1165	744.0	91.8		
16	ODP Site 1165	1169.4	8.9		
16	ODP Site 1165	1267.7	41.3	***n=***	***13***
16	ODP Site 1165	450.3	62.7		
16	ODP Site 1165	1212.8	70.8		
16	ODP Site 1165	513.6	22.1		
16	ODP Site 1165	1244.9	90.4		
16	ODP Site 1165	989.3	61.3		
16	ODP Site 1165	1443.9	10.4		
16	ODP Site 1165	1172.1	42.1		
16	ODP Site 1165	1095.1	8.4		
16	ODP Site 1165	3165.6	12.4		
16	ODP Site 1165	521.4	14.5		
16	ODP Site 1165	539.8	10.8		
16	ODP Site 1165	586.0	46.5		
16	ODP Site 1165	564.5	8.0	***n=***	***21***
16	ODP Site 1165	1189.0	19.7		
16	ODP Site 1165	1186.5	167.7		
16	ODP Site 1165	2615.4	37.8		
16	ODP Site 1165	1146.2	60.4		
16	ODP Site 1165	1017.4	33.0		
16	ODP Site 1165	1372.5	154.8		
16	ODP Site 1165	1199.4	23.8		
16	ODP Site 1165	545.8	20.8		
16	ODP Site 1165	1143.0	33.2		
16	ODP Site 1165	813.3	146.9		
16	ODP Site 1165	1187.1	7.0		
16	ODP Site 1165	1131.1	12.2		
16	ODP Site 1165	1181.6	19.6		
16	ODP Site 1165	1184.0	22.5		
16	ODP Site 1165	530.9	18.0		
16	ODP Site 1165	2665.5	20.5		

16	ODP Site 1165	529.4	9.3		
16	ODP Site 1165	567.1	6.5		
16	ODP Site 1165	1188.6	27.5		
16	ODP Site 1165	647.8	55.3		
17	NBP 01-01 JPC 34	943.0	53.0	*n*=	*231*
17	NBP 01-01 JPC 34	993.9	23.6		
17	NBP 01-01 JPC 34	869.7	14.8		
17	NBP 01-01 JPC 34	555.7	16.1		
17	NBP 01-01 JPC 34	956.8	32.7		
17	NBP 01-01 JPC 34	1226.2	85.0		
17	NBP 01-01 JPC 34	2682.3	47.3		
17	NBP 01-01 JPC 34	989.4	9.6		
17	NBP 01-01 JPC 34	649.4	21.3		
17	NBP 01-01 JPC 34	1718.3	231.4		
17	NBP 01-01 JPC 34	1026.2	20.9		
17	NBP 01-01 JPC 34	573.9	12.0		
17	NBP 01-01 JPC 34	1336.2	70.4		
17	NBP 01-01 JPC 34	718.4	57.3		
17	NBP 01-01 JPC 34	756.9	60.5		
17	NBP 01-01 JPC 34	814.0	26.6		
17	NBP 01-01 JPC 34	884.0	30.3		
17	NBP 01-01 JPC 34	576.2	16.2		
17	NBP 01-01 JPC 34	1099.3	23.9		
17	NBP 01-01 JPC 34	1016.2	64.2		
17	NBP 01-01 JPC 34	1175.8	71.5		
17	NBP 01-01 JPC 34	916.9	8.5		
17	NBP 01-01 JPC 34	570.3	20.9		
17	NBP 01-01 JPC 34	801.1	21.9		
17	NBP 01-01 JPC 34	745.8	18.2		
17	NBP 01-01 JPC 34	909.7	20.1		
17	NBP 01-01 JPC 34	1398.2	147.3		
17	NBP 01-01 JPC 34	970.0	33.4		
17	NBP 01-01 JPC 34	1179.7	69.7		
17	NBP 01-01 JPC 34	1389.5	42.1		
17	NBP 01-01 JPC 34	542.1	9.4		
17	NBP 01-01 JPC 34	894.4	22.9		
17	NBP 01-01 JPC 34	1074.2	29.0		
17	NBP 01-01 JPC 34	864.7	38.2		
17	NBP 01-01 JPC 34	1087.4	45.7		
17	NBP 01-01 JPC 34	863.2	20.5		
17	NBP 01-01 JPC 34	966.1	38.9		
17	NBP 01-01 JPC 34	535.6	10.5		
17	NBP 01-01 JPC 34	572.3	26.0		
17	NBP 01-01 JPC 34	553.5	32.1		
17	NBP 01-01 JPC 34	1045.9	53.6		
17	NBP 01-01 JPC 34	1746.2	68.6		
17	NBP 01-01 JPC 34	975.9	20.1		
17	NBP 01-01 JPC 34	1589.2	104.2		
17	NBP 01-01 JPC 34	551.9	20.7		

17	NBP 01-01 JPC 34	931.4	14.9
17	NBP 01-01 JPC 34	993.6	52.2
17	NBP 01-01 JPC 34	698.1	23.4
17	NBP 01-01 JPC 34	715.4	26.8
17	NBP 01-01 JPC 34	954.2	18.6
17	NBP 01-01 JPC 34	1026.2	43.2
17	NBP 01-01 JPC 34	1175.8	56.2
17	NBP 01-01 JPC 34	924.0	14.8
17	NBP 01-01 JPC 34	1083.7	34.5
17	NBP 01-01 JPC 34	591.2	29.4
17	NBP 01-01 JPC 34	543.4	15.9
17	NBP 01-01 JPC 34	527.5	8.1
17	NBP 01-01 JPC 34	700.1	10.1
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17	NBP 01-01 JPC 34	973.2	44.2
17	NBP 01-01 JPC 34	965.6	38.6
17	NBP 01-01 JPC 34	560.4	20.3
17	NBP 01-01 JPC 34	977.8	33.2
17	NBP 01-01 JPC 34	566.6	9.3
17	NBP 01-01 JPC 34	955.7	22.4
17	NBP 01-01 JPC 34	494.6	25.9
17	NBP 01-01 JPC 34	917.2	29.3
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17	NBP 01-01 JPC 34	847.2	21.5
17	NBP 01-01 JPC 34	1022.7	28.8
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17	NBP 01-01 JPC 34	1033.2	60.0
17	NBP 01-01 JPC 34	994.1	9.2
17	NBP 01-01 JPC 34	932.4	37.5
17	NBP 01-01 JPC 34	971.4	34.6
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17	NBP 01-01 JPC 34	576.1	17.9
17	NBP 01-01 JPC 34	398.4	11.7
17	NBP 01-01 JPC 34	563.2	24.8
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17	NBP 01-01 JPC 34	1856.6	60.8
17	NBP 01-01 JPC 34	598.2	13.7
17	NBP 01-01 JPC 34	520.3	7.1
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17	NBP 01-01 JPC 34	1109.1	51.2
17	NBP 01-01 JPC 34	1042.6	49.4
17	NBP 01-01 JPC 34	532.4	11.9
17	NBP 01-01 JPC 34	533.9	12.1
17	NBP 01-01 JPC 34	883.3	34.3
17	NBP 01-01 JPC 34	1094.5	69.2

17	NBP 01-01 JPC 34	1779.1	18.6
17	NBP 01-01 JPC 34	903.6	11.9
17	NBP 01-01 JPC 34	2026.8	124.0
17	NBP 01-01 JPC 34	1452.6	54.2
17	NBP 01-01 JPC 34	973.6	12.4
17	NBP 01-01 JPC 34	823.1	14.5
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17	NBP 01-01 JPC 34	536.7	38.4
17	NBP 01-01 JPC 34	2317.4	30.7
17	NBP 01-01 JPC 34	674.9	30.4
17	NBP 01-01 JPC 34	2032.2	35.9
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17	NBP 01-01 JPC 34	516.5	8.4
17	NBP 01-01 JPC 34	568.7	18.8
17	NBP 01-01 JPC 34	2023.3	31.9
17	NBP 01-01 JPC 34	515.4	13.0
17	NBP 01-01 JPC 34	1647.0	74.8
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17	NBP 01-01 JPC 34	2680.4	38.4
17	NBP 01-01 JPC 34	2494.6	65.2
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17	NBP 01-01 JPC 34	1657.8	346.7
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17	NBP 01-01 JPC 34	538.5	8.0
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17	NBP 01-01 JPC 34	843.9	9.3
17	NBP 01-01 JPC 34	1698.5	118.6
17	NBP 01-01 JPC 34	2113.5	37.4
17	NBP 01-01 JPC 34	1931.5	51.4
17	NBP 01-01 JPC 34	1275.6	77.1
17	NBP 01-01 JPC 34	2396.1	66.0
17	NBP 01-01 JPC 34	606.9	21.0
17	NBP 01-01 JPC 34	547.0	6.8
17	NBP 01-01 JPC 34	946.4	40.0
17	NBP 01-01 JPC 34	950.9	32.5
17	NBP 01-01 JPC 34	891.2	9.9

17	NBP 01-01 JPC 34	2748.1	43.2
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17	NBP 01-01 JPC 34	552.7	10.1
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17	NBP 01-01 JPC 34	901.1	26.5
17	NBP 01-01 JPC 34	925.6	22.5
17	NBP 01-01 JPC 34	860.9	17.0
17	NBP 01-01 JPC 34	547.2	26.6
17	NBP 01-01 JPC 34	562.2	20.4
17	NBP 01-01 JPC 34	923.1	9.7
17	NBP 01-01 JPC 34	1769.5	76.4
17	NBP 01-01 JPC 34	2073.6	29.8
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17	NBP 01-01 JPC 34	3140.1	26.4
17	NBP 01-01 JPC 34	924.0	11.7
17	NBP 01-01 JPC 34	894.1	13.2
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17	NBP 01-01 JPC 34	610.9	5.8
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17	NBP 01-01 JPC 34	743.1	43.1
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17	NBP 01-01 JPC 34	528.9	18.5
17	NBP 01-01 JPC 34	2007.1	48.6
17	NBP 01-01 JPC 34	941.8	27.8
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17	NBP 01-01 JPC 34	545.7	10.9
17	NBP 01-01 JPC 34	2092.6	70.7
17	NBP 01-01 JPC 34	1004.4	19.3
17	NBP 01-01 JPC 34	587.6	25.6

17	NBP 01-01 JPC 34	2678.5	152.2		
17	NBP 01-01 JPC 34	634.3	52.5		
17	NBP 01-01 JPC 34	487.9	16.0		
17	NBP 01-01 JPC 34	559.0	10.8		
17	NBP 01-01 JPC 34	524.6	21.5		
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17	NBP 01-01 JPC 34	512.0	16.1		
17	NBP 01-01 JPC 34	2047.2	30.6		
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17	NBP 01-01 JPC 34	2000.3	71.3		
17	NBP 01-01 JPC 34	531.5	8.2		
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17	NBP 01-01 JPC 34	1088.2	19.4		
17	NBP 01-01 JPC 34	539.0	40.8		
17	NBP 01-01 JPC 34	2295.2	33.7		
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17	NBP 01-01 JPC 34	978.7	16.6		
17	NBP 01-01 JPC 34	1265.8	72.0		
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17	NBP 01-01 JPC 34	863.3	29.8		
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17	NBP 01-01 JPC 34	455.9	12.7		
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17	NBP 01-01 JPC 34	1040.2	20.7		
17	NBP 01-01 JPC 34	524.8	23.7		
17	NBP 01-01 JPC 34	1283.8	133.4		
17	NBP 01-01 JPC 34	552.2	19.9		
17	NBP 01-01 JPC 34	938.5	13.4		
17	NBP 01-01 JPC 34	1195.3	31.6		
17	NBP 01-01 JPC 34	535.5	8.1		
17	NBP 01-01 JPC 34	568.8	19.3		
17	NBP 01-01 JPC 34	585.4	55.6		
17	NBP 01-01 JPC 34	1070.1	24.5		
17	NBP 01-01 JPC 34	1339.4	19.4		
18	ODP 1166A	350.9	27.3	***n=***	***232***
18	ODP 1166A	691.2	31.1		
18	ODP 1166A	542.9	5.2		
18	ODP 1166A	496.2	14.1		
18	ODP 1166A	854.7	8.3		
18	ODP 1166A	406.5	22.8		
18	ODP 1166A	623.5	46.9		
18	ODP 1166A	531.1	5.8		
18	ODP 1166A	630.7	6.5		
18	ODP 1166A	941.3	28.2		

18	ODP 1166A	619.1	14.9
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18	ODP 1166A	588.6	7.3
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18	ODP 1166A	608.3	18.3
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18	ODP 1166A	901.1	87.5
18	ODP 1166A	905.4	15.4
18	ODP 1166A	558.4	8.4
18	ODP 1166A	933.1	15.7
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18	ODP 1166A	921.1	28.2
18	ODP 1166A	536.3	19.1
18	ODP 1166A	641.3	16.0
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18	ODP 1166A	3110.7	61.2
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18	ODP 1166A	520.9	12.0
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18	ODP 1166A	556.1	8.1
18	ODP 1166A	595.5	16.8
18	ODP 1166A	586.0	13.0
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18	ODP 1166A	711.0	23.2
18	ODP 1166A	958.7	28.8
18	ODP 1166A	548.7	9.0
18	ODP 1166A	953.7	95.2
18	ODP 1166A	875.0	43.1
18	ODP 1166A	555.8	15.0
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18	ODP 1166A	838.9	39.9
18	ODP 1166A	611.9	18.8
18	ODP 1166A	537.5	18.5
18	ODP 1166A	1001.0	25.9
18	ODP 1166A	571.9	17.9
18	ODP 1166A	688.6	9.1
18	ODP 1166A	543.3	15.6
18	ODP 1166A	1012.3	26.4
18	ODP 1166A	691.8	13.4
18	ODP 1166A	532.3	7.7
18	ODP 1166A	520.4	13.1
18	ODP 1166A	581.4	42.8
18	ODP 1166A	550.0	11.0
18	ODP 1166A	1142.4	73.8

18	ODP 1166A	665.1	48.4
18	ODP 1166A	523.6	10.8
18	ODP 1166A	562.3	14.7
18	ODP 1166A	831.2	28.7
18	ODP 1166A	567.9	25.1
18	ODP 1166A	530.0	18.9
18	ODP 1166A	531.0	13.8
18	ODP 1166A	946.2	40.5
18	ODP 1166A	758.1	69.0
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18	ODP 1166A	652.9	11.6
18	ODP 1166A	638.5	11.8
18	ODP 1166A	553.0	23.2
18	ODP 1166A	715.5	47.4
18	ODP 1166A	547.3	6.1
18	ODP 1166A	2734.2	79.2
18	ODP 1166A	2781.2	52.6
18	ODP 1166A	575.5	14.2
18	ODP 1166A	944.9	39.4
18	ODP 1166A	648.3	6.2
18	ODP 1166A	618.0	9.2
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18	ODP 1166A	601.0	20.2
18	ODP 1166A	954.4	20.6
18	ODP 1166A	612.9	11.0
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18	ODP 1166A	544.7	9.5
18	ODP 1166A	593.3	33.5
18	ODP 1166A	571.8	6.7
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18	ODP 1166A	519.2	10.5
18	ODP 1166A	3439.3	105.0
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18	ODP 1166A	3525.4	73.3
18	ODP 1166A	716.6	64.8
18	ODP 1166A	632.6	14.9
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18	ODP 1166A	900.1	19.9
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18	ODP 1166A	561.0	9.0
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18	ODP 1166A	541.0	14.5

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18	ODP 1166A	528.6	18.8
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18	ODP 1166A	566.9	13.7
18	ODP 1166A	444.3	27.3
18	ODP 1166A	530.9	32.4
18	ODP 1166A	718.0	31.1
18	ODP 1166A	548.3	27.4
18	ODP 1166A	856.3	46.6
18	ODP 1166A	955.3	15.5
18	ODP 1166A	952.2	17.3
18	ODP 1166A	865.9	36.0
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18	ODP 1166A	537.6	12.0
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18	ODP 1166A	574.5	29.5
18	ODP 1166A	937.6	24.0
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18	ODP 1166A	637.6	22.8
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18	ODP 1166A	798.2	14.5
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18	ODP 1166A	579.6	14.6
18	ODP 1166A	643.0	13.5
18	ODP 1166A	528.5	12.2
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18	ODP 1166A	736.1	39.6
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18	ODP 1166A	1637.1	29.5
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18	ODP 1166A	529.2	8.5
18	ODP 1166A	577.2	36.1
18	ODP 1166A	621.7	8.8
18	ODP 1166A	1657.1	72.3
18	ODP 1166A	1087.8	34.6

18	ODP 1166A	1504.7	45.3
18	ODP 1166A	857.3	68.7
18	ODP 1166A	884.6	30.3
18	ODP 1166A	3199.1	34.5
18	ODP 1166A	860.0	26.7
18	ODP 1166A	660.3	16.6
18	ODP 1166A	508.1	14.7
18	ODP 1166A	549.2	24.1
18	ODP 1166A	868.6	25.7
18	ODP 1166A	532.4	8.8
18	ODP 1166A	919.9	19.4
18	ODP 1166A	638.1	32.5
18	ODP 1166A	608.2	5.8
18	ODP 1166A	2155.4	67.9
18	ODP 1166A	533.3	25.0
18	ODP 1166A	529.0	5.1
18	ODP 1166A	860.5	17.5
18	ODP 1166A	842.5	21.0
18	ODP 1166A	754.4	38.3
18	ODP 1166A	1094.6	23.2
18	ODP 1166A	552.3	5.3
18	ODP 1166A	1715.9	29.5
18	ODP 1166A	737.3	10.0
18	ODP 1166A	2745.2	16.5
18	ODP 1166A	553.2	6.3
18	ODP 1166A	1014.6	54.9
18	ODP 1166A	586.7	14.5
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18	ODP 1166A	848.8	25.2
18	ODP 1166A	570.0	8.4
18	ODP 1166A	1014.0	17.8
18	ODP 1166A	619.7	14.1
18	ODP 1166A	601.8	23.1
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18	ODP 1166A	1081.9	67.9
18	ODP 1166A	570.4	12.8
18	ODP 1166A	514.7	7.2
18	ODP 1166A	521.2	12.7
18	ODP 1166A	523.6	22.5
18	ODP 1166A	523.6	12.0
18	ODP 1166A	524.1	11.9
18	ODP 1166A	526.7	11.4
18	ODP 1166A	528.0	17.8
18	ODP 1166A	529.6	17.5
18	ODP 1166A	530.7	11.0

18	ODP 1166A	537.9	14.8		
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18	ODP 1166A	623.2	15.4		
18	ODP 1166A	630.3	6.8		
18	ODP 1166A	631.2	27.8		
18	ODP 1166A	888.1	31.8		
18	ODP 1166A	888.6	24.3		
18	ODP 1166A	889.9	8.3		
18	ODP 1166A	915.4	18.9		
18	ODP 1166A	933.9	13.2		
18	ODP 1166A	957.4	23.5		
18	ODP 1166A	964.0	54.3		
18	ODP 1166A	965.5	12.5		
18	ODP 1166A	992.0	40.9		
18	ODP 1166A	997.3	9.2		
18	ODP 1166A	1025.6	33.1		
18	ODP 1166A	1036.5	12.1		
18	ODP 1166A	1042.0	35.2		
18	ODP 1166A	2057.3	32.0		
18	ODP 1166A	2716.9	25.4		
18	ODP 1166A	2900.2	65.4		
18	ODP 1166A	2994.9	43.0		
19	NBP01-01 JPC25	471.6	17.9	***n=***	***126***
19	NBP01-01 JPC25	483.6	10.4		
19	NBP01-01 JPC25	494.4	15.9		
19	NBP01-01 JPC25	496.3	8.5		
19	NBP01-01 JPC25	517.2	6.7		
19	NBP01-01 JPC25	518.3	6.8		
19	NBP01-01 JPC25	522.0	19.0		
19	NBP01-01 JPC25	525.5	16.9		
19	NBP01-01 JPC25	526.8	14.3		
19	NBP01-01 JPC25	529.3	16.1		
19	NBP01-01 JPC25	529.4	7.4		
19	NBP01-01 JPC25	530.6	6.8		
19	NBP01-01 JPC25	534.1	7.0		
19	NBP01-01 JPC25	535.2	14.8		
19	NBP01-01 JPC25	536.5	5.5		
19	NBP01-01 JPC25	537.6	11.2		
19	NBP01-01 JPC25	538.3	14.3		
19	NBP01-01 JPC25	538.3	8.1		
19	NBP01-01 JPC25	538.6	8.7		
19	NBP01-01 JPC25	538.9	8.5		
19	NBP01-01 JPC25	539.3	5.7		
19	NBP01-01 JPC25	539.8	8.8		
19	NBP01-01 JPC25	547.0	38.4		

19	NBP01-01 JPC25	551.5	14.0
19	NBP01-01 JPC25	554.2	6.1
19	NBP01-01 JPC25	554.8	5.9
19	NBP01-01 JPC25	557.2	25.9
19	NBP01-01 JPC25	561.6	14.1
19	NBP01-01 JPC25	562.1	12.6
19	NBP01-01 JPC25	564.7	5.4
19	NBP01-01 JPC25	564.9	5.7
19	NBP01-01 JPC25	565.1	20.6
19	NBP01-01 JPC25	565.5	11.7
19	NBP01-01 JPC25	566.9	8.2
19	NBP01-01 JPC25	576.9	5.5
19	NBP01-01 JPC25	581.9	28.1
19	NBP01-01 JPC25	584.3	13.7
19	NBP01-01 JPC25	586.3	11.1
19	NBP01-01 JPC25	586.8	39.4
19	NBP01-01 JPC25	587.8	12.3
19	NBP01-01 JPC25	588.6	14.6
19	NBP01-01 JPC25	588.8	38.5
19	NBP01-01 JPC25	589.6	12.5
19	NBP01-01 JPC25	597.9	33.6
19	NBP01-01 JPC25	602.4	11.5
19	NBP01-01 JPC25	620.2	34.1
19	NBP01-01 JPC25	620.8	17.0
19	NBP01-01 JPC25	626.4	25.2
19	NBP01-01 JPC25	648.5	47.1
19	NBP01-01 JPC25	658.0	25.7
19	NBP01-01 JPC25	658.7	12.7
19	NBP01-01 JPC25	673.8	14.8
19	NBP01-01 JPC25	674.0	20.7
19	NBP01-01 JPC25	679.2	38.2
19	NBP01-01 JPC25	682.4	65.3
19	NBP01-01 JPC25	682.7	12.6
19	NBP01-01 JPC25	685.3	39.7
19	NBP01-01 JPC25	694.7	31.2
19	NBP01-01 JPC25	695.6	51.2
19	NBP01-01 JPC25	699.8	15.6
19	NBP01-01 JPC25	701.6	20.6
19	NBP01-01 JPC25	702.4	29.8
19	NBP01-01 JPC25	702.6	26.1
19	NBP01-01 JPC25	710.7	43.5
19	NBP01-01 JPC25	718.1	8.5
19	NBP01-01 JPC25	734.5	43.7
19	NBP01-01 JPC25	734.6	30.6
19	NBP01-01 JPC25	738.5	9.5
19	NBP01-01 JPC25	748.7	38.8
19	NBP01-01 JPC25	750.4	40.3
19	NBP01-01 JPC25	751.7	21.4
19	NBP01-01 JPC25	753.4	17.7

19	NBP01-01 JPC25	755.0	32.6
19	NBP01-01 JPC25	759.9	74.4
19	NBP01-01 JPC25	765.5	55.3
19	NBP01-01 JPC25	777.6	32.6
19	NBP01-01 JPC25	787.4	33.4
19	NBP01-01 JPC25	790.4	57.7
19	NBP01-01 JPC25	803.8	36.5
19	NBP01-01 JPC25	808.6	67.9
19	NBP01-01 JPC25	810.4	12.9
19	NBP01-01 JPC25	812.9	20.9
19	NBP01-01 JPC25	813.1	25.3
19	NBP01-01 JPC25	830.0	63.4
19	NBP01-01 JPC25	840.4	60.7
19	NBP01-01 JPC25	857.2	33.3
19	NBP01-01 JPC25	858.8	15.2
19	NBP01-01 JPC25	860.4	16.8
19	NBP01-01 JPC25	865.0	22.2
19	NBP01-01 JPC25	872.6	28.7
19	NBP01-01 JPC25	879.9	9.3
19	NBP01-01 JPC25	882.7	52.5
19	NBP01-01 JPC25	882.8	14.4
19	NBP01-01 JPC25	883.3	18.9
19	NBP01-01 JPC25	885.3	36.9
19	NBP01-01 JPC25	886.8	13.6
19	NBP01-01 JPC25	889.0	23.0
19	NBP01-01 JPC25	889.5	84.0
19	NBP01-01 JPC25	892.2	48.8
19	NBP01-01 JPC25	894.9	8.4
19	NBP01-01 JPC25	895.9	24.1
19	NBP01-01 JPC25	908.2	35.7
19	NBP01-01 JPC25	911.1	55.0
19	NBP01-01 JPC25	912.5	16.2
19	NBP01-01 JPC25	915.6	53.6
19	NBP01-01 JPC25	920.2	12.5
19	NBP01-01 JPC25	921.2	13.3
19	NBP01-01 JPC25	928.5	10.6
19	NBP01-01 JPC25	930.7	18.4
19	NBP01-01 JPC25	932.8	30.7
19	NBP01-01 JPC25	932.9	52.4
19	NBP01-01 JPC25	939.6	70.9
19	NBP01-01 JPC25	957.5	15.3
19	NBP01-01 JPC25	970.8	16.5
19	NBP01-01 JPC25	974.9	36.7
19	NBP01-01 JPC25	994.9	56.5
19	NBP01-01 JPC25	1001.6	21.9
19	NBP01-01 JPC25	1002.5	68.1
19	NBP01-01 JPC25	1006.8	34.4
19	NBP01-01 JPC25	1040.2	51.3
19	NBP01-01 JPC25	1117.3	34.8

19	NBP01-01 JPC25	1133.2	47.8		
19	NBP01-01 JPC25	1257.8	82.5		
19	NBP01-01 JPC25	1477.6	59.4		
19	NBP01-01 JPC25	1798.5	162.3		
19	NBP01-01 JPC25	2480.3	58.0		
20	ELT49-30			***n=***	***0***
21	ELT37-16	1122.3	22.5	*n=*	*143*
21	ELT37-16	1132.6	30.9		
21	ELT37-16	1138.4	49.7		
21	ELT37-16	1140.0	9.3		
21	ELT37-16	1142.1	15.3		
21	ELT37-16	1147.6	9.0		
21	ELT37-16	1149.9	17.7		
21	ELT37-16	1151.2	20.4		
21	ELT37-16	1153.5	12.6		
21	ELT37-16	1158.8	42.0		
21	ELT37-16	1159.1	18.7		
21	ELT37-16	1160.1	29.0		
21	ELT37-16	1161.7	17.4		
21	ELT37-16	1166.1	49.8		
21	ELT37-16	1170.9	16.8		
21	ELT37-16	1172.3	34.5		
21	ELT37-16	1173.7	21.2		
21	ELT37-16	1174.5	19.4		
21	ELT37-16	1180.2	32.7		
21	ELT37-16	1180.2	26.0		
21	ELT37-16	1220.7	83.0		
21	ELT37-16	1271.8	201.3		
21	ELT37-16	1287.7	117.2		
21	ELT37-16	1321.2	146.6		
21	ELT37-16	1323.2	148.6		
21	ELT37-16	1351.9	155.2		
21	ELT37-16	1367.6	133.8		
21	ELT37-16	1394.3	83.4		
21	ELT37-16	1417.3	18.0		
21	ELT37-16	1422.2	116.1		
21	ELT37-16	1431.4	65.8		
21	ELT37-16	1447.6	59.2		
21	ELT37-16	1466.6	20.7		
21	ELT37-16	1478.1	71.5		
21	ELT37-16	1490.4	9.0		
21	ELT37-16	1500.4	23.2		
21	ELT37-16	1507.8	7.5		
21	ELT37-16	1509.9	15.9		
21	ELT37-16	1513.1	21.5		
21	ELT37-16	1516.6	12.1		
21	ELT37-16	1520.0	14.9		
21	ELT37-16	1525.7	12.7		
21	ELT37-16	1537.9	26.6		

21	ELT37-16	1544.1	19.7
21	ELT37-16	1544.2	23.7
21	ELT37-16	1544.5	23.8
21	ELT37-16	1545.0	8.5
21	ELT37-16	1546.1	10.7
21	ELT37-16	1547.0	32.7
21	ELT37-16	1548.4	27.7
21	ELT37-16	1552.1	56.4
21	ELT37-16	1561.2	3.7
21	ELT37-16	1566.1	49.6
21	ELT37-16	1567.1	70.3
21	ELT37-16	1568.9	62.9
21	ELT37-16	1572.5	33.0
21	ELT37-16	1573.4	9.0
21	ELT37-16	1576.2	43.9
21	ELT37-16	1589.2	4.6
21	ELT37-16	1593.8	12.2
21	ELT37-16	1607.2	8.3
21	ELT37-16	1607.6	25.8
21	ELT37-16	1610.3	87.4
21	ELT37-16	1615.1	35.6
21	ELT37-16	1734.7	13.7
21	ELT37-16	480.4	8.2
21	ELT37-16	1095.1	46.3
21	ELT37-16	1095.8	43.4
21	ELT37-16	1129.0	28.9
21	ELT37-16	1129.1	4.4
21	ELT37-16	1130.5	35.5
21	ELT37-16	1133.0	12.0
21	ELT37-16	1136.1	15.4
21	ELT37-16	1136.4	27.5
21	ELT37-16	1136.7	10.5
21	ELT37-16	1141.4	13.3
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21	ELT37-16	1146.9	35.8
21	ELT37-16	1147.1	10.1
21	ELT37-16	1148.0	15.1
21	ELT37-16	1149.9	15.4
21	ELT37-16	1150.2	12.5
21	ELT37-16	1150.6	34.0
21	ELT37-16	1151.7	14.5
21	ELT37-16	1154.7	21.4
21	ELT37-16	1156.6	16.5
21	ELT37-16	1158.1	22.1
21	ELT37-16	1158.4	14.9
21	ELT37-16	1161.0	23.7
21	ELT37-16	1162.9	13.6
21	ELT37-16	1166.0	96.1
21	ELT37-16	1166.1	48.7

21	ELT37-16	1173.8	76.9
21	ELT37-16	1174.6	36.9
21	ELT37-16	1176.9	50.9
21	ELT37-16	1176.9	10.0
21	ELT37-16	1190.2	63.1
21	ELT37-16	1191.8	21.0
21	ELT37-16	1194.2	118.6
21	ELT37-16	1219.6	50.0
21	ELT37-16	1239.6	141.8
21	ELT37-16	1282.8	118.5
21	ELT37-16	1292.3	113.3
21	ELT37-16	1401.7	78.2
21	ELT37-16	1402.3	142.2
21	ELT37-16	1437.3	20.7
21	ELT37-16	1452.6	132.9
21	ELT37-16	1461.7	89.7
21	ELT37-16	1462.2	16.7
21	ELT37-16	1481.1	13.4
21	ELT37-16	1483.7	16.5
21	ELT37-16	1495.6	4.4
21	ELT37-16	1498.8	48.3
21	ELT37-16	1505.6	6.9
21	ELT37-16	1506.8	23.3
21	ELT37-16	1506.9	84.3
21	ELT37-16	1509.9	5.8
21	ELT37-16	1510.3	8.7
21	ELT37-16	1510.8	47.2
21	ELT37-16	1512.0	16.2
21	ELT37-16	1518.9	17.7
21	ELT37-16	1519.3	15.2
21	ELT37-16	1529.0	11.3
21	ELT37-16	1532.1	21.5
21	ELT37-16	1534.6	13.0
21	ELT37-16	1535.2	20.7
21	ELT37-16	1535.4	27.3
21	ELT37-16	1540.8	11.0
21	ELT37-16	1542.8	5.7
21	ELT37-16	1557.0	51.8
21	ELT37-16	1561.8	28.8
21	ELT37-16	1562.0	18.1
21	ELT37-16	1582.6	6.8
21	ELT37-16	1594.6	10.0
21	ELT37-16	1599.4	19.5
21	ELT37-16	1600.7	27.2
21	ELT37-16	1601.5	5.6
21	ELT37-16	1609.1	25.7
21	ELT37-16	1624.9	68.7
21	ELT37-16	1625.9	22.6
21	ELT37-16	1627.0	28.3

21	ELT37-16	1706.9	11.0		
21	ELT37-16	2811.6	2.6		
22	ELT37-13	501.1	5.4	***n=***	***159***
22	ELT37-13	561.3	18.3		
22	ELT37-13	1130.1	75.7		
22	ELT37-13	1131.5	56.8		
22	ELT37-13	1135.4	53.6		
22	ELT37-13	1135.5	31.1		
22	ELT37-13	1137.0	33.8		
22	ELT37-13	1174.7	68.8		
22	ELT37-13	1178.7	40.5		
22	ELT37-13	1184.6	54.7		
22	ELT37-13	1204.8	87.9		
22	ELT37-13	1256.8	107.0		
22	ELT37-13	1262.1	60.9		
22	ELT37-13	1416.9	99.5		
22	ELT37-13	1516.1	66.4		
22	ELT37-13	1519.4	81.6		
22	ELT37-13	1524.2	44.7		
22	ELT37-13	1528.8	98.4		
22	ELT37-13	1538.4	38.8		
22	ELT37-13	1547.5	74.2		
22	ELT37-13	1556.4	53.5		
22	ELT37-13	1580.6	36.3		
22	ELT37-13	1583.1	45.8		
22	ELT37-13	1586.8	51.2		
22	ELT37-13	1607.8	63.0		
22	ELT37-13	1610.8	64.8		
22	ELT37-13	1637.8	123.1		
22	ELT37-13	1638.4	53.3		
22	ELT37-13	1655.4	32.8		
22	ELT37-13	1673.2	54.1		
22	ELT37-13	1716.4	566.9		
22	ELT37-13	1825.9	130.2		
22	ELT37-13	2411.0	609.1		
22	ELT37-13	572.7	7.6		
22	ELT37-13	578.8	14.5		
22	ELT37-13	1127.2	11.4		
22	ELT37-13	1129.6	26.4		
22	ELT37-13	1131.7	12.2		
22	ELT37-13	1137.4	14.4		
22	ELT37-13	1137.7	18.4		
22	ELT37-13	1140.1	6.0		
22	ELT37-13	1143.6	18.0		
22	ELT37-13	1150.3	22.2		
22	ELT37-13	1151.8	29.6		
22	ELT37-13	1152.7	37.1		
22	ELT37-13	1153.6	17.0		
22	ELT37-13	1158.2	10.4		

22	ELT37-13	1159.6	27.2
22	ELT37-13	1163.5	26.2
22	ELT37-13	1209.6	38.3
22	ELT37-13	1219.8	86.6
22	ELT37-13	1240.7	102.7
22	ELT37-13	1442.5	79.1
22	ELT37-13	1494.3	12.1
22	ELT37-13	1496.5	14.1
22	ELT37-13	1503.3	77.1
22	ELT37-13	1503.4	15.6
22	ELT37-13	1507.0	8.3
22	ELT37-13	1512.9	20.4
22	ELT37-13	1519.8	14.2
22	ELT37-13	1523.5	29.1
22	ELT37-13	1534.1	22.6
22	ELT37-13	1539.5	21.4
22	ELT37-13	1543.3	14.7
22	ELT37-13	1549.5	28.0
22	ELT37-13	1550.7	8.1
22	ELT37-13	1552.3	8.5
22	ELT37-13	1554.0	9.7
22	ELT37-13	1555.7	10.6
22	ELT37-13	1555.8	38.8
22	ELT37-13	1555.9	11.2
22	ELT37-13	1560.0	6.4
22	ELT37-13	1560.7	12.6
22	ELT37-13	1561.5	7.7
22	ELT37-13	1562.6	12.6
22	ELT37-13	1563.0	17.0
22	ELT37-13	1563.4	5.7
22	ELT37-13	1569.4	14.6
22	ELT37-13	1574.8	11.2
22	ELT37-13	1577.3	87.0
22	ELT37-13	1582.0	14.8
22	ELT37-13	1584.9	12.4
22	ELT37-13	1585.5	6.3
22	ELT37-13	1587.8	4.2
22	ELT37-13	1590.7	6.3
22	ELT37-13	1593.7	19.4
22	ELT37-13	1596.7	12.3
22	ELT37-13	1601.9	54.0
22	ELT37-13	1602.9	9.3
22	ELT37-13	1606.6	72.9
22	ELT37-13	1637.4	47.6
22	ELT37-13	1764.7	35.8
22	ELT37-13	111.2	4.5
22	ELT37-13	115.4	8.6
22	ELT37-13	130.9	12.1
22	ELT37-13	557.2	19.7

22	ELT37-13	1132.2	20.7
22	ELT37-13	1136.3	10.8
22	ELT37-13	1146.0	7.6
22	ELT37-13	1147.9	26.3
22	ELT37-13	1150.4	15.1
22	ELT37-13	1156.5	41.2
22	ELT37-13	1158.1	23.0
22	ELT37-13	1158.2	13.0
22	ELT37-13	1162.6	70.4
22	ELT37-13	1165.0	32.9
22	ELT37-13	1172.9	58.3
22	ELT37-13	1174.4	32.7
22	ELT37-13	1174.6	53.4
22	ELT37-13	1178.6	26.9
22	ELT37-13	1181.4	34.1
22	ELT37-13	1192.0	70.9
22	ELT37-13	1198.5	166.8
22	ELT37-13	1209.9	40.6
22	ELT37-13	1212.0	121.5
22	ELT37-13	1221.7	120.0
22	ELT37-13	1224.1	59.8
22	ELT37-13	1268.6	129.4
22	ELT37-13	1273.4	155.3
22	ELT37-13	1471.3	39.2
22	ELT37-13	1483.6	15.1
22	ELT37-13	1487.8	40.7
22	ELT37-13	1492.8	26.0
22	ELT37-13	1526.4	48.6
22	ELT37-13	1526.5	59.7
22	ELT37-13	1526.6	5.8
22	ELT37-13	1527.2	13.7
22	ELT37-13	1535.1	12.8
22	ELT37-13	1538.4	8.7
22	ELT37-13	1551.6	14.8
22	ELT37-13	1553.9	12.2
22	ELT37-13	1555.7	7.7
22	ELT37-13	1563.5	48.6
22	ELT37-13	1564.4	6.8
22	ELT37-13	1566.9	9.0
22	ELT37-13	1569.0	7.1
22	ELT37-13	1569.6	9.3
22	ELT37-13	1569.8	52.8
22	ELT37-13	1571.1	24.1
22	ELT37-13	1571.6	7.5
22	ELT37-13	1571.8	13.6
22	ELT37-13	1573.5	36.9
22	ELT37-13	1576.3	59.5
22	ELT37-13	1579.9	9.8
22	ELT37-13	1580.9	2.6

22	ELT37-13	1581.0	37.6		
22	ELT37-13	1581.9	23.0		
22	ELT37-13	1583.2	4.0		
22	ELT37-13	1586.1	24.8		
22	ELT37-13	1588.3	37.9		
22	ELT37-13	1590.8	19.9		
22	ELT37-13	1591.0	59.1		
22	ELT37-13	1592.2	55.6		
22	ELT37-13	1595.3	16.1		
22	ELT37-13	1600.8	58.1		
22	ELT37-13	1606.2	31.2		
22	ELT37-13	1610.1	17.9		
22	ELT37-13	1774.8	5.0		
22	ELT37-13	2641.3	15.9		
23	ELT37-09	508.6	9.9	***n=***	***44***
23	ELT37-09	604.6	12.5		
23	ELT37-09	607.0	12.0		
23	ELT37-09	707.7	40.2		
23	ELT37-09	1604.5	62.9		
23	ELT37-09	1655.3	213.8		
23	ELT37-09	1770.7	83.7		
23	ELT37-09	1969.5	162.7		
23	ELT37-09	2441.7	83.2		
23	ELT37-09	2521.0	123.0		
23	ELT37-09	55.0	3.0		
23	ELT37-09	132.3	2.2		
23	ELT37-09	489.0	12.8		
23	ELT37-09	497.0	7.5		
23	ELT37-09	509.0	27.4		
23	ELT37-09	514.0	4.9		
23	ELT37-09	532.2	18.1		
23	ELT37-09	549.0	15.8		
23	ELT37-09	554.8	13.8		
23	ELT37-09	569.2	31.7		
23	ELT37-09	577.8	5.0		
23	ELT37-09	577.8	9.8		
23	ELT37-09	587.5	6.0		
23	ELT37-09	593.1	22.8		
23	ELT37-09	594.2	14.5		
23	ELT37-09	652.4	24.3		
23	ELT37-09	861.8	32.3		
23	ELT37-09	1088.6	22.4		
23	ELT37-09	1102.2	11.5		
23	ELT37-09	1105.4	28.6		
23	ELT37-09	1140.3	80.2		
23	ELT37-09	1161.5	6.5		
23	ELT37-09	1173.3	103.8		
23	ELT37-09	1599.9	11.9		
23	ELT37-09	1629.2	7.9		

23	ELT37-09	1739.4	24.5		
23	ELT37-09	1793.1	5.7		
23	ELT37-09	1900.7	7.5		
23	ELT37-09	2373.8	3.1		
23	ELT37-09	2442.1	36.5		
23	ELT37-09	2455.0	2.9		
23	ELT37-09	2474.6	26.4		
23	ELT37-09	2716.0	16.8		
23	ELT37-09	3207.1	3.1		
24	NBP 01-01 JPC11	2433.9	40.5	***n*=**	*18*
24	NBP 01-01 JPC11	2452.0	79.8		
24	NBP 01-01 JPC11	2462.6	53.4		
24	NBP 01-01 JPC11	2942.2	45.3		
24	NBP 01-01 JPC11	1748.2	5.7		
24	NBP 01-01 JPC11	2473.7	47.3		
24	NBP 01-01 JPC11	2224.3	62.9		
24	NBP 01-01 JPC11	2439.7	2.8		
24	NBP 01-01 JPC11	1806.6	313.3		
24	NBP 01-01 JPC11	1771.8	15.9		
24	NBP 01-01 JPC11	2394.0	16.8		
24	NBP 01-01 JPC11	1712.0	3.6		
24	NBP 01-01 JPC11	1617.2	9.7		
24	NBP 01-01 JPC11	1603.4	13.8		
24	NBP 01-01 JPC11	445.4	15.4		
24	NBP 01-01 JPC11	2396.7	34.9		
24	NBP 01-01 JPC11	1774.4	14.1		
24	NBP 01-01 JPC11	519.3	19.1		
25	DF79-47	319.4	28.6	***n*=**	*104*
25	DF79-47	501.2	4.8		
25	DF79-47	514.4	29.3		
25	DF79-47	516.4	5.9		
25	DF79-47	532.0	20.8		
25	DF79-47	552.8	5.3		
25	DF79-47	561.4	5.4		
25	DF79-47	574.2	5.5		
25	DF79-47	597.7	5.7		
25	DF79-47	599.2	5.7		
25	DF79-47	610.7	5.8		
25	DF79-47	628.5	6.0		
25	DF79-47	804.3	8.9		
25	DF79-47	1135.9	61.4		
25	DF79-47	1930.1	94.1		
25	DF79-47	2361.0	58.2		
25	DF79-47	3305.4	25.1		
25	DF79-47	266.9	5.1		
25	DF79-47	364.8	10.9		
25	DF79-47	394.2	14.7		
25	DF79-47	489.7	52.2		
25	DF79-47	529.6	11.7		

25	DF79-47	534.0	15.3
25	DF79-47	539.4	19.1
25	DF79-47	540.6	15.3
25	DF79-47	541.6	60.1
25	DF79-47	548.4	7.9
25	DF79-47	559.7	69.7
25	DF79-47	560.4	12.8
25	DF79-47	562.7	49.1
25	DF79-47	563.1	15.9
25	DF79-47	565.9	12.7
25	DF79-47	566.6	18.1
25	DF79-47	570.5	13.4
25	DF79-47	572.0	14.7
25	DF79-47	575.4	30.9
25	DF79-47	576.1	51.8
25	DF79-47	576.3	18.8
25	DF79-47	576.6	25.8
25	DF79-47	577.7	25.6
25	DF79-47	578.7	9.4
25	DF79-47	579.2	17.2
25	DF79-47	580.2	10.2
25	DF79-47	581.0	7.8
25	DF79-47	586.4	13.3
25	DF79-47	589.3	10.2
25	DF79-47	589.8	30.4
25	DF79-47	593.4	44.2
25	DF79-47	599.9	14.5
25	DF79-47	603.7	17.2
25	DF79-47	604.6	15.2
25	DF79-47	637.3	5.4
25	DF79-47	890.5	31.9
25	DF79-47	902.6	102.9
25	DF79-47	941.1	18.0
25	DF79-47	961.2	23.4
25	DF79-47	1033.7	106.5
25	DF79-47	1048.4	13.3
25	DF79-47	1054.0	165.3
25	DF79-47	1122.5	33.1
25	DF79-47	1146.3	65.8
25	DF79-47	1170.8	64.8
25	DF79-47	1181.7	40.0
25	DF79-47	1210.8	32.4
25	DF79-47	1234.0	50.5
25	DF79-47	1426.8	89.6
25	DF79-47	1455.0	17.7
25	DF79-47	1476.4	35.3
25	DF79-47	1584.2	13.0
25	DF79-47	1598.6	5.8
25	DF79-47	1610.5	10.1

25	DF79-47	1617.3	20.4		
25	DF79-47	1687.1	10.7		
25	DF79-47	1722.1	3.6		
25	DF79-47	2509.6	25.8		
25	DF79-47	2510.5	27.5		
25	DF79-47	2514.0	6.7		
25	DF79-47	2712.1	9.6		
25	DF79-47	2714.0	6.0		
25	DF79-47	3080.5	12.2		
25	DF79-47	3359.7	5.6		
25	DF79-47	479.3	9.0		
25	DF79-47	560.0	12.7		
25	DF79-47	1714.2	172.9		
25	DF79-47	284.3	3.7		
25	DF79-47	549.6	7.7		
25	DF79-47	510.2	18.8		
25	DF79-47	1636.9	7.9		
25	DF79-47	528.4	47.8		
25	DF79-47	527.8	3.7		
25	DF79-47	1219.7	20.7		
25	DF79-47	1040.4	19.2		
25	DF79-47	1013.0	24.2		
25	DF79-47	1118.4	17.2		
25	DF79-47	597.4	17.0		
25	DF79-47	3433.8	15.8		
25	DF79-47	586.5	7.2		
25	DF79-47	526.8	30.5		
25	DF79-47	1596.6	90.4		
25	DF79-47	1227.7	11.8		
25	DF79-47	1614.6	13.6		
25	DF79-47	515.7	52.7		
25	DF79-47	618.6	18.0		
25	DF79-47	548.5	7.4		
26	DF80-34	186.4	3.2	***n=***	*88*
26	DF80-34	357.5	3.5		
26	DF80-34	442.9	27.7		
26	DF80-34	484.2	5.8		
26	DF80-34	488.1	43.0		
26	DF80-34	495.7	4.8		
26	DF80-34	498.3	4.8		
26	DF80-34	502.6	4.8		
26	DF80-34	521.8	14.3		
26	DF80-34	555.1	7.6		
26	DF80-34	824.0	21.7		
26	DF80-34	849.7	21.7		
26	DF80-34	870.0	14.7		
26	DF80-34	1032.1	58.5		
26	DF80-34	1414.8	68.6		
26	DF80-34	1434.8	135.5		

26	DF80-34	2701.1	50.8
26	DF80-34	50.2	2.8
26	DF80-34	110.8	2.1
26	DF80-34	277.4	5.1
26	DF80-34	364.4	18.4
26	DF80-34	364.9	36.7
26	DF80-34	365.9	5.5
26	DF80-34	371.5	6.0
26	DF80-34	374.5	20.8
26	DF80-34	378.2	8.2
26	DF80-34	381.5	5.6
26	DF80-34	386.4	16.6
26	DF80-34	387.2	19.9
26	DF80-34	387.6	4.3
26	DF80-34	391.5	8.5
26	DF80-34	391.9	60.6
26	DF80-34	392.3	9.7
26	DF80-34	393.3	19.8
26	DF80-34	397.2	34.2
26	DF80-34	399.2	17.3
26	DF80-34	408.3	9.2
26	DF80-34	423.7	10.9
26	DF80-34	459.2	14.0
26	DF80-34	459.8	24.7
26	DF80-34	475.3	6.7
26	DF80-34	475.4	38.0
26	DF80-34	479.2	43.7
26	DF80-34	488.1	20.6
26	DF80-34	492.2	8.8
26	DF80-34	494.3	13.7
26	DF80-34	495.7	12.8
26	DF80-34	499.0	19.6
26	DF80-34	501.0	10.2
26	DF80-34	506.8	7.7
26	DF80-34	506.9	21.2
26	DF80-34	510.2	20.9
26	DF80-34	522.6	8.7
26	DF80-34	522.8	44.6
26	DF80-34	523.0	4.7
26	DF80-34	525.4	18.3
26	DF80-34	525.8	37.5
26	DF80-34	527.4	20.4
26	DF80-34	536.4	5.7
26	DF80-34	538.9	23.3
26	DF80-34	539.5	88.1
26	DF80-34	540.9	61.3
26	DF80-34	547.4	13.7
26	DF80-34	560.8	24.2
26	DF80-34	561.9	22.5

26	DF80-34	563.0	8.5		
26	DF80-34	563.9	18.2		
26	DF80-34	571.5	18.5		
26	DF80-34	572.7	32.8		
26	DF80-34	572.9	9.5		
26	DF80-34	577.6	7.9		
26	DF80-34	579.9	76.6		
26	DF80-34	582.3	11.6		
26	DF80-34	589.9	21.0		
26	DF80-34	592.1	14.7		
26	DF80-34	598.6	29.1		
26	DF80-34	974.3	76.6		
26	DF80-34	1042.7	15.6		
26	DF80-34	1046.4	34.5		
26	DF80-34	1063.5	63.8		
26	DF80-34	1134.2	18.0		
26	DF80-34	1137.5	14.3		
26	DF80-34	1181.8	175.1		
26	DF80-34	1203.5	10.3		
26	DF80-34	1233.8	10.7		
26	DF80-34	1324.4	104.0		
26	DF80-34	1785.5	8.0		
26	DF80-34	1803.7	25.8		
27	DF80-25			***n=***	***0***
28	DF80-20			***n=***	***0***

Chapter 3. Appendix B. $^{40}Ar/^{39}Ar$ hornblende data. $^{40}Ar/^{39}Ar$ analyses were performed at L-DEO's AGES lab.

Core ID	Sample Name	Run ID Number	Ca/K	Cl/K	Mol 39Ar	%40Ar*	Age	Internal Error	± Age	Size Fraction	n
1	IWSOE 68-11	12647-36	0.16515	0.0039	0.11	83.7	51.80	1.07	1.18	>150	67
1	IWSOE 68-11	12647-04	1.6624	0.04062	0.116	36.6	89.00	2.18	2.34	>150	
1	IWSOE 68-11	12647-34	10.73163	0.05211	0.031	99.5	109.61	3.40	3.57	>150	
1	IWSOE 68-11	12647-32	20.10268	0.00463	0.018	78	113.89	5.97	6.07	>150	
1	IWSOE 68-11	12647-48	2.85654	-0.00938	0.046	86.2	135.68	2.52	2.84	>150	
1	IWSOE 68-11	12647-65	21.11144	-0.02153	0.009	67.6	174.75	12.86	12.97	>150	
1	IWSOE 68-11	12647-50	25.20956	0.22683	0.01	90.6	181.87	10.52	10.67	>150	
1	IWSOE 68-11	12647-20	1.61773	-0.16641	0.006	27.6	343.97	34.56	34.72	>150	
1	IWSOE 68-11	12647-11	0.05656	-0.38715	0.004	54.3	364.21	47.17	47.30	>150	
1	IWSOE 68-11	12647-37	24.87592	0.10847	0.009	95.3	672.39	12.06	13.72	>150	
1	IWSOE 68-11	12647-57	36.58748	0.03187	0.007	93.7	977.78	17.12	19.58	>150	
1	IWSOE 68-11	12647-28	6.1483	0.02383	0.118	99.1	978.93	2.84	9.92	>150	
1	IWSOE 68-11	12647-09	14.30418	0.11503	0.069	81.7	990.66	4.45	10.60	>150	
1	IWSOE 68-11	12647-70	6.35591	-0.01859	0.015	97.9	993.12	8.57	12.90	>150	
1	IWSOE 68-11	12647-08	12.90936	0.1405	0.146	87.1	993.75	3.27	10.19	>150	
1	IWSOE 68-11	12647-47	10.02358	0.02682	0.026	98.4	1001.63	6.06	11.46	>150	
1	IWSOE 68-11	12647-30	15.44037	0.1034	0.012	99.8	1013.53	11.59	15.21	>150	
1	IWSOE 68-11	12647-27	9.23468	0.01462	0.08	96.9	1019.41	3.43	10.48	>150	
1	IWSOE 68-11	12647-79	4.97364	0.15599	0.011	96.7	1024.65	12.25	15.78	>150	
1	IWSOE 68-11	12647-13	5.89838	0.01215	0.121	100.2	1029.93	2.69	10.36	>150	
1	IWSOE 68-11	12647-58	16.16855	-0.06613	0.009	94.1	1034.34	14.96	18.02	>150	
1	IWSOE 68-11	12647-38	69.58627	0.23692	0.004	90.4	1035.00	34.50	35.94	>150	
1	IWSOE 68-11	12647-40	12.00619	0.05929	0.031	99.7	1037.92	5.31	11.39	>150	
1	IWSOE 68-11	12647-29	25.09569	0.00497	0.013	92.3	1040.54	10.52	14.59	>150	
1	IWSOE 68-11	12647-84	27.12519	0.0906	0.004	61.8	1046.54	26.59	28.47	>150	
1	IWSOE 68-11	12647-78	30.34233	0.37314	0.003	92.6	1049.42	38.31	39.65	>150	
1	IWSOE 68-11	12647-55	7.57517	0.04157	0.042	99.1	1060.18	4.70	11.32	>150	
1	IWSOE 68-11	12647-53	16.85866	0.01813	0.013	99.2	1062.23	10.53	14.74	>150	
1	IWSOE 68-11	12647-46	11.79768	-0.01711	0.022	97.7	1064.30	6.14	12.02	>150	

1	IWSOE 68-11	12647-68	10.97152	0.0193	0.013	99	1076.43	10.27	14.65	>150
1	IWSOE 68-11	12647-60	9.10964	0.05162	0.005	90.5	1078.15	27.15	29.10	>150
1	IWSOE 68-11	12647-69	1.01744	0.06347	0.007	100.6	1079.63	13.75	17.29	>150
1	IWSOE 68-11	12647-31	17.06273	0.01471	0.029	95.5	1087.97	6.02	12.16	>150
1	IWSOE 68-11	12647-16	8.16393	0.01518	0.118	102.6	1088.29	3.38	11.10	>150
1	IWSOE 68-11	12647-62	0.32059	0.03101	0.029	100.4	1089.12	5.47	11.91	>150
1	IWSOE 68-11	12647-42	30.30344	0.07153	0.007	80.2	1091.09	18.46	21.28	>150
1	IWSOE 68-11	12647-74	13.48353	0.02689	0.011	99.3	1096.65	10.77	15.15	>150
1	IWSOE 68-11	12647-54	31.61401	0.13598	0.015	96.1	1105.07	9.64	14.42	>150
1	IWSOE 68-11	12647-18	8.36025	-0.02394	0.058	103.6	1113.16	5.00	11.91	>150
1	IWSOE 68-11	12647-56	9.64379	0.00634	0.085	98.4	1114.63	3.44	11.36	>150
1	IWSOE 68-11	12647-23	9.91952	0.00397	0.023	99.3	1119.87	6.14	12.49	>150
1	IWSOE 68-11	12647-39	26.43813	0.02107	0.012	97.7	1123.54	11.96	16.19	>150
1	IWSOE 68-11	12647-17	8.49591	0.01098	0.179	100.4	1128.21	2.55	11.25	>150
1	IWSOE 68-11	12647-33	8.37599	-0.00472	0.03	96.5	1128.79	6.62	12.81	>150
1	IWSOE 68-11	12647-14	25.66186	-0.04961	0.02	88.7	1135.72	10.63	15.32	>150
1	IWSOE 68-11	12647-59	6.78029	0.00175	0.012	94.3	1136.60	12.89	16.97	>150
1	IWSOE 68-11	12647-67	7.90798	0.0376	0.036	98.4	1150.23	6.01	12.68	>150
1	IWSOE 68-11	12647-51	52.9438	0.09856	0.005	88.2	1155.94	24.20	26.68	>150
1	IWSOE 68-11	12647-76	44.49258	0.12855	0.003	91.4	1170.32	36.61	38.33	>150
1	IWSOE 68-11	12647-64	9.58717	-0.04535	0.012	100.3	1170.71	11.11	15.90	>150
1	IWSOE 68-11	12647-19	8.40245	-0.02471	0.055	103.2	1170.86	4.55	12.25	>150
1	IWSOE 68-11	12647-75	17.39199	-0.09797	0.009	95.2	1185.52	14.11	18.21	>150
1	IWSOE 68-11	12647-35	17.45126	0.03424	0.015	93.1	1186.71	10.44	15.55	>150
1	IWSOE 68-11	12647-26	18.05256	0.04454	0.032	98.8	1205.53	5.53	12.95	>150
1	IWSOE 68-11	12647-77	11.14394	0.10103	0.017	99.3	1211.83	7.92	14.19	>150
1	IWSOE 68-11	12647-15	6.07386	-0.04647	0.059	105.4	1213.06	4.86	12.74	>150
1	IWSOE 68-11	12647-52	18.72133	0.07946	0.014	96.7	1218.08	11.16	16.26	>150
1	IWSOE 68-11	12647-66	20.15955	0.05026	0.012	99.2	1221.73	13.08	17.66	>150
1	IWSOE 68-11	12647-24	11.14801	-0.00838	0.028	96.6	1225.71	7.19	13.91	>150
1	IWSOE 68-11	12647-44	12.41115	0.00744	0.009	100.7	1226.16	15.33	19.41	>150
1	IWSOE 68-11	12647-41	27.21596	0.0963	0.014	99.1	1229.66	9.30	15.14	>150
1	IWSOE 68-11	12647-25	13.56242	0.05925	0.028	99.8	1241.55	6.05	13.49	>150
1	IWSOE 68-11	12647-71	15.03851	0.22408	0.006	101.4	1251.07	21.24	24.47	>150
1	IWSOE 68-11	12647-12	13.87901	0.02741	0.068	99.2	1253.15	4.15	12.86	>150
1	IWSOE 68-11	12647-43	24.74571	0.02354	0.01	96.8	1283.44	13.19	18.15	>150

1	IWSOE 68-11	12647-21	7.43308	0.01975	0.052	95.9	1378.72	5.19	14.36	>150	
1	IWSOE 68-11	12647-85	21.12219	0.03345	0.004	97.5	1486.77	30.42	33.67	>150	
2	IWSOE68 G8	12638-07	12.78382	0.02456	0.003	2.7	176.35	68.20	68.22	>150	*6*
2	IWSOE68 G8	12638-08	16.58322	0.11478	0.002	10.1	346.74	61.25	61.34	>150	
2	IWSOE68 G8	12638-01	8.19739	0.01127	0.311	92.2	481.92	1.28	4.85	>150	
2	IWSOE68 G8	12638-15	7.72143	-0.01671	0.023	96.2	489.50	5.90	7.58	>150	
2	IWSOE68 G8	12638-02	18.19448	0.00741	0.046	78.8	490.24	3.53	5.93	>150	
2	IWSOE68 G8	12638-04	15.13614	-0.03931	0.005	76.8	893.69	21.54	23.22	>150	
3	IWSOE70 2-22-1	12636-107	39.30669	0.17588	0.002	9.6	17.72	67.07	67.07	>150	71
3	IWSOE70 2-22-1	12636-108	27.23109	0.02192	0.009	31.2	167.46	12.94	13.05	>150	
3	IWSOE70 2-22-1	12636-20	11.53312	0.12621	0.041	98.1	189.15	3.31	3.82	>150	
3	IWSOE70 2-22-1	12636-62	0.45077	-0.00256	0.038	25.6	197.05	5.92	6.24	>150	
3	IWSOE70 2-22-1	12636-105	22.5179	-0.00911	0.008	92.3	202.48	13.27	13.42	>150	
3	IWSOE70 2-22-1	12636-71	22.61232	0.09223	0.008	93.8	346.39	11.90	12.39	>150	
3	IWSOE70 2-22-1	12636-84	1.80642	0.09548	0.009	81.6	439.82	11.85	12.64	>150	
3	IWSOE70 2-22-1	12636-61	15.71271	0.02306	0.011	82.7	446.79	11.35	12.20	>150	
3	IWSOE70 2-22-1	12636-35	38.49951	0.06172	0.002	76.2	451.84	52.57	52.76	>150	
3	IWSOE70 2-22-1	12636-101	38.01362	0.16464	0.006	86.3	463.23	18.05	18.63	>150	
3	IWSOE70 2-22-1	12636-65	31.90551	0.11334	0.011	84	469.50	10.13	11.16	>150	
3	IWSOE70 2-22-1	12636-10	14.75702	0.00463	0.039	95	471.05	3.60	5.93	>150	
3	IWSOE70 2-22-1	12636-33	6.28759	0.04761	0.035	90.7	472.15	3.93	6.14	>150	
3	IWSOE70 2-22-1	12636-79	56.06088	-0.08504	0.002	86.5	475.93	50.49	50.72	>150	
3	IWSOE70 2-22-1	12636-17	10.4131	0.02048	0.025	92.1	477.00	5.41	7.21	>150	
3	IWSOE70 2-22-1	12636-44	18.84053	-0.01439	0.008	97.4	478.69	14.93	15.68	>150	
3	IWSOE70 2-22-1	12636-36	9.16906	0.05919	0.025	91	481.45	5.71	7.47	>150	
3	IWSOE70 2-22-1	12636-14	14.07925	0.06436	0.019	94.4	481.90	6.71	8.26	>150	
3	IWSOE70 2-22-1	12636-21	15.70387	-0.09236	0.002	84.2	483.30	55.37	55.58	>150	
3	IWSOE70 2-22-1	12636-32	13.99554	0.06894	0.033	93	485.92	4.17	6.40	>150	
3	IWSOE70 2-22-1	12636-51	12.65108	-0.02777	0.017	96.1	486.93	7.04	8.56	>150	
3	IWSOE70 2-22-1	12636-04	7.44489	0.01214	0.112	99.1	488.55	1.69	5.17	>150	

3	IWSOE70 2-22-1	12636-12	5.70676	0.01656	0.138	98.6	489.43	1.66	5.17	>150
3	IWSOE70 2-22-1	12636-26	5.76859	0.01176	0.112	99.6	489.71	1.83	5.23	>150
3	IWSOE70 2-22-1	12636-30	32.48421	-0.07282	0.003	46.5	490.39	38.69	39.00	>150
3	IWSOE70 2-22-1	12636-24	6.19174	0.03795	0.059	98.3	491.60	2.69	5.60	>150
3	IWSOE70 2-22-1	12636-60	8.32979	-0.0015	0.036	97.7	492.28	3.75	6.19	>150
3	IWSOE70 2-22-1	12636-88	8.77888	0.12316	0.011	96.9	492.46	10.15	11.29	>150
3	IWSOE70 2-22-1	12636-29	6.74698	0.01764	0.053	99.2	493.12	2.87	5.71	>150
3	IWSOE70 2-22-1	12636-43	11.80684	0.09815	0.005	100.1	493.28	24.04	24.54	>150
3	IWSOE70 2-22-1	12636-53	5.50905	0.05126	0.021	98.3	498.30	6.55	8.23	>150
3	IWSOE70 2-22-1	12636-42	7.71981	0.00572	0.034	98.9	498.40	4.09	6.45	>150
3	IWSOE70 2-22-1	12636-76	4.6195	0.06744	0.022	103.4	498.96	4.81	6.93	>150
3	IWSOE70 2-22-1	12636-81	17.88226	-0.02238	0.013	96.6	499.71	7.48	9.00	>150
3	IWSOE70 2-22-1	12636-54	4.68595	0.02572	0.028	80.8	501.09	5.52	7.45	>150
3	IWSOE70 2-22-1	12636-07	7.89781	0.09112	0.031	96.8	501.56	4.47	6.72	>150
3	IWSOE70 2-22-1	12636-49	11.74892	-0.10269	0.011	97.5	503.13	11.25	12.33	>150
3	IWSOE70 2-22-1	12636-48	6.24855	-0.01395	0.05	99.5	507.26	3.28	6.04	>150
3	IWSOE70 2-22-1	12636-01	18.83789	0.02527	0.077	98.2	508.12	2.40	5.62	>150
3	IWSOE70 2-22-1	12636-95	9.2981	0.0461	0.026	99.7	508.17	4.50	6.78	>150
3	IWSOE70 2-22-1	12636-47	6.39316	-0.01814	0.046	71.8	509.55	3.75	6.33	>150
3	IWSOE70 2-22-1	12636-25	8.8683	0.04947	0.02	88.3	509.93	6.38	8.17	>150
3	IWSOE70 2-22-1	12636-28	5.5406	0.02665	0.051	98.4	510.23	3.03	5.93	>150
3	IWSOE70 2-22-1	12636-18	19.31936	0.08615	0.015	98.4	512.57	8.96	10.33	>150
3	IWSOE70 2-22-1	12636-41	8.88848	0.02671	0.018	78.4	513.67	7.60	9.17	>150
3	IWSOE70 2-22-1	12636-52	14.68258	0.0881	0.019	103.5	516.06	6.68	8.44	>150
3	IWSOE70 2-22-1	12636-77	65.61571	0.28412	0.004	96.9	519.19	21.71	22.32	>150
3	IWSOE70 2-22-1	12636-15	6.65581	0.00986	0.039	98.4	525.00	3.82	6.49	>150
3	IWSOE70 2-22-1	12636-68	9.03142	0.03852	0.018	98.6	525.35	7.13	8.86	>150
3	IWSOE70 2-22-1	12636-82	4.52309	0.01336	0.122	98.5	528.48	1.75	5.57	>150
3	IWSOE70 2-22-1	12636-23	5.66283	0.02115	0.046	100.6	529.41	3.17	6.17	>150
3	IWSOE70 2-22-1	12636-73	4.6297	0.07499	0.012	94.4	530.75	8.87	10.33	>150
3	IWSOE70 2-22-1	12636-31	6.75273	0.03096	0.064	96.5	535.83	2.55	5.93	>150
3	IWSOE70 2-22-1	12636-27	7.80894	0.0262	0.049	99.6	539.90	3.50	6.44	>150
3	IWSOE70 2-22-1	12636-70	7.13587	-0.02088	0.026	103.1	552.35	4.69	7.25	>150
3	IWSOE70 2-22-1	12636-46	7.20223	-0.02464	0.046	99.6	554.25	3.36	6.48	>150
3	IWSOE70 2-22-1	12636-05	7.19555	0.11032	0.034	96	561.52	4.49	7.19	>150
3	IWSOE70 2-22-1	12636-45	6.57333	0.01726	0.018	89.9	567.69	7.91	9.74	>150

3	IWSOE70 2-22-1	12636-11	14.07921	0.06555	0.025	92.3	587.86	5.87	8.31	>150	
3	IWSOE70 2-22-1	12636-13	9.26903	0.00165	0.041	98.5	590.69	3.89	7.07	>150	
3	IWSOE70 2-22-1	12636-72	21.57406	0.01082	0.015	72.5	638.67	7.55	9.89	>150	
3	IWSOE70 2-22-1	12636-67	8.50984	0.03997	0.027	96.7	696.41	5.21	8.70	>150	
3	IWSOE70 2-22-1	12636-38	9.96117	0.02336	0.022	92.5	698.66	6.69	9.67	>150	
3	IWSOE70 2-22-1	12636-63	13.67332	0.02693	0.052	97.4	825.58	3.63	9.02	>150	
3	IWSOE70 2-22-1	12636-69	29.54472	0.01559	0.005	87.9	932.35	21.44	23.38	>150	
3	IWSOE70 2-22-1	12636-40	7.50937	0.0387	0.015	97.8	1041.29	9.18	13.88	>150	
3	IWSOE70 2-22-1	12636-58	29.55405	-0.0185	0.007	91.6	1082.89	18.65	21.57	>150	
3	IWSOE70 2-22-1	12636-64	14.16618	-0.02455	0.014	93.9	1113.02	9.80	14.83	>150	
3	IWSOE70 2-22-1	12636-59	30.48578	-0.08447	0.007	96.4	1203.54	19.15	22.61	>150	
3	IWSOE70 2-22-1	12636-02	19.12208	0.01045	0.016	95.2	1225.77	8.66	15.01	>150	
3	IWSOE70 2-22-1	12636-06	27.9012	0.00159	0.026	97.8	1268.19	7.44	14.71	>150	
4	IWSOE69 G17	12640-56	7.95832	-0.0335	0.014	96.7	517.98	12.38	13.36	>150	*96*
4	IWSOE69 G17	12640-66	47.5923	0.16018	0.004	76.7	666.56	28.30	29.03	>150	
4	IWSOE69 G17	12640-30	29.89203	-0.05284	0.009	80	773.94	13.32	15.29	>150	
4	IWSOE69 G17	12640-85	74.20188	0.10692	0.002	70.4	773.97	44.05	44.68	>150	
4	IWSOE69 G17	12640-21	39.84649	-0.00412	0.006	73.7	851.36	18.97	20.69	>150	
4	IWSOE69 G17	12640-23	9.16229	0.00343	0.025	88.4	881.91	5.77	10.33	>150	
4	IWSOE69 G17	12640-86	98.24375	0.36813	0.004	85.2	900.84	30.57	31.80	>150	
4	IWSOE69 G17	12640-63	59.44829	0.01066	0.008	95.9	909.46	16.16	18.42	>150	
4	IWSOE69 G17	12640-11	1.41423	0.01595	0.046	96	940.90	4.42	10.15	>150	
4	IWSOE69 G17	12640-91	40.22646	0.06297	0.007	88.3	971.02	17.02	19.46	>150	
4	IWSOE69 G17	12640-36	13.68263	0.00802	0.09	96.9	973.58	3.18	9.97	>150	
4	IWSOE69 G17	12640-03	16.05604	0.05106	0.015	67.2	977.32	9.59	13.49	>150	
4	IWSOE69 G17	12640-06	49.0649	0.03978	0.014	77	979.49	10.14	13.91	>150	
4	IWSOE69 G17	12640-61	41.2256	0.40883	0.008	94.1	983.55	17.33	19.79	>150	
4	IWSOE69 G17	12640-101	21.80114	-0.01322	0.019	95.1	995.16	6.65	11.73	>150	
4	IWSOE69 G17	12640-33	25.56528	-0.017	0.018	81.3	995.34	8.69	13.00	>150	
4	IWSOE69 G17	12640-92	30.92992	0.01346	0.01	91.4	995.39	12.56	15.85	>150	
4	IWSOE69 G17	12640-64	46.51051	0.10864	0.007	71.9	997.76	20.19	22.39	>150	
4	IWSOE69 G17	12640-24	30.67076	-0.03494	0.006	82	1001.98	21.40	23.51	>150	
4	IWSOE69 G17	12640-90	74.13462	0.3817	0.004	82.5	1003.70	30.34	31.86	>150	
4	IWSOE69 G17	12640-01	5.65967	0.0278	0.028	92.6	1006.33	6.13	11.54	>150	

4	IWSOE69 G17	12640-96	17.17793	-0.03401	0.012	69.6	1008.96	11.66	15.23	>150
4	IWSOE69 G17	12640-05	29.00639	0.06093	0.012	93.6	1009.62	11.15	14.85	>150
4	IWSOE69 G17	12640-35	23.14757	0.00087	0.209	97.8	1010.51	2.41	10.11	>150
4	IWSOE69 G17	12640-81	63.53403	0.06528	0.011	97	1010.86	12.45	15.86	>150
4	IWSOE69 G17	12640-32	30.50195	-0.00145	0.01	84.1	1011.74	13.69	16.85	>150
4	IWSOE69 G17	12640-09	12.66935	0.04998	0.026	89.6	1016.49	6.83	12.00	>150
4	IWSOE69 G17	12640-27	17.17562	0.0919	0.014	93.1	1017.06	9.48	13.69	>150
4	IWSOE69 G17	12640-49	14.51211	-0.01935	0.021	78.1	1017.74	10.69	14.56	>150
4	IWSOE69 G17	12640-40	16.39559	-0.03627	0.037	92.9	1018.57	6.86	12.04	>150
4	IWSOE69 G17	12640-39	22.55728	-0.02572	0.031	89.8	1022.49	8.07	12.79	>150
4	IWSOE69 G17	12640-02	22.40502	0.12308	0.01	54.1	1025.52	13.92	17.12	>150
4	IWSOE69 G17	12640-99	12.996	-0.05788	0.012	95.6	1027.16	10.98	14.84	>150
4	IWSOE69 G17	12640-07	9.9037	0.01231	0.041	97.7	1031.78	4.41	10.95	>150
4	IWSOE69 G17	12640-106	39.38743	-0.03415	0.007	94.3	1033.29	18.09	20.68	>150
4	IWSOE69 G17	12640-28	8.94246	0.01301	0.055	97.7	1033.91	4.42	10.97	>150
4	IWSOE69 G17	12640-08	14.32547	-0.00056	0.04	87.4	1034.51	5.78	11.59	>150
4	IWSOE69 G17	12640-103	7.98651	-0.0083	0.016	99.4	1036.72	8.76	13.35	>150
4	IWSOE69 G17	12640-37	38.80655	0.00664	0.022	64.6	1036.97	10.66	14.67	>150
4	IWSOE69 G17	12640-70	20.57857	-0.00264	0.021	94.2	1038.77	7.69	12.68	>150
4	IWSOE69 G17	12640-54	17.5613	-0.12844	0.017	97.8	1039.72	10.39	14.49	>150
4	IWSOE69 G17	12640-16	13.98665	0.03453	0.038	97.5	1039.81	5.31	11.41	>150
4	IWSOE69 G17	12640-62	56.0766	0.20512	0.007	91.9	1041.60	20.28	22.67	>150
4	IWSOE69 G17	12640-94	14.28485	0.11652	0.009	97.8	1043.02	15.22	18.28	>150
4	IWSOE69 G17	12640-93	39.92469	0.29828	0.004	79.3	1043.08	29.04	30.76	>150
4	IWSOE69 G17	12640-68	26.93031	-0.03382	0.007	99.5	1048.24	17.05	19.86	>150
4	IWSOE69 G17	12640-20	8.6225	-0.01036	0.056	98.8	1048.55	4.27	11.04	>150
4	IWSOE69 G17	12640-87	11.50704	-0.05974	0.011	89.1	1052.26	12.97	16.52	>150
4	IWSOE69 G17	12640-60	7.79843	0.01447	0.026	98.2	1052.61	5.88	11.79	>150
4	IWSOE69 G17	12640-69	16.97467	0.03245	0.031	83.5	1054.36	6.55	12.16	>150
4	IWSOE69 G17	12640-100	65.13783	0.26262	0.005	85	1058.77	21.19	23.55	>150
4	IWSOE69 G17	12640-18	11.2091	0.00998	0.016	98.5	1058.93	8.68	13.46	>150
4	IWSOE69 G17	12640-89	17.38638	-0.00289	0.016	95.1	1059.15	8.94	13.63	>150
4	IWSOE69 G17	12640-53	24.44691	-0.03865	0.021	98.1	1059.96	9.26	13.85	>150

4	IWSOE69 G17	12640-22	18.83823	0.01174	0.011	101.3	1061.38	11.94	15.78	>150
4	IWSOE69 G17	12640-71	12.24233	0.00457	0.026	97.8	1063.15	5.95	11.91	>150
4	IWSOE69 G17	12640-25	26.72256	0.0826	0.016	84.5	1063.43	10.43	14.68	>150
4	IWSOE69 G17	12640-51	24.99747	-0.10791	0.017	86.6	1064.04	11.49	15.45	>150
4	IWSOE69 G17	12640-67	75.85093	-0.04177	0.004	92.5	1065.28	32.43	34.04	>150
4	IWSOE69 G17	12640-97	3.44466	0.02212	0.016	101	1066.72	8.35	13.31	>150
4	IWSOE69 G17	12640-34	16.31457	0.24443	0.008	92	1067.38	16.29	19.31	>150
4	IWSOE69 G17	12640-58	11.03087	0.02783	0.021	102.8	1067.82	9.01	13.74	>150
4	IWSOE69 G17	12640-38	14.93673	-0.0121	0.089	90.2	1072.92	4.09	11.19	>150
4	IWSOE69 G17	12640-12	28.7278	0.08531	0.01	82.1	1072.92	11.92	15.83	>150
4	IWSOE69 G17	12640-107	18.46756	0.03282	0.012	98.8	1074.75	11.63	15.63	>150
4	IWSOE69 G17	12640-76	42.13013	-0.02907	0.009	97.3	1074.84	13.31	16.91	>150
4	IWSOE69 G17	12640-82	46.19625	-0.22291	0.005	93.4	1074.98	21.49	23.90	>150
4	IWSOE69 G17	12640-73	13.62623	0.0067	0.016	97.6	1075.93	8.70	13.60	>150
4	IWSOE69 G17	12640-14	25.96746	0.2139	0.009	19	1081.32	32.51	34.16	>150
4	IWSOE69 G17	12640-41	16.43519	-0.00548	0.037	96	1081.87	5.53	11.87	>150
4	IWSOE69 G17	12640-72	18.45945	0.02374	0.03	93.7	1090.28	5.96	12.15	>150
4	IWSOE69 G17	12640-77	18.67316	0.00283	0.014	97.7	1092.30	9.79	14.44	>150
4	IWSOE69 G17	12640-98	16.25694	-0.10771	0.008	98.8	1100.90	15.18	18.57	>150
4	IWSOE69 G17	12640-10	19.78015	0.1077	0.014	97.7	1101.66	10.80	15.20	>150
4	IWSOE69 G17	12640-95	21.15998	0.01679	0.014	94.9	1106.17	10.52	15.03	>150
4	IWSOE69 G17	12640-105	39.67323	0.12652	0.007	83.9	1106.17	17.63	20.65	>150
4	IWSOE69 G17	12640-43	14.19392	-0.01577	0.046	97.9	1113.47	6.05	12.39	>150
4	IWSOE69 G17	12640-84	24.32086	-0.00248	0.01	94.7	1114.95	12.83	16.79	>150
4	IWSOE69 G17	12640-19	20.1631	0.04346	0.006	89	1115.35	19.39	22.21	>150
4	IWSOE69 G17	12640-55	11.10002	-0.00312	0.024	100.7	1125.97	8.12	13.62	>150
4	IWSOE69 G17	12640-57	14.00946	-0.03707	0.026	99	1128.58	9.13	14.26	>150
4	IWSOE69 G17	12640-75	19.74701	-0.01251	0.015	94.1	1138.24	9.21	14.39	>150
4	IWSOE69 G17	12640-42	17.79435	0.06693	0.023	51.2	1151.90	11.47	16.02	>150
4	IWSOE69 G17	12640-102	31.22497	0.13237	0.007	99.5	1154.58	15.72	19.31	>150
4	IWSOE69 G17	12640-46	21.65298	0.09223	0.035	94.6	1166.22	6.37	13.00	>150
4	IWSOE69 G17	12640-79	51.93014	0.10003	0.007	103.5	1171.16	20.38	23.34	>150
4	IWSOE69 G17	12640-04	14.4102	0.16287	0.009	81	1172.32	14.69	18.58	>150

4	IWSOE69 G17	12640-59	11.32504	0.03381	0.023	101.6	1181.03	8.05	14.01	>150	
4	IWSOE69 G17	12640-29	31.0548	0.01376	0.011	92.6	1194.31	14.39	18.49	>150	
4	IWSOE69 G17	12640-74	39.30733	0.16077	0.006	103.4	1205.48	22.37	25.25	>150	
4	IWSOE69 G17	12640-50	28.66374	0.1628	0.012	22.5	1244.86	29.68	32.05	>150	
4	IWSOE69 G17	12640-15	23.96988	0.24584	0.006	93.9	1267.03	20.03	23.51	>150	
4	IWSOE69 G17	12640-52	55.65813	-0.08911	0.011	78.3	1278.21	15.98	20.23	>150	
4	IWSOE69 G17	12640-48	20.72658	-0.09616	0.02	105.8	1318.78	10.82	16.77	>150	
4	IWSOE69 G17	12640-44	13.1608	-0.17906	0.004	98.7	1591.07	37.57	40.62	>150	
4	IWSOE69 G17	12640-47	68.23874	-0.20618	0.008	98.1	1700.07	24.32	29.40	>150	
5	IWSOE69 G21 hb	14305-04	6.21838	0.08721	0.002	6.4	131.86	17.87	18.06	> 150	55
5	IWSOE69 G21 hb	14305-10	7.92066	0.1181	0.015	91.9	180.19	1.19	3.80	> 150	
5	IWSOE69 G21 hb	14305-06	70.32126	0.00803	0.003	49.3	197.61	5.62	6.87	> 150	
5	IWSOE69 G21 hb	14305-12	26.39133	-0.10046	0.001	19.9	202.88	13.95	14.53	> 150	
5	IWSOE69 G21 hb	14305-20	54.28485	0.00628	0.005	40.3	243.60	4.76	6.81	> 150	
5	IWSOE69 G21 hb	13488-01	166.48495	-0.03515	0.0990	67.1	288.36	5.81	6.48	> 150	
5	IWSOE69 G21 hb	13488-24	4.61724	0.01698	0.016	97.2	379.59	1.72	4.17	> 150	
5	IWSOE69 G21 hb	13488-15	15.27365	0.01364	0.003	39.8	441.01	9.48	10.46	> 150	
5	IWSOE69 G21 hb	13488-30	19.64712	0.00397	0.02	96.6	467.94	1.74	4.99	> 150	
5	IWSOE69 G21 hb	14305-07	6.86481	0.03213	0.009	98.5	474.36	2.66	9.85	> 150	
5	IWSOE69 G21 hb	13488-26	17.57166	-0.02383	0.012	87.4	481.82	2.57	5.46	> 150	
5	IWSOE69 G21 hb	14305-18	16.50699	0.04046	0.004	95.3	486.69	4.37	10.67	> 150	
5	IWSOE69 G21 hb	13488-18	9.45271	0.00027	0.053	96.2	489.69	2.18	5.36	> 150	
5	IWSOE69 G21 hb	13488-29	8.01727	0.00675	0.039	97.7	496.19	1.32	5.13	> 150	
5	IWSOE69 G21 hb	14305-17	8.74372	0.00878	0.02	99.5	497.58	2.05	10.16	> 150	
5	IWSOE69 G21 hb	14305-19	17.24244	0.04703	0.009	95	502.14	2.78	10.42	> 150	
5	IWSOE69 G21 hb	13488-19	6.99676	0.00194	0.01	91.8	502.80	3.10	5.90	> 150	
5	IWSOE69 G21 hb	13488-14	7.1258	0.01364	0.012	64.1	507.75	3.65	6.26	> 150	
5	IWSOE69 G21 hb	14305-03	10.80734	0.02082	0.011	97.3	514.07	2.35	10.55	> 150	
5	IWSOE69 G21 hb	14305-02	6.90262	0.02051	0.012	97.5	517.70	2.19	10.58	> 150	
5	IWSOE69 G21 hb	14305-16	16.37783	0.0076	0.016	98.9	518.55	2.23	10.61	> 150	
5	IWSOE69 G21 hb	13488-17	16.04776	0.0012	0.078	98.2	521.57	0.98	5.31	> 150	
5	IWSOE69 G21 hb	13488-02	5.83686	0.00534	0.7170	100	523.32	3.63	6.37	> 150	
5	IWSOE69 G21 hb	13488-09	8.04288	0.02048	0.0940	98.1	616.20	5.97	8.58	> 150	
5	IWSOE69 G21 hb	14305-15	14.12617	0.01617	0.02	71.3	723.03	3.68	14.92	> 150	
5	IWSOE69 G21 hb	13488-21	0.05551	0.00427	0.242	99.9	941.18	2.00	9.62	> 150	

5	IWSOE69 G21 hb	13488-23	7.60695	0.02455	0.012	98.3	953.28	3.68	10.22	> 150	
5	IWSOE69 G21 hb	13488-25	6.37778	0.22025	0.011	94.8	964.65	7.86	12.44	> 150	
5	IWSOE69 G21 hb	14305-01	11.33491	0.06681	0.006	98.5	971.31	5.45	20.18	> 150	
5	IWSOE69 G21 hb	13488-27	7.9829	0.04982	0.006	98.7	976.35	7.90	12.56	> 150	
5	IWSOE69 G21 hb	13488-22	10.46756	0.06712	0.008	97.6	979.39	4.93	10.96	> 150	
5	IWSOE69 G21 hb	14305-13	4.73318	0.0222	0.023	98.4	979.78	2.95	19.82	> 150	
5	IWSOE69 G21 hb	13488-05	6.5409	0.13339	0.3410	100.5	991.75	6.60	11.91	> 150	
5	IWSOE69 G21 hb	13488-03	7.36788	0.05255	0.5580	99.7	992.65	5.79	11.49	> 150	
5	IWSOE69 G21 hb	13488-06	7.56462	0.01419	0.4300	100.3	994.78	5.62	11.42	> 150	
5	IWSOE69 G21 hb	13488-10	19.9136	-0.00642	0.1740	99.8	1000.71	5.99	11.66	> 150	
5	IWSOE69 G21 hb	13488-20	11.70044	0.02561	0.006	97.6	1002.71	10.40	14.44	> 150	
5	IWSOE69 G21 hb	13488-07	25.31501	0.02021	0.0310	98.7	1010.72	9.16	13.64	> 150	
5	IWSOE69 G21 hb	13488-28	5.17224	0.02757	0.006	97.4	1028.72	5.55	11.69	> 150	
5	IWSOE69 G21 hb	14305-08	8.32876	0.02341	0.01	99.7	1035.98	4.20	21.14	> 150	
5	IWSOE69 G21 hb	13488-08	8.34628	0.00548	0.1400	100.4	1049.86	6.18	12.18	> 150	
5	IWSOE69 G21 hb	13488-04	8.98092	0.02401	0.5890	99.5	1058.78	5.96	12.15	> 150	
5	IWSOE69 G21 hb	14305-11	21.98824	0.09702	0.004	97	1064.87	8.92	23.09	> 150	
5	IWSOE69 G21 hb	14305-09	6.39447	0.07658	0.039	97.2	1086.51	2.50	21.87	> 150	
5	IWSOE69 G21 hb	14305-21	12.21178	0.01703	0.013	96.3	493.01	2.39	10.15	> 150	
5	IWSOE69 G21 hb	14305-22	13.68026	0.03812	0.01	97.8	479.54	2.69	9.96	> 150	
5	IWSOE69 G21 hb	14305-24	5.80064	0.05167	0.11	99.7	1150.07	2.10	23.10	> 150	
5	IWSOE69 G21 hb	14305-27	4.61851	0.01282	0.13	83.5	171.48	0.60	3.48	> 150	
5	IWSOE69 G21 hb	14305-28	5.62354	0.02379	0.018	85.9	316.73	1.60	6.53	> 150	
5	IWSOE69 G21 hb	14305-31	8.29819	0.02885	0.016	99.6	520.22	2.11	10.62	> 150	
5	IWSOE69 G21 hb	14305-32	10.83577	0.04478	0.006	95.7	929.95	6.43	19.68	> 150	
5	IWSOE69 G21 hb	14305-34	9.50278	0.07065	0.006	99.4	980.73	5.69	20.42	> 150	
5	IWSOE69 G21 hb	14305-35	12.77679	0.05834	0.03	99	1064.65	2.66	21.46	> 150	
5	IWSOE69 G21 hb	14305-36	18.84649	0.00531	0.036	98.5	508.35	1.43	10.27	> 150	
5	IWSOE69 G21 hb	14305-37	19.55541	0.05752	0.01	98.5	820.22	3.86	16.85	> 150	
6	IWSOE68-13	12639-12	14.50491	0.71929	0.002	5.4	73.06	86.11	86.12	>150	*46*
6	IWSOE68-13	12639-29	13.73652	0.05986	0.033	93.7	495.89	4.47	6.57	>150	
6	IWSOE68-13	12639-16	9.41328	0.04557	0.027	87.2	498.39	5.24	7.13	>150	
6	IWSOE68-13	12639-26	12.09173	0.07986	0.029	92.5	499.40	4.46	6.59	>150	
6	IWSOE68-13	12639-19	8.7111	-0.00482	0.051	90.5	505.72	3.52	6.05	>150	
6	IWSOE68-13	12639-06	5.00745	0.03182	0.151	94.2	505.77	1.57	5.16	>150	

6	IWSOE68-13	12639-38	9.25896	0.0164	0.033	102.5	509.29	4.58	6.74	>150
6	IWSOE68-13	12639-44	10.66923	0.00366	0.028	93.3	512.89	5.14	7.16	>150
6	IWSOE68-13	12639-39	9.07824	0.00709	0.044	91.8	516.65	3.57	6.16	>150
6	IWSOE68-13	12639-07	7.62283	0.01193	0.12	96.8	518.15	1.89	5.38	>150
6	IWSOE68-13	12639-37	11.48835	-0.03672	0.031	97	518.24	4.60	6.82	>150
6	IWSOE68-13	12639-09	6.22443	0.01627	0.082	95.1	520.06	2.50	5.64	>150
6	IWSOE68-13	12639-48	5.49229	0.01997	0.087	97.5	524.12	2.18	5.54	>150
6	IWSOE68-13	12639-33	8.54058	0.00536	0.089	93.5	526.33	2.34	5.62	>150
6	IWSOE68-13	12639-18	10.09023	0.01362	0.041	90	531.49	3.70	6.35	>150
6	IWSOE68-13	12639-32	11.06783	0.00357	0.036	84.1	555.96	4.69	7.15	>150
6	IWSOE68-13	12639-45	26.10428	0.00289	0.011	99	558.81	11.57	12.78	>150
6	IWSOE68-13	12639-23	21.67617	0.07175	0.022	70.3	596.92	6.82	8.95	>150
6	IWSOE68-13	12639-08	15.31759	-0.00263	0.035	86.3	598.12	4.70	7.47	>150
6	IWSOE68-13	12639-28	34.56262	-0.15682	0.01	74.9	599.27	13.64	14.83	>150
6	IWSOE68-13	12639-24	13.86009	0.03763	0.025	93.1	724.71	6.32	9.46	>150
6	IWSOE68-13	12639-31	14.02769	-0.17121	0.003	38.4	727.75	36.98	37.65	>150
6	IWSOE68-13	12639-20	3.11265	0.24475	0.003	61.6	757.83	36.84	37.57	>150
6	IWSOE68-13	12639-50	20.94222	0.02541	0.027	94.6	773.39	5.96	9.59	>150
6	IWSOE68-13	12639-10	26.98964	0.00723	0.016	89.2	920.95	8.40	12.27	>150
6	IWSOE68-13	12639-01	5.10688	0.03729	0.127	95	989.82	2.69	9.98	>150
6	IWSOE68-13	12639-34	17.48125	-0.00883	0.056	97	993.62	4.21	10.53	>150
6	IWSOE68-13	12639-49	5.71695	0.03644	0.07	99.3	994.27	3.65	10.32	>150
6	IWSOE68-13	12639-47	6.49513	-0.01387	0.028	95.4	995.34	6.38	11.58	>150
6	IWSOE68-13	12639-17	5.59977	0.04305	0.135	96.3	998.48	2.75	10.08	>150
6	IWSOE68-13	12639-14	6.61472	0.00026	0.044	94.8	1024.78	5.13	11.20	>150
6	IWSOE68-13	12639-42	3.98963	0.20006	0.026	99.4	1026.38	6.63	11.97	>150
6	IWSOE68-13	12639-22	18.13691	0.03787	0.021	96.2	1028.16	7.33	12.39	>150
6	IWSOE68-13	12639-40	8.08848	0.01241	0.035	47	1034.12	9.94	14.13	>150
6	IWSOE68-13	12639-43	12.13439	0.01517	0.019	96.4	1039.49	8.40	13.13	>150
6	IWSOE68-13	12639-21	12.35436	0.00989	0.053	97.2	1042.65	4.01	10.89	>150
6	IWSOE68-13	12639-13	5.92242	0.01457	0.098	98.9	1045.38	3.09	10.61	>150
6	IWSOE68-13	12639-27	5.08968	0.00862	0.101	98.3	1047.35	2.96	10.59	>150
6	IWSOE68-13	12639-30	16.44524	-0.01393	0.038	97.1	1048.54	4.69	11.21	>150
6	IWSOE68-13	12639-11	6.22684	0.023	0.116	98.6	1049.06	2.83	10.57	>150
6	IWSOE68-13	12639-41	12.34959	-0.0125	0.037	96	1049.26	4.97	11.34	>150
6	IWSOE68-13	12639-04	11.05718	0.0417	0.057	97.8	1055.29	4.02	11.01	>150

6	IWSOE68-13	12639-25	7.98774	0.029	0.062	98.4	1056.49	3.87	10.97	>150	
6	IWSOE68-13	12639-46	13.1685	-0.00381	0.037	96.8	1063.18	5.24	11.58	>150	
6	IWSOE68-13	12639-15	9.39589	0.02835	0.025	96.2	1066.64	6.89	12.44	>150	
6	IWSOE68-13	12639-05	5.78877	0.02905	0.233	98.3	1090.30	2.27	10.83	>150	
7	IWSOE70 03-11-03 228-230 hb	13487-10	1.87641	0.00988	0.1100	81.1	191.00	2.87	3.44	> 150	20
7	IWSOE70 03-11-03 228-230 hb	13487-03	8.1779	0.01887	0.2040	97.5	517.27	4.63	6.94	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-11	6.74431	0.0191	0.034	47.1	478.90	4.56	6.61	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-12	0.00281	-0.00311	0.137	56.8	169.68	1.21	2.08	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-15	12.51342	-0.02128	0.001	62.1	603.23	26.59	27.27	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-16	12.00471	0.10356	0.009	82.2	185.45	2.33	2.98	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-19	0.07538	0.00628	0.022	61.8	225.85	1.95	2.99	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-20	7.55271	0.0273	0.008	88.7	465.51	5.26	7.03	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-23	5.2887	-0.12254	0.002	3.7	275.83	54.31	54.38	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-25	1.13373	-0.01932	0.011	84.9	279.31	2.00	3.44	> 150	
7	IWSOE70 03-11-03 228-230 hb	13487-26	0.0886	-0.00394	0.044	85.6	174.21	1.05	2.04	> 150	
7	IWSOE70 03-11-03 228-230 hb	14315-01	27.0393	0.02552	0.005	27.6	168.54	5.20	6.20	> 150	
7	IWSOE70 03-11-03 228-230 hb	14315-20	2.46016	0.04256	0.004	42.1	180.40	4.89	6.08	> 150	
7	IWSOE70 03-11-03 228-230 hb	14315-02	7.96163	0.06128	0.007	90.7	463.76	3.28	9.84	> 150	
7	IWSOE70 03-11-03 228-230 hb	14315-06	8.40473	0.1057	0.029	98.1	472.94	1.47	9.57	> 150	
7	IWSOE70 03-11-03 228-230 hb	14315-19	7.88112	0.098	0.013	98.7	507.22	2.64	10.48	> 150	

7	IWSOE70 03-11-03 228-230 hb	14315-10	6.19473	0.02001	0.102	99.1	509.50	1.13	10.25	> 150	
7	IWSOE70 03-11-03 228-230 hb	14315-08	66.55449	0.03783	0.006	87.4	740.61	5.26	15.72	> 150	
7	IWSOE70 03-11-03 228-230 hb	14315-14	12.464	0.09385	0.011	99	947.52	4.18	19.41	> 150	
7	IWSOE70 03-11-03 228-230 hb	14315-11	6.54334	0.08684	0.009	99.6	1029.94	4.30	21.04	> 150	
8	IO 1578-27 hb	14309-10	38.47017	-0.02101	0.008	7.9	12.58	2.39	2.40	> 150	62
8	IO 1578-27 hb	14309-11	7.3159	-0.01457	0.004	18	90.95	5.28	5.59	> 150	
8	IO 1578-27 hb	14309-01	0.94616	0.01596	0.011	81.2	152.56	1.40	3.36	> 150	
8	IO 1578-27 hb	14309-06	2.84515	0.01455	0.029	81.3	156.89	0.88	3.26	> 150	
8	IO 1578-27 hb	14309-18	2.40321	0.00525	0.038	93.5	183.82	0.72	3.75	> 150	
8	IO 1578-27 hb	13497-18	12.03868	-0.10764	0.018	6.3	224.15	22.39	22.50	> 150	
8	IO 1578-27 hb	14309-19	2.54933	0.01997	0.019	82.2	232.06	1.31	4.82	> 150	
8	IO 1578-27 hb	13497-11	5.06318	-0.00089	0.006	68.5	273.10	3.73	4.62	> 150	
8	IO 1578-27 hb	14309-13	3.28882	0.02234	0.014	85.9	301.93	1.77	6.29	> 150	
8	IO 1578-27 hb	13497-15	15.49401	-0.02792	0.003	56.5	316.58	9.23	9.76	> 150	
8	IO 1578-27 hb	14309-15	6.4635	0.03015	0.007	90.1	324.17	2.62	6.99	> 150	
8	IO 1578-27 hb	14309-02	6.83793	-0.0035	0.004	79.3	367.39	4.64	8.69	> 150	
8	IO 1578-27 hb	14309-08	6.10245	0.03404	0.006	91.9	379.62	3.37	8.31	> 150	
8	IO 1578-27 hb	14309-04	8.89293	0.01534	0.098	99	442.01	0.98	8.89	> 150	
8	IO 1578-27 hb	13497-19	7.83319	0.00065	0.025	46.5	446.54	4.11	6.07	> 150	
8	IO 1578-27 hb	14309-17	16.64544	0.03215	0.014	96.5	458.87	2.06	9.41	> 150	
8	IO 1578-27 hb	13497-23	6.97294	0.00202	0.051	98.2	462.93	1.17	4.78	> 150	
8	IO 1578-27 hb	13497-26	6.85592	0.00949	0.047	97.4	467.48	2.15	5.14	> 150	
8	IO 1578-27 hb	13497-17	8.00996	-0.02005	0.012	71.5	476.38	3.00	5.63	> 150	
8	IO 1578-27 hb	13497-12	7.42753	0.02155	0.013	86.2	477.41	2.60	5.43	> 150	
8	IO 1578-27 hb	13497-01	5.45704	0.00895	0.9370	100.2	477.60	3.29	5.80	> 150	
8	IO 1578-27 hb	13497-13	6.98223	0.02611	0.01	95.2	478.14	4.17	6.34	> 150	
8	IO 1578-27 hb	13497-09	7.94273	-0.00241	0.5420	101.2	481.50	3.46	5.93	> 150	
8	IO 1578-27 hb	13497-20	7.88963	0.01966	0.038	91.3	487.73	1.53	5.11	> 150	
8	IO 1578-27 hb	13497-08	5.95585	0.00307	0.9190	100.2	487.87	3.35	5.92	> 150	
8	IO 1578-27 hb	13497-02	5.13503	-0.0009	0.3580	100.9	490.89	3.70	6.15	> 150	
8	IO 1578-27 hb	13497-03	14.37649	-0.00561	0.4800	100.3	494.35	3.61	6.12	> 150	

8	IO 1578-27 hb	13497-04	12.4476	0.00621	0.3200	98	496.28	3.61	6.14	> 150
8	IO 1578-27 hb	13497-25	5.6447	0.01165	0.073	99.7	496.82	0.97	5.06	> 150
8	IO 1578-27 hb	13497-22	18.87558	0.02325	0.017	94.2	504.55	3.31	6.03	> 150
8	IO 1578-27 hb	13497-10	7.40708	0.01732	0.5070	100.8	504.74	3.68	6.25	> 150
8	IO 1578-27 hb	13497-06	19.89118	0.01278	0.2180	98.8	507.62	4.71	6.93	> 150
8	IO 1578-27 hb	13497-14	9.30702	0.02307	0.047	98.6	519.38	1.35	5.37	> 150
8	IO 1578-27 hb	13497-05	6.61025	-0.00056	0.3520	98.5	566.40	4.64	7.32	> 150
8	IO 1578-27 hb	13497-16	29.97828	0.03719	0.012	53	602.32	4.96	7.80	> 150
8	IO 1578-27 hb	13497-21	6.59915	0.00815	0.024	98.1	876.87	2.49	9.12	> 150
8	IO 1578-27 hb	14309-03	51.8272	0.01192	0.013	92.2	897.06	3.43	18.27	> 150
8	IO 1578-27 hb	13497-07	10.78694	0.00098	0.4040	100.2	1005.98	6.83	12.16	> 150
8	IO 1578-27 hb	14309-14	0.42319	0.00961	0.194	99.8	1064.56	1.65	21.36	> 150
9	IO 1578-28 hb	14307-01	1.59616	0.01373	0.021	56.8	46.63	0.82	1.24	> 150
9	IO 1578-28 hb	14307-32	3.22229	0.00406	0.017	58.7	66.42	1.09	1.72	> 150
9	IO 1578-28 hb	14307-17	0.26756	0.00819	0.063	83.7	66.44	0.33	1.37	> 150
9	IO 1578-28 hb	14307-16	0.03466	0.01463	0.031	81.2	71.21	0.52	1.51	> 150
9	IO 1578-28 hb	14307-33	1.18113	0.00578	0.015	79.3	81.89	1.02	1.93	> 150
9	IO 1578-28 hb	14307-14	1.37136	0.00421	0.015	68.1	93.38	1.10	2.17	> 150
9	IO 1578-28 hb	14307-11	3.07701	0.01971	0.016	78.6	145.26	1.14	3.12	> 150
9	IO 1578-28 hb	14307-25	9.64448	0.00949	0.027	83.5	153.69	0.81	3.18	> 150
9	IO 1578-28 hb	14307-19	1.66774	0.00933	0.041	81.2	157.48	0.78	3.25	> 150
9	IO 1578-28 hb	14307-31	17.61837	-0.01335	0.003	64.2	170.67	4.70	5.81	> 150
9	IO 1578-28 hb	13496-07	35.88044	-0.15845	0.0150	87.5	206.98	6.93	7.23	> 150
9	IO 1578-28 hb	13496-06	3.03925	-0.00564	0.1930	96	213.09	1.94	2.88	> 150
9	IO 1578-28 hb	14307-10	31.06395	-0.00385	0.001	50.9	227.86	12.32	13.14	> 150
9	IO 1578-28 hb	14307-02	95.97125	-0.0529	0.003	9.8	260.76	17.47	18.23	> 150
9	IO 1578-28 hb	13496-09	13.13681	-0.00371	0.0320	102.7	471.79	7.90	9.20	> 150
9	IO 1578-28 hb	13496-08	10.28869	-0.03645	0.0440	101.9	479.73	4.37	6.49	> 150
9	IO 1578-28 hb	13496-10	11.41443	0.04107	0.0330	101.9	537.43	5.63	7.78	> 150
9	IO 1578-28 hb	14307-18	21.14312	0.04075	0.004	64.5	543.93	5.88	12.37	> 150
9	IO 1578-28 hb	13496-04	19.05196	0.01704	0.0440	94.7	730.21	11.59	13.70	> 150
9	IO 1578-28 hb	13496-02	22.81218	0.0198	0.1050	100.3	1985.07	10.07	22.26	> 150
9	IO 1578-28 hb	13496-01	9.43246	-0.00873	0.2460	100.1	3156.85	14.85	34.89	> 150
9	IO 1578-28 hb	13496-03	14.8702	0.02043	0.0270	100.3	3320.82	19.41	38.47	> 150
9	IO 1578-28 hb	13496-05	14.66382	0.00201	0.0270	100.6	3681.81	19.08	41.47	> 150

10	IWSOE17 3-17-2	12646-21	8.69657	0.18073	0.023	5	33.22	8.92	8.92	>150	97
10	IWSOE17 3-17-2	12646-108	0.25119	-0.00675	0.079	80.5	57.23	1.58	1.67	>150	
10	IWSOE17 3-17-2	12646-54	0.21866	-0.01044	0.112	64.8	60.90	1.56	1.66	>150	
10	IWSOE17 3-17-2	12646-74	0.34118	-0.00993	0.033	37	63.43	3.34	3.39	>150	
10	IWSOE17 3-17-2	12646-95	2.07302	-0.02989	0.025	57.3	69.77	4.21	4.26	>150	
10	IWSOE17 3-17-2	12646-83	0.80397	-0.01843	0.03	95.8	87.34	3.57	3.66	>150	
10	IWSOE17 3-17-2	12646-109	2.35525	0.02515	0.018	57.6	93.38	6.23	6.30	>150	
10	IWSOE17 3-17-2	12646-03	0.34125	0.00551	0.433	78	125.71	0.58	1.35	>150	
10	IWSOE17 3-17-2	12646-100	0.78369	-0.02062	0.036	83	131.20	2.94	3.20	>150	
10	IWSOE17 3-17-2	12646-86	9.2428	0.0177	0.044	86.8	238.42	2.72	3.57	>150	
10	IWSOE17 3-17-2	12646-38	20.94609	0.05585	0.021	54.5	286.42	7.04	7.57	>150	
10	IWSOE17 3-17-2	12646-22	10.74745	0.05632	0.059	60.7	336.67	3.51	4.79	>150	
10	IWSOE17 3-17-2	12646-13	10.42929	0.04171	0.034	65.7	353.73	4.14	5.38	>150	
10	IWSOE17 3-17-2	12646-27	8.91872	0.00475	0.013	79	362.06	9.61	10.23	>150	
10	IWSOE17 3-17-2	12646-37	9.55325	0.06935	0.033	77.4	385.98	4.41	5.79	>150	
10	IWSOE17 3-17-2	12646-15	7.19242	0.03827	0.073	76	397.48	2.42	4.55	>150	
10	IWSOE17 3-17-2	12646-46	11.35495	0.01863	0.013	76.4	402.82	9.91	10.65	>150	
10	IWSOE17 3-17-2	12646-34	6.97405	0.01427	0.09	95.2	408.10	2.16	4.51	>150	
10	IWSOE17 3-17-2	12646-18	7.36474	0.04743	0.076	81	414.32	2.52	4.75	>150	
10	IWSOE17 3-17-2	12646-76	22.92227	0.01442	0.005	85.3	431.15	19.07	19.53	>150	
10	IWSOE17 3-17-2	12646-64	28.17433	0.11702	0.008	50.6	431.17	13.46	14.10	>150	
10	IWSOE17 3-17-2	12646-28	14.25604	0.01246	0.024	77.1	435.45	5.51	6.94	>150	
10	IWSOE17 3-17-2	12646-12	7.40454	0.00477	0.097	86.2	443.43	2.06	4.77	>150	
10	IWSOE17 3-17-2	12646-99	9.54993	-0.04276	0.02	92.9	443.46	5.42	6.93	>150	
10	IWSOE17 3-17-2	12646-89	70.89383	0.1483	0.005	92.6	451.25	18.79	19.30	>150	
10	IWSOE17 3-17-2	12646-33	31.52875	0.07883	0.01	89.5	452.34	12.00	12.78	>150	
10	IWSOE17 3-17-2	12646-91	14.8868	0.05045	0.025	88.5	453.28	4.45	6.26	>150	
10	IWSOE17 3-17-2	12646-19	9.05472	0.04455	0.12	86.2	456.11	2.24	4.96	>150	
10	IWSOE17 3-17-2	12646-73	22.30393	-0.02212	0.01	90.2	462.90	10.20	11.15	>150	
10	IWSOE17 3-17-2	12646-26	5.92112	0.01526	0.04	90.8	466.20	3.90	5.97	>150	
10	IWSOE17 3-17-2	12646-106	9.09114	0.00278	0.031	82.4	468.81	4.17	6.18	>150	
10	IWSOE17 3-17-2	12646-04	14.48516	0.04469	0.114	73.5	469.11	2.52	5.20	>150	

10	IWSOE17 3-17-2	12646-93	16.21497	0.10589	0.014	92.6	474.88	8.23	9.44	>150
10	IWSOE17 3-17-2	12646-10	12.18628	0.01221	0.079	90.5	475.49	2.31	5.16	>150
10	IWSOE17 3-17-2	12646-71	12.8298	0.03185	0.02	98.5	478.87	5.14	6.93	>150
10	IWSOE17 3-17-2	12646-101	6.3789	0.03578	0.025	94.7	480.89	4.70	6.63	>150
10	IWSOE17 3-17-2	12646-16	8.22526	0.01625	0.13	76.4	480.89	2.33	5.22	>150
10	IWSOE17 3-17-2	12646-68	13.48116	0.06141	0.012	98.9	485.08	8.25	9.50	>150
10	IWSOE17 3-17-2	12646-11	8.28662	-0.0038	0.058	84.8	486.53	2.95	5.57	>150
10	IWSOE17 3-17-2	12646-85	8.70874	0.04479	0.03	98.9	487.44	3.76	6.05	>150
10	IWSOE17 3-17-2	12646-97	7.93482	-0.00525	0.034	95	487.71	3.81	6.08	>150
10	IWSOE17 3-17-2	12646-79	16.82904	0.05628	0.015	94.2	491.44	6.83	8.33	>150
10	IWSOE17 3-17-2	12646-103	3.96029	0.01635	0.026	93.9	492.08	4.47	6.54	>150
10	IWSOE17 3-17-2	12646-81	11.59189	-0.01458	0.026	93.2	492.36	4.45	6.53	>150
10	IWSOE17 3-17-2	12646-09	12.56337	0.00874	0.09	94.6	493.04	1.87	5.14	>150
10	IWSOE17 3-17-2	12646-58	6.80111	0.02355	0.034	91	494.79	4.73	6.74	>150
10	IWSOE17 3-17-2	12646-75	10.41289	0.00899	0.007	87.4	495.29	13.17	14.02	>150
10	IWSOE17 3-17-2	12646-41	7.24536	0.00558	0.051	96.1	495.38	3.13	5.74	>150
10	IWSOE17 3-17-2	12646-59	7.25701	0.00063	0.028	97.8	495.92	5.00	6.95	>150
10	IWSOE17 3-17-2	12646-84	11.99428	0.00022	0.012	98.1	496.61	9.01	10.22	>150
10	IWSOE17 3-17-2	12646-102	7.58949	0.00135	0.028	96.2	497.86	4.64	6.70	>150
10	IWSOE17 3-17-2	12646-30	5.74377	0.01532	0.134	99.3	499.25	1.69	5.13	>150
10	IWSOE17 3-17-2	12646-50	6.78341	-0.02109	0.074	102.3	500.68	2.37	5.41	>150
10	IWSOE17 3-17-2	12646-48	15.23288	-0.02592	0.021	93.6	502.52	6.99	8.53	>150
10	IWSOE17 3-17-2	12646-107	8.97318	0.04415	0.019	94.1	505.15	5.94	7.71	>150
10	IWSOE17 3-17-2	12646-55	7.18217	-0.02264	0.028	94.5	505.58	5.38	7.28	>150
10	IWSOE17 3-17-2	12646-96	17.34302	-0.03442	0.012	59.3	506.21	8.89	10.16	>150
10	IWSOE17 3-17-2	12646-92	12.94097	0.07231	0.026	96.3	508.09	4.49	6.67	>150
10	IWSOE17 3-17-2	12646-77	16.25139	0.11832	0.011	89	508.42	10.40	11.51	>150
10	IWSOE17 3-17-2	12646-53	24.89907	-0.01696	0.02	76.3	519.46	7.79	9.28	>150
10	IWSOE17 3-17-2	12646-67	7.98272	0.05273	0.019	102	520.57	6.15	7.96	>150
10	IWSOE17 3-17-2	12646-32	11.40371	0.0344	0.024	94.5	521.15	5.38	7.38	>150
10	IWSOE17 3-17-2	12646-49	6.9149	-0.01457	0.037	102.7	523.03	4.19	6.59	>150
10	IWSOE17 3-17-2	12646-94	10.45521	0.05607	0.021	98.7	523.92	5.77	7.69	>150

10	IWSOE17 3-17-2	12646-39	5.2874	0.02865	0.091	100.2	531.38	2.24	5.63	>150
10	IWSOE17 3-17-2	12646-51	11.47148	0.02487	0.052	98.1	534.69	3.46	6.24	>150
10	IWSOE17 3-17-2	12646-69	17.68225	0.04495	0.013	95.6	535.46	7.55	9.17	>150
10	IWSOE17 3-17-2	12646-112	11.58469	0.04657	0.015	100.7	537.68	7.25	8.94	>150
10	IWSOE17 3-17-2	12646-65	13.53327	0.08324	0.013	103.7	593.25	8.27	10.08	>150
10	IWSOE17 3-17-2	12646-29	24.95807	0.05022	0.008	78.6	680.94	14.77	16.19	>150
10	IWSOE17 3-17-2	12646-01	12.96659	0.02899	0.573	91.4	768.32	1.86	7.69	>150
10	IWSOE17 3-17-2	12646-14	13.60938	0.07512	0.027	60.2	1005.27	7.97	12.61	>150
10	IWSOE17 3-17-2	12646-05	3.43057	0.0124	0.466	98.3	1683.94	2.82	16.60	>150
10	IWSOE17 3-17-2	12646-105	14.20442	-0.09499	0.007	68.5	2535.93	26.76	36.37	>150
10	IWSOE17 3-17-2	12646-35	13.15637	0.02231	0.066	97.6	2634.81	6.78	26.47	>150
10	IWSOE17 3-17-2	12646-72	9.282	-0.00839	0.006	96	2843.52	30.90	41.44	>150
10	IWSOE17 3-17-2	12646-63	14.01502	0.06704	0.015	99.2	2874.80	14.61	31.51	>150
10	IWSOE17 3-17-2	12646-25	24.50695	-0.02291	0.011	91.8	2905.22	21.62	35.54	>150
10	IWSOE17 3-17-2	12646-40	11.49484	-0.00892	0.026	99.7	2927.88	11.08	30.52	>150
10	IWSOE17 3-17-2	12646-20	19.33978	0.09267	0.033	93.5	2971.54	12.12	31.30	>150
10	IWSOE17 3-17-2	12646-88	45.00235	-0.02912	0.006	96.8	3000.00	27.15	39.82	>150
10	IWSOE17 3-17-2	12646-47	23.67351	0.08962	0.015	98.2	3050.93	16.92	34.12	>150
10	IWSOE17 3-17-2	12646-62	28.89779	0.04059	0.01	99.3	3062.66	14.03	32.89	>150
10	IWSOE17 3-17-2	12646-36	16.41719	0.04176	0.032	97.4	3069.37	11.48	31.94	>150
10	IWSOE17 3-17-2	12646-52	14.56829	-0.00891	0.026	99	3071.21	12.56	32.36	>150
10	IWSOE17 3-17-2	12646-56	7.63689	0.0272	0.022	99.7	3102.91	12.05	32.45	>150
10	IWSOE17 3-17-2	12646-06	13.30082	0.05456	0.07	97.2	3103.85	7.96	31.18	>150
10	IWSOE17 3-17-2	12646-110	9.19293	0.0064	0.021	99.9	3105.47	14.87	33.62	>150
10	IWSOE17 3-17-2	12646-08	10.19373	0.00394	0.065	99.2	3114.34	7.53	31.17	>150
10	IWSOE17 3-17-2	12646-98	14.80391	-0.02276	0.006	99.8	3121.72	27.89	41.19	>150
10	IWSOE17 3-17-2	12646-70	0.0287	0.04698	0.006	97.7	3141.83	29.50	42.44	>150
10	IWSOE17 3-17-2	12646-23	17.60166	0.00043	0.052	99.6	3144.12	8.03	31.57	>150
10	IWSOE17 3-17-2	12646-90	12.72852	0.00728	0.032	99.3	3146.63	9.94	32.14	>150
10	IWSOE17 3-17-2	12646-24	10.59003	0.03403	0.02	97.5	3156.13	13.86	33.64	>150
10	IWSOE17 3-17-2	12646-87	30.7862	0.07554	0.008	97.8	3175.13	25.69	40.13	>150
10	IWSOE17 3-17-2	12646-60	8.21047	0.05582	0.013	98.9	3207.18	18.35	36.15	>150
10	IWSOE17 3-17-2	12646-80	19.04388	0.0174	0.008	99.7	3322.22	19.42	37.66	>150

11	IO 1578-16 128-130 hb	13486-03	6.66277	0.00506	0.1980	98.6	463.30	3.37	5.73	> 150	29
11	IO 1578-16 128-130 hb	13486-10	6.2505	0.01707	0.3880	69.1	506.41	8.81	10.16	> 150	
11	IO 1578-16 128-130 hb	13486-02	27.92274	0.02524	0.1040	99.4	1008.36	6.57	12.03	> 150	
11	IO 1578-16 128-130 hb	13486-06	7.16145	0.03138	0.0740	97.6	1263.06	8.71	15.34	> 150	
11	IO 1578-16 128-130 hb	13486-01	38.25245	-0.03997	0.0470	99.2	2889.84	14.80	32.47	> 150	
11	IO 1578-16 128-130 hb	13486-08	25.98871	-0.01313	0.0610	100	2891.62	14.16	32.20	> 150	
11	IO 1578-16 128-130 hb	13486-07	12.31178	-0.00756	0.3760	100	2907.14	14.42	32.45	> 150	
11	IO 1578-16 128-130 hb	13486-09	11.00036	-0.01438	0.1350	100.1	3064.95	12.50	33.10	> 150	
11	IO 1578-16 128-130 hb	13486-05	53.66905	-0.07184	0.0220	100.3	3091.28	22.42	38.19	> 150	
11	IO 1578-16 128-130 hb	13486-04	39.0579	0.22214	0.0390	100	3126.60	15.52	34.90	> 150	
11	IO 1578-16 128-130 hb	13486-11	29.53609	-0.0164	0.004	97.8	2733.60	17.38	32.40	> 150	
11	IO 1578-16 128-130 hb	13486-12	14.39568	-0.05248	0.004	97.8	2820.81	14.94	31.92	> 150	
11	IO 1578-16 128-130 hb	13486-13	8.38851	-0.01877	0.009	97.6	2678.22	7.64	27.85	> 150	
11	IO 1578-16 128-130 hb	13486-14	7.33502	-0.00697	0.005	72.5	415.83	4.07	5.82	> 150	
11	IO 1578-16 128-130 hb	13486-15	7.05269	0.00709	0.01	79.1	453.97	4.81	6.61	> 150	
11	IO 1578-16 128-130 hb	13486-16	36.62013	0.04289	0.002	97	2894.20	22.05	36.39	> 150	
11	IO 1578-16 128-130 hb	13486-18	6.32384	0.0177	0.013	88	409.01	3.43	5.34	> 150	
11	IO 1578-16 128-130 hb	13486-19	27.93818	0.1264	0.002	97.6	2679.78	18.75	32.70	> 150	
11	IO 1578-16 128-130 hb	13486-21	14.99804	0.00845	0.02	94.7	2815.30	6.44	28.88	> 150	
11	IO 1578-16 128-130 hb	13486-22	6.63448	0.03478	0.008	99.2	470.65	5.16	6.98	> 150	
11	IO 1578-16 128-130 hb	13486-23	44.01046	0.00437	0.005	89.3	463.87	3.88	6.05	> 150	
11	IO 1578-16 128-130 hb	13486-24	17.22341	-0.01402	0.002	99.9	515.89	7.68	9.25	> 150	
11	IO 1578-16 128-130 hb	13486-25	12.4036	0.16027	0.003	92.5	463.62	6.18	7.73	> 150	
11	IO 1578-16 128-130 hb	14313-07	1.97873	0.01163	0.041	75.3	117.94	0.71	2.46	> 150	
11	IO 1578-16 128-130 hb	14313-03	1.61606	0.01064	0.027	94.1	260.51	1.05	5.32	> 150	
11	IO 1578-16 128-130 hb	14313-06	4.83123	0.01606	0.019	93	339.90	1.46	6.95	> 150	
11	IO 1578-16 128-130 hb	14313-08	3.04416	-0.02486	0.001	77.9	757.69	23.16	27.68	> 150	
11	IO 1578-16 128-130 hb	14313-19	9.31442	0.0321	0.056	99.7	1511.65	3.11	30.39	> 150	
11	IO 1578-16 128-130 hb	14313-13	13.60741	0.08247	0.003	100	2869.84	14.73	59.26	> 150	
12	IWSOE70 3-18-01 hb	14302-01	0.03359	0.01592	0.035	79.5	91.28	0.55	1.91	> 150	46
12	IWSOE70 3-18-01 hb	14302-07	5.06065	0.00824	0.122	89.7	166.85	0.47	3.37	> 150	
12	IWSOE70 3-18-01 hb	13494-24	12.99555	-0.1157	0.003	90.3	421.05	6.70	5.21	> 150	
12	IWSOE70 3-18-01 hb	13494-23	15.79698	-0.01053	0.009	85	441.42	6.48	4.74	> 150	
12	IWSOE70 3-18-01 hb	14302-12	4.44192	0.03279	0.002	79.6	468.78	7.05	11.73	> 150	

12	IWSOE70 3-18-01 hb	13494-16	9.41223	0.02253	0.004	96	472.75	6.30	4.16	> 150
12	IWSOE70 3-18-01 hb	14302-15	12.38248	0.01407	0.021	99.6	479.60	1.71	9.74	> 150
12	IWSOE70 3-18-01 hb	13494-19	5.15133	0.06516	0.007	97.3	484.54	7.23	5.37	> 150
12	IWSOE70 3-18-01 hb	14302-23	6.18576	0.02413	0.008	99.5	491.94	2.82	10.23	> 150
12	IWSOE70 3-18-01 hb	13494-11	9.51955	0.04058	0.007	95.6	515.28	6.37	3.74	> 150
12	IWSOE70 3-18-01 hb	14302-02	39.72592	0.01259	0.002	98.6	568.36	9.58	14.86	> 150
12	IWSOE70 3-18-01 hb	14302-29	8.34423	0.04946	0.008	98.9	705.87	3.89	14.64	> 150
12	IWSOE70 3-18-01 hb	14302-14	7.28263	0.0863	0.004	96.3	735.00	5.95	15.86	> 150
12	IWSOE70 3-18-01 hb	14302-09	8.54836	0.10241	0.002	98.5	1128.51	11.59	25.37	> 150
12	IWSOE70 3-18-01 hb	14302-17	18.56729	0.08838	0.003	90.4	1633.96	14.12	35.60	> 150
12	IWSOE70 3-18-01 hb	14302-28	2.64411	0.00404	0.152	99.5	2530.67	3.13	50.71	> 150
12	IWSOE70 3-18-01 hb	13494-05	53.42878	-0.0714	0.0400	98.4	2531.93	15.22	29.54	> 150
12	IWSOE70 3-18-01 hb	14302-10	42.20518	0.19169	0.001	98.9	2687.99	26.44	59.91	> 150
12	IWSOE70 3-18-01 hb	14302-30	16.99648	0.0458	0.008	99.4	2800.66	9.21	56.77	> 150
12	IWSOE70 3-18-01 hb	14302-25	20.18207	0.02431	0.01	99.7	2831.41	8.21	57.22	> 150
12	IWSOE70 3-18-01 hb	13494-03	34.62787	-0.02636	0.0260	99.1	2840.60	36.22	46.03	> 150
12	IWSOE70 3-18-01 hb	13494-12	13.2678	0.00101	0.007	99.6	2875.58	29.65	7.21	> 150
12	IWSOE70 3-18-01 hb	13494-25	8.75752	-0.00286	0.015	99.7	2879.55	31.95	13.84	> 150
12	IWSOE70 3-18-01 hb	13494-09	33.86819	-0.08427	0.0160	100.1	2885.45	26.78	39.37	> 150
12	IWSOE70 3-18-01 hb	13494-01	116.47505	-0.11954	0.0290	99.8	2885.89	16.24	33.11	> 150
12	IWSOE70 3-18-01 hb	13494-20	27.96719	0.08129	0.003	99.6	2924.37	33.05	15.41	> 150
12	IWSOE70 3-18-01 hb	13494-10	18.27182	-0.01695	0.0500	100.6	2930.68	25.94	39.14	> 150
12	IWSOE70 3-18-01 hb	13494-04	20.7313	0.00663	0.0520	99.7	2935.77	14.27	32.64	> 150
12	IWSOE70 3-18-01 hb	13494-21	50.65492	-0.03606	0.005	99.9	2937.02	31.20	10.53	> 150
12	IWSOE70 3-18-01 hb	14302-24	13.48138	0.03485	0.011	99.9	2961.45	6.76	59.61	> 150
12	IWSOE70 3-18-01 hb	13494-22	28.57615	-0.05218	0.003	99.6	2966.74	53.17	44.13	> 150
12	IWSOE70 3-18-01 hb	13494-13	14.27971	-0.01266	0.009	99.8	2997.20	30.93	7.64	> 150
12	IWSOE70 3-18-01 hb	14302-32	17.91175	0.0198	0.009	99.9	3003.92	8.74	60.71	> 150
12	IWSOE70 3-18-01 hb	14302-31	12.45933	0.01891	0.012	99.9	3006.79	7.36	60.58	> 150
12	IWSOE70 3-18-01 hb	14302-21	19.87313	0.02229	0.005	96.4	3013.04	11.98	61.44	> 150
12	IWSOE70 3-18-01 hb	13494-06	11.03117	-0.03363	0.0420	100.3	3018.45	24.39	38.80	> 150
12	IWSOE70 3-18-01 hb	13494-18	20.409	0.00196	0.005	99.7	3025.21	41.09	27.80	> 150
12	IWSOE70 3-18-01 hb	13494-07	43.13273	-0.04618	0.0350	100.5	3025.71	17.37	34.89	> 150
12	IWSOE70 3-18-01 hb	13494-02	23.13029	-0.04014	0.0640	100.4	3037.85	14.50	33.66	> 150
12	IWSOE70 3-18-01 hb	14302-13	12.76379	0.04409	0.008	99.9	3054.23	8.47	61.67	> 150
12	IWSOE70 3-18-01 hb	14302-16	15.55191	0.02797	0.01	99.6	3057.95	7.77	61.65	> 150

12	IWSOE70 3-18-01 hb	14302-19	12.1063	0.03284	0.012	99.7	3065.17	7.44	61.75	> 150	
12	IWSOE70 3-18-01 hb	13494-17	39.83445	-0.03567	0.011	99.5	3068.07	31.46	6.96	> 150	
12	IWSOE70 3-18-01 hb	13494-15	21.37897	-0.02394	0.015	99.7	3205.14	32.74	6.66	> 150	
12	IWSOE70 3-18-01 hb	13494-08	104.0027	-0.10207	0.0140	99.9	3380.24	29.01	44.55	> 150	
12	IWSOE70 3-18-01 hb	14302-03	16.51788	0.00656	0.017	99.5	3527.88	6.45	70.85	> 150	
13	IO 1277-41 1161-1173 hb	13485-01	12.81199	0.01574	0.4050	94.2	397.33	3.45	5.26	> 150	23
13	IO 1277-41 1161-1173 hb	13485-12	13.80363	0.01681	0.003	68.7	426.40	5.72	7.14	> 150	
13	IO 1277-41 1161-1173 hb	13485-13	19.73125	0.01007	0.006	87.6	461.82	3.78	5.97	> 150	
13	IO 1277-41 1161-1173 hb	13485-20	6.69201	0.00268	0.009	95.3	467.83	5.65	7.34	> 150	
13	IO 1277-41 1161-1173 hb	13485-08	15.48815	0.01364	0.0540	99.2	467.90	4.36	6.40	> 150	
13	IO 1277-41 1161-1173 hb	13485-16	14.68595	-0.12511	0.002	95.9	468.86	7.40	8.76	> 150	
13	IO 1277-41 1161-1173 hb	13485-24	7.71033	-0.00224	0.01	97.7	469.36	2.28	5.22	> 150	
13	IO 1277-41 1161-1173 hb	13485-19	18.0058	-0.00423	0.002	93.3	471.63	5.13	6.97	> 150	
13	IO 1277-41 1161-1173 hb	13485-07	14.82677	0.01908	0.1160	98.8	476.31	3.61	5.98	> 150	
13	IO 1277-41 1161-1173 hb	13485-21	6.62203	0.01985	0.007	97.3	481.94	3.03	5.69	> 150	
13	IO 1277-41 1161-1173 hb	13485-09	8.22645	0.04548	0.0430	93.7	482.38	6.86	8.38	> 150	
13	IO 1277-41 1161-1173 hb	13485-02	5.46203	0.00584	0.5730	100.6	485.99	3.04	5.73	> 150	
13	IO 1277-41 1161-1173 hb	13485-10	6.2784	0.0477	0.1340	99.6	487.12	3.51	6.00	> 150	
13	IO 1277-41 1161-1173 hb	13485-04	9.64241	0.00075	0.3860	99.8	494.62	3.65	6.15	> 150	
13	IO 1277-41 1161-1173 hb	13485-17	14.62916	-0.06463	0.002	98.9	495.46	6.05	7.82	> 150	
13	IO 1277-41 1161-1173 hb	13485-05	8.22123	0.0259	0.1770	100.9	502.56	3.43	6.08	> 150	
13	IO 1277-41 1161-1173 hb	13485-03	19.4859	0.01491	0.1560	92.6	535.50	5.92	7.98	> 150	
13	IO 1277-41 1161-1173 hb	13485-25	9.09377	0.04449	0.004	96.2	572.96	4.34	7.19	> 150	
13	IO 1277-41 1161-1173 hb	13485-15	12.64448	-0.00453	0.01	96.1	594.39	2.91	6.62	> 150	
13	IO 1277-41 1161-1173 hb	13485-23	10.64638	0.25076	0.003	97.1	701.71	10.33	12.49	> 150	
13	IO 1277-41 1161-1173 hb	13485-18	31.47467	0.37213	0.007	78	1203.69	10.67	16.08	> 150	
13	IO 1277-41 1161-1173 hb	13485-14	76.93679	-0.00552	0.002	95.8	1349.12	11.54	17.75	> 150	
13	IO 1277-41 1161-1173 hb	13485-06	34.61651	0.3184	0.0340	97.1	1507.18	12.28	19.44	> 150	
14	IO 1277-23 hb	13489-15	0.06304	-0.00055	0.25	97.3	26.50	0.10	0.28	> 150	57
14	IO 1277-23 hb	13489-17	9.42029	-0.00099	0.009	90.5	377.66	2.47	4.51	> 150	
14	IO 1277-23 hb	13484-11	6.33939	0.03762	0.006	96.6	419.03	2.92	5.11	> 150	
14	IO 1277-23 hb	13489-20	7.79258	0.04496	0.007	97.3	431.69	2.56	5.02	> 150	
14	IO 1277-23 hb	13489-24	7.50119	0.01693	0.007	92.9	442.82	4.58	6.37	> 150	
14	IO 1277-23 hb	13489-13	11.79129	0.01931	0.005	94.7	446.15	3.52	5.68	> 150	

14	IO 1277-23 hb	13489-16	2.00219	0.02221	0.04	98.3	448.56	1.23	4.65	> 150
14	IO 1277-23 hb	13484-03	7.08187	0.02023	0.009	98.2	450.91	2.39	5.10	> 150
14	IO 1277-23 hb	14311-05	8.45622	0.03288	0.009	98.8	451.28	2.30	9.31	> 150
14	IO 1277-23 hb	13489-23	9.76972	-0.0901	0.002	76.7	453.22	8.40	9.55	> 150
14	IO 1277-23 hb	13484-14	9.62421	0.04827	0.013	96.8	456.26	2.01	4.99	> 150
14	IO 1277-23 hb	13489-04	11.38321	0.02038	0.0510	97.9	456.37	5.91	7.47	> 150
14	IO 1277-23 hb	13489-22	10.45427	-0.04985	0.003	87.1	458.95	5.56	7.21	> 150
14	IO 1277-23 hb	13484-06	13.94758	0.0019	0.008	97.7	460.97	2.32	5.16	> 150
14	IO 1277-23 hb	14311-02	8.09937	0.03066	0.008	99	462.33	2.71	9.63	> 150
14	IO 1277-23 hb	13484-08	7.29446	-0.01284	0.008	97.4	463.90	2.44	5.24	> 150
14	IO 1277-23 hb	13484-09	6.46488	0.02845	0.021	98.9	464.52	1.73	4.96	> 150
14	IO 1277-23 hb	13489-19	9.37051	0.02832	0.005	94.2	464.61	3.87	6.05	> 150
14	IO 1277-23 hb	13489-21	14.20458	-0.01364	0.002	91.1	466.36	5.82	7.46	> 150
14	IO 1277-23 hb	14311-03	5.59946	0.10768	0.006	99.5	469.63	3.24	9.94	> 150
14	IO 1277-23 hb	14311-12	7.44193	0.05756	0.009	98.7	471.60	2.75	9.82	> 150
14	IO 1277-23 hb	13489-11	7.86525	0.0387	0.016	97.8	473.89	1.89	5.10	> 150
14	IO 1277-23 hb	13489-06	12.81817	0.01408	0.0560	98.5	474.67	6.75	8.25	> 150
14	IO 1277-23 hb	13489-10	11.20571	-0.0158	0.0360	86	474.84	6.14	7.77	> 150
14	IO 1277-23 hb	13484-02	8.28581	0.03475	0.004	98.6	477.07	4.62	6.64	> 150
14	IO 1277-23 hb	13484-07	7.58454	0.01514	0.024	98.8	477.21	2.76	5.51	> 150
14	IO 1277-23 hb	14311-16	10.00073	0.11579	0.005	98.3	479.17	3.75	10.29	> 150
14	IO 1277-23 hb	14311-15	8.85272	0.01439	0.049	99.6	483.14	1.28	9.75	> 150
14	IO 1277-23 hb	13484-12	11.03924	0.02747	0.007	95.4	483.35	2.54	5.46	> 150
14	IO 1277-23 hb	14311-08	7.81392	0.02903	0.011	99.2	487.77	2.44	10.06	> 150
14	IO 1277-23 hb	13489-25	9.22133	-0.04123	0.002	92.2	488.65	5.43	7.31	> 150
14	IO 1277-23 hb	14311-18	11.22869	0.04633	0.021	99.7	489.10	1.69	9.93	> 150
14	IO 1277-23 hb	13489-02	8.10457	0.1294	0.3890	99.5	489.68	3.78	6.18	> 150
14	IO 1277-23 hb	13489-03	7.64759	-0.00325	0.2520	98.4	490.44	3.54	6.05	> 150
14	IO 1277-23 hb	13489-01	6.14786	0.03675	0.2800	100.1	491.10	3.61	6.10	> 150
14	IO 1277-23 hb	14311-21	8.19392	0.0287	0.048	99.6	493.24	1.18	9.93	> 150
14	IO 1277-23 hb	13489-14	7.84054	0.0283	0.009	91.2	497.63	4.50	6.71	> 150
14	IO 1277-23 hb	13489-07	13.19032	-0.00063	0.0670	102.9	503.27	3.72	6.26	> 150
14	IO 1277-23 hb	13489-08	7.9233	0.01783	0.0760	99.6	504.03	3.98	6.42	> 150
14	IO 1277-23 hb	13489-09	8.90984	0.0228	0.0500	100.3	504.59	6.68	8.37	> 150
14	IO 1277-23 hb	13489-05	5.97688	0.01519	0.0670	100	507.89	4.01	6.47	> 150
14	IO 1277-23 hb	14311-17	8.9731	0.14297	0.005	98.4	510.70	3.84	10.91	> 150

14	IO 1277-23 hb	13484-10	6.5685	-0.01967	0.011	97.6	510.96	2.27	5.59	> 150	
14	IO 1277-23 hb	14311-06	8.21526	0.04311	0.012	99.8	515.00	2.42	10.58	> 150	
14	IO 1277-23 hb	14311-11	7.18308	0.04673	0.007	99	515.99	3.41	10.87	> 150	
14	IO 1277-23 hb	14311-20	15.12356	0.05415	0.004	100.1	516.67	4.13	11.13	> 150	
14	IO 1277-23 hb	13484-04	16.57621	-0.0094	0.004	95.7	518.59	8.19	9.69	> 150	
14	IO 1277-23 hb	14311-22	9.89206	0.06855	0.007	98.5	520.75	3.53	11.00	> 150	
14	IO 1277-23 hb	14311-10	18.0653	0.03588	0.005	97.2	521.86	3.88	11.14	> 150	
14	IO 1277-23 hb	13484-01	6.02839	0.09318	0.022	98.8	522.86	1.80	5.53	> 150	
14	IO 1277-23 hb	13484-15	7.96576	0.02271	0.012	96.2	547.49	4.60	7.15	> 150	
14	IO 1277-23 hb	14311-13	10.48214	0.04081	0.006	97.3	561.87	3.90	11.90	> 150	
14	IO 1277-23 hb	14311-09	10.61328	0.08721	0.005	99.1	563.86	4.20	12.03	> 150	
14	IO 1277-23 hb	14311-19	18.77767	0.02566	0.006	100.2	600.69	4.52	12.84	> 150	
14	IO 1277-23 hb	14311-14	31.44609	0.0618	0.014	83	646.25	3.07	13.28	> 150	
14	IO 1277-23 hb	13484-05	9.8415	0.02116	0.018	99.1	1117.86	3.22	11.63	> 150	
14	IO 1277-23 hb	13484-13	29.99626	0.00962	0.003	94.1	1240.19	10.33	16.14	> 150	
15	JPC40 2245-2250	12514-09	3.00087	-0.01033	0.001	6.2	185.38	97.74	97.76	>150	*13*
15	JPC40 2245-2250	12514-01	4.8377	0.05872	1.203	98.4	507.87	0.49	5.10	>150	
15	JPC40 2280-2285	12522-18	2.27635	0.02931	0.014	81.8	528.17	5.49	7.62	>150	
15	JPC40 2245-2250	12514-02	1.23291	0.00016	0.107	95.3	540.58	1.72	5.67	>150	
15	JPC40 2245-2250	12514-15	1.80647	-0.34444	0.001	24.7	660.15	64.46	64.80	>150	
15	JPC40 2245-2250	12514-14	12.82094	-0.0629	0.007	80.8	821.59	12.66	15.09	>150	
15	JPC40 2370-2375	12521-06	1.35292	0.02007	0.018	87.8	918.87	7.11	11.62	>150	
15	JPC40 2370-2375	12521-09	34.25551	0.09577	0.001	18.2	1560.99	65.43	67.27	>150	
15	JPC40 2245-2250	12514-17	9.08256	0.13147	0.002	73	1595.05	54.83	57.10	>150	
15	JPC40 2245-2250	12514-18	1.50207	-0.22843	0.001	78.1	2078.09	106.98	108.98	>150	
15	JPC40 2245-2250	12514-08	20.16246	-0.00431	0.002	87	3082.73	47.48	56.61	>150	
15	JPC40 2280-2285	12522-05	1.55514	0.14188	0.001	91	3745.77	138.61	143.58	>150	
15	JPC40 2245-2250	12514-06	2.46359	0.01397	0.002	71.8	4658.10	66.37	81.08	>150	
17	JPC34 292-297	12655-170	40.98532	0.13926	0.026	40.1	40.12	6.71	6.72	>150	*318*
17	JPC34 292-297	12655-83E	41.36656	0.13018	0.025	25.6	151.37	8.41	8.54	>150	

17	JPC34 345-350	12667-44	36.92753	0.05586	0.015	16.4	155.78	13.39	13.48	>150
17	JPC34 292-297	12655-82A	21.13859	0.05296	0.041	9	187.50	6.50	6.76	>150
17	JPC34 292-297	12655-123	86.02873	0.03721	0.007	8.8	248.28	23.94	24.07	>150
17	JPC34 292-297	12518-16	1.33089	-0.137	0.003	10.3	264.23	22.28	22.44	>150
17	JPC34 292-297	12655-82F	31.45148	0.05014	0.047	55.5	289.72	4.17	5.08	>150
17	JPC34 292-297	12655-88	5.82479	0.00361	0.638	90.8	329.23	0.56	3.34	>150
17	JPC34 292-297	12655-104	16.58543	0.03237	0.188	79.2	395.80	1.25	4.15	>150
17	JPC34 292-297	12655-83C	15.41803	0.05102	0.148	81	399.69	1.67	4.33	>150
17	JPC34 345-350	12667-47	25.32083	0.03139	0.072	78.1	404.26	2.69	4.86	>150
17	JPC34 345-350	12667-51	31.01758	0.02904	0.082	77.4	405.91	2.58	4.81	>150
17	JPC34 292-297	12655-92	9.76599	0.04397	0.143	81.7	410.07	1.57	4.39	>150
17	JPC34 292-297	12655-22	54.18542	-0.01372	0.063	85.8	414.10	2.79	4.99	>150
17	JPC34 292-297	12655-100	13.51384	0.03659	0.243	86.5	418.56	1.06	4.32	>150
17	JPC34 292-297	12655-83D	16.14974	0.04086	0.149	84.4	421.24	1.65	4.52	>150
17	JPC34 292-297	12655-110	17.21149	0.02166	0.077	84.4	424.32	2.70	5.03	>150
17	JPC34 292-297	12655-99	15.99896	0.01035	0.3	79.3	427.97	0.95	4.38	>150
17	JPC34 345-350	12667-50	35.06907	0.01801	0.132	80.4	429.90	1.90	4.70	>150
17	JPC34 292-297	12655-96	23.79751	0.02439	0.115	81.6	448.08	1.83	4.84	>150
17	JPC34 292-297	12655-62	14.64266	0.0216	0.156	89.4	450.74	1.60	4.78	>150
17	JPC34 345-350	12667-18	29.37316	0.02079	0.071	77.3	455.26	3.27	5.61	>150
17	JPC34 345-350	12667-63	8.63479	0.01889	0.259	91.4	457.50	1.24	4.74	>150
17	JPC34 292-297	12655-15	31.12735	-0.01223	0.06	91.9	460.18	3.31	5.67	>150
17	JPC34 345-350	12667-52	10.80562	0.00674	0.201	88.4	460.79	1.45	4.83	>150
17	JPC34 292-297	12655-108	16.55666	0.02474	0.098	89.1	461.16	2.33	5.17	>150
17	JPC34 345-350	12667-39	20.12983	-0.00145	0.103	94.2	463.59	1.94	5.03	>150
17	JPC34 292-297	12655-174	6.78998	0.00365	0.386	96.4	463.59	0.94	4.73	>150
17	JPC34 292-297	12655-	51.59678	-0.00455	0.072	92.5	466.37	3.09	5.59	>150

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17	JPC34 345-350	12667-58	20.07374	0.02521	0.196	93	466.76	1.51	4.90	>150
17	JPC34 292-297	12655-77	12.43729	0.01335	0.184	93.6	466.80	1.35	4.86	>150
17	JPC34 345-350	12667-69	7.79291	0.01765	0.403	94.4	466.94	0.90	4.76	>150
17	JPC34 292-297	12655-27	13.96787	0.03035	0.147	97.7	467.73	1.62	4.95	>150
17	JPC34 345-350	12667-68	14.89687	0.05012	0.317	92.5	468.54	1.13	4.82	>150
17	JPC34 345-350	12667-42	13.67377	0.00852	0.118	91	468.91	1.83	5.03	>150
17	JPC34 292-297	12655-34	44.65732	0.00185	0.041	94.9	469.06	3.32	5.75	>150
17	JPC34 292-297	12655-23	7.72514	0.01564	0.323	99	469.87	0.97	4.80	>150
17	JPC34 292-297	12655-138	6.31001	0.02036	0.313	96.8	470.87	1.08	4.83	>150
17	JPC34 292-297	12655-07	17.67784	0.00581	0.138	94.7	471.29	1.58	4.97	>150
17	JPC34 345-350	12667-43	15.74754	0.01237	0.233	94.9	471.36	1.37	4.91	>150
17	JPC34 292-297	12655-89	10.15844	0.03492	0.142	65	471.90	1.79	5.05	>150
17	JPC34 345-350	12667-46	7.55707	0.00813	0.356	95.5	472.42	0.95	4.82	>150
17	JPC34 292-297	12655-93	15.19841	0.01242	0.344	92.2	472.72	0.94	4.82	>150
17	JPC34 345-350	12667-64	9.47704	0.01306	0.273	92.2	472.74	1.18	4.87	>150
17	JPC34 292-297	12655-01	37.41948	-0.00457	0.197	94.5	473.91	1.12	4.87	>150
17	JPC34 292-297	12655-71	15.18359	0.00293	0.081	96.6	474.16	3.11	5.67	>150
17	JPC34 292-297	12655-82D	7.85398	0.02538	0.852	96.3	475.32	0.61	4.79	>150
17	JPC34 345-350	12667-02	6.69217	0.0193	0.323	96.9	475.79	1.17	4.90	>150
17	JPC34 345-350	12667-65	14.34453	0.00963	0.345	91.4	475.82	1.02	4.87	>150
17	JPC34 292-297	12655-171	10.72737	0.01741	0.136	97.2	476.06	1.91	5.13	>150
17	JPC34 345-350	12667-57	10.62974	0.01023	0.245	96.5	476.32	1.25	4.92	>150
17	JPC34 292-297	12655-141	11.14808	0.01667	0.483	99	476.36	0.91	4.85	>150
17	JPC34 292-297	12655-139	14.88672	0.01726	0.306	97	476.47	1.18	4.91	>150
17	JPC34 292-297	12655-76	10.43756	-0.00203	0.334	96.9	476.74	1.00	4.87	>150
17	JPC34 292-297	12518-07	18.454	0.0045	0.082	97.7	477.07	1.90	5.14	>150
17	JPC34 292-297	12655-39	25.94417	0.00592	0.051	93.6	477.10	3.08	5.68	>150
17	JPC34 292-297	12655-105	9.59804	0.01575	0.11	88.7	477.15	2.00	5.17	>150
17	JPC34 292-297	12655-59	12.11776	0.03086	0.131	97.2	477.79	1.78	5.10	>150
17	JPC34 292-297	12655-	8.15964	0.00164	0.184	95.9	477.82	1.26	4.94	>150

17	JPC34 292-297	12655-133	13.09311	0.00566	0.128	55.7	478.23	2.14	5.24	>150
17	JPC34 345-350	12667-67	12.72392	0.01228	0.541	95.3	478.33	0.81	4.85	>150
17	JPC34 345-350	12667-66	6.8649	0.009	0.41	94.6	478.91	0.90	4.87	>150
17	JPC34 292-297	12655-11	8.52688	0.00653	0.39	99.5	479.43	0.83	4.87	>150
17	JPC34 292-297	12655-127	6.00665	0.0127	0.21	97.5	479.76	1.19	4.94	>150
17	JPC34 292-297	12655-147	5.44445	0.0073	0.467	98.4	480.34	0.90	4.89	>150
17	JPC34 292-297	12655-06	9.47867	0.01275	0.314	97.3	481.67	0.99	4.92	>150
17	JPC34 292-297	12655-82C	6.88993	0.02166	3.353	98.9	481.80	0.69	4.87	>150
17	JPC34 292-297	12655-69	15.32398	0.00736	0.196	98.7	482.46	1.54	5.06	>150
17	JPC34 345-350	12667-16	15.2165	0.02245	0.394	97.9	482.55	1.00	4.93	>150
17	JPC34 345-350	12667-49	10.68617	0.0306	0.271	93.3	482.86	1.30	5.00	>150
17	JPC34 292-297	12655-150	11.35445	0.0169	0.194	99.6	483.10	1.33	5.01	>150
17	JPC34 345-350	12667-61	21.4465	0.01704	0.25	92.3	483.12	1.33	5.01	>150
17	JPC34 292-297	12655-83B	10.08081	0.02237	4.162	99	484.01	0.70	4.89	>150
17	JPC34 292-297	12655-164	10.09732	0.01652	0.763	99.4	484.05	0.67	4.89	>150
17	JPC34 345-350	12667-36	9.19982	0.01196	0.359	98.1	484.78	0.85	4.92	>150
17	JPC34 292-297	12655-51	10.16843	0.00662	0.231	94.7	484.97	1.20	5.00	>150
17	JPC34 292-297	12655-114	20.05022	0.00468	0.183	98.4	485.02	1.30	5.02	>150
17	JPC34 292-297	12655-74	7.78096	0.00434	0.79	95.5	485.13	0.64	4.89	>150
17	JPC34 292-297	12655-33	8.25051	0.00882	0.219	98.7	485.15	1.09	4.97	>150
17	JPC34 345-350	12667-04	14.63022	0.0211	0.437	90.9	485.74	0.85	4.93	>150
17	JPC34 292-297	12655-35	13.5318	0.0028	0.128	98.2	485.97	1.72	5.16	>150
17	JPC34 345-350	12519-25	7.57252	0.02365	0.344	98	486.23	0.86	4.94	>150
17	JPC34 292-297	12655-49	35.61156	0.00314	0.127	93.3	486.51	1.92	5.23	>150
17	JPC34 292-297	12655-08	7.13817	0.01634	0.388	99.6	486.62	0.84	4.94	>150
17	JPC34 292-297	12655-37	6.76642	0.00383	0.351	99.3	486.70	0.89	4.95	>150
17	JPC34 292-297	12655-29	10.11976	-0.00034	0.179	99.3	487.18	1.20	5.02	>150
17	JPC34 70-75	12513-19	6.80802	0.007	0.1	94.8	487.31	1.54	5.11	>150
17	JPC34 292-297	12655-	6.98965	0.02342	2.107	98.6	487.52	0.46	4.90	>150

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17	JPC34 292-297	12655-44	6.86041	0.01384	0.276	99.6	487.80	1.14	5.01	>150
17	JPC34 292-297	12655-36	15.66633	0.01155	0.155	96.8	487.88	1.34	5.06	>150
17	JPC34 292-297	12655-83	6.48481	0.00373	0.344	97.3	488.52	0.96	4.98	>150
17	JPC34 292-297	12655-159	8.96101	0.00781	0.122	99.7	488.54	1.86	5.23	>150
17	JPC34 345-350	12667-32	7.69696	0.00475	0.291	99.1	488.95	1.14	5.02	>150
17	JPC34 345-350	12667-01	8.72515	0.00923	1.836	97.9	489.05	0.47	4.91	>150
17	JPC34 345-350	12667-29	10.57484	0.01053	0.204	96.5	489.19	1.45	5.10	>150
17	JPC34 292-297	12655-120	8.7523	0.02202	0.325	70.1	489.38	1.09	5.01	>150
17	JPC34 292-297	12655-85	7.63769	0.01148	0.986	96.9	489.56	0.59	4.93	>150
17	JPC34 292-297	12655-63	6.82062	0.05796	0.2	99.2	489.77	1.43	5.10	>150
17	JPC34 345-350	12667-59	6.91709	0.00247	0.497	97.1	489.93	0.91	4.98	>150
17	JPC34 345-350	12667-41	10.6315	0.00323	0.433	97.4	490.01	0.81	4.97	>150
17	JPC34 292-297	12655-109	13.76201	0.01467	0.195	87.9	490.13	1.62	5.16	>150
17	JPC34 292-297	12655-143	9.13932	0.01413	0.612	99.5	490.19	0.74	4.96	>150
17	JPC34 345-350	12667-21	9.17817	0.00691	0.562	99.4	490.94	0.79	4.97	>150
17	JPC34 292-297	12655-13	11.8749	-0.00489	0.15	98.2	491.07	1.54	5.15	>150
17	JPC34 345-350	12667-33	6.89802	-0.01064	0.113	89.9	491.27	2.18	5.38	>150
17	JPC34 292-297	12655-144	9.45266	0.00457	0.235	98.9	491.99	1.29	5.09	>150
17	JPC34 292-297	12655-156	10.81146	0.00443	0.158	94.8	492.01	1.63	5.18	>150
17	JPC34 70-75	12513-23	6.6867	0.03526	0.147	97.7	492.17	1.21	5.07	>150
17	JPC34 345-350	12667-38	10.49897	0.01129	0.581	98.9	492.31	0.80	4.99	>150
17	JPC34 292-297	12655-60	10.66719	0.00077	0.065	62.1	492.37	3.34	5.95	>150
17	JPC34 292-297	12655-46	7.06503	0.00178	0.376	99.4	492.52	0.91	5.01	>150
17	JPC34 292-297	12655-68	14.6307	0.00572	0.254	98.5	492.83	1.12	5.05	>150
17	JPC34 292-297	12655-172	5.77824	-0.00094	0.218	99.6	492.85	1.31	5.10	>150
17	JPC34 292-297	12655-10	8.66955	0.00232	0.334	99.4	492.87	0.96	5.02	>150
17	JPC34 292-297	12655-149	24.33881	-0.00477	0.059	98.7	492.90	3.44	6.01	>150
17	JPC34 345-350	12667-15	19.63619	0.00651	0.167	94.6	493.01	1.55	5.17	>150

17	JPC34 345-350	12667-17	7.61632	0.01176	1.409	98	493.10	0.53	4.96	>150
17	JPC34 292-297	12655-61	8.66746	0.00027	1.39	96.8	493.20	0.55	4.96	>150
17	JPC34 292-297	12655-128	7.07015	0.0052	0.225	99.2	493.86	1.25	5.09	>150
17	JPC34 345-350	12667-22	7.09409	0.00916	0.491	97.8	494.00	0.80	5.00	>150
17	JPC34 292-297	12655-24	9.45224	0.04272	0.255	100.4	494.27	1.07	5.06	>150
17	JPC34 292-297	12655-65	7.36451	0.00201	0.253	98.4	494.49	1.43	5.15	>150
17	JPC34 292-297	12655-135	21.08686	-0.00637	0.158	99	494.58	1.57	5.19	>150
17	JPC34 345-350	12519-24	7.09407	0.01325	0.208	96.5	494.74	1.32	5.12	>150
17	JPC34 345-350	12667-25	23.55394	0.01852	0.121	96.4	494.91	2.12	5.38	>150
17	JPC34 292-297	12655-47	10.92884	0.00258	0.526	99.3	494.96	0.71	5.00	>150
17	JPC34 292-297	12655-72	9.31689	0.00609	0.224	94.3	495.12	1.59	5.20	>150
17	JPC34 292-297	12655-82	7.09261	-0.00045	0.579	95.1	495.60	0.83	5.03	>150
17	JPC34 292-297	12655-12	7.4155	-0.00409	0.416	99.8	495.72	0.89	5.04	>150
17	JPC34 292-297	12518-17	7.4063	0.02318	0.121	94.7	495.87	1.53	5.19	>150
17	JPC34 345-350	12519-29	10.86341	0.01949	0.405	98.3	495.94	0.87	5.04	>150
17	JPC34 292-297	12655-18	6.43753	0.01873	0.219	99.6	495.98	1.33	5.13	>150
17	JPC34 345-350	12519-36	19.10821	0.00519	0.06	95.6	496.61	2.27	5.46	>150
17	JPC34 345-350	12667-09	13.38101	0.00481	0.174	97.6	497.14	1.79	5.28	>150
17	JPC34 292-297	12655-153	8.9289	0.00947	0.333	99.1	497.27	1.00	5.07	>150
17	JPC34 345-350	12519-27	6.08791	0.03317	0.843	98.8	497.31	0.60	5.01	>150
17	JPC34 70-75	12513-08	22.89205	0.00479	0.091	97.9	497.65	1.51	5.20	>150
17	JPC34 292-297	12655-14	9.09228	0.0143	0.492	97.8	497.79	0.73	5.03	>150
17	JPC34 292-297	12655-161	19.51754	-0.00363	0.23	97.5	497.80	1.14	5.11	>150
17	JPC34 292-297	12655-80	6.6575	0.02971	0.134	100	498.45	1.75	5.28	>150
17	JPC34 70-75	12513-03	12.68563	0.01332	0.272	97.9	498.55	0.79	5.05	>150
17	JPC34 292-297	12518-02	9.4781	0.00677	0.215	99.2	498.60	1.06	5.10	>150
17	JPC34 345-350	12667-10	7.78002	0.01437	0.268	101.4	498.71	1.24	5.14	>150
17	JPC34 292-297	12655-55	7.27834	0.00635	0.232	99.6	498.77	1.27	5.15	>150
17	JPC34 292-297	12518-12	6.67974	0.00208	0.206	98.9	499.39	1.08	5.11	>150
17	JPC34 292-297	12518-11	11.30117	0.00297	0.146	99	499.48	1.56	5.23	>150
17	JPC34 292-297	12655-50	10.67506	0.01667	0.153	94.7	500.00	1.79	5.31	>150
17	JPC34 345-350	12667-55	6.82379	0.00566	0.243	98.7	500.31	1.34	5.18	>150

17	JPC34 70-75	12513-16	7.78408	0.01357	0.151	97.3	500.37	1.23	5.15	>150
17	JPC34 345-350	12667-12	8.13434	0.00458	0.457	98.6	501.15	0.97	5.10	>150
17	JPC34 70-75	12513-12	9.40749	0.01074	0.122	98.5	501.60	1.57	5.26	>150
17	JPC34 292-297	12655-41	7.33882	0.00805	0.248	97.7	501.80	1.17	5.15	>150
17	JPC34 292-297	12655-52	20.0332	-0.00559	0.064	102.5	501.85	3.24	5.97	>150
17	JPC34 292-297	12655-40	10.43466	0.00913	0.197	98.8	501.92	1.30	5.18	>150
17	JPC34 70-75	12513-14	9.63345	0.00465	0.143	98.7	501.99	1.51	5.24	>150
17	JPC34 292-297	12655-112	5.70361	0.01492	0.375	94	501.99	1.04	5.13	>150
17	JPC34 345-350	12667-20	9.26989	0.0049	0.59	98.4	502.14	0.86	5.09	>150
17	JPC34 345-350	12519-28	8.81162	0.02687	0.447	97.6	502.15	0.71	5.07	>150
17	JPC34 292-297	12655-87	9.15649	0.01055	0.885	97.2	502.27	0.65	5.06	>150
17	JPC34 70-75	12513-09	7.76531	0.0078	0.425	98.9	502.45	0.70	5.07	>150
17	JPC34 345-350	12667-53	7.80752	0.00537	0.246	97.6	502.52	1.24	5.17	>150
17	JPC34 345-350	12519-34	25.49118	0.06213	0.08	93.5	502.52	1.90	5.37	>150
17	JPC34 292-297	12655-17	9.34294	0.00055	0.525	97.2	502.90	0.87	5.10	>150
17	JPC34 345-350	12667-11	6.12518	0.00906	0.4	101.1	502.90	1.11	5.15	>150
17	JPC34 345-350	12519-16	11.45637	0.01985	0.134	97.3	503.44	1.55	5.27	>150
17	JPC34 70-75	12513-01	7.93159	0.00918	0.812	97.1	503.56	0.86	5.11	>150
17	JPC34 292-297	12655-70	7.13336	-0.00052	0.407	90.9	503.88	1.00	5.14	>150
17	JPC34 292-297	12518-14	13.24214	0.01116	0.122	99.4	504.14	1.43	5.24	>150
17	JPC34 345-350	12519-19	14.39218	0.00218	0.64	97.2	504.84	0.71	5.10	>150
17	JPC34 345-350	12519-18	12.54104	0.00653	0.305	97.7	504.85	0.89	5.13	>150
17	JPC34 70-75	12513-07	10.40048	0.01617	0.276	97.1	505.05	0.94	5.14	>150
17	JPC34 292-297	12655-16	6.3427	0.01458	0.284	100.1	505.06	1.03	5.15	>150
17	JPC34 345-350	12667-23	30.99139	0.00702	0.096	85.6	505.37	2.41	5.60	>150
17	JPC34 70-75	12513-21	6.29222	0.00707	0.135	97.2	505.57	1.22	5.20	>150
17	JPC34 292-297	12655-53	13.93135	0.00991	0.071	101.8	506.04	2.95	5.86	>150
17	JPC34 292-297	12655-30	8.56965	0.00219	0.531	93	507.22	0.80	5.13	>150
17	JPC34 345-350	12519-15	8.81611	0.02657	0.14	94.4	507.82	1.62	5.33	>150
17	JPC34 292-297	12655-125	7.81528	0.01248	0.259	99	508.32	1.27	5.24	>150
17	JPC34 70-75	12513-24	7.17274	0.0235	0.157	98	508.49	1.31	5.25	>150
17	JPC34 292-297	12655-42	12.69125	0.00897	0.248	98.7	508.66	1.30	5.25	>150
17	JPC34 292-297	12655-126	10.32889	0.03017	0.264	97.7	508.72	1.13	5.21	>150

17	JPC34 292-297	12655-116	10.48228	0.02283	0.144	95.2	509.00	1.54	5.32	>150
17	JPC34 345-350	12667-07	26.94659	-0.00712	0.175	78.6	509.01	1.80	5.40	>150
17	JPC34 70-75	12513-15	12.18811	0.00566	0.105	96.3	509.34	1.61	5.34	>150
17	JPC34 292-297	12518-21	8.25345	0.00852	0.122	97.1	509.61	1.49	5.31	>150
17	JPC34 292-297	12655-151	6.01831	0.00903	0.256	97.8	509.80	1.29	5.26	>150
17	JPC34 70-75	12513-20	7.93215	0.01802	0.159	97.4	509.81	1.14	5.22	>150
17	JPC34 292-297	12655-165	14.08511	0.01383	0.11	91.2	509.81	2.14	5.53	>150
17	JPC34 292-297	12518-18	15.67302	-0.00165	0.009	55	510.59	7.90	9.40	>150
17	JPC34 292-297	12655-107	12.12559	0.00795	0.142	89.2	511.65	1.78	5.42	>150
17	JPC34 70-75	12513-13	9.28405	0.0069	0.262	99.1	514.03	0.95	5.23	>150
17	JPC34 345-350	12519-05	8.26262	0.00979	0.441	98.2	514.31	0.71	5.19	>150
17	JPC34 292-297	12655-119	11.37273	0.01764	0.46	97.4	514.35	0.94	5.23	>150
17	JPC34 292-297	12655-148	9.65189	0.00485	0.232	99.7	515.47	1.31	5.32	>150
17	JPC34 292-297	12655-78	10.62705	0.01731	0.338	98.2	515.98	1.05	5.27	>150
17	JPC34 292-297	12655-91	7.3239	0.03261	0.325	89.2	516.19	0.88	5.24	>150
17	JPC34 292-297	12655-154	7.93574	0.01145	0.213	96.6	517.37	1.30	5.33	>150
17	JPC34 292-297	12655-21	6.40542	0.04224	0.568	99.1	517.67	0.80	5.24	>150
17	JPC34 345-350	12519-37	7.17299	0.00229	0.584	98.2	517.70	0.65	5.22	>150
17	JPC34 70-75	12513-04	43.7564	-0.00272	0.067	91.8	520.60	1.89	5.54	>150
17	JPC34 292-297	12655-169	6.68301	0.00624	0.213	99	520.90	1.38	5.39	>150
17	JPC34 292-297	12655-146	7.8984	0.04085	0.139	98.8	521.03	1.94	5.56	>150
17	JPC34 292-297	12655-136	7.46391	0.02109	0.235	95.5	521.17	1.45	5.41	>150
17	JPC34 345-350	12667-19	11.33219	0.00165	0.253	99.6	522.19	1.26	5.37	>150
17	JPC34 292-297	12655-160	6.67934	0.00849	0.813	98.5	522.30	0.75	5.28	>150
17	JPC34 292-297	12655-140	11.28115	0.01743	0.18	98.2	522.38	1.52	5.44	>150

17	JPC34 345-350	12519-04	5.92053	0.02095	0.27	87.4	523.36	0.97	5.32	>150
17	JPC34 345-350	12519-35	8.24521	0.02224	0.176	98.5	523.43	1.33	5.40	>150
17	JPC34 292-297	12655-57	5.05136	0.03765	0.683	98.2	523.91	0.71	5.29	>150
17	JPC34 292-297	12655-38	6.8718	0.00267	0.254	99	523.94	1.15	5.36	>150
17	JPC34 292-297	12655-117	8.46776	0.01439	0.134	73.2	523.98	2.01	5.61	>150
17	JPC34 292-297	12655-131	18.72044	0.01175	0.133	97	524.90	1.78	5.54	>150
17	JPC34 292-297	12655-28	9.21969	0.00697	0.158	98.8	525.42	1.79	5.55	>150
17	JPC34 292-297	12655-101	9.35607	0.01672	0.426	89.8	525.46	0.92	5.34	>150
17	JPC34 70-75	12513-18	11.65583	0.02493	0.089	94	525.62	1.69	5.52	>150
17	JPC34 345-350	12519-26	12.01859	0.00446	0.154	98.9	526.15	1.36	5.43	>150
17	JPC34 292-297	12655-132	10.53897	0.0067	0.308	99.2	526.47	1.15	5.39	>150
17	JPC34 345-350	12667-45	16.22517	0.00693	0.124	89	527.56	1.84	5.59	>150
17	JPC34 292-297	12655-66	10.49894	0.03118	0.084	98.1	527.94	2.68	5.92	>150
17	JPC34 292-297	12655-102	9.19303	0.02291	0.392	91.3	529.31	0.99	5.38	>150
17	JPC34 70-75	12513-10	18.99822	0.01996	0.174	98.3	529.49	1.01	5.39	>150
17	JPC34 345-350	12519-21	15.88034	0.00349	0.73	96.3	531.06	0.64	5.35	>150
17	JPC34 345-350	12667-62	12.15472	0.01397	0.247	91.9	532.94	1.27	5.48	>150
17	JPC34 292-297	12655-158	20.43191	0.00425	0.182	78.8	533.60	1.67	5.59	>150
17	JPC34 345-350	12667-35	11.54381	0.01143	0.179	97.6	534.82	1.78	5.64	>150
17	JPC34 292-297	12655-05	9.35557	0.01021	0.838	99	537.59	0.71	5.42	>150
17	JPC34 292-297	12655-124	6.26832	0.01382	0.597	98.2	539.32	0.83	5.46	>150
17	JPC34 292-297	12655-64	17.52485	0.03153	0.068	91.6	540.68	3.26	6.31	>150
17	JPC34 292-297	12655-152	7.40967	0.00865	0.186	99.7	542.68	1.70	5.69	>150
17	JPC34 292-297	12655-113	20.85338	0.03649	0.079	80.9	545.45	3.06	6.26	>150
17	JPC34 292-297	12655-134	9.47982	0.00361	0.215	99	546.68	1.32	5.62	>150
17	JPC34 292-297	12655-94	9.20021	0.00504	0.375	90	546.75	0.97	5.55	>150
17	JPC34 345-350	12667-05	19.15199	0.00122	0.252	97.9	547.83	1.36	5.64	>150

17	JPC34 292-297	12655-79	17.75584	-0.00057	0.156	97.9	550.78	1.87	5.82	>150
17	JPC34 292-297	12655-115	15.06294	0.01163	0.147	89.2	552.38	1.55	5.74	>150
17	JPC34 292-297	12655-25	10.94859	0.00464	0.577	99.3	553.00	0.85	5.60	>150
17	JPC34 292-297	12518-04	8.07638	0.00614	0.366	94.9	554.36	0.88	5.61	>150
17	JPC34 292-297	12655-31	28.04361	0.01864	0.058	94.9	558.44	3.11	6.39	>150
17	JPC34 292-297	12655-26	22.7679	0.02371	0.122	97.2	560.53	2.08	5.98	>150
17	JPC34 70-75	12513-22	10.44023	0.01924	0.098	93.6	562.58	1.77	5.90	>150
17	JPC34 292-297	12655-168	15.69097	0.01803	0.148	98.4	564.33	1.67	5.88	>150
17	JPC34 345-350	12519-08	7.76724	0.00598	0.21	98.7	565.88	1.06	5.76	>150
17	JPC34 292-297	12655-137	19.46943	0.00481	0.25	98.2	572.37	1.40	5.89	>150
17	JPC34 292-297	12655-43	22.18139	0.03522	0.089	93.7	572.48	2.35	6.19	>150
17	JPC34 292-297	12655-162	6.24186	0.00333	0.248	99.6	574.17	1.32	5.89	>150
17	JPC34 345-350	12667-13	27.89179	0.01831	0.06	92.9	574.89	3.60	6.78	>150
17	JPC34 70-75	12513-11	8.05367	0.0224	0.204	96.7	579.65	1.08	5.90	>150
17	JPC34 345-350	12667-08	6.19015	0.00193	0.443	100.3	582.79	1.09	5.93	>150
17	JPC34 292-297	12518-03	33.90511	0.00589	0.082	89.1	583.32	2.22	6.24	>150
17	JPC34 70-75	12513-25	6.04101	0.02071	0.21	96.8	587.42	1.19	5.99	>150
17	JPC34 292-297	12655-129	8.27981	0.01033	0.135	94.5	592.16	2.03	6.26	>150
17	JPC34 292-297	12655-67	56.36651	0.0207	0.049	75.4	593.04	4.36	7.36	>150
17	JPC34 292-297	12655-166	10.93377	0.0346	0.568	95.9	595.99	0.90	6.03	>150
17	JPC34 70-75	12513-02	13.69264	0.00917	0.383	97	597.12	1.09	6.07	>150
17	JPC34 292-297	12655-163	3.45382	0.01964	0.111	99.9	600.68	2.15	6.38	>150
17	JPC34 292-297	12655-84	44.36353	0.0302	0.058	67.5	602.12	3.70	7.07	>150
17	JPC34 292-297	12655-48	30.5079	0.01554	0.14	93.3	605.06	2.02	6.38	>150
17	JPC34 292-297	12655-56	13.14181	0.01771	0.37	97.9	605.94	1.06	6.15	>150
17	JPC34 70-75	12513-05	6.95752	0.02347	0.273	97.3	609.33	1.17	6.20	>150
17	JPC34 292-297	12655-90	9.80311	0.00714	0.469	95.4	613.43	1.15	6.24	>150
17	JPC34 292-297	12655-167	12.34461	0.0123	0.189	97.5	614.29	1.53	6.33	>150
17	JPC34 292-297	12655-	19.55521	0.00179	0.19	94.5	616.75	1.63	6.38	>150

17	JPC34 345-350	12667-14 121	16.89355	0.0168	0.141	98.8	617.05	2.08	6.51	>150
17	JPC34 292-297	12655-145	8.69538	0.02548	0.17	96.4	617.64	1.59	6.38	>150
17	JPC34 292-297	12655-106	14.54323	0.0521	0.277	98.3	620.44	1.22	6.32	>150
17	JPC34 292-297	12655-04	9.20616	0.01316	1.015	98.6	622.48	0.70	6.26	>150
17	JPC34 292-297	12655-95	34.77212	0.08401	0.063	78	624.04	3.68	7.24	>150
17	JPC34 345-350	12667-40	7.85383	0.01099	0.648	98.9	625.62	0.77	6.30	>150
17	JPC34 292-297	12518-08	7.87791	0.04011	0.536	94.8	628.26	0.91	6.35	>150
17	JPC34 292-297	12655-157	10.70614	0.01557	0.216	97	628.32	1.48	6.46	>150
17	JPC34 292-297	12655-20	4.77532	0.00792	0.498	99.7	629.79	1.00	6.38	>150
17	JPC34 292-297	12655-111	29.88584	0.02212	0.073	84.4	632.49	3.25	7.11	>150
17	JPC34 345-350	12667-54	24.38614	0.03099	0.101	97.5	663.23	2.59	7.12	>150
17	JPC34 292-297	12655-02	16.70526	0.01215	0.612	97.1	670.54	0.77	6.75	>150
17	JPC34 345-350	12519-23	17.5248	0.01821	0.156	97.9	674.15	1.74	6.96	>150
17	JPC34 345-350	12519-30	9.98001	0.02784	0.281	97.5	698.61	1.33	7.11	>150
17	JPC34 345-350	12519-22	7.34601	0.00687	1.275	99.5	700.58	0.68	7.04	>150
17	JPC34 292-297	12655-09	16.92574	0.01842	0.156	94.6	712.51	1.88	7.37	>150
17	JPC34 292-297	12655-03	28.19796	-0.00264	0.192	95	714.89	1.79	7.37	>150
17	JPC34 70-75	12513-06	32.29201	0.0024	0.042	90.6	720.07	3.22	7.89	>150
17	JPC34 292-297	12655-173	10.54293	0.00314	0.085	100.1	725.13	3.20	7.93	>150
17	JPC34 345-350	12519-32	9.50552	0.08871	0.066	97.5	734.11	2.85	7.88	>150
17	JPC34 345-350	12519-02	8.96059	0.00204	0.543	96.7	740.01	0.96	7.46	>150
17	JPC34 292-297	12655-155	36.33029	0.0144	0.069	89.4	745.38	3.67	8.31	>150
17	JPC34 292-297	12655-142	15.88196	-0.00337	0.122	93.9	762.92	2.68	8.09	>150
17	JPC34 345-350	12667-56	15.40139	0.03918	0.218	96.1	770.37	1.73	7.90	>150
17	JPC34 292-297	12518-09	15.91886	0.00557	0.118	99.9	775.54	2.07	8.03	>150
17	JPC34 345-350	12667-24	15.68365	0.02557	0.139	97.1	843.66	2.49	8.80	>150
17	JPC34 345-350	12519-03	5.46619	0.09064	1.726	97.3	849.93	0.87	8.54	>150
17	JPC34 292-297	12655-103	10.8699	0.02133	0.884	97.1	862.15	1.07	8.69	>150

17	JPC34 345-350	12519-14	11.35943	0.01503	0.291	96.8	878.50	1.58	8.93	>150	
17	JPC34 292-297	12518-19	87.91534	0.01033	0.016	65.8	882.20	6.62	11.03	>150	
17	JPC34 292-297	12655-54	13.17486	0.02526	0.094	100.6	889.37	3.51	9.56	>150	
17	JPC34 292-297	12655-58	16.00951	0.2108	0.1	97.9	892.93	3.31	9.52	>150	
17	JPC34 292-297	12655-81	8.8533	0.01954	0.34	99.5	902.06	1.54	9.15	>150	
17	JPC34 345-350	12667-60	15.28248	0.01373	0.244	95.6	913.96	1.84	9.32	>150	
17	JPC34 292-297	12655-45	10.28644	0.01175	0.245	99	923.30	1.69	9.39	>150	
17	JPC34 292-297	12655-73	21.78829	0.0219	0.326	96.6	982.25	1.70	9.97	>150	
17	JPC34 345-350	12519-20	17.88742	0.13591	0.236	93.4	998.14	1.99	10.18	>150	
17	JPC34 292-297	12655-19	9.20621	0.02129	0.282	99.5	1025.63	1.79	10.41	>150	
17	JPC34 345-350	12667-30	5.97978	0.06259	0.308	99.4	1056.73	1.73	10.71	>150	
17	JPC34 345-350	12667-31	12.49821	0.01924	0.073	98.6	1072.12	4.63	11.68	>150	
17	JPC34 292-297	12655-86	13.72607	0.00457	0.144	97.9	1108.09	2.83	11.44	>150	
17	JPC34 292-297	12655-32	9.88897	0.02377	0.325	99.4	1123.53	1.68	11.36	>150	
17	JPC34 345-350	12519-13	15.96565	0.02517	0.015	83.8	1243.50	10.68	16.39	>150	
17	JPC34 345-350	12667-27	15.22734	-0.00174	0.039	60.4	1250.04	7.66	14.66	>150	
17	JPC34 345-350	12519-06	26.06237	-0.00012	0.155	98.2	1266.49	2.38	12.89	>150	
17	JPC34 292-297	12518-05	24.89455	0.02413	0.069	97.4	1274.91	4.06	13.38	>150	
17	JPC34 345-350	12519-10	14.47709	0.01568	0.006	68.6	1300.94	16.25	20.81	>150	
17	JPC34 345-350	12667-37	42.78261	0.00195	0.204	94.8	1323.77	2.39	13.45	>150	
17	JPC34 345-350	12667-26	17.45192	0.01164	0.095	98.2	1338.62	4.24	14.04	>150	
17	JPC34 345-350	12667-34	14.99141	0.03939	0.156	89.3	1396.06	3.32	14.35	>150	
17	JPC34 292-297	12655-97	13.38144	0.02284	0.49	93.3	1446.70	1.94	14.60	>150	
17	JPC34 292-297	12655-83A	18.36526	0.05164	0.085	94	1472.84	5.00	15.55	>150	
17	JPC34 345-350	12667-48	14.51322	0.02203	0.103	92.7	1672.24	4.72	17.38	>150	
17	JPC34 345-350	12667-28	7.60622	0.1235	0.376	99.7	2164.01	2.93	21.84	>150	
17	JPC34 292-297	12655-122	60.11529	0.58063	0.001	47.5	2190.54	206.20	207.36	>150	
17	JPC34 292-297	12655-118	11.8716	0.05436	0.274	99.3	2205.08	3.43	22.32	>150	
18	1166A 22-1W 60-62	12632-47	20.93883	0.14324	0.047	80.4	414.99	4.68	6.26	>150	*160*
18	1166A 26-1W 100-102	12616-36	70.67025	-0.04056	0.014	82.2	418.71	6.12	7.42	>150	
18	1166A 22-1W 60-62	12632-23	10.16526	0.0088	0.057	78.1	419.59	3.06	5.19	>150	

18	1166A 26-1W 100-102	12616-63	155.83828	0.06798	0.005	110.7	421.05	13.70	14.34	>150
18	1166A 22-1W 60-62	12632-51	10.05317	-0.17137	0.006	75.2	421.86	30.29	30.58	>150
18	1166A 22-1W 60-62	12632-97	10.27789	0.02549	0.021	85.1	436.69	6.61	7.92	>150
18	1166A 24-1W 80/82	12511-08	12.08875	0.01033	0.042	37	449.58	3.15	5.49	>150
18	1166A 22-1W 60-62	12632-26	11.70621	0.01962	0.084	89.9	458.02	2.61	5.27	>150
18	1166A 22-1W 60-62	12632-05	13.52238	0.01251	0.197	93.8	460.98	0.98	4.71	>150
18	1166A 22-1W 60-62	12632-29	7.03792	0.03711	0.079	92.2	465.33	2.53	5.30	>150
18	1166A 22-1W 60-62	12632-15	10.2343	0.01359	0.115	94.4	469.93	2.23	5.20	>150
18	1166A 26-1W 100-102	12616-16	33.66285	0.22049	0.124	97.8	471.83	1.51	4.95	>150
18	1166A 22-1W 60-62	12632-45	11.11223	0.00696	0.087	52	472.15	3.08	5.64	>150
18	1166A 26-1W 100/102	12509-21	34.46027	-0.00648	0.016	94.2	473.08	15.28	16.00	>150
18	1166A 26-1W 100/102	12509-26	37.11935	0.01002	0.005	94.5	473.14	43.63	43.89	>150
18	1166A 22-1W 60-62	12632-74	7.99815	0.03963	0.082	95.1	474.16	2.85	5.53	>150
18	1166A 22-1W 60-62	12632-52	7.95573	-0.00046	0.127	96.1	476.15	1.90	5.13	>150
18	1166A 24-1W 80/82	12511-05	6.14739	0.0459	0.115	38.6	477.05	2.15	5.23	>150
18	1166A 22-1W 60-62	12632-96	6.03137	0.02383	0.093	92.1	477.58	2.08	5.21	>150
18	1166A 26-1W 100-102	12616-18	7.76282	0.00525	0.136	98.8	478.41	1.51	5.02	>150
18	1166A 26-1W 100/102	12509-16	7.78853	0.01519	0.028	98	478.78	8.79	10.01	>150
18	1166A 26-1W 100-102	12616-46	26.32412	0.00772	0.061	99.7	478.85	2.32	5.32	>150
18	1166A 26-1W 100-102	12616-03	40.10561	0.0022	0.15	93.6	479.57	1.26	4.96	>150
18	1166A 26-1W 100-102	12616-34	12.14441	0.01645	0.081	99.1	481.57	1.60	5.07	>150
18	1166A 22-1W 60-62	12632-38	11.13086	0.02125	0.062	96.8	482.25	3.41	5.91	>150
18	1166A 26-1W 100-102	12616-01	39.51866	0.00214	0.234	98.2	482.82	0.96	4.92	>150
18	1166A 22-1W 60-62	12632-92	14.97852	0.12325	0.005	78.7	483.09	23.15	23.65	>150
18	1166A 22-1W 60-62	12632-12	15.31045	0.02703	0.155	96.8	483.43	1.74	5.14	>150
18	1166A 22-1W 60-62	12632-62	15.39999	0.00941	0.05	98.2	484.48	4.43	6.57	>150
18	1166A 22-1W 60-62	12632-93	8.91186	0.00154	0.041	97.7	485.08	4.03	6.31	>150
18	1166A 22-1W 60-62	12632-63	6.15531	0.06997	0.177	94.4	485.83	1.68	5.14	>150
18	1166A 22-1W 60-62	12632-80	5.48903	0.13098	0.068	99.3	486.28	2.94	5.68	>150
18	1166A 24-1W 80/82	12511-04	10.29639	0.00679	0.029	80.7	486.73	3.15	5.80	>150
18	1166A 22-1W 60-62	12632-31	8.16644	0.02756	0.132	97	486.91	1.76	5.18	>150
18	1166A 26-1W 100-102	12616-08	19.54352	-0.00018	0.13	99.4	486.98	1.29	5.04	>150
18	1166A 26-1W 100-102	12616-19	20.50496	-0.00034	0.095	98.2	487.17	1.64	5.14	>150
18	1166A 22-1W 60-62	12632-41	6.66947	0.03261	0.185	97.9	487.22	1.58	5.12	>150
18	1166A 26-1W 100-102	12616-64	28.15236	-0.01023	0.016	108.8	487.41	5.81	7.59	>150
18	1166A 22-1W 60-62	12632-56	6.04707	0.01162	0.151	97.4	487.88	1.80	5.20	>150

18	1166A 22-1W 60-62	12632-85	20.80948	0.02988	0.021	89.9	488.01	8.27	9.61	>150
18	1166A 24-1W 80/82	12511-07	8.26693	0.00793	0.063	91.4	488.58	2.01	5.28	>150
18	1166A 22-1W 60-62	12632-27	17.14577	-0.001	0.069	91.5	489.51	2.86	5.67	>150
18	1166A 26-1W 100-102	12616-14	26.47186	0.00697	0.148	89.7	489.84	1.34	5.08	>150
18	1166A 26-1W 100/102	12509-18	8.92116	0.00952	0.05	97.7	490.21	4.97	6.98	>150
18	1166A 22-1W 60-62	12632-18	8.43764	0.02317	0.121	97.6	491.02	2.19	5.38	>150
18	1166A 22-1W 60-62	12632-03	7.55478	0.02314	0.609	98.4	491.57	0.72	4.97	>150
18	1166A 22-1W 60-62	12632-32	6.33298	0.03215	0.046	89.7	491.83	4.34	6.56	>150
18	1166A 22-1W 60-62	12632-69	23.01124	0.0217	0.04	93.9	492.34	5.14	7.12	>150
18	1166A 26-1W 100-102	12616-23	7.31845	0.01321	0.385	100.1	492.89	0.73	4.98	>150
18	1166A 22-1W 60-62	12632-16	10.59718	0.01613	0.226	100.1	493.21	1.42	5.13	>150
18	1166A 22-1W 60-62	12632-20	8.73056	0.00652	0.081	102.5	493.90	2.85	5.70	>150
18	1166A 26-1W 100-102	12616-32	24.67687	-0.00076	0.035	98.1	494.27	3.16	5.87	>150
18	1166A 22-1W 60-62	12632-73	18.78544	0.03768	0.055	81.4	494.59	3.77	6.22	>150
18	1166A 26-1W 100-102	12616-50	14.0463	0.01871	0.074	100.7	495.10	2.65	5.61	>150
18	1166A 22-1W 60-62	12632-57	6.14009	0.00173	0.258	100.1	495.31	1.06	5.06	>150
18	1166A 22-1W 60-62	12632-11	8.03768	0.01579	0.248	98.3	495.69	1.27	5.12	>150
18	1166A 26-1W 100-102	12616-47	13.73384	0.01041	0.04	94.5	495.77	2.95	5.77	>150
18	1166A 22-1W 60-62	12632-25	17.83163	0.09623	0.172	96.4	496.09	1.55	5.20	>150
18	1166A 22-1W 60-62	12632-44	5.26855	-0.00977	0.105	95.5	496.31	2.07	5.38	>150
18	1166A 22-1W 60-62	12632-58	7.23901	0.02891	0.065	99.1	496.34	3.24	5.93	>150
18	1166A 22-1W 60-62	12632-24	6.72858	0.03663	0.143	98.2	496.37	1.89	5.31	>150
18	1166A 26-1W 100-102	12616-24	5.70131	0.0094	0.552	99.9	497.19	0.76	5.03	>150
18	1166A 26-1W 100-102	12616-59	7.58977	0.00801	0.167	101.5	497.43	1.36	5.16	>150
18	1166A 22-1W 60-62	12632-55	9.15071	0.01409	0.098	97.6	498.09	2.51	5.58	>150
18	1166A 22-1W 60-62	12632-36	11.52058	0.00753	0.129	99.7	498.10	1.86	5.32	>150
18	1166A 22-1W 60-62	12632-64	8.28164	0.01497	0.164	96.9	498.21	1.67	5.25	>150
18	1166A 22-1W 60-62	12632-39	6.15877	0.01083	0.147	100.3	498.24	1.72	5.27	>150
18	1166A 22-1W 60-62	12632-43	6.99691	0.01841	0.079	100.6	498.61	2.71	5.68	>150
18	1166A 22-1W 60-62	12632-30	8.159	0.01682	0.097	99.5	498.77	2.20	5.45	>150
18	1166A 26-1W 100-102	12616-54	7.40701	0.02598	0.216	99.8	499.38	1.33	5.17	>150
18	1166A 26-1W 100/102	12509-24	7.02097	0.0066	0.024	98.5	499.46	10.16	11.33	>150
18	1166A 22-1W 60-62	12632-75	5.83218	0.03267	0.07	100.3	499.46	3.08	5.87	>150
18	1166A 26-1W 100-102	12616-31	12.50776	0.0414	0.116	98.5	500.12	1.54	5.23	>150
18	1166A 26-1W 100/102	12509-14	11.77152	0.02647	0.036	69.6	500.17	6.99	8.59	>150
18	1166A 22-1W 60-62	12632-60	7.12423	0.01386	0.062	100.8	500.59	3.29	5.99	>150

18	1166A 24-1W 80/82	12511-12	6.76063	0.03605	0.092	97.6	500.81	1.74	5.30	>150
18	1166A 26-1W 100-102	12616-57	10.24499	-0.00122	0.085	102	503.08	2.11	5.46	>150
18	1166A 24-1W 80/82	12511-02	40.8728	0.02524	0.017	78.2	503.83	4.43	6.71	>150
18	1166A 26-1W 100-102	12616-15	10.24691	0.035	0.264	99.3	503.90	1.03	5.14	>150
18	1166A 26-1W 100-102	12616-11	8.32788	0.00835	0.768	99.8	504.21	0.62	5.08	>150
18	1166A 26-1W 100-102	12616-53	10.09623	0.00949	0.095	100.2	504.45	1.62	5.30	>150
18	1166A 22-1W 60-62	12632-82	6.52256	0.02024	0.059	101.9	504.52	3.43	6.10	>150
18	1166A 26-1W 100-102	12616-49	5.27352	0.14271	0.084	99.1	504.64	1.91	5.39	>150
18	1166A 26-1W 100-102	12616-07	26.22647	0.01631	0.148	98.9	504.78	1.35	5.23	>150
18	1166A 26-1W 100-102	12616-38	9.83384	0.01853	0.262	100.6	505.26	1.14	5.18	>150
18	1166A 22-1W 60-62	12632-67	63.2445	0.06927	0.009	99.4	505.93	20.35	20.97	>150
18	1166A 22-1W 60-62	12632-17	19.64255	0.02113	0.078	98.5	506.83	3.13	5.95	>150
18	1166A 22-1W 60-62	12632-22	18.5502	0.00228	0.282	74.1	506.86	1.25	5.22	>150
18	1166A 26-1W 100-102	12616-27	11.40957	0.0044	0.143	101.5	507.67	1.41	5.27	>150
18	1166A 22-1W 60-62	12632-76	6.6305	-0.0035	0.051	101.6	507.67	3.86	6.38	>150
18	1166A 26-1W 100-102	12616-29	7.84804	0.01943	0.105	100.1	507.85	1.76	5.37	>150
18	1166A 22-1W 60-62	12632-08	33.00938	0.01317	0.092	97.7	507.92	2.69	5.75	>150
18	1166A 26-1W 100-102	12616-52	7.46985	0.00368	0.123	99.7	508.29	1.53	5.31	>150
18	1166A 26-1W 100-102	12616-10	14.02761	0.00727	0.392	99.6	508.65	0.69	5.13	>150
18	1166A 26-1W 100-102	12616-56	7.80243	0.01262	0.168	101.2	508.76	1.67	5.35	>150
18	1166A 22-1W 60-62	12632-50	9.00951	0.01119	0.088	104.1	508.86	2.51	5.67	>150
18	1166A 22-1W 60-62	12632-19	16.44695	-0.00365	0.027	102	509.27	7.17	8.80	>150
18	1166A 22-1W 60-62	12632-34	10.21552	0.00914	0.096	102	509.54	2.32	5.60	>150
18	1166A 22-1W 60-62	12632-21	8.62465	0.03585	0.105	101.5	509.74	2.27	5.58	>150
18	1166A 26-1W 100-102	12616-62	10.78431	0.00694	0.052	85.6	510.54	2.88	5.86	>150
18	1166A 26-1W 100/102	12509-25	6.88002	0.02525	0.042	99	511.37	5.95	7.84	>150
18	1166A 26-1W 100-102	12616-28	28.62996	-0.00606	0.057	98	511.71	2.68	5.78	>150
18	1166A 26-1W 100-102	12616-58	7.28802	0.00865	0.072	101.8	513.30	2.49	5.70	>150
18	1166A 26-1W 100-102	12616-55	23.78207	0.01522	0.032	100.3	515.49	3.20	6.07	>150
18	1166A 22-1W 60-62	12632-72	8.42846	-0.01048	0.073	103.9	515.86	3.18	6.06	>150
18	1166A 26-1W 100-102	12616-35	7.99385	0.01555	0.159	99.1	516.27	1.26	5.31	>150
18	1166A 22-1W 60-62	12632-83	7.04451	0.00393	0.044	103	516.78	4.55	6.89	>150
18	1166A 22-1W 60-62	12632-71	3.91712	-0.01449	0.03	44.7	516.87	7.17	8.84	>150
18	1166A 26-1W 100-102	12616-40	6.06833	0.02503	0.105	100.9	520.26	7.31	8.98	>150
18	1166A 26-1W 100-102	12616-61	19.79164	0.01403	0.102	100.9	520.45	2.24	5.67	>150
18	1166A 22-1W 60-62	12632-66	10.90861	-0.02386	0.052	105.3	520.81	4.16	6.66	>150

18	1166A 22-1W 60-62	12632-88	5.51286	-0.00322	0.037	95.2	521.20	5.14	7.32	>150
18	1166A 22-1W 60-62	12632-14	9.21139	0.05254	0.155	97.3	521.76	1.71	5.49	>150
18	1166A 26-1W 100-102	12616-26	27.8543	0.03359	0.059	99.8	522.69	2.52	5.80	>150
18	1166A 22-1W 60-62	12632-89	4.89258	-0.00819	0.042	104.5	525.44	4.61	6.99	>150
18	1166A 22-1W 60-62	12632-02	6.73806	0.01761	0.185	98.1	526.37	1.56	5.49	>150
18	1166A 22-1W 60-62	12632-10	11.43014	0.00226	0.197	99.6	527.08	1.56	5.50	>150
18	1166A 22-1W 60-62	12632-77	12.69206	0.00821	0.047	98.9	529.10	4.45	6.91	>150
18	1166A 22-1W 60-62	12632-42	12.43903	0.03852	0.037	95	531.66	5.35	7.54	>150
18	1166A 22-1W 60-62	12632-59	13.08704	-0.00848	0.023	101.7	531.94	8.13	9.71	>150
18	1166A 26-1W 100-102	12616-65	45.8021	0.00603	0.022	107.7	533.76	4.60	7.05	>150
18	1166A 26-1W 100/102	12509-01	9.52983	0.04058	0.213	98.7	536.20	1.59	5.59	>150
18	1166A 26-1W 100-102	12616-66	6.51258	0.08448	0.093	98.6	538.76	2.04	5.76	>150
18	1166A 22-1W 60-62	12632-13	33.21293	-0.01252	0.145	95.6	538.79	1.75	5.67	>150
18	1166A 26-1W 100-102	12616-44	22.63848	0.03074	0.025	104	545.59	3.82	6.66	>150
18	1166A 26-1W 100-102	12616-06	15.45567	0.00538	0.312	98.6	549.74	0.90	5.57	>150
18	1166A 26-1W 100-102	12616-69	12.9929	0.25636	0.023	103.3	550.17	4.58	7.16	>150
18	1166A 26-1W 100-102	12616-67	35.67319	0.02663	0.022	96.1	553.05	4.76	7.30	>150
18	1166A 26-1W 100-102	12616-42	7.0958	0.01923	0.075	101	570.20	5.73	8.08	>150
18	1166A 22-1W 60-62	12632-49	6.81118	0.00273	0.031	109.2	574.63	6.38	8.58	>150
18	1166A 26-1W 100-102	12616-37	19.07842	0.00267	0.136	101.2	578.20	1.69	6.03	>150
18	1166A 26-1W 100-102	12616-60	10.27215	0.0085	0.071	100.9	581.78	2.24	6.24	>150
18	1166A 26-1W 100-102	12616-41	13.9189	0.00725	0.048	101	589.45	3.48	6.84	>150
18	1166A 22-1W 60-62	12632-40	5.9424	-0.00156	0.104	98.9	589.62	2.44	6.38	>150
18	1166A 26-1W 100-102	12616-30	14.83493	0.01023	0.089	100.3	593.56	2.13	6.31	>150
18	1166A 26-1W 100-102	12616-13	9.68201	0.01216	0.153	97.4	594.87	1.36	6.10	>150
18	1166A 22-1W 60-62	12632-87	5.25106	-0.03019	0.018	108.7	600.08	9.90	11.58	>150
18	1166A 22-1W 60-62	12632-90	12.98693	-0.13193	0.016	107.5	603.80	10.06	11.74	>150
18	1166A 22-1W 60-62	12632-94	29.66447	0.09091	0.017	95.5	609.35	7.73	9.84	>150
18	1166A 26-1W 100-102	12616-22	10.89628	0.01399	0.437	100	620.75	0.85	6.27	>150
18	1166A 26-1W 100-102	12616-12	8.33718	0.0085	0.385	98.6	638.65	1.01	6.47	>150
18	1166A 26-1W 100-102	12616-02	11.09812	0.03317	0.328	98.9	640.05	0.95	6.47	>150
18	1166A 22-1W 60-62	12632-61	14.63501	0.02416	0.139	98.4	646.13	1.99	6.76	>150
18	1166A 22-1W 60-62	12632-68	19.17016	-0.4331	0.004	128.7	660.60	39.74	40.28	>150
18	1166A 26-1W 100-102	12616-25	15.58075	0.01567	0.071	101.2	669.52	2.36	7.10	>150
18	1166A 26-1W 100-102	12616-20	53.89476	0.00974	0.056	56.8	675.71	3.54	7.63	>150
18	1166A 26-1W 100-102	12616-04	22.68193	0.01028	0.183	98.8	681.21	1.29	6.93	>150

18	1166A 26-1W 100-102	12616-43	9.63211	0.00327	0.043	101.4	689.00	4.11	8.02	>150	
18	1166A 22-1W 60-62	12632-33	9.47459	0.02655	0.111	100.4	691.14	2.26	7.27	>150	
18	1166A 22-1W 60-62	12632-37	6.9842	0.01006	0.114	97	698.97	2.62	7.46	>150	
18	1166A 22-1W 60-62	12632-09	25.54957	0.01579	0.088	97.3	741.77	3.13	8.05	>150	
18	1166A 22-1W 60-62	12632-04	18.36443	0.03261	0.024	91.5	742.55	8.45	11.25	>150	
18	1166A 26-1W 100-102	12616-05	5.64032	0.02825	1.267	99.9	799.31	1.63	8.16	>150	
18	1166A 22-1W 60-62	12632-86	5.2646	0.00829	0.052	98.6	828.29	4.67	9.51	>150	
18	1166A 22-1W 60-62	12632-65	28.38068	-0.00722	0.031	102.4	832.29	6.67	10.66	>150	
18	1166A 22-1W 60-62	12632-01	9.83735	0.00667	0.573	99.4	1349.72	1.65	13.60	>150	
18	1166A 22-1W 60-62	12632-46	14.6079	0.02241	0.071	98	1526.67	5.91	16.37	>150	
18	1166A 26-1W 100-102	12616-39	11.47308	0.02703	0.089	88.9	1887.97	4.86	19.50	>150	
18	1166A 22-1W 60-62	12632-06	10.44868	0.02069	0.16	99.1	2411.93	4.28	24.50	>150	
18	1166A 22-1W 60-62	12632-79	31.58804	1.17987	0.002	82.3	3189.22	103.30	108.11	>150	
19	JPC 25 1305-1310	12512-07	14.77681	0.02259	0.103	76.6	489.64	1.78	5.21	>150	*37*
19	JPC 25 1503-1510	12517-08	7.31953	0.03092	0.158	85.5	495.84	1.39	5.15	>150	
19	JPC 25 1503-1510	12517-25	5.06334	0.03735	0.16	94.9	496.04	1.46	5.17	>150	
19	JPC 25 1405-1410	12516-18	4.02798	0.19115	0.206	98.6	498.70	1.00	5.09	>150	
19	JPC 25 1305-1310	12512-10	4.88079	0.21607	0.17	99.4	499.01	1.38	5.18	>150	
19	JPC 25 1503-1510	12517-26	4.14195	0.10207	0.253	98.6	499.70	0.96	5.09	>150	
19	JPC 25 1405-1410	12516-10	4.61438	0.17478	0.242	98	499.91	1.08	5.11	>150	
19	JPC 25 1405-1410	12516-05	5.56355	0.11315	0.677	98.7	500.38	0.58	5.04	>150	
19	JPC 25 1305-1310	12512-18	7.8648	0.00178	0.187	98.1	501.34	1.19	5.15	>150	
19	JPC 25 1305-1310	12512-13	10.16808	0.01525	0.15	94.9	502.04	1.30	5.19	>150	
19	JPC 25 1503-1510	12517-12	6.73703	0.04521	0.184	97.9	502.58	1.11	5.15	>150	
19	JPC 25 1305-1310	12512-03	12.00415	0.01103	0.111	93.7	502.88	1.36	5.21	>150	
19	JPC 25 1405-1410	12516-06	9.07004	0.0102	0.363	98.8	503.32	0.81	5.10	>150	
19	JPC 25 1503-1510	12517-09	5.08206	0.18041	0.24	94.5	503.33	0.90	5.11	>150	
19	JPC 25 1503-1510	12517-17	4.76103	0.22624	0.156	97.3	504.31	1.20	5.18	>150	
19	JPC 25 1503-1510	12517-11	5.25778	0.17236	0.263	98.5	504.35	1.16	5.17	>150	
19	JPC 25 1305-1310	12512-16	5.98912	0.15658	0.137	98.7	504.61	1.35	5.22	>150	
19	JPC 25 1305-1310	12512-05	8.52227	0.23167	0.199	97.3	505.47	1.18	5.19	>150	
19	JPC 25 1405-1410	12516-03	8.05151	0.03213	0.512	99.2	508.36	0.63	5.12	>150	
19	JPC 25 1503-1510	12517-05	5.04279	0.01659	0.527	97.5	511.67	0.65	5.16	>150	
19	JPC 25 1305-1310	12512-19	4.81821	0.15666	0.312	99	517.29	0.81	5.24	>150	

19	JPC 25 1503-1510	12517-14	2.53858	0.00201	0.618	97.7	521.94	0.61	5.25	>150	
19	JPC 25 1405-1410	12516-02	7.2289	0.19275	0.393	99	531.85	0.84	5.38	>150	
19	JPC 25 1503-1510	12517-01	5.86954	0.05448	2.369	99.1	538.00	0.49	5.40	>150	
19	JPC 25 1305-1310	12512-25	8.16886	-0.00133	0.211	96.9	542.30	1.26	5.57	>150	
19	JPC 25 1503-1510	12517-02	4.42202	0.17419	3.348	98.7	543.62	0.65	5.47	>150	
19	JPC 25 1405-1410	12516-04	9.0013	0.01397	0.192	96.5	551.48	1.26	5.66	>150	
19	JPC 25 1405-1410	12516-08	26.40082	0.22856	0.065	94.5	554.77	2.12	5.94	>150	
19	JPC 25 1305-1310	12512-09	8.13559	0.02191	0.185	98.1	582.69	1.31	5.97	>150	
19	JPC 25 1405-1410	12516-21	7.43926	0.00784	0.13	91.9	606.80	1.73	6.31	>150	
19	JPC 25 1305-1310	12512-27	8.87405	0.14163	0.17	94.2	616.80	1.40	6.33	>150	
19	JPC 25 1503-1510	12517-13	8.71757	0.0327	0.025	84.1	1423.21	6.94	15.83	>150	
19	JPC 25 1503-1510	12517-23	1.87653	-0.06446	0.001	32.7	1815.50	109.12	110.62	>150	
19	JPC 25 1503-1510	12517-24	41.6869	0.02099	0.002	33.2	1863.95	79.90	82.04	>150	
19	JPC 25 1305-1310	12512-17	1.04443	-0.25811	0.001	72.7	2767.23	147.59	150.16	>150	
19	JPC 25 1405-1410	12516-07	1.57366	-0.26586	0.001	55.5	3015.56	128.14	131.64	>150	
19	JPC 25 1305-1310	12512-12	1.22739	0.68347	0.001	90.9	4144.39	171.93	176.86	>150	
20	ELT49-30 hb	12673-22	8.17817	-0.00747	0.122	98.7	661.15	2.37	7.02	> 150	34
20	ELT49-30 hb	12673-26	20.22232	-0.02419	0.029	97.3	1135.28	7.21	13.45	> 150	
20	ELT49-30 hb	12673-19	6.49868	-0.00009	0.159	99.2	1150.81	3.00	11.89	> 150	
20	ELT49-30 hb	12673-23	6.15927	-0.00243	0.164	99.2	1155.78	2.83	11.90	> 150	
20	ELT49-30 hb	12673-25	7.94718	0.00198	0.113	95.8	1164.09	3.31	12.10	> 150	
20	ELT49-30 hb	12673-20	6.04748	0.0077	0.571	99.5	1172.68	2.30	11.95	> 150	
20	ELT49-30 hb	12673-18	6.80707	0.02547	0.375	99	1364.59	2.66	13.90	> 150	
20	ELT49-30 hb	12673-21	6.30127	-0.0089	0.048	97.9	1477.64	6.83	16.28	> 150	
20	ELT49-30 hb	12673-02	6.59551	0.01079	0.392	99.1	1164.88	4.39	12.45	>150	
20	ELT49-30 hb	12673-03	5.1076	0.05835	2.302	1.2	3.49	5.20	5.20	>150	
20	ELT49-30 hb	12673-06	10.97325	0.02388	0.563	99.3	1203.83	4.76	12.95	>150	
20	ELT49-30 hb	12673-07	5.57445	0.02019	0.435	96.1	1163.85	4.70	12.55	>150	
20	ELT49-30 hb	12673-08	6.35349	-0.00045	0.602	78.7	582.21	4.77	7.53	>150	
20	ELT49-30 hb	12673-09	16.0711	0.01649	0.487	98.8	1113.89	4.14	11.89	>150	
20	ELT49-30 hb	12673-10	6.98301	0.00532	0.341	85.7	671.18	4.34	7.99	>150	

20	ELT49-30 hb	12673-13	9.35143	0.02165	0.834	92.5	1242.90	6.40	13.98	>150	
20	ELT49-30 hb	12673-14	5.14668	-0.00115	0.209	99.4	798.07	3.22	8.61	>150	
20	ELT49-30 hb	12673-15	7.04795	-0.00584	0.07	98.6	1152.40	4.34	12.31	>150	
20	ELT49-30 hb	12932-18	3.75189	0.00886	0.01	5.4	23.52	5.89	5.90	> 150	
20	ELT49-30 hb	12932-11	7.20778	0.01187	0.083	90	1135.87	3.64	11.93	> 150	
20	ELT49-30 hb	12932-10	7.22154	0.01193	0.07	99.4	1138.62	3.25	11.84	> 150	
20	ELT49-30 hb	12932-09	7.26258	0.013	0.231	99.4	1164.48	2.55	11.92	> 150	
20	ELT49-30 hb	12932-08	6.39021	0.00772	0.115	99.2	1172.05	2.71	12.03	> 150	
20	ELT49-30 hb	12932-22	6.42643	0.00548	0.09	99.1	1172.70	3.09	12.13	> 150	
20	ELT49-30 hb	12932-13	7.46358	0.01648	0.248	96.6	1180.25	2.69	12.10	> 150	
20	ELT49-30 hb	12932-17	6.92773	0.01582	0.017	97.4	1189.16	6.59	13.60	> 150	
20	ELT49-30 hb	13187-02A	12.55072	-0.01178	0.09	98.1	1169.11	12.39	17.03	> 150	
20	ELT49-30 hb	13187-03A	5.8936	0.01523	0.128	97.9	1133.51	11.90	16.43	> 150	
20	ELT49-30 hb	13187-04A	15.02749	-0.04135	0.053	101.4	1190.81	13.10	17.71	> 150	
20	ELT49-30 hb	13187-05A	4.86782	0.04463	0.099	99.4	1162.95	12.15	16.82	> 150	
20	ELT49-30 hb	13187-06A	6.87292	-0.01099	0.091	98.9	1147.23	12.34	16.85	> 150	
20	ELT49-30 hb	13187-07A	3.83124	0.01209	0.063	97.6	1157.32	13.41	17.71	> 150	
20	ELT49-30 hb	13187-08A	5.01837	-0.00791	0.071	99.6	1265.49	13.01	18.15	> 150	
20	ELT49-30 hb	13187-09A	3.53255	0.01527	0.117	98.3	1190.66	12.22	17.06	> 150	
21	ELT37-16 hb	12680-01	3.17171	0.00165	1.28	99.7	1250.07	2.78	12.81	> 150	63
21	ELT37-16 hb	12680-02	11.44255	0.00421	0.411	99.4	1632.84	3.75	16.75	> 150	*38*
21	ELT37-16 hb	12680-03	7.54908	0.00233	0.166	98.8	1302.18	3.56	13.50	> 150	
21	ELT37-16 hb	12680-04	21.44905	-0.0202	0.044	98.2	1194.11	6.31	13.51	> 150	
21	ELT37-16 hb	12680-06	65.38187	0.03673	0.042	96.8	2017.55	8.55	21.91	> 150	
21	ELT37-16 hb	12680-07	23.43376	0.00792	0.087	99.2	2309.63	6.32	23.94	> 150	
21	ELT37-16 hb	12680-08	21.38554	0.04417	0.02	95.3	1143.85	10.03	15.21	> 150	
21	ELT37-16 hb	12680-09	23.30239	0.03658	0.035	98.1	1497.16	8.69	17.31	> 150	
21	ELT37-16 hb	12680-10	18.72199	0.01827	0.08	99.5	1171.64	4.50	12.55	> 150	

21	ELT37-16 hb	12680-11	10.36479	0.00141	0.138	99.2	1197.80	3.35	12.44	> 150
21	ELT37-16 hb	12680-12	13.53421	0.00171	0.131	99.2	1152.30	3.70	12.10	> 150
21	ELT37-16 hb	12680-13	18.29366	0.00664	0.028	98.5	1250.00	9.41	15.64	> 150
21	ELT37-16 hb	12680-14	16.37397	-0.00089	0.051	99.5	1496.50	6.12	16.17	> 150
21	ELT37-16 hb	12680-15	9.96974	0.00496	0.193	98.3	1481.72	4.16	15.39	> 150
21	ELT37-16 hb	12680-16	10.46987	-0.01706	0.117	99.7	1149.73	3.27	11.95	> 150
21	ELT37-16 hb	12680-22	7.47265	0.00057	0.33	98.2	1155.49	2.86	11.90	> 150
21	ELT37-16 hb	12680-24	6.78632	0.00453	0.351	99	1195.63	2.66	12.25	> 150
21	ELT37-16 hb	12680-18	16.30465	0.03666	0.022	91.7	1330.53	7.71	15.38	> 150
21	ELT37-16 hb	12680-21	7.28225	0.00436	0.503	99	1489.89	2.63	15.13	> 150
21	ELT37-16 hb	12680-17	16.276	0.00607	0.25	99.1	1549.89	3.27	15.84	> 150
21	ELT37-16 hb	12680-23	23.38785	0.02168	0.118	98.1	2330.49	4.99	23.83	> 150
21	ELT37-16 hb	12980-16	2.48009	0.01677	0.14	49.9	354.21	3.87	5.24	> 150
21	ELT37-16 hb	12980-24	12.81148	0.01338	0.046	87.6	1128.40	5.16	12.41	> 150
21	ELT37-16 hb	12980-31	11.09251	0.00128	0.222	97.6	1131.54	2.85	11.67	> 150
21	ELT37-16 hb	12980-06	9.0119	0.00407	0.587	98.5	1131.66	2.68	11.63	> 150
21	ELT37-16 hb	12980-17	11.68396	0.00281	0.636	94.5	1132.31	2.85	11.68	> 150
21	ELT37-16 hb	12980-34	7.63834	0.00959	0.26	98.2	1136.43	3.03	11.76	> 150
21	ELT37-16 hb	12980-41	8.26589	0.0049	0.116	99.4	1141.05	3.29	11.87	> 150
21	ELT37-16 hb	12980-25	6.89157	0.00327	0.389	99.2	1144.09	2.44	11.70	> 150
21	ELT37-16 hb	12980-23	27.58413	0.00616	0.064	94.7	1145.53	3.87	12.09	> 150
21	ELT37-16 hb	12980-15	10.56146	0.00346	0.181	98.2	1147.65	3.24	11.92	> 150
21	ELT37-16 hb	12980-21	7.41926	0.01218	0.428	98.9	1156.84	2.74	11.89	> 150
21	ELT37-16 hb	12980-14	12.98396	0.00234	0.176	98.8	1158.13	2.86	11.93	> 150
21	ELT37-16 hb	12980-22	16.64825	0.01027	0.065	92.8	1160.66	4.06	12.30	> 150
21	ELT37-16 hb	12980-01	22.5215	0.00035	0.216	98.2	1162.95	2.79	11.96	> 150
21	ELT37-16 hb	12980-37	8.16526	0.00618	0.082	97.9	1164.69	3.30	12.10	> 150
21	ELT37-16 hb	12980-08	7.47336	0.00264	2.722	99.3	1167.60	3.02	12.06	> 150
21	ELT37-16 hb	12980-40	8.4108	0.00375	0.174	98.8	1167.65	3.40	12.16	> 150
21	ELT37-16 hb	12980-42	5.87249	0.00775	0.499	96.7	1169.02	2.92	12.05	> 150
21	ELT37-16 hb	12980-32	17.95697	0.01917	0.058	95.6	1174.08	4.45	12.56	> 150
21	ELT37-16 hb	12980-36	5.24229	0.0085	0.458	98.9	1176.90	2.66	12.07	> 150
21	ELT37-16 hb	12980-12	11.21189	0.00305	0.45	98.5	1199.60	2.63	12.28	> 150
21	ELT37-16 hb	12980-30	7.3083	0.0076	0.225	96.9	1215.96	3.16	12.56	> 150
21	ELT37-16 hb	12980-28	7.54955	0.00708	0.171	94.1	1273.31	3.44	13.19	> 150
21	ELT37-16 hb	12980-02	25.34668	-0.01483	0.03	78.2	1351.98	6.61	15.05	> 150

21	ELT37-16 hb	12980-09	35.53666	0.01381	0.174	97.3	1405.44	3.54	14.49	> 150
21	ELT37-16 hb	12980-19	40.67461	0.01279	0.112	96.7	1433.47	3.83	14.84	> 150
21	ELT37-16 hb	12980-18	9.02436	0.00831	0.346	99.4	1456.67	3.25	14.93	> 150
21	ELT37-16 hb	12980-11	16.6597	0.00555	0.212	92.9	1463.81	4.04	15.19	> 150
21	ELT37-16 hb	12980-35	28.48244	0.00329	0.056	96.6	1479.88	5.19	15.68	> 150
21	ELT37-16 hb	12980-04	19.58876	0.01614	0.078	83.9	1519.52	5.18	16.06	> 150
21	ELT37-16 hb	12980-13	25.0238	0.02902	0.038	92.1	1528.19	6.05	16.44	> 150
21	ELT37-16 hb	12980-10	10.1525	0.01218	0.046	99.1	1528.79	4.67	15.99	> 150
21	ELT37-16 hb	12980-05	32.69251	0.00081	0.276	87	1634.40	4.47	16.95	> 150
21	ELT37-16 hb	12980-07	28.2396	0.01027	0.053	88.7	1705.84	5.88	18.04	> 150
21	ELT37-16 hb	12980-26	14.11781	0.0053	0.664	93.1	1709.72	4.22	17.61	> 150
21	ELT37-16 hb	12980-27	35.17421	0.0042	0.102	95.5	1711.30	4.65	17.73	> 150
21	ELT37-16 hb	12980-29	11.40088	0.00924	0.2	99.1	1765.31	3.42	17.98	> 150
21	ELT37-16 hb	12980-03	48.05452	-0.00219	0.045	86.9	1777.05	6.84	19.04	> 150
21	ELT37-16 hb	12980-33	13.38322	0.00773	0.252	99	1881.16	3.82	19.20	> 150
21	ELT37-16 hb	12980-38	15.26778	-0.00288	0.121	97.8	1941.65	4.54	19.94	> 150
21	ELT37-16 hb	12980-39	27.5257	0.01323	0.049	98.6	1967.55	6.13	20.61	> 150
21	ELT37-16 hb	12980-20	45.47058	0.00682	0.118	93.7	2421.16	5.32	24.79	> 150
21	ELT37-16-A hb	14633-12A	8.74943	0.02006	0.082	99.1	1114.94	1.89	11.31	> 150
21	ELT37-16-A hb	14633-07A	7.47561	0.03886	0.014	99.3	1134.05	3.87	11.98	> 150
21	ELT37-16-A hb	14633-36A	13.35409	0.03182	0.022	98.7	1136.08	3.19	11.80	> 150
21	ELT37-16-A hb	14633-02A	12.92542	0.02173	0.029	98.6	1140.21	3.06	11.81	> 150
21	ELT37-16-A hb	14633-13A	8.35168	0.028	0.025	99.4	1141.29	3.18	11.85	> 150
21	ELT37-16-A hb	14633-37A	7.93887	0.01593	0.032	96.3	1142.67	2.93	11.80	> 150
21	ELT37-16-A hb	14633-09A	15.87113	0.06518	0.005	95.6	1148.37	6.33	13.11	> 150
21	ELT37-16-A hb	14633-39A	12.13171	0.03115	0.014	96.7	1149.30	3.93	12.15	> 150
21	ELT37-16-A hb	14633-31A	13.34392	0.03954	0.011	92	1159.79	5.33	12.76	> 150
21	ELT37-16-A hb	14633-	31.54577	0.14045	0.004	96.1	1164.79	8.03	14.15	> 150

21	ELT37-16-A hb	14633-28A	12.43666	0.02997	0.023	98.9	1172.67	3.83	12.34	> 150
21	ELT37-16-A hb	14633-16A	9.78354	0.02001	0.033	97.9	1174.08	2.89	12.09	> 150
21	ELT37-16-A hb	14633-20A	5.42863	0.02093	0.039	99.5	1181.19	2.59	12.09	> 150
21	ELT37-16-A hb	14633-35A	6.76416	0.01954	0.014	98	1184.34	4.41	12.64	> 150
21	ELT37-16-A hb	14633-05A	8.76465	0.0144	0.077	98.8	1185.99	2.43	12.11	> 150
21	ELT37-16-A hb	14633-18A	12.64179	0.01135	0.053	97.5	1196.78	2.36	12.20	> 150
21	ELT37-16-A hb	14633-15A	7.95573	0.02097	0.028	88.1	1198.39	3.62	12.52	> 150
21	ELT37-16-A hb	14633-10A	9.97214	0.03034	0.038	98.7	1200.63	3.01	12.38	> 150
21	ELT37-16-A hb	14633-29A	7.38611	0.01465	0.031	99.3	1203.90	3.01	12.41	> 150
21	ELT37-16-A hb	14633-32A	22.31645	0.02788	0.014	98.1	1211.60	4.40	12.89	> 150
21	ELT37-16-A hb	14633-14A	9.09527	0.0145	0.057	98.6	1219.77	2.41	12.43	> 150
21	ELT37-16-A hb	14633-17A	23.35834	0.05338	0.015	99.2	1224.28	4.47	13.03	> 150
21	ELT37-16-A hb	14633-27A	7.62721	0.01702	0.039	96.5	1246.76	3.28	12.89	> 150
21	ELT37-16-A hb	14633-34A	19.82641	0.03892	0.014	92.8	1290.41	5.20	13.91	> 150
21	ELT37-16-A hb	14633-22A	19.05231	0.03313	0.013	98.2	1377.52	4.78	14.58	> 150
21	ELT37-16-A hb	14633-26A	13.78761	0.0471	0.01	96.4	1404.74	5.70	15.16	> 150
21	ELT37-16-A hb	14633-08A	7.90514	0.03661	0.015	99.5	1408.32	4.81	14.88	> 150
21	ELT37-16-A hb	14633-11A	8.12501	0.01329	0.044	99.3	1424.27	2.93	14.54	> 150
		14633-03A								

21	ELT37-16-A hb	14633-30A	11.00603	0.01627	0.015	99.1	1441.57	4.54	15.11	> 150	
21	ELT37-16-A hb	14633-24A	11.48331	0.03546	0.017	96.2	1463.05	5.03	15.47	> 150	
21	ELT37-16-A hb	14633-01A	11.22771	0.01108	0.021	95.8	1478.40	4.07	15.33	> 150	
21	ELT37-16-A hb	14633-06A	11.94952	0.03992	0.012	98.9	1480.46	5.62	15.84	> 150	
21	ELT37-16-A hb	14633-25A	12.86762	0.01993	0.033	99.6	1512.70	3.22	15.47	> 150	
21	ELT37-16-A hb	14633-21A	19.8416	0.02082	0.038	97.2	1571.96	3.88	16.19	> 150	
21	ELT37-16-A hb	14633-19A	11.37128	0.03886	0.018	99	1599.73	4.73	16.68	> 150	
21	ELT37-16-A hb	14633-04A	21.91512	0.0344	0.01	97.7	1608.50	7.07	17.57	> 150	
21	ELT37-16-A hb	14633-23A	8.87323	0.04018	0.018	98.6	1623.86	4.83	16.94	> 150	
21	ELT37-16-A hb	14633-38A	40.08205	0.07784	0.003	97.2	1909.37	13.93	23.64	> 150	
22	ELT37-13 hb	12979-05	9.76933	0.00931	0.187	99.5	1121.27	2.77	11.55	> 150	47
22	ELT37-13 hb	12979-04	12.97786	0.00414	0.176	99.3	1128.57	2.60	11.58	> 150	*44*
22	ELT37-13 hb	12979-02	5.41983	0.00322	3.264	99.8	1139.19	2.86	11.74	> 150	
22	ELT37-13 hb	12979-06	13.56411	-0.00181	0.1	99.1	1179.44	3.00	12.17	> 150	
22	ELT37-13 hb	12979-01	9.73409	0.01426	0.777	96.9	1257.95	2.72	12.87	> 150	
22	ELT37-13 hb	12679-01	12.89935	0.00386	0.266	99	1114.88	3.03	11.55	> 150	
22	ELT37-13 hb	12679-03	7.88209	0.00944	0.302	98.4	1205.27	2.99	12.42	> 150	
22	ELT37-13 hb	12679-05	6.22964	0.00819	0.273	99.7	1128.56	2.97	11.67	> 150	
22	ELT37-13 hb	12679-06	13.99852	0.00232	0.252	99.3	1447.51	3.65	14.93	> 150	
22	ELT37-13 hb	12679-07	9.51268	0.00768	0.089	99.4	1363.31	4.46	14.34	> 150	
22	ELT37-13 hb	12679-08	57.05087	0.12589	0.004	79.7	2055.67	39.84	44.83	> 150	
22	ELT37-13 hb	12679-09	24.51428	-0.00126	0.246	92.9	1225.68	3.92	12.87	> 150	
22	ELT37-13 hb	12679-11	8.36614	0.00112	0.757	99.7	1125.53	2.54	11.54	> 150	
22	ELT37-13 hb	12679-12	5.23601	0.01991	0.005	75.1	1293.45	41.29	43.27	> 150	
22	ELT37-13 hb	12679-13	11.34937	-0.01701	0.049	97.3	1216.49	6.48	13.79	> 150	
22	ELT37-13 hb	12679-14	6.35363	0.00332	0.134	99.7	1127.20	3.56	11.82	> 150	

22	ELT37-13 hb	12679-15	28.40905	-0.01991	0.04	97.7	1386.57	7.14	15.59	> 150
22	ELT37-13 hb	12679-18	1.86986	0.01586	0.078	95.6	538.86	2.51	5.94	> 150
22	ELT37-13 hb	12679-22	2.3292	-0.01879	0.01	94.3	1089.91	15.96	19.32	> 150
22	ELT37-13 hb	12679-23	12.24865	-0.00425	0.099	93.7	1110.61	3.99	11.80	> 150
22	ELT37-13 hb	12679-19	9.72061	-0.00327	0.174	97.5	1117.64	2.99	11.57	> 150
22	ELT37-13 hb	12679-16	6.94007	0.00339	0.167	98.7	1120.72	3.09	11.63	> 150
22	ELT37-13 hb	12679-28	10.79683	0.02475	0.064	97.3	1123.22	4.35	12.05	> 150
22	ELT37-13 hb	12679-25	6.46002	0.01184	0.043	98.1	1131.44	5.89	12.76	> 150
22	ELT37-13 hb	12679-20	11.49504	0.02549	0.067	97.8	1132.86	4.70	12.26	> 150
22	ELT37-13 hb	12679-29	9.39301	0.00329	0.318	97	1136.59	2.70	11.68	> 150
22	ELT37-13 hb	12679-17	8.8582	0.00523	0.506	98.7	1137.47	2.43	11.63	> 150
22	ELT37-13 hb	12679-30	10.79568	0.00104	0.125	97	1138.27	3.41	11.88	> 150
22	ELT37-13 hb	12679-27	18.06721	0.01886	0.043	96.5	1162.46	5.44	12.83	> 150
22	ELT37-13 hb	12679-24	7.20951	-0.00042	0.127	95.7	1181.73	3.51	12.33	> 150
22	ELT37-13 hb	12679-26	41.25096	0.00777	0.054	98.9	2013.32	7.51	21.49	> 150
22	ELT37-13 hb	12979-24	14.50738	0.00258	0.135	96.9	1080.87	2.99	11.22	> 150
22	ELT37-13 hb	12979-33	15.07214	0.00427	0.258	97.6	1101.66	2.84	11.38	> 150
22	ELT37-13 hb	12979-28	18.77428	0.00296	0.03	96.2	1110.77	4.38	11.94	> 150
22	ELT37-13 hb	12979-34	7.61102	0.00986	0.254	85.7	1162.06	3.76	12.21	> 150
22	ELT37-13 hb	12979-29	7.81791	0.00548	0.46	98.8	1172.56	2.46	11.98	> 150
22	ELT37-13 hb	12979-25	8.02304	-0.00925	0.031	98.5	1175.81	4.78	12.69	> 150
22	ELT37-13 hb	12979-32	38.23289	-0.03684	0.009	77.4	1193.63	11.79	16.78	> 150
22	ELT37-13 hb	12979-26	8.97237	0.00801	0.045	96.3	1198.64	4.66	12.86	> 150
22	ELT37-13 hb	12979-35	10.06447	0.00949	0.081	92.1	1199.20	3.51	12.49	> 150
22	ELT37-13 hb	12979-30	17.86613	0.00615	0.095	97.4	1215.28	3.61	12.68	> 150
22	ELT37-13 hb	12979-27	19.34789	0.00775	0.068	80.3	1255.46	5.20	13.59	> 150
22	ELT37-13 hb	12979-37	14.54053	0.00046	0.025	85.8	1257.53	5.72	13.82	> 150
22	ELT37-13 hb	12979-31	37.91826	0.01815	0.027	96.8	1283.92	6.26	14.28	> 150
22	ELT37-13 hb	12979-23	13.88472	0.01894	0.047	59.3	1288.17	8.96	15.69	> 150
22	ELT37-13 hb	12979-36	36.54656	0.02633	0.019	46.1	1684.36	16.45	23.54	> 150
22	ELT37-13 hb	12979-22	9.45756	0.02063	0.907	97.8	1815.36	3.55	18.50	> 150
22	ELT37-13-A hb	14635-01A	21.61467	0.03604	0.016	99	1321.77	4.26	13.89	> 150
22	ELT37-13-A hb	14635-02A	29.05038	0.05556	0.004	95.6	1198.93	7.07	13.92	> 150
22	ELT37-13-A hb	14635-	19.57467	0.02315	0.016	97.9	1559.73	4.92	16.35	> 150

22	ELT37-13-A hb	14635-03A	8.26113	0.00919	0.052	99.7	1116.69	2.31	11.40	> 150
22	ELT37-13-A hb	14635-04A	8.70724	0.01967	0.049	98.8	1160.99	2.48	11.87	> 150
22	ELT37-13-A hb	14635-05A	8.94654	-0.00726	0.032	64.1	1143.01	5.09	12.51	> 150
22	ELT37-13-A hb	14635-06A	5.35031	0.02275	0.018	64.8	418.11	2.61	4.93	> 150
22	ELT37-13-A hb	14635-07A	19.23831	0.0585	0.009	96.5	1174.07	5.08	12.79	> 150
22	ELT37-13-A hb	14635-08A	11.2319	0.0382	0.017	95.1	1253.57	3.88	13.12	> 150
22	ELT37-13-A hb	14635-09A	9.77093	0.02052	0.024	91.7	1062.59	3.50	11.19	> 150
22	ELT37-13-A hb	14635-10A	25.58979	0.05216	0.012	94.5	2752.20	8.41	28.78	> 150
22	ELT37-13-A hb	14635-11A	7.314	0.01019	0.03	87.8	1151.77	3.29	11.98	> 150
22	ELT37-13-A hb	14635-12A	10.99084	0.02036	0.013	55.3	952.89	6.60	11.59	> 150
22	ELT37-13-A hb	14635-13A	13.34129	0.04284	0.006	79.5	954.39	6.14	11.35	> 150
22	ELT37-13-A hb	14635-14A	9.26767	0.03492	0.02	96.7	1170.33	3.39	12.18	> 150
22	ELT37-13-A hb	14635-15A	5.13153	0.02921	0.052	94.4	1345.95	2.83	13.75	> 150
22	ELT37-13-A hb	14635-16A	6.06964	0.03302	0.015	98.5	1110.72	4.11	11.84	> 150
22	ELT37-13-A hb	14635-42A	6.30172	0.02161	0.051	99.8	1107.00	2.31	11.31	> 150
22	ELT37-13-A hb	14635-24A	6.9145	0.03259	0.02	99.7	1116.08	3.22	11.62	> 150
22	ELT37-13-A hb	14635-41A	7.84314	0.02109	0.033	97.2	1059.18	2.79	10.95	> 150
22	ELT37-13-A hb	14635-25A	8.10111	0.01875	0.035	99.3	1142.17	2.80	11.76	> 150
		14635-32A								

22	ELT37-13-A hb	14635-30A	8.10829	0.00921	0.073	99.9	1284.20	2.42	13.07	> 150
22	ELT37-13-A hb	14635-18A	8.10881	0.01702	0.049	99.2	1150.40	2.64	11.80	> 150
22	ELT37-13-A hb	14635-34A	8.93639	0.04848	0.009	94.2	1128.27	5.93	12.75	> 150
22	ELT37-13-A hb	14635-31A	9.19454	0.02412	0.018	99.2	1144.21	3.87	12.08	> 150
22	ELT37-13-A hb	14635-17A	9.76338	0.02239	0.018	99.5	1152.68	3.53	12.06	> 150
22	ELT37-13-A hb	14635-27A	9.82766	0.02722	0.007	98.5	1064.73	5.27	11.88	> 150
22	ELT37-13-A hb	14635-35A	10.13632	0.03367	0.011	99.5	1107.84	5.04	12.17	> 150
22	ELT37-13-A hb	14635-40A	10.4365	0.0281	0.01	95.1	1085.39	4.69	11.82	> 150
22	ELT37-13-A hb	14635-36A	10.46518	0.02039	0.028	97.8	1118.47	2.83	11.54	> 150
22	ELT37-13-A hb	14635-29A	10.64755	0.02127	0.03	99.5	1120.20	3.00	11.60	> 150
22	ELT37-13-A hb	14635-37A	10.99886	0.04456	0.008	98.9	1494.71	6.23	16.19	> 150
22	ELT37-13-A hb	14635-21A	11.5775	0.01018	0.057	98.6	1252.39	2.32	12.74	> 150
22	ELT37-13-A hb	14635-39A	13.6381	0.03723	0.018	96.2	1204.24	4.37	12.81	> 150
22	ELT37-13-A hb	14635-20A	15.15384	0.06665	0.006	97.3	1351.01	6.64	15.05	> 150
22	ELT37-13-A hb	14635-43A	15.55919	0.02273	0.015	98	1131.44	4.14	12.05	> 150
22	ELT37-13-A hb	14635-23A	16.1927	0.03556	0.017	98.4	1116.00	3.54	11.71	> 150
22	ELT37-13-A hb	14635-33A	17.1385	0.01236	0.046	96.5	1010.27	2.54	10.42	> 150
22	ELT37-13-A hb	14635-22A	18.03369	0.01528	0.055	98.5	1376.48	2.93	14.07	> 150
22	ELT37-13-A hb	14635-	19.01623	0.02518	0.032	98.5	1302.40	3.15	13.40	> 150

22	ELT37-13-A hb	19A 14635-28A	21.52774	0.04342	0.005	99.1	1449.42	8.83	16.97	> 150	
22	ELT37-13-A hb	14635-26A	27.04318	0.03925	0.02	99.5	1432.81	3.58	14.77	> 150	
22	ELT37-13-A hb	14635-45A	55.18661	0.07317	0.004	70.9	1146.33	8.87	14.49	> 150	
23	ELT37-09 hb	12674-03	7.33485	0.01013	0.605	99.9	1715.69	6.60	18.38	>150	45
23	ELT37-09 hb	12674-04	5.77156	0.00455	0.267	94.4	1429.27	6.09	15.53	>150	*16*
23	ELT37-09 hb	12674-05	2.23335	0.00177	0.273	97.1	1287.67	4.85	13.76	>150	
23	ELT37-09 hb	12674-07	8.83598	0.01678	0.213	99.4	1609.36	5.57	17.03	>150	
23	ELT37-09 hb	12674-09	17.96544	0.05361	0.048	100	1660.62	8.27	18.55	>150	
23	ELT37-09 hb	12674-10	32.73616	0.05953	0.082	98.5	1874.23	6.07	19.70	>150	
23	ELT37-09 hb	12674-12	9.25045	0.0063	0.273	99.5	1547.56	5.26	16.34	>150	
23	ELT37-09 hb	12674-15	11.3095	0.01995	0.338	72.2	98.82	1.22	1.57	>150	
23	ELT37-09 hb	12978-16	6.99763	0.0674	0.103	52.5	4.25	0.35	0.36	> 150	
23	ELT37-09 hb	12978-04	9.25228	0.01717	0.078	36.7	127.65	2.25	2.59	> 150	
23	ELT37-09 hb	12978-12	15.08758	0.01268	0.034	50.4	132.07	1.91	2.32	> 150	
23	ELT37-09 hb	12978-08	22.81568	0.19692	0.027	30.7	301.62	6.49	7.16	> 150	
23	ELT37-09 hb	12978-15	12.27431	0.0313	0.034	61.9	894.37	6.21	10.89	> 150	
23	ELT37-09 hb	12978-01	10.72956	0.02691	0.029	98.1	1448.51	5.14	15.37	> 150	
23	ELT37-09 hb	12978-22	10.98124	0.00939	0.052	95	1495.99	4.45	15.61	> 150	
23	ELT37-09 hb	12978-11	16.19903	-0.00731	0.029	92.3	1583.04	6.36	17.06	> 150	
23	ELT37-09 hb	12978-17	28.99154	0.01266	0.161	98.7	1681.20	3.33	17.14	> 150	
23	ELT37-09 hb	12978-10	7.51069	0.09332	0.049	94.7	1690.03	4.55	17.50	> 150	
23	ELT37-09 hb	12978-18	51.14565	-0.00654	0.026	98.2	1748.56	7.80	19.15	> 150	
23	ELT37-09 hb	12978-23	12.41936	0.04783	0.027	92.5	1755.44	7.68	19.16	> 150	
23	ELT37-09 hb	12978-19	6.3361	0.02429	0.067	98.1	1768.87	4.49	18.25	> 150	
23	ELT37-09 hb	12978-07	9.20599	0.03506	0.16	98.8	1785.31	3.58	18.21	> 150	
23	ELT37-09 hb	12978-03	43.39233	0.04073	0.036	95.1	1841.73	6.55	19.55	> 150	
23	ELT37-09 hb	12978-06	4.32943	0.2495	0.002	62.7	4063.12	50.82	65.06	> 150	
23	ELT37-09 hb	13184-01A	12.85272	0.03557	0.387	95.1	115.51	1.86	2.19	> 150	
23	ELT37-09 hb	13184-02A	5.23818	0.04189	0.28	97.3	539.00	6.54	8.47	> 150	

23	ELT37-09 hb	13184-03A	11.00415	0.09016	0.091	73.9	128.60	5.08	5.24	> 150
23	ELT37-09 hb	13184-04A	13.30093	0.04127	0.207	98.4	1659.30	14.15	21.81	> 150
23	ELT37-09 hb	13184-06A	5.5894	0.26071	0.027	78.1	1531.21	28.58	32.42	> 150
23	ELT37-09 hb	13184-08A	12.87927	0.03868	0.209	99.5	1693.48	13.68	21.77	> 150
23	ELT37-09 hb	13184-09A	11.61379	0.06003	0.099	98.1	1789.98	15.27	23.53	> 150
23	ELT37-09 hb	13184-10A	1.03142	-0.10265	0.023	92.6	1651.45	22.86	28.20	> 150
23	ELT37-09 hb	13184-11A	7.22988	0.00636	0.108	98.3	1707.68	15.37	22.97	> 150
23	ELT37-09 hb	13184-12A	7.61725	-0.01503	0.075	97.8	1785.69	17.32	24.88	> 150
23	ELT37-09 hb	13184-13A	9.85743	-0.15889	0.025	100.6	1778.57	15.96	23.90	> 150
23	ELT37-09 hb	13184-14A	7.00821	-0.08373	0.045	99.7	1794.48	18.16	25.53	> 150
23	ELT37-09 hb	13184-15A	9.03718	0.13751	0.035	99.4	1676.81	15.29	22.69	> 150
23	ELT37-09 hb	13184-17A	13.79903	-0.06219	0.031	96.8	1687.60	16.94	23.91	> 150
23	ELT37-09 hb	13184-18A	6.78487	0.12474	0.038	101	1783.25	17.78	25.18	> 150
23	ELT37-09 hb	13184-19A	8.57142	0.05666	0.101	99.2	1894.38	16.37	25.04	> 150
23	ELT37-09 hb	13184-20A	8.29247	0.00917	0.051	96.3	1592.35	17.73	23.83	> 150
23	ELT37-09 hb	13184-21A	6.35906	0.01968	0.173	97.9	493.27	6.20	7.92	> 150
23	ELT37-09 hb	13184-22A	19.66375	-0.01066	0.045	98.6	1712.31	18.17	24.97	> 150
23	ELT37-09 hb	13184-23A	3.32213	-0.0331	0.044	97.1	1761.06	16.47	24.11	> 150
23	ELT37-09 hb	13184-	7.77236	0.27625	0.028	97.4	1595.23	16.68	23.08	> 150

23	ELT37-09-A hb	14632-25A	11.57938	-0.03476	0.001	90.4	482.65	10.63	11.67	> 150	
23	ELT37-09-A hb	14632-16A	5.57924	0.02185	0.026	98.7	537.29	1.85	5.68	> 150	
23	ELT37-09-A hb	14632-14A	12.64701	0.04908	0.009	99	1477.50	5.94	15.93	> 150	
23	ELT37-09-A hb	14632-03A	31.22426	0.0225	0.027	98.4	1506.14	3.80	15.53	> 150	
23	ELT37-09-A hb	14632-11A	9.96759	0.06075	0.034	97.2	1536.30	3.34	15.72	> 150	
23	ELT37-09-A hb	14632-07A	14.28686	0.06474	0.05	97.3	1611.67	3.11	16.41	> 150	
23	ELT37-09-A hb	14632-10A	15.07738	0.03165	0.013	99.1	1651.82	5.24	17.33	> 150	
23	ELT37-09-A hb	14632-09A	9.85821	0.03893	0.036	98.4	1695.06	3.37	17.28	> 150	
23	ELT37-09-A hb	14632-02A	14.46498	0.05251	0.014	99.1	1697.05	5.50	17.84	> 150	
23	ELT37-09-A hb	14632-06A	40.75765	0.08663	0.004	95.6	2214.30	12.58	25.47	> 150	
23	ELT37-09-A hb	14632-08A	4.07745	0.02212	0.047	77.8	219.20	1.02	2.42	> 150	
23	ELT37-09-A hb	14632-17A	5.55542	0.01013	0.012	87.2	355.93	1.93	4.05	> 150	
23	ELT37-09-A hb	14632-24A	6.20628	0.03277	0.013	76.8	530.98	2.90	6.05	> 150	
23	ELT37-09-A hb	14632-23A	10.88672	0.08345	0.008	88.4	1262.30	5.47	13.76	> 150	
23	ELT37-09-A hb	14632-22A	10.36772	0.03129	0.016	74.7	1265.39	5.45	13.78	> 150	
23	ELT37-09-A hb	14632-20A	8.54574	0.06483	0.012	91.8	1346.88	4.62	14.24	> 150	
23	ELT37-09-A hb	14632-18A									
24	JPC11 2305-2310 hb	12507-04	0.0078	0.0003	4.196	99.8	1611.75	3.72	16.54	> 150	56
24	JPC11 2305-2310 hb	12507-05	22.32632	0.00947	0.188	98.3	1668.36	3.33	17.01	> 150	
24	JPC11 2305-2310 hb	12507-06	33.77635	0.00584	0.046	97.6	1650.51	6.70	17.81	> 150	

24	JPC11 2305-2310 hb	12507-07	20.12419	0.00874	0.084	97.2	1729.90	5.55	18.17	> 150
24	JPC11 2305-2310 hb	12507-08	7.27876	0.00465	0.231	98.6	1704.86	2.96	17.30	> 150
24	JPC11 2305-2310 hb	12507-09	57.91119	0.06279	0.014	92	2212.65	12.90	25.61	> 150
24	JPC11 2305-2310 hb	12507-10	0.65296	0.04869	0.002	77.8	1506.80	35.56	38.62	> 150
24	JPC11 2305-2310 hb	12507-11	0.1759	-0.00017	0.63	99.3	1431.76	2.02	14.46	> 150
24	JPC11 2305-2310 hb	12507-12	0.59148	0.00244	0.172	83.2	1613.05	3.84	16.58	> 150
24	JPC11 2305-2310 hb	12507-13	0.66761	0.00098	0.418	93.7	1091.91	1.70	11.05	> 150
24	JPC11 2305-2310 hb	12507-14	30.50721	0.00838	0.051	96.5	1729.59	5.74	18.22	> 150
24	JPC11 2305-2310 hb	12507-15	11.93941	0.01859	0.126	97.4	1546.05	3.76	15.91	> 150
24	JPC11 2305-2310 hb	12507-16	36.24223	0.01438	0.029	93.6	1726.78	7.92	19.00	> 150
24	JPC11 2305-2310 hb	12507-17	14.07825	0.0045	0.095	99.2	1756.08	5.25	18.33	> 150
24	JPC11 2305-2310 hb	12507-18	7.85514	0.00682	0.078	97.8	1420.01	4.76	14.98	> 150
24	JPC11 2370-2375 hb	12635-01	26.70138	0.00972	0.591	94.5	1757.43	2.42	17.74	> 150
24	JPC11 2370-2375 hb	12635-02	17.22664	0.01241	0.436	96.2	1696.20	2.27	17.11	> 150
24	JPC11 2370-2375 hb	12635-03	53.70243	0.01856	0.151	90.1	3248.97	5.13	32.89	> 150
24	JPC11 2370-2375 hb	12635-04	6.78385	0.00613	1.23	94.3	1158.37	1.84	11.73	> 150
24	JPC11 2370-2375 hb	12635-05	6.94557	0.00458	0.686	98.7	1579.50	2.15	15.94	> 150
24	JPC11 2370-2375 hb	12635-06	33.79887	-0.00126	0.278	97.9	1929.63	3.25	19.57	> 150
24	JPC11 2370-2375 hb	12635-07	35.81388	0.00531	0.118	96.4	1708.95	3.82	17.51	> 150
24	JPC11 2370-2375 hb	12635-08	24.52023	0.00077	0.158	96.5	2002.07	4.45	20.51	> 150
24	JPC11 2370-2375 hb	12635-09	29.245	0.00201	0.183	95.8	1687.44	3.12	17.16	> 150
24	JPC11 2370-2375 hb	12635-10	19.68589	0.00559	0.246	95.7	1754.11	2.77	17.76	> 150
24	JPC11 2370-2375 hb	12635-11	31.57426	0.00733	0.151	96.6	1752.28	3.64	17.90	> 150
24	JPC11 2370-2375 hb	12635-12	0.51514	-0.00023	3.222	99.6	1613.82	2.86	16.39	> 150
24	JPC11 2370-2375 hb	12635-13	11.96913	0.02178	0.261	97.3	1743.42	2.88	17.67	> 150
24	JPC11 2370-2375 hb	12635-14	31.4551	0.01022	0.074	91.1	1829.16	5.56	19.12	> 150
24	JPC11 2370-2375 hb	12635-15	56.88529	0.02096	0.046	92.1	2282.94	8.20	24.26	> 150
24	JPC11 2370-2375 hb	12635-16	15.69341	0.01807	0.145	96.4	1895.70	4.05	19.38	> 150
24	JPC11 2370-2375 hb	12635-17	22.70609	0.02273	0.069	93.2	1651.09	4.55	17.13	> 150
24	JPC11 2370-2375 hb	12635-18	9.97799	0.01978	0.372	98.8	1578.70	2.45	15.98	> 150
24	JPC11 2370-2375 hb	12635-19	14.958	0.01835	0.166	95.7	1665.35	3.17	16.95	> 150
24	JPC11 2370-2375 hb	12635-20	12.43042	0.00786	0.145	97.5	1821.41	4.29	18.71	> 150
24	JPC11 2370-2375 hb	12635-21	22.59055	0.00869	0.217	97.3	1943.71	3.30	19.71	> 150
24	JPC11 2370-2375 hb	12635-22	13.35981	0.01121	0.254	97.4	1754.90	2.95	17.80	> 150
24	JPC11 2370-2375 hb	12635-23	2.14067	0.00044	0.61	97.3	1433.78	1.90	14.46	> 150
24	JPC11 2370-2375 hb	12635-24	0.35033	0.00051	1.32	99.5	1566.18	2.34	15.84	> 150

24	JPC11 2370-2375 hb	12635-25	64.47626	-0.00448	0.027	94	2888.19	14.12	32.15	> 150	
24	JPC11 2370-2375 hb	12635-26	63.15348	-0.01328	0.042	96.1	2463.99	10.10	26.63	> 150	
24	JPC11 2370-2375 hb	12635-27	20.67141	0.00186	0.256	96.7	1667.74	2.85	16.92	> 150	
24	JPC11 2370-2375 hb	12635-28	19.35601	0.02118	0.143	95.4	1568.37	3.80	16.14	> 150	
24	JPC11 2370-2375 hb	12635-29	48.21788	0.01108	0.039	96.6	2078.62	9.30	22.77	> 150	
24	JPC11 2370-2375 hb	12635-30	0.54833	-0.00022	3.099	99.4	1477.08	2.72	15.02	> 150	
24	JPC11 2370-2375 hb	12635-31	29.99707	-0.00135	0.172	95.1	1602.77	3.56	16.42	> 150	
24	JPC11 2370-2375 hb	12635-32	12.56434	0.01097	0.231	98.3	1542.40	2.80	15.68	> 150	
24	JPC11 2370-2375 hb	12635-33	13.40714	0.00366	0.259	96.6	1689.76	2.76	17.12	> 150	
24	JPC11 2370-2375 hb	12635-34	18.91264	0.00687	0.195	97.6	1676.27	3.19	17.06	> 150	
24	JPC11 2370-2375 hb	12635-35	28.09366	0.02987	0.042	93.9	2541.76	9.23	27.04	> 150	
24	JPC11 2370-2375 hb	12635-36	24.33676	-0.01162	0.08	96.7	1712.19	5.54	18.00	> 150	
24	JPC11 2370-2375 hb	12635-37	36.83839	-0.01923	0.072	96.2	2285.84	5.76	23.57	> 150	
24	JPC11 2370-2375 hb	12635-38	14.96535	0.00951	0.201	98	1819.36	3.37	18.50	> 150	
24	JPC11 2370-2375 hb	12635-39	34.11192	-0.01609	0.04	94.7	1784.25	6.73	19.07	> 150	
24	JPC11 2370-2375 hb	12635-40	22.83852	-0.00735	0.116	97.4	2454.30	4.89	25.02	> 150	
24	JPC11 2370-2375 hb	12635-41	16.06268	0.00814	0.067	96.8	1458.82	5.12	15.46	> 150	
25	DF79-47 hb	12685-05	2.37059	0.01687	0.122	38	180.01	3.56	3.99	> 150	46
25	DF79-47 hb	12685-14	4.70811	-0.22949	0.001	34.4	431.69	66.38	66.52	> 150	*18*
25	DF79-47 hb	12685-15	6.2587	-0.00347	0.056	50.4	494.82	6.11	7.86	> 150	
25	DF79-47 hb	12685-02	9.54973	0.00617	0.05	95.6	514.84	3.31	6.12	> 150	
25	DF79-47 hb	12685-04	4.47714	0.00486	0.15	84.6	517.76	2.44	5.72	> 150	
25	DF79-47 hb	12685-10	7.5997	-0.20608	0.003	86.6	599.15	35.33	35.83	> 150	
25	DF79-47 hb	12685-09	12.6577	-0.00277	0.05	85.2	613.47	3.76	7.19	> 150	
25	DF79-47 hb	12685-13	8.40591	0.0116	0.049	71.3	1041.39	7.05	12.58	> 150	
25	DF79-47 hb	12685-01	7.79916	0.01699	0.145	98.4	1474.84	3.85	15.24	> 150	
25	DF79-47 hb	12685-21	10.15418	0.01739	0.022	8.1	4.97	4.76	4.76	> 150	
25	DF79-47 hb	12685-22	66.89985	0.21874	0.003	9.9	247.33	47.36	47.42	> 150	
25	DF79-47 hb	12685-16	7.68478	0.0062	0.064	94.9	490.53	2.74	5.62	> 150	
25	DF79-47 hb	12685-18	5.60775	0.03088	0.008	55.5	1520.61	22.74	27.35	> 150	
25	DF79-47 hb	12685-26	7.0264	0.02002	0.029	98	1649.56	8.44	18.53	> 150	
25	DF79-47 hb	12977-23	0.98964	0.00916	0.05	90.4	485.65	2.35	5.40	> 150	
25	DF79-47 hb	12977-17	0.03839	0.00271	0.142	96.6	557.22	1.56	5.79	> 150	
25	DF79-47 hb	12977-07	7.01002	0.00451	0.283	94.9	1089.09	2.61	11.20	> 150	
25	DF79-47 hb	12977-16	7.78879	0.00331	0.143	99.3	1129.54	2.65	11.60	> 150	

25	DF79-47 hb	12977-22	7.28079	0.01717	0.056	97.9	1231.46	3.80	12.89	> 150
25	DF79-47 hb	12977-09	7.97982	0.00244	0.098	99	1426.46	3.85	14.77	> 150
25	DF79-47 hb	12977-14	8.75023	0.01878	0.07	99.5	1435.37	3.63	14.80	> 150
25	DF79-47 hb	12977-11	8.86541	0.02355	0.033	98.3	1460.30	5.74	15.69	> 150
25	DF79-47 hb	12977-18	8.67059	0.00769	0.076	94.6	1476.42	4.28	15.37	> 150
25	DF79-47 hb	12977-12	11.00843	0.01091	0.029	96.2	1555.43	5.62	16.54	> 150
25	DF79-47 hb	12977-02	6.59405	0.04518	5.173	99.7	1741.76	4.68	18.04	> 150
25	DF79-47 hb	12977-03	25.3946	0.00984	0.037	99.9	1881.66	6.63	19.95	> 150
25	DF79-47 hb	12977-01	4.55152	0.14329	0.003	82.7	3299.22	34.73	47.90	> 150
25	DF79-47 hb	13185-01A	16.99535	-0.04916	0.059	94.6	529.71	8.47	9.99	> 150
25	DF79-47 hb	13185-02A	26.32185	-0.15503	0.023	92.3	1430.01	18.15	23.11	> 150
25	DF79-47 hb	13185-03A	4.94522	0.02011	0.136	99.3	1191.49	11.86	16.81	> 150
25	DF79-47 hb	13185-04A	7.07881	0.02905	0.187	95.2	505.74	6.77	8.45	> 150
25	DF79-47 hb	13185-06A	6.29252	-0.0043	0.113	100	477.10	5.79	7.50	> 150
25	DF79-47 hb	13185-07A	9.29667	-0.02644	0.062	95.2	556.63	8.38	10.06	> 150
25	DF79-47 hb	13185-08A	5.99902	-0.03114	0.101	92.7	492.11	7.87	9.28	> 150
25	DF79-47 hb	13185-09A	4.29808	-0.04074	0.137	97.6	500.63	6.50	8.20	> 150
25	DF79-47 hb	13185-10A	15.47538	-0.02376	0.077	99.8	1530.10	14.58	21.13	> 150
25	DF79-47 hb	13185-12A	77.98733	-0.30772	0.02	104.5	1708.85	21.67	27.60	> 150
25	DF79-47 hb	13185-13A	7.02658	0.00032	0.106	94	511.54	7.62	9.18	> 150
25	DF79-47 hb	13185-14A	7.01443	0.08374	0.121	98.1	1700.70	14.83	22.56	> 150
25	DF79-47 hb	13185-16A	6.72283	0.0232	0.052	97.6	1378.56	13.94	19.61	> 150
25	DF79-47 hb	13185-17A	5.72914	-0.00319	0.163	99.1	1682.18	14.06	21.93	> 150

25	DF79-47 hb	13185-19A	9.88904	0.03419	0.047	94.4	517.35	8.95	10.34	> 150
25	DF79-47 hb	13185-20A	16.16265	-0.03808	0.048	92.5	518.58	9.13	10.50	> 150
25	DF79-47 hb	13185-21A	4.5758	-0.12897	0.053	101.2	1469.94	12.44	19.26	> 150
25	DF79-47 hb	13185-22A	6.15686	0.01124	0.152	91.1	423.21	6.78	7.99	> 150
25	DF79-47 hb	13185-23A	8.36834	0.00017	0.13	98.2	1988.63	17.03	26.18	> 150
25	DF79-47-A hb	14639-02A	3.10711	0.01579	0.032	84.3	410.35	1.50	4.37	> 150
25	DF79-47-A hb	14639-19A	11.60403	0.02705	0.015	66.2	474.62	3.05	5.64	> 150
25	DF79-47-A hb	14639-14A	17.80367	0.03091	0.008	94.1	481.41	3.23	5.80	> 150
25	DF79-47-A hb	14639-08A	7.80422	0.01012	0.033	97.9	492.57	1.49	5.15	> 150
25	DF79-47-A hb	14639-06A	5.82833	0.05099	0.016	96.4	510.28	1.90	5.44	> 150
25	DF79-47-A hb	14639-27A	18.44528	0.02169	0.004	89.8	605.44	4.72	7.68	> 150
25	DF79-47-A hb	14639-10A	10.63643	0.03586	0.014	97.3	1029.77	3.61	10.91	> 150
25	DF79-47-A hb	14639-11A	5.52934	0.01823	0.036	96.6	1077.43	2.61	11.09	> 150
25	DF79-47-A hb	14639-21A	29.01855	0.03211	0.008	96.7	1080.00	5.41	12.08	> 150
25	DF79-47-A hb	14639-26A	10.49382	0.06182	0.005	90.1	1170.27	6.96	13.61	> 150
25	DF79-47-A hb	14639-17A	7.93548	0.04321	0.01	98.3	1181.31	5.10	12.87	> 150
25	DF79-47-A hb	14639-01A	11.31932	0.11743	0.002	91.3	1265.22	13.37	18.40	> 150
25	DF79-47-A hb	14639-23A	20.89857	0.20984	0.006	93	1270.94	6.17	14.13	> 150
25	DF79-47-A hb	14639-	8.60576	0.06192	0.009	97	1370.10	6.01	14.96	> 150

25	DF79-47-A hb	16A 14639-18A	8.59429	0.0853	0.007	98.7	1442.74	7.04	16.05	> 150	
25	DF79-47-A hb	14639-25A	8.03788	0.04805	0.014	98	1455.73	5.87	15.70	> 150	
25	DF79-47-A hb	14639-07A	7.04039	0.04482	0.016	98.4	1574.13	4.52	16.38	> 150	
25	DF79-47-A hb	14639-20A	5.6782	0.08422	0.023	95.4	1705.61	4.52	17.65	> 150	
26	DF80-34 hb	12691-09	5.27409	0.01901	0.123	2.7	0.79	1.01	1.01	> 150	36
26	DF80-34 hb	12691-14	7.63484	0.01068	0.193	5.4	6.28	1.78	1.78	> 150	
26	DF80-34 hb	12691-11	7.39049	-0.01169	0.014	5.6	8.75	7.71	7.71	> 150	
26	DF80-34 hb	12691-13	5.75784	0.02763	0.088	45.3	8.89	1.25	1.26	> 150	
26	DF80-34 hb	12691-07	8.57737	-0.00076	0.066	4.3	10.69	4.06	4.06	> 150	
26	DF80-34 hb	12691-05	3.20515	0.00144	0.002	0.1	12.02	164.97	164.97	> 150	
26	DF80-34 hb	12691-02	42.12188	-0.07207	0.014	32.8	57.63	7.32	7.34	> 150	
26	DF80-34 hb	12691-06	22.24842	-0.12419	0.005	2.8	205.65	103.32	103.34	> 150	
26	DF80-34 hb	12691-04	1.52704	0.02669	0.003	38.3	817.50	43.53	44.29	> 150	
26	DF80-34 hb	12691-01	8.15435	0.02906	0.096	92.1	1141.44	5.63	12.73	> 150	
26	DF80-34 hb	12691-08	8.89858	0.00134	0.128	96.2	1159.74	4.86	12.57	> 150	
26	DF80-34 hb	12691-22	4.56073	0.01848	0.667	9.3	2.92	0.21	0.21	> 150	
26	DF80-34 hb	12691-16	8.66996	0.00471	0.6	26.2	3.75	0.26	0.27	> 150	
26	DF80-34 hb	12691-17	2.6199	0.01184	0.609	8.7	9.40	0.91	0.92	> 150	
26	DF80-34 hb	12691-18	7.22599	0.00678	0.059	93.4	497.37	3.02	5.82	> 150	
26	DF80-34 hb	12691-23	7.62276	0.0168	0.038	77.4	499.14	2.97	5.81	> 150	
26	DF80-34 hb	12923-30	14.06459	0.00649	0.006	34.4	83.48	5.52	5.59	> 150	
26	DF80-34 hb	12923-25	17.16385	0.02666	0.016	18.1	125.18	5.60	5.74	> 150	
26	DF80-34 hb	12923-12	9.09137	0.01322	0.035	89.2	416.98	2.07	4.65	> 150	
26	DF80-34 hb	12923-16	11.16042	0.02308	0.019	91.7	478.95	3.30	5.82	> 150	
26	DF80-34 hb	12923-10	32.58829	0.02237	0.013	93	482.47	3.65	6.05	> 150	
26	DF80-34 hb	12923-14	8.3821	0.03515	0.039	94	483.71	2.24	5.33	> 150	
26	DF80-34 hb	12923-23	8.76369	-0.00213	0.022	92.7	489.74	2.85	5.67	> 150	
26	DF80-34 hb	12923-07	70.02775	0.00342	0.019	501	491.64	3.99	6.33	> 150	
26	DF80-34 hb	12923-28	25.76539	0.04864	0.013	81.9	492.43	4.37	6.58	> 150	

26	DF80-34 hb	12923-26	17.08506	0.01008	0.092	91.2	502.77	1.77	5.33	> 150
26	DF80-34 hb	12923-27	9.58465	0.01833	0.045	92	528.24	2.42	5.81	> 150
26	DF80-34 hb	12923-24	13.99904	0.13357	0.001	13	628.91	43.84	44.29	> 150
26	DF80-34 hb	12923-20	6.75473	0.05353	0.002	16.6	914.75	39.94	40.98	> 150
26	DF80-34 hb	12923-13	8.70245	0.02108	0.075	97.1	1179.68	3.23	12.23	> 150
26	DF80-34 hb	13186-02A	15.18334	0.00073	0.045	100.8	1901.25	14.79	24.09	> 150
26	DF80-34 hb	13186-03A	9.09946	0.03828	0.171	92.5	501.30	7.55	9.06	> 150
26	DF80-34 hb	13186-04A	9.43369	-0.01149	0.214	99.4	541.80	6.35	8.35	> 150
26	DF80-34 hb	13186-06A	3.31287	0.07895	0.047	83.4	495.14	11.65	12.66	> 150
26	DF80-34 hb	13186-09A	18.02137	0.03191	0.02	101.8	447.92	13.82	14.53	> 150
26	DF80-34 hb	13186-10A	12.28013	0.03566	0.042	105.6	439.83	8.53	9.60	> 150
26	DF80-34-A hb	14640-14A	11.12583	0.02468	0.04	52	34.56	0.54	0.64	> 150
26	DF80-34-A hb	14640-16A	5.30582	0.0218	0.026	30.5	48.79	1.29	1.38	> 150
26	DF80-34-A hb	14640-17A	6.52413	0.00855	0.033	58.9	84.99	0.88	1.22	> 150
26	DF80-34-A hb	14640-10A	6.82997	0.00177	0.002	69	87.68	4.79	4.87	> 150
26	DF80-34-A hb	14640-13A	15.56459	0.02506	0.01	85.5	204.56	1.62	2.61	> 150
26	DF80-34-A hb	14640-08A	1.6348	0.028	0.017	53.9	285.38	2.85	4.03	> 150
26	DF80-34-A hb	14640-11A	9.56959	0.04073	0.023	99.2	472.42	1.68	5.01	> 150
26	DF80-34-A hb	14640-01A	9.31821	0.03181	0.054	96.2	490.93	1.42	5.11	> 150
26	DF80-34-A hb	14640-18A	3.36313	0.03776	0.013	99.6	2310.67	8.32	24.56	> 150
26	DF80-34-A hb	14640-09A	46.99964	0.05008	0.01	99.6	2594.96	7.75	27.08	> 150

27	DF80-35 hb	12690-02	3.02673	0.01617	0.109	0.4	3.03	11.28	11.28	> 150	21
27	DF80-35 hb	12690-03	9.57969	0.00182	0.083	20.1	5.71	1.45	1.45	> 150	*11*
27	DF80-35 hb	12690-05	4.42151	0.0158	0.319	15.3	16.08	1.45	1.46	> 150	
27	DF80-35 hb	12690-01	48.81312	0.02183	0.2	26.3	23.15	1.22	1.24	> 150	
27	DF80-35 hb	12690-07	3.30523	0.00801	6.417	42.9	9.63	0.08	0.13	> 150	
27	DF80-35 hb	12690-09	5.59235	0.01844	0.579	1.3	0.77	0.35	0.35	> 150	
27	DF80-35 hb	12690-16	7.49857	0.0241	0.108	4.3	2.69	0.76	0.76	> 150	
27	DF80-35 hb	12690-15	10.10302	0.00588	0.445	12.6	4.10	0.25	0.25	> 150	
27	DF80-35 hb	12690-14	3.06318	0.02173	0.92	1.5	6.78	2.03	2.03	> 150	
27	DF80-35 hb	12690-08	3.33203	0.00529	0.097	9.4	11.44	1.03	1.04	> 150	
27	DF80-35 hb	12690-19	1.57053	0.01704	0.709	85.1	98.78	0.39	1.06	> 150	
27	DF80-35 hb	12922-06	7.46521	0.00815	0.07	12.1	6.80	0.69	0.69	> 150	
27	DF80-35 hb	12922-07	7.44774	0.01847	0.016	18.2	8.37	1.97	1.97	> 150	
27	DF80-35 hb	12922-12	10.81235	-0.00027	0.02	13.7	10.13	1.82	1.82	> 150	
27	DF80-35 hb	12922-18	10.0335	0.01517	0.158	47.6	10.38	0.25	0.27	> 150	
27	DF80-35 hb	12922-14	1.44238	0.00571	0.003	18.7	83.57	12.21	12.23	> 150	
27	DF80-35 hb	12922-10	3.08324	0.00691	0.083	68.1	330.55	2.18	3.96	> 150	
27	DF80-35 hb	12922-08	6.07094	0.19473	0.002	29.8	333.58	18.30	18.60	> 150	
27	DF80-35 hb	12922-15	6.82018	0.03076	0.028	95.7	476.50	2.40	5.34	> 150	
27	DF80-35 hb	12922-17	16.69373	0.03804	0.013	35.1	477.86	8.90	10.10	> 150	
27	DF80-35 hb	12922-09	6.86422	0.03355	0.027	78.6	485.42	3.09	5.75	> 150	
27	DF80-35-A hb	14642-01A	5.76287	0.02026	0.068	26.2	18.40	0.47	0.51	> 150	
27	DF80-35-A hb	14642-09A	6.93335	0.02	0.012	37.2	28.46	1.08	1.11	> 150	
27	DF80-35-A hb	14642-12A	7.07841	0.02667	0.077	28.2	9.10	0.26	0.28	> 150	
27	DF80-35-A hb	14642-13A	4.05952	0.02807	0.112	3.7	2.49	0.48	0.48	> 150	
27	DF80-35-A hb	14642-15A	5.84072	0.02215	0.159	3.8	3.08	0.55	0.55	> 150	
27	DF80-35-A hb	14642-26A	1.85191	0.01086	0.016	73.9	155.76	1.23	1.98	> 150	
27	DF80-35-A hb	14642-23A	2.3691	0.01802	0.064	71.4	111.83	0.62	1.28	> 150	
27	DF80-35-A hb	14642-	3.04818	0.02436	0.042	29.1	15.06	0.51	0.53	> 150	

27	DF80-35-A hb	25A 14642-16A	4.3096	0.01769	0.06	2.2	0.78	0.39	0.39	> 150	
27	DF80-35-A hb	14642-18A	4.35134	0.02781	0.148	15.9	5.34	0.26	0.27	> 150	
27	DF80-35-A hb	14642-20A	5.32605	0.02073	0.071	8.5	2.25	0.30	0.30	> 150	
28	DF80-20 hb	12686-11	9.25028	-0.14469	0.01	10	31.00	13.91	13.92	> 150	8
28	DF80-20 hb	12686-08	13.68731	0.09943	0.036	56.9	126.15	4.61	4.78	> 150	
28	DF80-20 hb	12686-14	5.45543	-0.05761	0.009	31.3	243.96	15.50	15.69	> 150	
28	DF80-20 hb	12686-04	18.01687	0.00466	0.091	97.1	476.95	2.33	5.31	> 150	
28	DF80-20 hb	12686-13	14.61673	-0.07042	0.019	71.3	504.20	7.36	8.92	> 150	
28	DF80-20 hb	12686-16	13.10768	0.02205	0.042	72.2	372.94	4.31	5.70	> 150	
28	DF80-20 hb	12686-19	25.01592	-0.05136	0.016	78.1	362.89	6.95	7.84	> 150	
28	DF80-20 hb	12686-22	23.52487	0.04813	0.052	92.2	363.12	2.93	4.67	> 150	

Chapter 3. Appendix C. $^{40}Ar/^{39}Ar$ biotite data. $^{40}Ar/^{39}Ar$ analyses were performed at L-DEO's AGES lab.

Core ID	Sample Name	Run ID Number	Ca/K	Cl/K	Mol 39Ar	%40Ar*	Age	Internal Error	± Age	Size Fraction	n
1	IWSOE68-11	14644-01A	0.03237	0.00528	0.018	94.5	190.53	0.90	2.11	> 150	11
1	IWSOE68-11	14644-02A	0.14233	0.0234	0.005	97.3	977.35	5.38	11.16	> 150	
1	IWSOE68-11	14644-03A	0.00629	0.01514	0.029	99.6	1010.29	2.53	10.41	> 150	
1	IWSOE68-11	14644-04A	0.04287	0.00666	0.3	99.3	347.72	0.68	3.54	> 150	
1	IWSOE68-11	14644-06A	0.05198	0.02581	0.012	96.4	914.61	3.86	9.93	> 150	
1	IWSOE68-11	14644-07A	0.07402	0.02255	0.039	99.4	1040.81	2.47	10.70	> 150	
1	IWSOE68-11	14644-08A	0.17528	0.0086	0.013	54.7	114.39	1.50	1.89	> 150	
1	IWSOE68-11	14644-09A	0.08305	0.03211	0.014	99.7	1110.68	3.92	11.78	> 150	
1	IWSOE68-11	14644-10A	0.1087	0.03181	0.023	98.3	615.74	1.98	6.47	> 150	
1	IWSOE68-11	14644-11A	0.39126	0.08533	0.005	46.2	196.20	3.65	4.15	> 150	
1	IWSOE68-11	14644-12A	0.01342	0.01367	0.041	99	969.19	2.41	9.99	> 150	
2	IWSOE 68 G8	no biotites									
3	IWSOE 70 2-22-1	no biotites									
4	IWSOE 69 G17 bio	14647-04A	0.15994	0.04311	0.003	84.7	585.06	6.84	9.00	> 150	13
4	IWSOE 69 G17 bio	14647-01A	0.06945	0.02946	0.02	97.4	977.76	3.23	10.30	> 150	
4	IWSOE 69 G17 bio	14647-11A	0.20436	0.07502	0.005	97	1003.31	6.38	11.89	> 150	
4	IWSOE 69 G17 bio	14647-10A	0.08626	0.0397	0.014	99.4	1018.15	3.81	10.87	> 150	
4	IWSOE 69 G17 bio	14647-03A	0.13739	0.04697	0.008	99.3	1025.81	4.52	11.21	> 150	
4	IWSOE 69 G17 bio	14647-08A	0.02298	0.01232	0.074	100	1030.45	2.12	10.52	> 150	
4	IWSOE 69 G17 bio	14647-14A	0.1297	0.0259	0.01	99.3	1032.24	4.27	11.17	> 150	
4	IWSOE 69 G17 bio	14647-12A	0.14051	0.06493	0.006	99.8	1037.40	5.03	11.53	> 150	
4	IWSOE 69 G17 bio	14647-13A	0.10788	0.06017	0.005	99.5	1038.12	5.97	11.98	> 150	
4	IWSOE 69 G17 bio	14647-09A	0.06147	0.029	0.017	99.8	1060.29	3.93	11.31	> 150	
4	IWSOE 69 G17 bio	14647-07A	0.08085	0.03728	0.006	99.7	1061.27	5.01	11.73	> 150	
4	IWSOE 69 G17 bio	14647-15A	0.16202	0.0203	0.011	99.6	1063.58	4.61	11.59	> 150	
4	IWSOE 69 G17 bio	14647-05A	0.26615	0.04686	0.006	99.5	1064.51	5.86	12.15	> 150	

5	IWSOE69 G21 bio	14306-10	0.01963	0.01496	0.042	96.4	160.80	3.27	0.57	> 150	9
5	IWSOE69 G21 bio	14306-04	0.03594	0.01614	0.091	99.7	544.32	10.94	1.11	> 150	
5	IWSOE69 G21 bio	14306-03	0.24926	0.00411	0.207	99.3	587.17	11.78	0.96	> 150	
5	IWSOE69 G21 bio	14306-01	0.03461	0.01323	0.071	99.6	928.85	18.67	1.81	> 150	
5	IWSOE69 G21 bio	14306-08	0.04168	0.00536	0.251	99.9	938.98	18.83	1.36	> 150	
5	IWSOE69 G21 bio	14306-05	0.25879	0.01217	0.065	99.8	947.31	19.04	1.87	> 150	
5	IWSOE69 G21 bio	14306-09	0.0123	0.01202	0.046	99.7	957.18	19.26	2.11	> 150	
5	IWSOE69 G21 bio	14306-02	0.16761	0.03228	0.021	95.6	975.03	19.73	3.03	> 150	
5	IWSOE69 G21 bio	14306-07	0.04053	0.02231	0.016	99.4	998.74	20.25	3.32	> 150	
6	IWSOE68-13	14645-14A	0.37655	0.08911	0.001	49.6	250.59	14.34	14.55	> 150	
6	IWSOE68-13	14645-09A	0.02149	0.04647	0.008	97.9	467.14	2.96	5.53	> 150	
6	IWSOE68-13	14645-19A	8.09897	0.06062	0.004	86.4	479.99	4.47	6.56	> 150	17
6	IWSOE68-13	14645-05A	0.07873	0.02522	0.019	92.4	886.25	3.27	9.45	> 150	
6	IWSOE68-13	14645-07A	0.31831	0.01705	0.035	98	942.66	2.35	9.72	> 150	
6	IWSOE68-13	14645-11A	0.63143	0.02759	0.024	98.7	964.63	2.87	10.07	> 150	
6	IWSOE68-13	14645-12A	0.01169	0.012	0.082	99.2	966.69	1.79	9.83	> 150	
6	IWSOE68-13	14645-10A	0.01696	0.02016	0.031	98.1	967.73	2.75	10.06	> 150	
6	IWSOE68-13	14645-02A	0.02383	0.0241	0.03	99.6	968.25	2.57	10.02	> 150	
6	IWSOE68-13	14645-03A	0.07091	0.06124	0.008	94.7	973.76	4.85	10.88	> 150	
6	IWSOE68-13	14645-08A	0.03293	0.04364	0.018	99.1	978.91	3.12	10.27	> 150	
6	IWSOE68-13	14645-16A	0.02842	0.0144	0.053	96.6	979.92	2.18	10.04	> 150	
6	IWSOE68-13	14645-17A	0.0251	0.02788	0.026	99.8	1006.37	2.94	10.49	> 150	
6	IWSOE68-13	14645-04A	0.26348	0.01368	0.067	99.2	1009.59	2.05	10.30	> 150	
6	IWSOE68-13	14645-15A	0.02609	0.01488	0.046	99.7	1015.22	2.54	10.47	> 150	
6	IWSOE68-13	14645-18A	0.03429	0.02168	0.025	98.6	1021.84	3.12	10.68	> 150	
6	IWSOE68-13	14645-06A	0.0469	0.01777	0.036	98.6	1031.45	2.49	10.61	> 150	
7	IWSOE70 03-11-03 228-230 bio	14316-04	0.03661	0.07245	0.002	91.9	352.11	10.80	8.19	> 150	4
7	IWSOE70 03-11-03 228-230 bio	14316-06	0.354	0.01338	0.063	92.3	479.26	9.68	1.35	> 150	
7	IWSOE70 03-11-03 228-230 bio	14316-01	0.03314	0.00636	0.139	99.7	484.24	9.73	0.93	> 150	
7	IWSOE70 03-11-03 228-230 bio	14316-03	0.01246	0.01469	0.053	99.8	1009.97	20.32	2.20	> 150	

8	IO 1578-27 bio	14310-01	0.02369	0.00793	0.035	57.3	153.74	3.33	1.27	> 150	19
8	IO 1578-27 bio	14310-09	0.0233	0.01159	0.044	93.9	211.26	4.28	0.68	> 150	
8	IO 1578-27 bio	14310-04	0.05301	-0.02889	0.059	19.4	250.95	8.84	7.28	> 150	
8	IO 1578-27 bio	14310-15	0.00951	-0.09074	0.078	12	310.23	16.29	15.07	> 150	
8	IO 1578-27 bio	14310-03	0.00693	0.00685	0.12	97.5	386.09	7.77	0.82	> 150	
8	IO 1578-27 bio	14310-08	0.01575	0.00927	0.046	99.9	413.33	8.35	1.16	> 150	
8	IO 1578-27 bio	14310-19	0.00779	0.04546	0.016	99.3	422.07	8.67	1.98	> 150	
8	IO 1578-27 bio	14310-21	0.07053	0.01963	0.025	98.2	428.29	8.70	1.50	> 150	
8	IO 1578-27 bio	14310-05	0.19341	0.00777	0.096	98.6	429.39	8.64	0.98	> 150	
8	IO 1578-27 bio	14310-14	0.00423	0.01039	0.14	92.3	434.61	8.76	1.06	> 150	
8	IO 1578-27 bio	14310-18	0.00754	0.00378	0.204	99.8	441.13	8.86	0.83	> 150	
8	IO 1578-27 bio	14310-25	0.01371	0.01501	0.033	99.6	450.03	9.11	1.39	> 150	
8	IO 1578-27 bio	14310-11	0.00764	0.01484	0.063	98.8	452.25	9.11	1.08	> 150	
8	IO 1578-27 bio	14310-12	0.00794	0.01188	0.083	99.4	458.33	9.23	1.10	> 150	
8	IO 1578-27 bio	14310-24	0.00414	0.01804	0.027	81.9	470.70	9.60	1.90	> 150	
8	IO 1578-27 bio	14310-20	0.00791	0.02239	0.027	99.5	472.50	9.58	1.54	> 150	
8	IO 1578-27 bio	14310-07	0.00831	0.01125	0.107	99.5	475.33	9.56	0.97	> 150	
8	IO 1578-27 bio	14310-06	0.00686	0.00421	0.134	99.3	502.19	10.10	1.02	> 150	
8	IO 1578-27 bio	14310-16	0.00698	0.0081	0.079	99.7	566.81	11.41	1.27	> 150	
9	IO 1578-28 bio	14308-03	0.22586	0.01394	0.046	78.4	155.96	3.21	0.75	> 150	8
9	IO 1578-28 bio	14308-05	2.73923	0.11284	0.002	22.1	204.39	9.84	8.95	> 150	
9	IO 1578-28 bio	14308-01	1.06155	0.00796	0.037	80	219.86	4.53	1.07	> 150	
9	IO 1578-28 bio	14308-02	0.14462	0.03001	0.005	74.6	235.67	5.53	2.89	> 150	
9	IO 1578-28 bio	14308-09	0.02853	0.02378	0.021	99.7	487.02	9.89	1.72	> 150	
9	IO 1578-28 bio	14308-07	0.0295	0.0088	0.035	97.5	494.21	9.99	1.48	> 150	
9	IO 1578-28 bio	14308-04	0.01646	0.02192	0.036	98.7	1179.47	23.76	2.83	> 150	
9	IO 1578-28 bio	14308-08	0.07114	0.01489	0.039	98.9	1951.90	39.23	3.90	> 150	
10	IWSOE70 3/17/2	14646-01A	0.00619	0.00783	0.225	100	1249.25	1.87	12.63	> 150	27
10	IWSOE70 3/17/2	14646-02A	0.10191	0.01478	0.037	99.9	2755.06	4.54	27.92	> 150	
10	IWSOE70 3/17/2	14646-03A	0.01888	0.01864	0.086	99.9	480.41	1.14	4.94	> 150	
10	IWSOE70 3/17/2	14646-04A	0.10224	0.03463	0.019	99.9	2891.78	6.78	29.70	> 150	
10	IWSOE70 3/17/2	14646-05A	0.14367	0.01506	0.055	99.9	2772.88	3.99	28.01	> 150	
10	IWSOE 70 3/17/2 bio	14646-24A	0.09701	0.05523	0.01	95.4	393.51	2.27	4.54	> 150	
10	IWSOE 70 3/17/2 bio	14646-10A	-0.08851	0.0017	0.007	95.8	412.70	2.81	4.99	> 150	

10	IWSOE 70 3/17/2 bio	14646-07A	0.09301	0.04443	0.009	93.4	427.71	2.51	4.96	> 150	
10	IWSOE 70 3/17/2 bio	14646-15A	0.13695	0.0146	0.002	95.1	432.98	5.80	7.24	> 150	
10	IWSOE 70 3/17/2 bio	14646-11A	0.01043	0.02675	0.035	99.4	447.49	1.36	4.68	> 150	
10	IWSOE 70 3/17/2 bio	14646-26A	0.08481	0.03548	0.009	97.3	450.66	2.44	5.12	> 150	
10	IWSOE 70 3/17/2 bio	14646-18A	0.12118	0.04906	0.012	96.3	453.13	2.07	4.98	> 150	
10	IWSOE 70 3/17/2 bio	14646-22A	0.18044	0.03823	0.012	97.1	464.01	1.94	5.03	> 150	
10	IWSOE 70 3/17/2 bio	14646-13A	0.00325	0.00979	0.015	98.9	468.05	1.96	5.07	> 150	
10	IWSOE 70 3/17/2 bio	14646-17A	0.01741	0.01108	0.076	99.7	469.23	1.09	4.82	> 150	
10	IWSOE 70 3/17/2 bio	14646-21A	0.06899	0.02628	0.019	98.5	513.20	1.95	5.49	> 150	
10	IWSOE 70 3/17/2 bio	14646-27A	0.0383	0.01332	0.013	99.1	515.87	2.12	5.58	> 150	
10	IWSOE 70 3/17/2 bio	14646-12A	0.0506	0.02434	0.021	79.2	727.20	3.25	7.96	> 150	
10	IWSOE 70 3/17/2 bio	14646-14A	0.12702	0.0306	0.008	76.1	895.97	5.20	10.36	> 150	
10	IWSOE 70 3/17/2 bio	14646-23A	0.05805	0.01497	0.146	99.9	1151.92	2.20	11.73	> 150	
10	IWSOE 70 3/17/2 bio	14646-09A	0.04517	-0.04995	0.001	93.2	1505.37	33.84	37.04	> 150	
10	IWSOE 70 3/17/2 bio	14646-16A	0.04147	0.02836	0.014	99.9	1927.79	6.23	20.26	> 150	
10	IWSOE 70 3/17/2 bio	14646-06A	0.13988	0.02401	0.018	99.4	2306.89	6.11	23.86	> 150	
10	IWSOE 70 3/17/2 bio	14646-08A	0.24984	0.02968	0.019	96.9	2397.32	5.96	24.70	> 150	
10	IWSOE 70 3/17/2 bio	14646-19A	0.2127	0.00586	0.199	100	2556.16	3.60	25.81	> 150	
10	IWSOE 70 3/17/2 bio	14646-20A	0.1441	0.07994	0.004	99.5	2663.99	14.46	30.31	> 150	
10	IWSOE 70 3/17/2 bio	14646-25A	0.25517	0.00569	0.405	99.9	2697.52	3.84	27.25	> 150	
11	IO 1578-16 128-130 bio	14314-24	0.13402	0.06138	0.005	84.9	61.75	3.03	2.76	> 150	22
11	IO 1578-16 128-130 bio	14314-07	0.07785	0.03491	0.02	96.9	405.38	8.25	1.55	> 150	
11	IO 1578-16 128-130 bio	14314-06	0.00715	0.01053	0.045	98.8	421.11	8.50	1.16	> 150	
11	IO 1578-16 128-130 bio	14314-17	0.00963	0.02119	0.009	95.4	422.06	8.85	2.65	> 150	
11	IO 1578-16 128-130 bio	14314-04	0.00572	0.01917	0.034	99.6	440.79	8.92	1.33	> 150	
11	IO 1578-16 128-130 bio	14314-19	0.01594	0.01289	0.035	100	444.72	8.99	1.28	> 150	
11	IO 1578-16 128-130 bio	14314-15	0.04899	0.01203	0.029	99.7	447.85	9.07	1.40	> 150	
11	IO 1578-16 128-130 bio	14314-14	0.02893	0.01036	0.055	92.7	449.71	9.08	1.25	> 150	
11	IO 1578-16 128-130 bio	14314-23	0.00394	0.02047	0.02	99.9	453.83	9.25	1.76	> 150	
11	IO 1578-16 128-130 bio	14314-13	0.05419	0.02235	0.025	99.5	458.22	9.29	1.50	> 150	
11	IO 1578-16 128-130 bio	14314-02	0.01898	0.01467	0.03	98.9	460.17	9.33	1.55	> 150	
11	IO 1578-16 128-130 bio	14314-08	0.02231	0.02024	0.021	99.7	461.61	9.38	1.63	> 150	
11	IO 1578-16 128-130 bio	14314-12	0.009	0.01912	0.019	98.8	463.28	9.48	2.00	> 150	
11	IO 1578-16 128-130 bio	14314-21	0.15384	0.02793	0.017	96.4	464.42	9.49	1.95	> 150	
11	IO 1578-16 128-130 bio	14314-05	0.00651	0.00751	0.06	99.3	464.98	9.38	1.23	> 150	

11	IO 1578-16 128-130 bio	14314-01	0.01216	0.0268	0.013	99.5	467.77	9.62	2.23	> 150	
11	IO 1578-16 128-130 bio	14314-11	0.00918	0.01307	0.028	99.7	470.10	9.53	1.57	> 150	
11	IO 1578-16 128-130 bio	14314-22	0.04692	0.03416	0.01	97.7	478.57	9.87	2.41	> 150	
11	IO 1578-16 128-130 bio	14314-10	0.00472	0.01527	0.13	99.7	502.45	10.10	1.02	> 150	
11	IO 1578-16 128-130 bio	14314-09	0.04036	0.0227	0.02	99.4	535.80	10.91	2.05	> 150	
11	IO 1578-16 128-130 bio	14314-20	0.06287	0.00888	0.072	99.3	1822.48	36.58	3.14	> 150	
11	IO 1578-16 130-132 bio	14317-01	0.0071	0.01315	0.064	99.5	487.57	9.83	1.21	> 150	
12	IWSOE70 3-18-01 bio	14303-04	0.00128	0.01445	0.05	100	450.92	9.08	1.08	> 150	27
12	IWSOE70 3-18-01 bio	14303-09	0.00755	0.01904	0.04	99.8	452.41	9.14	1.28	> 150	
12	IWSOE70 3-18-01 bio	14303-13	2.78302	0.03141	0.018	98.1	486.17	9.93	2.02	> 150	
12	IWSOE70 3-18-01 bio	14303-20	0.01151	0.01643	0.026	99.5	524.27	10.63	1.74	> 150	
12	IWSOE70 3-18-01 bio	14303-27	0.07723	0.02596	0.009	97.8	593.05	12.27	3.14	> 150	
12	IWSOE70 3-18-01 bio	14303-03	0.01344	0.04258	0.007	81.3	761.55	15.94	4.70	> 150	
12	IWSOE70 3-18-01 bio	14303-05	0.43188	0.09904	0.004	70.7	1033.51	22.52	8.93	> 150	
12	IWSOE70 3-18-01 bio	14303-11	0.06499	0.03643	0.018	99.1	1070.08	21.63	3.12	> 150	
12	IWSOE70 3-18-01 bio	14303-18	0.00587	0.01204	0.118	99.8	1119.71	22.47	1.86	> 150	
12	IWSOE70 3-18-01 bio	14303-30	0.10544	0.15588	0.001	90.4	1220.28	33.59	23.08	> 150	
12	IWSOE70 3-18-01 bio	14303-19	0.02825	0.01028	0.02	99.5	2513.53	50.60	5.78	> 150	
12	IWSOE70 3-18-01 bio	14303-21	0.02029	0.00326	0.627	100	2545.66	51.04	3.63	> 150	
12	IWSOE70 3-18-01 bio	14303-12	0.01554	0.01856	0.018	99.9	2550.23	51.34	5.89	> 150	
12	IWSOE70 3-18-01 bio	14303-10	0.0442	0.01227	0.04	99.9	2599.11	52.16	4.28	> 150	
12	IWSOE70 3-18-01 bio	14303-08	0.00829	0.01181	0.046	99.8	2601.31	52.17	3.89	> 150	
12	IWSOE70 3-18-01 bio	14303-17	0.13125	0.01069	0.038	100	2617.48	52.54	4.42	> 150	
12	IWSOE70 3-18-01 bio	14303-26	0.06351	0.01123	0.026	99.7	2631.71	52.87	5.03	> 150	
12	IWSOE70 3-18-01 bio	14303-01	0.00484	0.00389	0.122	100	2642.48	52.94	3.17	> 150	
12	IWSOE70 3-18-01 bio	14303-24	0.28952	0.05378	0.01	99.8	2653.42	53.62	7.67	> 150	
12	IWSOE70 3-18-01 bio	14303-02	0.05354	0.01304	0.03	99.8	2655.73	53.35	4.99	> 150	
12	IWSOE70 3-18-01 bio	14303-28	0.00957	0.02241	0.022	100	2677.50	53.83	5.47	> 150	
12	IWSOE70 3-18-01 bio	14303-31	0.01084	0.02798	0.019	99.9	2682.16	54.05	6.62	> 150	
12	IWSOE70 3-18-01 bio	14303-07	0.00083	0.00667	0.074	100	2707.64	54.29	3.86	> 150	
12	IWSOE70 3-18-01 bio	14303-14	0.02308	0.01239	0.058	100	2714.68	54.43	3.78	> 150	
12	IWSOE70 3-18-01 bio	14303-06	0.00991	0.01339	0.023	100	2729.96	54.94	6.10	> 150	
12	IWSOE70 3-18-01 bio	14303-23	0.02738	0.0157	0.035	99.8	2806.35	56.34	4.89	> 150	
12	IWSOE70 3-18-01 bio	14303-15	0.03908	0.01448	0.027	100	2828.55	56.80	5.04	> 150	

13	IO 1277-41	no biotites									
14	IO 1277-23 887-889 bio	14312-30	0.03559	0.00963	0.045	95.4	257.66	5.23	0.90	> 150	29
14	IO 1277-23 887-889 bio	14312-24	0.01684	0.01854	0.039	97.3	264.10	5.35	0.84	> 150	
14	IO 1277-23 887-889 bio	14312-23	0.03215	0.01421	0.036	97.1	329.59	6.67	1.05	> 150	
14	IO 1277-23 887-889 bio	14312-21	0.01467	0.00934	0.047	98.9	395.96	7.99	1.08	> 150	
14	IO 1277-23 887-889 bio	14312-02	0.0149	0.00952	0.04	97.5	403.06	8.16	1.25	> 150	
14	IO 1277-23 887-889 bio	14312-19	0.11518	0.01955	0.012	98.1	414.86	8.56	2.12	> 150	
14	IO 1277-23 887-889 bio	14312-28	0.05646	0.01882	0.044	99.2	415.84	8.39	1.11	> 150	
14	IO 1277-23 887-889 bio	14312-01	0.02742	0.01085	0.063	99.7	420.77	8.47	1.00	> 150	
14	IO 1277-23 887-889 bio	14312-10	0.00736	0.01219	0.038	97	420.99	8.51	1.26	> 150	
14	IO 1277-23 887-889 bio	14312-17	0.00514	0.00825	0.111	99.7	422.86	8.51	0.96	> 150	
14	IO 1277-23 887-889 bio	14312-14	0.04342	0.00751	0.048	99.4	423.29	8.55	1.17	> 150	
14	IO 1277-23 887-889 bio	14312-22	0.0113	0.02364	0.015	99.3	429.06	8.80	1.96	> 150	
14	IO 1277-23 887-889 bio	14312-27	0.0394	0.01817	0.051	99.8	430.35	8.67	1.03	> 150	
14	IO 1277-23 887-889 bio	14312-25	0.00907	0.01683	0.041	99.1	431.30	8.71	1.19	> 150	
14	IO 1277-23 887-889 bio	14312-26	0.05916	0.01236	0.056	99.1	439.35	8.85	1.06	> 150	
14	IO 1277-23 887-889 bio	14312-04	0.01285	0.02404	0.029	99	444.44	9.02	1.50	> 150	
14	IO 1277-23 887-889 bio	14312-06	0.00255	0.01156	0.069	99.9	446.31	8.99	1.03	> 150	
14	IO 1277-23 887-889 bio	14312-29	0.01497	0.01435	0.027	99.2	446.57	9.08	1.63	> 150	
14	IO 1277-23 887-889 bio	14312-16	0.00796	0.01614	0.025	99.8	449.93	9.15	1.65	> 150	
14	IO 1277-23 887-889 bio	14312-15	0.01596	0.01314	0.033	99.6	451.84	9.14	1.38	> 150	
14	IO 1277-23 887-889 bio	14312-18	0.00149	0.02294	0.031	99.8	452.61	9.15	1.33	> 150	
14	IO 1277-23 887-889 bio	14312-13	0.0091	0.01447	0.026	100	455.43	9.24	1.57	> 150	
14	IO 1277-23 887-889 bio	14312-05	0.01885	0.00446	0.034	99.6	457.21	9.24	1.34	> 150	
14	IO 1277-23 887-889 bio	14312-11	0.00966	0.01499	0.046	99.7	457.31	9.23	1.22	> 150	
14	IO 1277-23 887-889 bio	14312-12	0.01124	0.01218	0.044	98	470.14	9.50	1.38	> 150	
14	IO 1277-23 887-889 bio	14312-03	0.04249	0.00758	0.052	99.5	492.07	9.92	1.21	> 150	
14	IO 1277-23 887-889 bio	14312-09	0.00387	0.01252	0.371	99.7	494.44	9.93	0.86	> 150	
14	IO 1277-23 887-889 bio	14312-07	0.00653	0.01111	0.046	99.7	554.87	11.18	1.34	> 150	
14	IO 1277-23 887-889 bio	14312-20	0.02253	0.00966	0.072	98.9	720.75	14.50	1.60	> 150	
15	JPC 40 2240 bio	14653-07A	0.05903	0.00535	1.105	99.2	449.51	0.93	4.59	> 150	
15	JPC 40 2245 bio	14652-10A	0.01057	0.00717	0.157	94.8	497.05	1.24	5.12	> 150	
15	JPC 40 2240 bio	14653-02A	0.01079	0.01461	0.143	99.5	503.08	1.06	5.14	> 150	
15	JPC 40 2245 bio	14652-04A	0.00689	0.00844	0.358	99.5	503.87	1.06	5.15	> 150	

15	JPC 40 2370 bio	14654-01A	0.17873	0.02039	0.155	99.4	504.47	1.17	5.18	> 150	
15	JPC 40 2240 bio	14653-05A	0.03769	0.00733	0.358	99.7	510.54	1.07	5.22	> 150	
15	JPC 40 2240 bio	14653-08A	0.0037	0.03805	0.73	99.7	519.73	1.08	5.31	> 150	
15	JPC 40 2240 bio	14653-01A	0.14411	0.0062	0.183	98.8	520.28	1.10	5.32	> 150	
15	JPC 40 2370 bio	14654-09A	0.01121	0.00908	0.179	99	525.56	1.19	5.39	> 150	
15	JPC 40 2245 bio	14652-11A	0.012	0.00788	0.167	99	527.20	1.17	5.40	> 150	
15	JPC 40 2245 bio	14652-02A	0.0077	0.00812	0.144	98.8	528.48	1.18	5.42	> 150	
15	JPC 40 2245 bio	14652-08A	0.15406	0.01271	0.087	94.9	528.49	1.38	5.46	> 150	
15	JPC 40 2245 bio	14652-03A	0.01297	0.01292	0.185	99	530.66	1.16	5.43	> 150	
15	JPC 40 2370 bio	14654-08A	0.59466	0.00797	0.223	99.8	538.17	1.15	5.50	> 150	
15	JPC 40 2370 bio	14654-10A	0.0599	0.00982	0.319	99.5	548.47	1.11	5.60	> 150	
15	JPC 40 2245 bio	14652-01A	0.22143	0.00937	0.133	98.6	553.77	1.17	5.66	> 150	
15	JPC 40 2240 bio	14653-09A	0.01191	0.0096	0.194	99.4	560.72	1.20	5.73	> 150	
15	JPC 40 2370 bio	14654-04A	0.06666	0.01565	0.046	97.8	564.52	1.98	5.98	> 150	
15	JPC 40 2370 bio	14654-05A	0.01204	0.00734	0.131	99.2	582.53	1.41	5.99	> 150	
15	JPC 40 2370 bio	14654-11A	0.03983	0.01385	0.119	99.4	583.81	1.26	5.97	> 150	
15	JPC 40 2370 bio	14654-07A	0.20377	0.01084	0.325	97.8	617.44	1.38	6.33	> 150	
15	JPC 40 2245 bio	14652-09A	0.12264	0.00739	0.164	99.5	670.50	1.36	6.84	> 150	
15	JPC 40 2370 bio	14654-03A	0.26895	0.00896	0.193	99.9	784.04	1.50	7.98	> 150	
15	JPC 40 2370 bio	14654-06A	0.01486	0.01048	0.215	99.8	1093.08	1.97	11.11	> 150	
15	JPC 40 2370 bio	14654-02A	0.01937	0.00507	0.225	99.7	1492.78	2.54	15.14	> 150	
16	ELP-01 bio	13548-01	0.00086	-0.00003	0.691	99.5	507.43	3.82	6.35	> 150	145
16	ELP-01 bio	13548-02	-0.01341	-0.00039	0.385	99.4	1404.56	9.13	16.75	> 150	
16	ELP-01 bio	13548-03	0.10925	0.00212	2.915	98.6	1072.45	8.27	13.54	> 150	
16	ELP-01 bio	13548-04	0.00104	0.00033	3.249	99.8	1140.02	7.36	13.57	> 150	
16	ELP-01 bio	13548-05	0.00413	0.00201	0.612	98.6	523.69	4.09	6.65	> 150	
16	ELP-01 bio	13548-06	0.00293	0.01147	4.336	99.3	481.52	4.03	6.28	> 150	
16	ELP-01 bio	13548-07	8.0996	0.03579	0.115	98	939.97	7.23	11.86	> 150	
16	ELP-01 bio	13548-08	0.00167	0.0028	1.982	99.8	466.86	3.60	5.90	> 150	
16	ELP-01 bio	13548-09	0.00266	0.01164	1.417	99.9	1659.91	10.54	19.66	> 150	
16	ELP-01 bio	13548-10	0.02249	0.00555	0.972	98.3	722.00	5.69	9.19	> 150	
16	ELP-01 bio	13548-11	-0.00793	0.00981	0.303	99.2	1110.88	8.65	14.08	> 150	
16	ELP-01 bio	13548-12	0.00401	0.0035	0.602	98.4	1009.93	7.02	12.30	> 150	
16	ELP-01 bio	13548-13	-0.0021	-0.01121	0.079	99.8	1156.17	8.18	14.17	> 150	
16	ELP-01 bio	13548-14	0.01242	-0.00567	0.323	99.5	1058.82	7.05	12.72	> 150	

16	ELP-01 bio	13548-15	1.35936	0.00457	1.315	95.3	798.25	6.68	10.41	> 150
16	ELP-01 bio	13548-16	0.00986	0.00399	0.892	99.5	447.27	2.19	4.98	> 150
16	ELP-01 bio	13548-17	0.01871	0.00469	1.076	64	224.86	3.63	4.27	> 150
16	ELP-01 bio	13548-18	0.00873	0.00452	0.401	99.4	997.12	4.35	10.88	> 150
16	ELP-01 bio	13548-19	0.00102	0.0102	0.438	99.4	568.87	3.22	6.54	> 150
16	ELP-01 bio	13548-20	0.04174	0.00276	3.493	99.3	454.85	2.70	5.29	> 150
16	ELP-01 bio	13548-21	0.04196	0.00618	1.336	99.1	506.50	2.73	5.75	> 150
16	ELP-01 bio	13548-22	-0.00127	0.00524	0.77	99.9	1130.45	4.72	12.25	> 150
16	ELP-01 bio	13548-23	0.00133	0.00219	0.449	99	475.73	3.00	5.62	> 150
16	ELP-01 bio	13548-24	0.01142	0.00526	0.204	99.4	1147.07	5.32	12.64	> 150
16	ELP-01 bio	13548-25	-0.00687	0.01097	0.952	99.6	503.33	2.47	5.61	> 150
16	ELP-01 bio	13548-26	-0.01343	0.00608	0.481	99.5	510.70	3.01	5.93	> 150
16	ELP-01 bio	13548-27	0.00243	0.00783	0.72	99.5	1144.37	5.10	12.53	> 150
16	ELP-01 bio	13548-28	-0.05043	0.01002	0.088	89.3	483.94	3.87	6.20	> 150
16	ELP-01 bio	13548-29	-0.00461	0.01168	0.358	99.8	1119.95	4.76	12.17	> 150
16	ELP-01 bio	13548-31	0.00989	0.00505	0.675	83.3	343.52	3.02	4.57	> 150
16	ELP-01 bio	13548-32	-0.01971	-0.00057	0.43	99.6	1100.16	5.91	12.49	> 150
16	ELP-01 bio	13548-33	0.01485	0.00384	0.759	98.1	444.15	2.33	5.02	> 150
16	ELP-01 bio	13548-34	-0.05278	0.00796	0.082	98.3	499.95	3.36	6.03	> 150
16	ELP-01 bio	13548-35	-0.15758	0.04274	0.03	100.2	503.45	7.29	8.86	> 150
16	ELP-01 bio	13548-36	0.00767	0.00334	1.67	98.1	944.34	5.29	10.82	> 150
16	ELP-01 bio	13548-37	-0.0484	0.02062	0.122	97.6	535.07	3.27	6.27	> 150
16	ELP-01 bio	13548-38	0.02875	-0.01284	0.054	97.7	1093.03	7.39	13.19	> 150
16	ELP-01 bio	13548-39	0.06853	0.00887	0.228	56.8	220.64	4.56	5.07	> 150
16	ELP-01 bio	13548-40	0.01417	0.00414	0.169	98.7	645.95	3.59	7.39	> 150
16	ELP-01 bio	13548-41	-0.01407	0.0064	0.475	99.8	1176.76	6.07	13.24	> 150
16	ELP-01 bio	13548-42	-0.02039	0.01221	0.286	99.7	1141.40	5.04	12.48	> 150
16	ELP-02 bio	13551-01	0.00287	0.00407	2.209	96.7	515.07	4.36	6.75	> 150
16	ELP-02 bio	13551-02	0.00349	0.00412	1.971	99.4	774.58	6.01	9.81	> 150
16	ELP-02 bio	13551-03	-0.0118	0.00431	0.358	98.7	509.64	3.99	6.47	> 150
16	ELP-02 bio	13551-04	-0.01112	0.00776	0.606	99.7	915.38	6.20	11.05	> 150
16	ELP-02 bio	13551-05	0.04628	0.00103	0.825	97.9	908.72	6.78	11.34	> 150
16	ELP-02 bio	13551-06	0.02234	0.01522	0.115	99.2	508.25	5.11	7.21	> 150
16	ELP-02 bio	13551-07	0.08201	0.00893	1.403	99.7	1217.39	8.37	14.77	> 150
16	ELP-02 bio	13551-08	0.10319	0.00383	1.182	98.6	911.62	6.57	11.24	> 150
16	ELP-02 bio	13551-09	0.0235	0.00385	0.734	98.5	482.90	4.05	6.30	> 150

16	ELP-02 bio	13551-10	0.05517	0.00226	0.374	99.6	1508.11	9.97	18.08	> 150
16	ELP-02 bio	13551-11	0.08023	0.00492	1.225	99.5	1273.00	8.19	15.14	> 150
16	ELP-02 bio	13551-12	0.07386	0.00445	0.136	93.2	286.27	3.22	4.31	> 150
16	ELP-02 bio	13551-13	0.01007	0.00197	0.315	84.8	568.12	6.98	9.00	> 150
16	ELP-02 bio	13551-14	0.01367	0.00382	0.43	99	1098.27	7.32	13.20	> 150
16	ELP-02 bio	13551-15	0.0072	0.01089	3.869	99.8	1313.26	9.69	16.32	> 150
16	ELP-02 bio	13551-16	-0.0127	0.00789	0.766	99.7	963.08	4.98	10.84	> 150
16	ELP-02 bio	13551-17	-0.00269	0.00408	0.347	99.3	939.48	4.27	10.32	> 150
16	ELP-02 bio	13551-18	0.05821	0.00176	0.685	99.2	513.42	3.01	5.95	> 150
16	ELP-02 bio	13551-19	0.00229	0.00689	1.553	98.1	656.73	3.47	7.43	> 150
16	ELP-02 bio	13551-20	0.02915	0.01087	0.62	95.2	486.57	3.06	5.75	> 150
16	ELP-02 bio	13551-21	0.32719	0.00107	0.22	91.4	1256.76	7.03	14.40	> 150
16	ELP-02 bio	13551-22	0.90027	0.02056	0.092	31.3	159.05	8.11	8.27	> 150
16	ELP-02 bio	13551-23	-0.01485	0.00868	0.709	99.8	878.47	4.62	9.93	> 150
16	ELP-02 bio	13551-24	0.19459	0.00825	0.103	69.2	683.86	8.64	11.02	> 150
16	ELP-02 bio	13551-25	-0.02315	0.00602	0.273	98.6	531.12	2.91	6.06	> 150
16	ELP-02 bio	13551-26	0.01576	0.01103	0.626	94.7	431.31	2.77	5.12	> 150
16	ELP-02 bio	13551-27	0.02383	0.00392	0.432	99.1	1059.35	5.77	12.06	> 150
16	ELP-02 bio	13551-28	-0.01071	0.00883	0.224	99	493.29	3.55	6.08	> 150
16	ELP-06 bio	13560-01	0.03579	0.00014	0.272	24.5	278.80	21.43	21.61	> 150
16	ELP-06 bio	13560-02	0.00975	0.0043	0.266	95.1	524.26	4.11	6.66	> 150
16	ELP-06 bio	13560-03	-0.00176	0.00175	0.72	99.4	1109.64	5.74	12.49	> 150
16	ELP-06 bio	13560-04	0.00223	0.00442	1.794	99.5	505.61	2.85	5.81	> 150
16	ELP-06 bio	13560-05	0.01338	0.01786	1.732	99.2	519.14	2.95	5.97	> 150
16	ELP-06 bio	13560-06	0.00046	0.00538	0.646	99.7	3285.22	13.67	35.58	> 150
16	ELP-06 bio	13560-07	0.01186	0.00451	1.172	99.2	1067.11	5.72	12.11	> 150
16	ELP-06 bio	13560-08	0.00433	0.00201	2.027	99.6	1145.89	5.65	12.78	> 150
16	ELP-06 bio	13560-09	0.52025	-0.00264	0.546	90.5	918.08	7.28	11.72	> 150
16	ELP-06 bio	13560-10	-0.0031	0.00481	0.371	99.9	1150.61	6.60	13.26	> 150
16	ELP-06 bio	13560-11	-0.02697	0.00946	0.294	98.9	493.52	3.52	6.06	> 150
16	ELP-06 bio	13560-12	0.01416	0.00083	0.39	95.2	499.80	3.40	6.05	> 150
16	ELP-06 bio	13560-13	-0.00335	0.01853	0.493	92.7	487.09	3.63	6.07	> 150
16	ELP-06 bio	13560-14	-0.00127	0.00226	1.083	99.7	1041.83	5.85	11.95	> 150
16	ELP-06 bio	13560-15	0.01073	0.01023	0.323	99.8	487.96	3.37	5.93	> 150
16	ELP-06 bio	13560-16	0.01635	0.00197	3.29	99.9	1147.82	6.86	13.37	> 150
16	ELP-06 bio	13560-17	0.05165	0.00248	2.084	80.3	426.66	4.42	6.15	> 150

16	ELP-06 bio	13560-18	-0.0076	0.00752	0.373	98.2	502.99	3.36	6.05	> 150
16	ELP-06 bio	13560-19	0.03065	0.00044	0.807	89.9	497.14	3.76	6.23	> 150
16	ELP-06 bio	13560-20	-0.00029	0.01169	1.659	99.6	500.10	2.81	5.74	> 150
16	ELP-06 bio	13560-21	-0.00611	0.01142	0.487	97.6	516.54	3.01	5.98	> 150
16	ELP-06 bio	13560-22	0.05987	0.00538	0.377	69.8	239.60	3.61	4.33	> 150
16	ELP-06 bio	13560-23	0.00452	0.00822	0.524	99.3	493.84	2.70	5.63	> 150
16	ELP-06 bio	13560-24	0.00388	0.00798	0.276	48.9	66.60	2.14	2.24	> 150
16	ELP-06 bio	13560-25	-0.0095	0.00014	0.322	97.7	498.27	2.99	5.81	> 150
16	ELP-06 bio	13560-26	0.02175	0.00968	2.543	99	518.59	3.00	5.99	> 150
16	ELP-06 bio	13560-27	0.0009	-0.01101	0.203	24.8	199.06	13.21	13.36	> 150
16	ELP-06 bio	13560-28	0.00449	0.00392	0.618	99.7	836.70	4.55	9.53	> 150
16	ELP-06 bio	13560-29	-0.11361	-0.00093	0.074	99.1	528.20	3.30	6.23	> 150
16	ELP-06 bio	13560-30	-0.01041	0.01398	0.33	93	509.93	3.69	6.30	> 150
16	ELP-06 bio	13560-31	0.01164	0.00208	1.426	99.6	775.77	3.80	8.64	> 150
16	ELP-06 bio	13560-33	-0.00704	-0.00016	0.535	99	1082.27	5.78	12.27	> 150
16	ELP-06 bio	13560-34	-0.00592	0.00911	0.621	99.3	764.52	3.68	8.48	> 150
16	ELP-06 bio	13560-35	-0.00169	0.00374	4.04	99.9	894.95	5.28	10.39	> 150
16	ELP-06 bio	13560-36	0.01968	0.01191	1.251	97.7	596.63	3.31	6.82	> 150
16	ELP-06 bio	13560-37	0.01224	-0.00004	0.772	90	479.10	3.61	6.00	> 150
16	ELP-06 bio	13560-38	-0.04828	0.01207	0.085	93.6	464.34	3.66	5.91	> 150
16	ELP-06 bio	13560-40	-0.00572	0.00938	0.326	98.4	501.91	2.66	5.68	> 150
16	ELP-06 bio	13560-41	0.02196	0.00518	0.542	99.8	1147.75	4.83	12.45	> 150
16	ELP-09 bio	13568-01	-0.01652	0.00225	0.221	99.9	1217.29	2.63	12.45	> 150
16	ELP-09 bio	13568-02	0.00354	-0.00403	0.232	99.5	1199.20	2.62	12.27	> 150
16	ELP-09 bio	13568-03	0.04906	-0.00244	0.448	99.8	1354.18	2.66	13.80	> 150
16	ELP-09 bio	13568-04	0.30181	0.00354	4.572	99.7	525.95	2.22	5.71	> 150
16	ELP-09 bio	13568-05	0.0088	-0.00017	0.137	99.7	1222.83	7.43	14.31	> 150
16	ELP-09 bio	13568-07	-0.00255	0.00434	2.336	99.2	599.14	2.10	6.35	> 150
16	ELP-09 bio	13568-08	0.01109	-0.00126	0.353	98.4	573.59	1.18	5.86	> 150
16	ELP-09 bio	13568-10	0.00487	0.00749	0.477	100.2	518.54	0.92	5.27	> 150
16	ELP-09 bio	13568-11	0.00367	0.00651	0.252	100.3	527.70	1.28	5.43	> 150
16	ELP-09 bio	13568-12	0.00471	0.00615	0.704	99.7	516.71	0.82	5.23	> 150
16	ELP-09 bio	13568-13	-0.00846	0.00746	0.835	99.7	513.97	0.73	5.19	> 150
16	ELP-09 bio	13568-14	0.00597	0.00647	0.677	99.9	518.57	1.66	5.45	> 150
16	ELP-09 bio	13568-15	0.08958	0.00607	1.709	99.7	561.51	1.24	5.75	> 150
16	ELP-09 bio	13568-16	-0.0163	0.01024	0.12	97.1	519.13	2.03	5.58	> 150

16	ELP-09 bio	13568-17	-0.05456	0.01474	0.166	100	528.46	1.79	5.58	> 150	
16	ELP-09 bio	13568-18	-0.00778	0.00587	1.517	99.9	532.23	1.36	5.49	> 150	
16	ELP-09 bio	13568-20	0.00413	0.01332	0.799	99.9	532.27	0.90	5.40	> 150	
16	ELP-09 bio	13568-21	-0.0032	0.00741	0.879	99.6	519.12	0.79	5.25	> 150	
16	ELP-09 bio	13568-22	-0.01333	0.03717	0.217	99.8	533.86	2.48	5.89	> 150	
16	ELP-09 bio	13568-23	0.00325	0.00325	1.078	99.5	525.90	1.51	5.47	> 150	
16	ELP-09 bio	13568-24	1.7496	0.00067	0.287	98.2	573.71	2.18	6.14	> 150	
16	ELP-09 bio	13568-25	-0.03147	0.00544	0.236	99	528.01	1.37	5.46	> 150	
16	ELP-09 bio	13568-26	-0.00009	0.01054	0.882	99.2	527.41	1.47	5.48	> 150	
16	ELP-09 bio	13568-27	5.14894	0.08931	0.307	99.2	582.27	1.15	5.94	> 150	
16	ELP-09 bio	13568-28	-0.01798	0.00685	0.33	99.6	521.87	1.14	5.34	> 150	
16	ELP-09 bio	13568-29	-0.01345	0.00507	0.353	99.7	516.99	2.27	5.65	> 150	
16	ELP-09 bio	13568-30	0.00708	0.00486	0.391	99.6	513.39	1.82	5.45	> 150	
16	ELP-09 bio	13568-31	-0.01153	-0.00331	0.18	99.2	520.40	2.30	5.69	> 150	
16	ELP-09 bio	13568-32	0.00287	0.02875	0.131	100.7	520.09	2.95	5.98	> 150	
16	ELP-09 bio	13568-33	-0.00823	0.00428	0.389	99.7	1182.67	3.21	12.25	> 150	
16	ELP-09 bio	13568-34	-0.01202	0.00281	0.443	97.2	522.18	1.04	5.32	> 150	
16	ELP-09 bio	13568-35	-0.07805	-0.31715	0.002	56.4	580.68	37.19	37.65	> 150	
16	ELP-09 bio	13568-36	-0.01713	0.00678	0.322	99.9	530.27	0.98	5.39	> 150	
16	ELP-09 bio	13568-37	-0.03893	0.00697	0.306	98	523.43	0.96	5.32	> 150	
16	ELP-09 bio	13568-38	-0.14468	0.01073	0.05	102	535.14	3.32	6.30	> 150	
16	ELP-09 bio	13568-39	-0.11783	-0.0009	0.083	100.5	518.35	3.81	6.44	> 150	
16	ELP-09 bio	13568-40	-0.52835	0.00516	0.019	102.7	515.50	11.16	12.29	> 150	
17	JPC 34 345.5 bio	14648-01A	0.02305	0.01279	0.067	99	503.20	1.17	5.17	> 150	50
17	JPC 34 345.5 bio	14648-02A	0.05128	0.00522	0.095	57.6	383.51	2.28	4.46	> 150	
17	JPC 34 345.5 bio	14648-03A	0.05282	0.00408	0.527	99.4	479.25	0.81	4.86	> 150	
17	JPC 34 345.5 bio	14648-04A	0.00419	0.00448	0.357	99.6	506.74	0.91	5.15	> 150	
17	JPC 34 345.5 bio	14648-05A	0.0158	0.00876	0.081	98.5	488.96	1.09	5.01	> 150	
17	JPC 34 345.5 bio	14648-06A	0.0168	0.0502	0.058	99.7	525.96	1.19	5.39	> 150	
17	JPC 34 345.5 bio	14648-07A	0.0252	0.0152	0.059	98.8	457.22	1.07	4.70	> 150	
17	JPC 34 345.5 bio	14648-08A	0.00429	0.00845	0.17	98.5	490.09	0.90	4.98	> 150	
17	JPC 34 345.5 bio	14648-09A	0.01519	0.00976	0.141	99.6	499.73	0.94	5.08	> 150	
17	JPC 34 345.5 bio	14648-10A	0.01922	0.01746	0.05	97.8	473.08	1.22	4.89	> 150	
17	JPC 34 345.5 bio	14648-11A	0.0293	0.00705	0.152	97.2	482.02	0.91	4.90	> 150	
17	JPC 34 345.5 bio	14648-12A	0.02538	0.01058	0.342	81.8	480.58	1.36	4.99	> 150	

17	JPC 34 345.5 bio	14648-13A	0.02734	0.00888	0.094	87.7	399.41	1.04	4.13	> 150
17	JPC 34 345.5 bio	14648-14A	0.01915	0.0189	0.067	99.9	797.05	1.61	8.13	> 150
17	JPC 34 345.5 bio	14648-15A	0.23556	0.00818	0.164	99.9	485.61	0.85	4.93	> 150
17	JPC 34 345.5 bio	14648-16A	0.02082	0.0091	0.108	99.6	489.53	0.93	4.98	> 150
17	JPC 34 345.5 bio	14648-17A	0.00858	0.01151	0.092	99.4	510.81	1.07	5.22	> 150
17	JPC 34 345.5 bio	14648-18A	0.01639	0.01445	0.035	93.5	485.58	1.53	5.09	> 150
17	JPC 34 345.5 bio	14648-19A	0.01603	0.01594	0.066	99.7	482.31	1.03	4.93	> 150
17	JPC 34 345.5 bio	14648-20A	0.02615	0.007	0.154	99	434.80	0.80	4.42	> 150
17	JPC 34 345.5 bio	14648-21A	0.04615	0.00879	0.099	97.5	406.79	0.88	4.16	> 150
17	JPC 34 345.5 bio	14648-22A	0.00836	0.00466	0.2	94.1	492.44	1.24	5.08	> 150
17	JPC 34 345.5 bio	14648-23A	0.03108	0.01074	0.056	98.1	487.41	1.57	5.12	> 150
17	JPC 34 345.5 bio	14648-24A	0.03093	0.00596	0.18	96.8	497.59	1.14	5.11	> 150
17	JPC 34 292 bio	14649-20A	0.01544	0.0011	0.158	45.6	204.99	2.07	2.92	> 150
17	JPC 34 292 bio	14649-21A	0.01495	0.00548	0.276	98.9	492.11	1.09	5.04	> 150
17	JPC 34 292 bio	14649-22A	0.00684	0.00686	0.165	99.3	474.85	1.09	4.87	> 150
17	JPC 34 292 bio	14649-23A	0.01189	0.0139	0.086	96.9	476.79	1.27	4.93	> 150
17	JPC 34 292 bio	14649-24A	0.03204	0.00894	0.154	99.3	484.69	1.05	4.96	> 150
17	JPC 34 292 bio	14649-25A	0.01446	0.00897	0.154	89.8	498.98	1.45	5.20	> 150
17	JPC 34 292 bio	14649-26A	0.03997	0.00685	0.144	94.2	478.46	1.20	4.93	> 150
17	JPC34 292 bio	14649-01A	0.02415	0.01178	0.068	97.9	483.15	1.56	5.08	> 150
17	JPC34 292 bio	14649-02A	0.03582	0.0047	0.147	79.3	451.62	2.38	5.10	> 150
17	JPC34 292 bio	14649-03A	0.03902	0.01202	0.059	96.8	519.52	1.72	5.47	> 150
17	JPC34 292 bio	14649-04A	0.00681	0.00877	0.109	93.5	461.89	1.60	4.89	> 150
17	JPC34 292 bio	14649-05A	0.01423	0.01214	0.074	79.5	417.19	2.28	4.75	> 150
17	JPC34 292 bio	14649-06A	0.02021	0.01141	0.05	82	451.45	2.33	5.08	> 150
17	JPC34 292 bio	14649-07A	0.03709	0.01215	0.083	92.7	438.77	1.59	4.67	> 150
17	JPC34 292 bio	14649-08A	0.02456	0.0065	0.152	87.7	453.40	1.84	4.89	> 150
17	JPC34 292 bio	14649-09A	0.02637	0.01757	0.056	98.1	568.51	1.73	5.94	> 150
17	JPC34 292 bio	14649-10A	0.00833	0.01127	0.449	98.9	500.72	1.36	5.19	> 150
17	JPC34 292 bio	14649-11A	0.05262	0.02817	0.022	98.2	490.69	1.97	5.29	> 150
17	JPC34 292 bio	14649-12A	0.02361	0.01455	0.08	95.9	489.37	1.59	5.15	> 150
17	JPC34 292 bio	14649-13A	0.03093	0.01737	0.047	98.8	498.67	1.75	5.28	> 150
17	JPC34 292 bio	14649-14A	0.01815	0.01093	0.082	99.6	485.86	1.40	5.06	> 150
17	JPC34 292 bio	14649-15A	0.01956	0.01317	0.112	97.5	475.17	1.47	4.97	> 150
17	JPC34 292 bio	14649-16A	0.02841	0.00025	0.081	58	361.86	3.69	5.17	> 150
17	JPC34 292 bio	14649-17A	0.02766	0.01705	0.04	94.7	487.78	1.86	5.22	> 150

17	JPC34 292 bio	14649-18A	0.01959	0.01316	0.073	99.5	560.24	1.61	5.83	> 150	
17	JPC34 292 bio	14649-19A	0.04353	0.00743	0.144	98.5	453.78	1.32	4.73	> 150	
18	ODP188 1166A 26-1W 100-102 cm	12604-01	0.4			17	216		33		*16*
18	ODP188 1166A 26-1W 100-102 cm	12604-02	0			88	400		1		
18	ODP188 1166A 26-1W 100-102 cm	12604-03	0			91	342		1		
18	ODP188 1166A 26-1W 100-102 cm	12604-04	0			99	501		1		
18	ODP188 1166A 26-1W 100-102 cm	12604-05	0.2			94	516		3		
18	ODP188 1166A 26-1W 100-102 cm	12604-06	0.1			97	617		2		
18	ODP188 1166A 26-1W 100-102 cm	12604-07	0.2			97	529		2		
18	ODP188 1166A 26-1W 100-102 cm	12604-08	0.9			86	528		6		
18	ODP188 1166A 26-1W 100-102 cm	12604-09	0.3			95	552		2		
18	ODP188 1166A 26-1W 100-102 cm	12604-10	0.2			51	314		8		
18	ODP188 1166A 26-1W 100-102 cm	12604-11	0.1			96	499		1		
18	ODP188 1166A 26-1W 100-102 cm	12604-12	0			97	580		2		
18	ODP188 1166A 26-1W 100-102 cm	12604-13	0.2			95	560		2		
18	ODP188 1166A 26-1W 100-102 cm	12604-14	0			97	500		3		
18	ODP188 1166A 26-1W 100-102 cm	12604-16	0			202	585		52		
18	ODP188 1166A 26-1W 100-102 cm	12604-17	0.4			83	553		6		
19	JPC 25 1305 bio	14651-08A	0.04029	0.03215	0.038	93.8	477.76	1.60	5.04	> 150	14

19	JPC 25 1305 bio	14651-14A	0.12401	0.03946	0.013	83.4	481.80	2.61	5.48	> 150	
19	JPC 25 1305 bio	14651-12A	0.05736	0.02608	0.022	78.8	483.07	2.39	5.39	> 150	
19	JPC 25 1305 bio	14651-13A	0.13519	0.02507	0.017	78.2	487.67	2.65	5.55	> 150	
19	JPC 25 1305 bio	14651-05A	0.05908	0.02178	0.037	94.3	501.62	1.64	5.28	> 150	
19	JPC 25 1305 bio	14651-01A	0.04686	0.03988	0.04	98.3	502.53	1.39	5.21	> 150	
19	JPC 25 1305 bio	14651-03A	0.12078	0.0505	0.022	98.7	504.63	1.82	5.36	> 150	
19	JPC 25 1305 bio	14651-07A	0.0463	0.03857	0.024	91.6	506.94	2.04	5.46	> 150	
19	JPC 25 1305 bio	14651-06A	0.04606	0.02993	0.053	97.2	512.42	1.40	5.31	> 150	
19	JPC 25 1305 bio	14651-10A	0.11796	0.01993	0.025	99.4	526.11	1.73	5.54	> 150	
19	JPC 25 1305 bio	14651-04A	0.03053	0.024	0.036	98.9	539.25	1.71	5.66	> 150	
19	JPC 25 1305 bio	14651-11A	0.1746	0.02194	0.059	98	555.48	1.51	5.76	> 150	
19	JPC 25 1305 bio	14651-15A	0.11707	0.03477	0.009	94.4	576.45	2.84	6.43	> 150	
19	JPC 25 1305 bio	14651-02A	0.02112	0.00976	0.061	99.5	639.14	1.51	6.57	> 150	
20	ELT49-30 bio	12674-27	0.0191	0.00411	3.2	87.6	499.54	1.38	5.18	> 150	30
20	ELT49-30 bio	12674-29	0.00812	0.00719	1.637	98.2	510.41	1.29	5.27	> 150	
20	ELT49-30 bio	12674-28	0.01694	0.00451	1.677	94.2	854.75	2.03	8.79	> 150	
20	ELT49-30 bio	12674-31	0.1078	0.00026	2.784	98.8	1075.20	2.45	11.03	> 150	
20	ELT49-30 bio	12674-30	0.03331	-0.00068	1.427	99.6	1091.06	2.46	11.18	> 150	
20	ELT49-30 bio	12927-10	-0.0573	-0.01131	0.027	2	11.35	4.34	4.34	> 150	
20	ELT49-30 bio	12927-06	0.01065	0.0015	0.129	89.7	456.19	1.52	4.81	> 150	
20	ELT49-30 bio	12927-08	0.06087	0.0002	0.151	75.6	463.47	1.99	5.04	> 150	
20	ELT49-30 bio	12927-09	0.90698	0.01931	0.081	59.6	652.15	3.96	7.63	> 150	
20	ELT49-30 bio	12927-01	0.20779	0.0061	2.198	89.2	935.01	2.44	9.66	> 150	
20	ELT49-30 bio	12927-04	0.0014	0.0064	0.367	95.6	1085.08	2.25	11.08	> 150	
20	ELT49-30 bio	12927-02	0.0045	0.00142	2.803	96.9	1104.12	2.97	11.43	> 150	
20	ELT49-30 bio	12927-05	0.12393	0.00147	0.286	92.7	1111.97	2.58	11.41	> 150	
20	ELT49-30 Bio	13195-03A	0.2678	0.00404	0.644	97.5	480.13	7.30	8.73	> 150	
20	ELT49-30 Bio	13195-04A	0.57563	-0.00665	0.214	99.9	487.90	6.96	8.50	> 150	
20	ELT49-30 Bio	13195-05A	3.18496	0.03092	0.056	98.5	921.00	14.24	16.96	> 150	
20	ELT49-30 Bio	13195-06A	1.51149	0.07848	0.044	92.3	400.31	10.47	11.21	> 150	
20	ELT49-30 Bio	13195-07A	4.19708	0.00882	0.051	92.3	478.21	10.80	11.81	> 150	
20	ELT49-30 Bio	13195-08A	1.52924	0.01458	0.117	94.3	428.01	8.01	9.08	> 150	
20	ELT49-30 Bio	13195-09A	1.86067	0.03671	0.102	97.7	1065.65	14.75	18.20	> 150	
20	ELT49-30 bio 63-150	13469-10	-0.01363	0.00509	0.169	99.4	438.12	3.10	5.37	63-150	
20	ELT49-30 bio 63-150	13469-04	0.03295	0.00417	0.186	96	438.41	2.85	5.23	63-150	

20	ELT49-30 bio 63-150	13469-01	-0.19803	-0.00407	0.027	98.5	494.56	12.59	13.53	63-150	
20	ELT49-30 bio 63-150	13469-06	-0.10724	0.00632	0.071	86.3	855.80	8.22	11.87	63-150	
20	ELT49-30 bio 63-150	13469-03	4.23465	-0.1576	0.006	89.2	943.56	44.04	45.04	63-150	
20	ELT49-30 bio 63-150	13469-11	-0.03363	-0.0051	0.101	100.1	1083.44	3.93	11.52	63-150	
20	ELT49-30 bio 63-150	13469-07	-0.01664	-0.00336	0.014	100.1	1090.93	25.44	27.68	63-150	
20	ELT49-30 bio 63-150	13469-02	0.07033	0.01733	0.023	96.3	1138.72	19.30	22.40	63-150	
20	ELT49-30 bio 63-150	13469-05	-0.3537	0.01548	0.023	99.2	1195.70	20.73	23.93	63-150	
20	ELT49-30 bio 63-150	13469-09	-0.07478	-0.00133	0.092	100.2	1339.83	8.67	15.96	63-150	
21	ELT37-16 bio	12744-01	0.78351	-0.00007	2.901	99.1	1109.10	2.64	11.40	> 150	57
21	ELT37-16 bio	12744-02	0.19596	-0.00013	6.294	99.6	1115.09	3.09	11.57	> 150	
21	ELT37-16 bio	12744-03	0.00718	-0.00133	0.26	99.6	1137.77	2.37	11.62	> 150	
21	ELT37-16 bio	12744-04	0.00837	0.00057	2.255	99.8	1126.58	2.11	11.46	> 150	
21	ELT37-16 bio	12744-05	0.03913	0.00384	1.088	99.1	1117.68	2.60	11.48	> 150	
21	ELT37-16 bio	12744-06	0.06316	-0.00005	0.135	97.2	1126.77	3.56	11.82	> 150	
21	ELT37-16 bio	12744-07	0.04303	0.00514	0.512	98.6	1120.47	3.26	11.67	> 150	
21	ELT37-16 bio	12744-08	0.02158	0.00176	0.881	74.5	829.41	3.28	8.92	> 150	
21	ELT37-16 bio	12744-09	0.02949	0.00103	3.131	99.7	1146.70	2.34	11.70	> 150	
21	ELT37-16 bio	12744-10	0.03649	-0.00087	0.171	96.4	1119.21	3.16	11.63	> 150	
21	ELT37-16 bio	12744-11	0.03032	0.00238	2.05	99.7	1146.40	2.35	11.70	> 150	
21	ELT37-16 bio	12744-12	0.00762	0.00004	2.161	99.8	1141.36	2.28	11.64	> 150	
21	ELT37-16 bio	12744-13	0.01553	0.00143	0.326	99.4	1224.60	3.27	12.68	> 150	
21	ELT37-16 bio	12744-14	0.22075	0.00208	0.479	99.6	2156.93	3.82	21.90	> 150	
21	ELT37-16 bio	12744-15	0.0366	0.00523	0.222	99.2	1144.79	2.68	11.76	> 150	
21	ELT37-16 bio	12744-16	-0.013	0.00709	0.119	99.2	1106.67	3.32	11.55	> 150	
21	ELT37-16 bio	12928-01	0.00991	0.00446	0.697	99	1094.77	1.88	11.11	> 150	
21	ELT37-16 bio	12928-02	0.03699	0.00176	8.122	99.6	1144.80	3.42	11.95	> 150	
21	ELT37-16 bio	12928-03	0.02334	0.00161	8.255	99.5	1167.45	3.57	12.21	> 150	
21	ELT37-16 bio	12928-04	0.02066	0.00227	2.293	97.8	1107.49	2.56	11.37	> 150	
21	ELT37-16 bio	12928-05	0.0019	0.00095	2.939	99.4	1123.87	2.85	11.59	> 150	
21	ELT37-16 bio	12928-06	0.00294	0.00074	5.467	99.6	1102.29	4.02	11.73	> 150	
21	ELT37-16 bio	12928-07	0.29245	0.00274	3.525	99.7	1490.83	3.68	15.35	> 150	
21	ELT37-16 bio	12928-08	0.03367	0.00206	3.402	99.2	1141.51	2.93	11.79	> 150	
21	ELT37-16 bio	12928-09	-0.1358	0.05578	0.004	57	1265.44	37.17	39.27	> 150	
21	ELT37-16 bio	12928-10	0.01568	0.00235	2.992	98.9	1113.06	2.51	11.41	> 150	
21	ELT37-16 bio	12928-11	0.01372	0.00064	0.05	47	1111.21	8.36	13.91	> 150	

21	ELT37-16 bio	12928-12	48.9179	0.02073	0.083	89.3	1230.36	3.71	12.85	> 150
21	ELT37-16 bio	12928-13	0.00183	0.00193	11.52	99.8	1150.86	3.21	11.95	> 150
21	ELT37-16 bio	12928-14	0.18883	0.00087	10.913	99.8	1155.97	3.55	12.09	> 150
21	ELT37-16 bio	12928-27A	0.00646	0.00178	2.43931	99.66798	1115.91	11.41	15.96	> 150
21	ELT37-16 bio	12928-23A	0.01329	0.00414	1.21944	99.47380	1110.56	11.55	16.02	> 150
21	ELT37-16 bio	12928-24A	0.03889	0.00652	0.76394	98.81441	1161.58	12.11	16.78	> 150
21	ELT37-16 bio	12928-21A	0.06250	0.00345	4.08698	95.32834	1117.22	11.66	16.15	> 150
21	ELT37-16 bio	12928-22A	0.03447	0.00333	2.14866	97.36342	1304.94	13.34	18.66	> 150
21	ELT37-16 bio	12928-15A	0.42960	0.00648	0.15577	66.52241	1104.13	11.27	15.78	> 150
21	ELT37-16 bio	12928-16A	-0.00575	0.00151	0.45641	97.85219	1131.00	11.58	16.19	> 150
21	ELT37-16 bio	12928-29A	-0.02649	-0.00551	0.21533	93.96489	1261.66	12.88	18.03	> 150
21	ELT37-16 bio	12928-25A	-0.05943	-0.01322	0.26569	85.52506	1144.29	11.72	16.38	> 150
21	ELT37-16 bio	12928-18A	-0.38845	0.23639	0.78400	201.35899	1119.88	11.50	16.05	> 150
21	ELT37-16 bio	12928-31A	-0.59189	0.11312	0.01062	48.86034	987.44	10.15	14.16	> 150
21	ELT37-16 bio	12928-19A	0.17738	0.10509	0.12556	61.45938	1097.45	11.22	15.70	> 150
21	ELT37-16 bio	12928-17A	0.00133	0.00381	1.02270	99.23489	1130.20	11.50	16.12	> 150
21	ELT37-16 bio	12928-28A	0.16466	0.00527	0.13683	98.19529	1106.18	11.38	15.87	> 150
21	ELT37-16 bio	12928-26A	3.37668	0.01681	0.05430	97.55484	1074.88	11.23	15.55	> 150
21	ELT37-16 bio	12928-20A	20.88569	0.00899	0.12954	98.92938	1208.59	12.69	17.52	> 150
21	ELT37-16 bio 63-150	13459-05	0.10938	-0.09873	0.015	96	387.36	16.74	17.18	63-150
21	ELT37-16 bio 63-150	13459-06	-0.2063	-0.04991	0.018	93.9	938.30	18.76	20.97	63-150

21	ELT37-16 bio 63-150	13459-04	-0.10684	-0.01023	0.032	99	1039.19	14.60	17.92	63-150	
21	ELT37-16 bio 63-150	13459-09	-0.13782	0.00673	0.073	100.1	1098.66	10.63	15.29	63-150	
21	ELT37-16 bio 63-150	13459-01	-0.05007	-0.00496	0.057	100.3	1100.75	9.89	14.80	63-150	
21	ELT37-16 bio 63-150	13459-03	-0.0369	-0.00419	0.136	100.2	1108.44	6.87	13.04	63-150	
21	ELT37-16 bio 63-150	13459-02	0.00003	0.00588	0.136	100.3	1115.24	8.04	13.75	63-150	
21	ELT37-16 bio 63-150	13459-10	0.18306	-0.00591	0.136	100.1	1123.05	7.53	13.52	63-150	
21	ELT37-16 bio 63-150	13459-08	-0.08053	0.00029	0.115	99.9	1125.66	8.14	13.89	63-150	
21	ELT37-16 bio 63-150	13459-11	-0.11938	-0.01516	0.072	100.2	1159.67	9.52	15.00	63-150	
21	ELT37-16 bio 63-150	13459-07	-0.20122	-0.02043	0.046	100.6	1260.86	13.46	18.45	63-150	
22	ELT37-13 bio	12743-01	0.03879	0.0005	3.204	99.8	1118.64	2.08	11.38	> 150	29
22	ELT37-13 bio	12743-02	0.01056	0.00281	0.644	99.7	1123.23	2.42	11.49	> 150	
22	ELT37-13 bio	12743-03	0.01104	0.00099	0.976	99.7	1493.72	2.99	15.23	> 150	
22	ELT37-13 bio	12743-04	0.01585	0.00115	0.876	98.6	1076.41	2.70	11.10	> 150	
22	ELT37-13 bio	12743-05	0.0076	0.0004	1.184	99.3	1115.44	2.63	11.46	> 150	
22	ELT37-13 bio	12743-06	-0.0111	0.00194	0.266	99.2	1126.72	2.67	11.58	> 150	
22	ELT37-13 bio	12743-07	0.00756	0.00082	1.164	99.6	1128.97	2.36	11.53	> 150	
22	ELT37-13 bio	12743-08	0.01184	-0.00005	5.553	99.7	1115.94	2.66	11.47	> 150	
22	ELT37-13 bio	12743-09	0.05785	-0.00021	5.629	99.5	1139.43	2.47	11.66	> 150	
22	ELT37-13 bio	12743-10	0.01957	0.00095	0.491	98.5	1119.73	2.53	11.48	> 150	
22	ELT37-13 bio	12743-11	0.02869	-0.00175	0.187	98.9	1157.96	2.85	11.92	> 150	
22	ELT37-13 bio	12743-12	0.0056	0.00003	1.709	99.8	1128.95	2.29	11.52	> 150	
22	ELT37-13 bio	12743-13	0.03264	0.00366	0.217	89	1112.16	3.59	11.69	> 150	
22	ELT37-13 bio	12743-14	0.01	0.00094	0.901	99.4	1121.64	2.33	11.46	> 150	
22	ELT37-13 bio	12743-15	0.00394	0.00132	0.871	99.2	1121.45	2.83	11.56	> 150	
22	ELT37-13 bio	12743-16	3.63879	-0.00011	0.432	97.5	1097.12	2.73	11.31	> 150	
22	ELT37-13 bio	12743-17	0.02214	0.00103	0.38	99.2	1514.11	3.26	15.49	> 150	
22	ELT37-13 bio 63-150	13470-07	0.0205	-0.01823	0.099	96.1	861.02	5.76	10.36	63-150	
22	ELT37-13 bio 63-150	13470-09	0.00727	-0.01929	0.055	100.3	1087.61	6.29	12.56	63-150	
22	ELT37-13 bio 63-150	13470-12	-0.0658	-0.00607	0.106	99.4	1091.56	4.12	11.67	63-150	
22	ELT37-13 bio 63-150	13470-03	-0.02421	0.00296	0.155	99.9	1100.04	3.22	11.46	63-150	
22	ELT37-13 bio 63-150	13470-06	-0.05397	-0.013	0.039	97.9	1101.33	15.07	18.67	63-150	
22	ELT37-13 bio 63-150	13470-10	-0.06375	0.00089	0.065	100	1104.58	9.78	14.75	63-150	
22	ELT37-13 bio 63-150	13470-01	-0.04538	-0.00798	0.068	97.9	1105.80	9.35	14.48	63-150	
22	ELT37-13 bio 63-150	13470-02	-0.12526	-0.01857	0.052	100.1	1108.61	12.35	16.60	63-150	
22	ELT37-13 bio 63-150	13470-08	-0.03341	0.00898	0.121	99.7	1111.74	7.67	13.51	63-150	

22	ELT37-13 bio 63-150	13470-04	-0.0772	0.00113	0.09	100	1119.46	7.68	13.57	63-150	
22	ELT37-13 bio 63-150	13470-05	-0.09897	0.01371	0.066	99.9	1121.06	8.88	14.30	63-150	
22	ELT37-13 bio 63-150	13470-11	0.00695	-0.01869	0.056	100.3	1132.90	9.70	14.92	63-150	
23	ELT37-09 A bio	13577-05	0.62766	0.00038	0.371	76	111.29	0.78	1.36	> 150	87
23	ELT37-09 A bio	13577-01	0.01798	0.00209	2.435	99.5	459.80	1.53	4.84	> 150	
23	ELT37-09 A bio	13577-11	0.01207	0.00149	2.293	99.7	487.55	1.53	5.11	> 150	
23	ELT37-09 A bio	13577-15	0.003	0.00755	0.644	99.6	489.99	1.82	5.23	> 150	
23	ELT37-09 A bio	13577-10	0.00985	0.00244	0.603	99.1	490.03	1.58	5.15	> 150	
23	ELT37-09 A bio	13577-02	0.00079	0.01853	1.005	99.5	495.06	0.65	4.99	> 150	
23	ELT37-09 A bio	13577-04	0.11152	0.0008	0.706	99.9	499.77	0.80	5.06	> 150	
23	ELT37-09 A bio	13577-12	0.00194	0.00514	0.472	98	1479.01	2.06	14.93	> 150	
23	ELT37-09 A bio	13577-06	0.0352	-0.0059	0.379	72.1	1493.07	6.86	16.43	> 150	
23	ELT37-09 A bio	13577-07	0.13469	-0.00064	0.732	99.3	1559.09	2.21	15.75	> 150	
23	ELT37-09 A bio	13577-14	0.01444	0.00664	0.762	99.8	1590.40	5.24	16.75	> 150	
23	ELT37-09 A bio	13577-09	0.0173	0.00401	0.87	99.7	1647.52	4.93	17.20	> 150	
23	ELT37-09 A bio	13577-13	-0.00237	0.00173	1.831	99.9	1670.83	5.65	17.64	> 150	
23	ELT37-09 A bio	13577-03	0.00553	0.00239	4.186	100	1698.71	7.59	18.61	> 150	
23	ELT37-09 B bio	13578-06	0.0064	0.00058	3.085	99	481.45	1.66	5.09	> 150	
23	ELT37-09 B bio	13578-03	0.00039	0.00309	2.538	99.5	491.55	1.64	5.18	> 150	
23	ELT37-09 B bio	13578-08	-0.0051	-0.00135	0.415	99.8	493.08	1.86	5.27	> 150	
23	ELT37-09 B bio	13578-15	0.14303	0.00297	3.384	99.7	493.11	1.94	5.30	> 150	
23	ELT37-09 B bio	13578-09	-0.00514	0.00264	1.597	99.8	496.37	1.39	5.15	> 150	
23	ELT37-09 B bio	13578-07	-0.0101	0.00352	0.445	99.7	500.73	1.03	5.11	> 150	
23	ELT37-09 B bio	13578-12	-0.00043	0.00547	1.905	99.5	512.22	1.37	5.30	> 150	
23	ELT37-09 B bio	13578-14	0.06627	0.00054	7.264	99.9	1628.08	10.78	19.52	> 150	
23	ELT37-09 B bio	13578-11	-0.00036	0.00119	3.257	99.9	1668.48	7.26	18.19	> 150	
23	ELT37-09 B bio	13578-02	0.1212	0.00376	6.915	99.8	1679.27	8.75	18.94	> 150	
23	ELT37-09 B bio	13578-04	-0.00068	0.00185	2.315	99.8	1707.45	6.58	18.30	> 150	
23	ELT37-09 B bio	13578-01	0.00004	0.00093	6.957	99.7	1734.03	9.02	19.55	> 150	
23	ELT37-09 B bio	13578-10	0.0796	0.00227	3.799	99.8	1744.95	7.83	19.12	> 150	
23	ELT37-09 B bio	13578-05	0.00028	-0.00272	0.212	99.9	1767.14	7.80	19.31	> 150	
23	ELT37-09 bio	12742-01	0.61397	0.00556	1.581	23.3	53.63	1.46	1.55	> 150	
23	ELT37-09 bio	12742-06	0.03209	0.00359	0.895	87.6	97.64	0.49	1.09	> 150	
23	ELT37-09 bio	12742-13	0.0125	-0.00327	0.207	88.3	438.55	1.91	4.78	> 150	
23	ELT37-09 bio	12742-09	0.00815	0.0092	0.137	82	457.01	2.43	5.17	> 150	

23	ELT37-09 bio	12742-07	0.0737	0.00354	0.994	80.2	463.15	1.72	4.94	> 150
23	ELT37-09 bio	12742-12	0.00863	-0.00059	0.486	95.8	466.83	1.35	4.86	> 150
23	ELT37-09 bio	12742-04	0.0122	0.0135	0.782	98	492.55	1.23	5.08	> 150
23	ELT37-09 bio	12742-02	0.00138	0.01062	3.721	99.1	493.67	1.19	5.08	> 150
23	ELT37-09 bio	12742-08	0.11794	0.00094	4.695	98	494.76	1.18	5.09	> 150
23	ELT37-09 bio	12742-05	0.05914	0.00476	0.622	93.4	1393.71	3.13	14.28	> 150
23	ELT37-09 bio	12742-03	0.01303	0.00282	6.055	99.1	1554.62	3.71	15.98	> 150
23	ELT37-09 bio	12742-10	0.0505	0.00172	0.666	98.9	1575.93	2.93	16.03	> 150
23	ELT37-09 bio	12742-11	0.01059	0.00368	0.535	98.5	1604.52	3.31	16.38	> 150
23	ELT37-09 bio	12862-01	0.00371	0.002	1.24	98.3	1630.59	4.27	16.86	> 150
23	ELT37-09 bio	12862-02	0.00956	0.00411	0.877	96.9	1562.81	4.49	16.26	> 150
23	ELT37-09 bio	12862-03	0.01627	0.00436	1.909	94.5	459.54	1.96	5.00	> 150
23	ELT37-09 bio	12862-04	0.00423	0.00543	14.288	99	517.58	2.12	5.59	> 150
23	ELT37-09 bio	12862-05	0.00669	0.00375	2.765	95.3	481.12	1.74	5.12	> 150
23	ELT37-09 bio	12862-06	0.0423	0.01204	4.945	98.1	493.42	1.81	5.26	> 150
23	ELT37-09 bio	12862-07	0.00548	0.00356	0.864	90.7	489.41	2.38	5.44	> 150
23	ELT37-09 bio	12862-08	0.02137	0.00232	1.136	93.8	474.51	1.90	5.11	> 150
23	ELT37-09 bio	12862-09	0.00606	0.01182	4.794	99.7	1706.73	5.66	17.98	> 150
23	ELT37-09 bio	12862-10	0.00724	0.00217	2.135	96.4	485.08	1.65	5.12	> 150
23	ELT37-09 bio	12862-11	0.00883	0.00478	0.309	98.9	495.55	1.83	5.28	> 150
23	ELT37-09 bio	12862-12	0.003	0.00398	1.178	99.3	493.63	1.67	5.21	> 150
23	ELT37-09 bio	12862-13	0.1604	0.00136	5.647	99.1	399.55	1.33	4.21	> 150
23	ELT37-09 bio	12862-14	0.01683	0.01965	0.186	94.1	526.54	2.31	5.75	> 150
23	ELT37-09 bio	12862-15	0.01916	0.01067	1.789	97.8	328.27	1.18	3.49	> 150
23	ELT37-09 bio	12862-16	0.00123	0.0088	3.544	93.9	523.64	2.01	5.61	> 150
23	ELT37-09 bio	12862-17	0.00253	0.01242	0.837	96.1	504.53	1.99	5.42	> 150
23	ELT37-09 bio	12862-18	0.17598	0.00533	1.499	98.9	1666.70	4.91	17.38	> 150
23	ELT37-09 bio	12862-19	-0.0037	0.01227	0.326	95.4	512.56	1.90	5.47	> 150
23	ELT37-09 bio	12862-23	0.01161	0.00202	3.669	94.3	102.08	0.44	1.11	> 150
23	ELT37-09 bio	13192-01A	0.35185	0.01495	0.409	101.6	510.09	6.65	8.38	> 150
23	ELT37-09 bio	13192-02A	0.05144	0.00283	1.434	100.4	503.95	6.76	8.43	> 150
23	ELT37-09 bio	13192-03A	0.11267	0.00565	1.353	100.7	480.57	6.41	8.01	> 150
23	ELT37-09 bio	13192-04A	0.12603	-0.02221	0.266	103.2	479.72	6.08	7.75	> 150
23	ELT37-09 bio	13192-05A	-0.17184	-0.01029	0.174	104	526.71	6.52	8.38	> 150
23	ELT37-09 bio	13192-07A	1.01977	0.02026	0.116	100.2	512.89	7.62	9.19	> 150
23	ELT37-09 bio	13192-08A	0.3162	-0.01373	0.27	100.5	527.97	7.23	8.96	> 150

23	ELT37-09 bio	13192-10A	0.09734	0.0068	0.219	97.3	427.28	6.72	7.96	> 150	
23	ELT37-09 bio	13192-11A	0.11974	-0.00204	1.068	99.8	493.31	6.82	8.42	> 150	
23	ELT37-09 bio	13192-12A	1.03728	-0.01794	0.117	99.7	1204.77	14.99	19.23	> 150	
23	ELT37-09 bio	13192-13A	0.09573	0.01496	0.979	100.5	531.87	7.10	8.87	> 150	
23	ELT37-09 bio	13192-15A	6.09615	-0.0727	0.032	97.8	503.22	11.93	12.95	> 150	
23	ELT37-09 bio	13192-16A	18.01166	0.13756	0.02	101.5	1595.01	19.60	25.27	> 150	
23	ELT37-09 bio	13192-17A	0.04384	0.01561	0.428	101.4	505.16	6.65	8.35	> 150	
23	ELT37-09 bio	13192-18A	0.02743	0.0268	0.648	100.5	497.00	6.72	8.36	> 150	
23	ELT37-09 bio	13192-19A	1.0176	0.00253	0.136	93.9	229.49	4.92	5.43	> 150	
23	ELT37-09 bio 63-150	13460-04	-0.01645	0.00799	0.064	95.9	475.27	6.15	7.77	63-150	
23	ELT37-09 bio 63-150	13460-02	-0.02178	-0.07665	0.018	94.9	481.87	15.50	16.23	63-150	
23	ELT37-09 bio 63-150	13460-01	0.03363	0.01959	0.057	94.8	501.05	7.29	8.84	63-150	
23	ELT37-09 bio 63-150	13460-03	-0.07072	-0.01991	0.077	100.4	1113.04	8.47	13.99	63-150	
23	ELT37-09 bio 63-150	13460-11	-0.09499	0.12157	0.011	100.7	1527.53	25.07	29.36	63-150	
23	ELT37-09 bio 63-150	13460-08	-0.08241	0.02505	0.057	99.7	1560.71	12.98	20.30	63-150	
23	ELT37-09 bio 63-150	13460-06	-0.11719	-0.01054	0.049	99.7	1567.05	16.00	22.40	63-150	
23	ELT37-09 bio 63-150	13460-10	-0.05406	0.00487	0.108	100.1	1568.10	12.59	20.11	63-150	
23	ELT37-09 bio 63-150	13460-09	-0.09124	-0.01119	0.044	98.9	1644.10	18.00	24.38	63-150	
23	ELT37-09 bio 63-150	13460-07	-0.19651	-0.05173	0.025	97.8	1733.04	22.16	28.14	63-150	
24	JPC11 2305-2310 bio	13575-01	-0.02704	-0.00185	0.236	99.9	1683.21	6.40	18.01	> 150	29
24	JPC11 2305-2310 bio	13575-02	0.04358	0.00363	1.222	99.5	1594.16	5.12	16.74	> 150	
24	JPC11 2305-2310 bio	13575-03	0.01262	0.00114	1.229	99.9	1709.11	2.55	17.28	> 150	
24	JPC11 2305-2310 bio	13575-04	-0.09654	0.01972	0.093	97.4	1655.07	5.00	17.29	> 150	
24	JPC11 2305-2310 bio	13575-06	0.01107	-0.00099	0.45	99.8	1634.58	5.76	17.33	> 150	
24	JPC11 2305-2310 bio	13575-07	-0.00065	0.00413	0.874	100	1656.97	5.24	17.38	> 150	
24	JPC11 2305-2310 bio	13575-08	0.00827	0.00165	0.226	99.2	1618.98	3.00	16.47	> 150	
24	JPC11 2305-2310 bio	13575-09	-0.00282	0.00237	1.912	99.9	1608.34	6.08	17.19	> 150	
24	JPC11 2305-2310 bio	13575-10	0.03228	-0.00018	1.237	99.9	1624.18	3.66	16.65	> 150	
24	JPC11 2305-2310 bio	13575-11	0.00031	0.00082	1.524	99.9	1686.12	2.52	17.05	> 150	
24	JPC11 2305-2310 bio	13575-12	-0.00132	0.00803	0.711	99.9	1635.44	2.15	16.50	> 150	
24	JPC11 2305-2310 bio	13575-13	0.00579	0.00119	0.266	99.7	1580.25	2.95	16.08	> 150	
24	JPC11 2305-2310 bio	13575-14	0.0148	0.00071	0.486	99.9	1583.01	2.18	15.98	> 150	
24	JPC11 2305-2310 bio	13575-15	0.27267	0.00502	6.489	99.8	1799.91	9.74	20.47	> 150	
24	JPC11 2370-2375 bio	13574-01	-0.00093	-0.00258	0.407	99.7	1581.00	2.70	16.04	> 150	
24	JPC11 2370-2375 bio	13574-03	0.43147	0.05247	0.016	83.5	1592.50	13.69	21.00	> 150	

24	JPC11 2370-2375 bio	13574-15	-0.01546	0.00738	0.305	99.8	1594.74	3.43	16.31	> 150	
24	JPC11 2370-2375 bio	13574-10	-0.00699	0.00444	0.39	99.9	1598.26	2.98	16.26	> 150	
24	JPC11 2370-2375 bio	13574-04	0.01763	-0.00005	0.171	99.9	1602.40	3.73	16.45	> 150	
24	JPC11 2370-2375 bio	13574-09	-0.00556	0.00878	0.276	99.9	1607.13	3.51	16.45	> 150	
24	JPC11 2370-2375 bio	13574-08	0.00917	0.00372	0.279	99.9	1617.25	4.81	16.87	> 150	
24	JPC11 2370-2375 bio	13574-06	0.01381	-0.00057	1.022	99.9	1618.66	5.45	17.08	> 150	
24	JPC11 2370-2375 bio	13574-05	-0.02394	-0.0027	0.144	100	1619.78	4.79	16.89	> 150	
24	JPC11 2370-2375 bio	13574-02	-0.03149	0.00426	0.188	99.8	1624.88	3.14	16.55	> 150	
24	JPC11 2370-2375 bio	13574-12	-0.00595	0.00353	0.26	99.8	1635.41	3.56	16.74	> 150	
24	JPC11 2370-2375 bio	13574-14	0.01228	0.00628	0.816	99.9	1640.17	4.93	17.13	> 150	
24	JPC11 2370-2375 bio	13574-07	-0.00741	-0.00091	0.464	99.9	1659.98	5.12	17.37	> 150	
24	JPC11 2370-2375 bio	13574-11	0.01619	0.00368	0.773	99.7	1674.24	4.98	17.47	> 150	
24	JPC11 2370-2375 bio	13574-13	-0.00273	0.00835	0.298	99.2	1698.25	2.66	17.19	> 150	
25	DF79-47 bio 63-150	13463-08	-0.05594	0.02097	0.037	72.3	429.50	8.73	9.73	63-150	10
25	DF79-47 bio 63-150	13463-07	-0.11661	0.01615	0.032	90	436.90	9.86	10.78	63-150	
25	DF79-47 bio 63-150	13463-06	-0.0795	-0.03976	0.033	98.6	462.78	9.83	10.87	63-150	
25	DF79-47 bio 63-150	13463-10	0.01295	0.00709	0.116	100.2	488.27	4.57	6.69	63-150	
25	DF79-47 bio 63-150	13463-05	-0.27545	0.01802	0.028	82.3	492.83	11.40	12.42	63-150	
25	DF79-47 bio 63-150	13463-11	-0.0352	0.00581	0.027	98.7	495.08	11.58	12.59	63-150	
25	DF79-47 bio 63-150	13463-09	-0.19732	-0.05853	0.014	100.3	535.89	17.17	17.99	63-150	
25	DF79-47 bio 63-150	13463-02	-0.02851	0.02942	0.051	99.3	547.15	7.63	9.39	63-150	
25	DF79-47 bio 63-150	13463-01	0.75776	0.06774	0.02	98.6	712.11	16.22	17.72	63-150	
25	DF79-47 bio 63-150	13463-03	-0.18376	0.04029	0.011	99.9	1385.58	24.76	28.37	63-150	
26	DF80-34 bio	12747-04	0.01568	0.00148	0.997	79.1	105.20	0.41	1.13	> 150	33
26	DF80-34 bio	12747-11	0.04545	-0.00278	0.203	77.5	127.39	0.76	1.48	> 150	
26	DF80-34 bio	12747-15	-0.00291	0.00203	0.313	89.7	303.00	1.10	3.22	> 150	
26	DF80-34 bio	12747-08	0.02562	0.00191	0.969	98.2	376.73	0.87	3.87	> 150	
26	DF80-34 bio	12747-16	0.00396	0.00197	0.148	95	446.65	1.75	4.80	> 150	
26	DF80-34 bio	12747-10	0.03041	0.00033	1.156	99	473.08	0.94	4.82	> 150	
26	DF80-34 bio	12747-07	0.03605	0.00105	0.942	98	483.97	0.98	4.94	> 150	
26	DF80-34 bio	12747-05	0.01834	0.00149	0.847	98.1	488.76	1.03	4.99	> 150	
26	DF80-34 bio	12747-17	-0.00309	0.00813	0.048	81	491.19	2.65	5.58	> 150	
26	DF80-34 bio	12747-02	0.02864	0.00014	1.554	98.2	497.64	0.89	5.06	> 150	
26	DF80-34 bio	12747-06	0.01838	0.00295	0.713	99.3	501.15	1.00	5.11	> 150	

26	DF80-34 bio	12747-03	0.00892	0.01229	0.707	96.2	521.42	1.19	5.35	> 150	
26	DF80-34 bio	12747-01	0.02569	0.00055	0.275	96.7	523.60	1.60	5.48	> 150	
26	DF80-34 bio	12747-13	0.01228	0.00148	0.754	98.1	561.69	1.22	5.75	> 150	
26	DF80-34 bio	12747-14	0.00873	0.00038	0.269	97.5	895.14	1.85	9.14	> 150	
26	DF80-34 bio	12747-12	0.05921	0.00449	0.167	93.6	1126.86	3.01	11.66	> 150	
26	DF80-34 Bio	13194-01A	0.55561	0.00798	0.078	94.2	516.23	9.63	10.93	> 150	
26	DF80-34 Bio	13194-02A	-0.00284	0.00592	0.301	97.8	367.34	5.78	6.85	> 150	
26	DF80-34 Bio	13194-03A	-0.09566	-0.02616	0.048	86.9	489.12	12.34	13.28	> 150	
26	DF80-34 Bio	13194-04A	1.98383	0.03908	0.088	71.5	84.99	4.65	4.73	> 150	
26	DF80-34 Bio	13194-06A	12.42474	-0.14798	0.02	66.5	345.38	19.82	20.11	> 150	
26	DF80-34 Bio	13194-07A	4.28675	0.05706	0.046	92	477.01	10.51	11.54	> 150	
26	DF80-34 Bio	13194-08A	0.8706	-0.02724	0.127	98.6	983.84	13.01	16.31	> 150	
26	DF80-34 bio 63-150	13465-05	0.02056	0.00807	0.048	98.7	369.83	5.44	6.57	63-150	
26	DF80-34 bio 63-150	13465-07	-0.02467	0.00439	0.058	96.8	389.56	5.39	6.65	63-150	
26	DF80-34 bio 63-150	13465-06	-0.02448	-0.00952	0.06	88.8	394.96	5.88	7.08	63-150	
26	DF80-34 bio 63-150	13465-01	-0.0043	0.01043	0.228	99.6	401.24	2.59	4.77	63-150	
26	DF80-34 bio 63-150	13465-08	-0.66651	0.00339	0.011	105.8	428.89	23.51	23.90	63-150	
26	DF80-34 bio 63-150	13465-04	-0.04155	0.00485	0.136	98.9	466.90	3.74	5.98	63-150	
26	DF80-34 bio 63-150	13465-03	-0.16039	-0.02773	0.023	103.2	496.42	14.39	15.22	63-150	
26	DF80-34 bio 63-150	13465-02	-0.13884	0.01224	0.027	98.8	510.72	11.97	13.01	63-150	
26	DF80-34 bio 63-150	13465-11	0.03057	0.00711	0.055	90.3	527.16	7.52	9.18	63-150	
26	DF80-34 bio 63-150	13465-10	-0.0305	0.01055	0.024	97.9	633.15	10.05	11.88	63-150	
27	DF80-35 bio	12746-02	0.02073	0.00213	0.296	94	374.14	1.04	3.88	> 150	23
27	DF80-35 bio	12746-03	0.01921	0.00625	0.285	97.5	372.74	0.92	3.84	> 150	
27	DF80-35 bio	12746-04	0.01787	0.00101	0.7	98.3	363.41	0.83	3.73	> 150	
27	DF80-35 bio	12746-05	0.89522	0.00141	0.277	80.2	474.86	1.61	5.02	> 150	
27	DF80-35 bio	12746-06	0.09196	-0.00061	0.203	91.2	374.94	1.23	3.95	> 150	
27	DF80-35 bio	12746-07	0.03854	-0.00047	0.216	84.6	414.16	1.48	4.40	> 150	
27	DF80-35 bio	12746-08	0.06551	-0.00057	0.087	88.3	352.13	1.58	3.86	> 150	
27	DF80-35 bio	12746-09	0.0223	0.00622	0.356	83.6	355.18	1.20	3.75	> 150	
27	DF80-35 bio	12746-10	0.04457	0.00725	0.087	87	362.41	1.97	4.13	> 150	
27	DF80-35 bio	12746-11	0.14178	0.00382	0.268	94.1	356.48	1.16	3.75	> 150	
27	DF80-35 bio	12746-12	0.01067	0.0043	0.132	81	375.11	1.71	4.12	> 150	
27	DF80-35 bio	12746-13	0.00152	0.00657	0.072	89.1	380.48	1.99	4.29	> 150	
27	DF80-35 bio 63-150	13468-09	-0.04147	-0.00941	0.059	98.8	310.44	5.48	6.30	63-150	

27	DF80-35 bio 63-150	13468-10	0.00686	0.00039	0.037	90.7	348.52	7.89	8.62	63-150	
27	DF80-35 bio 63-150	13468-01	-0.13959	-0.03687	0.028	101.1	361.24	8.79	9.50	63-150	
27	DF80-35 bio 63-150	13468-03	0.03628	-0.03175	0.049	96.6	362.98	6.34	7.30	63-150	
27	DF80-35 bio 63-150	13468-08	0.06789	-0.03439	0.008	94	371.12	31.67	31.88	63-150	
27	DF80-35 bio 63-150	13468-02	-0.02335	0.02344	0.1	96	376.06	3.68	5.26	63-150	
27	DF80-35 bio 63-150	13468-11	0.00995	0.00995	0.04	97.9	381.01	7.92	8.79	63-150	
27	DF80-35 bio 63-150	13468-04	0.12259	-0.02227	0.039	88.7	385.70	7.88	8.78	63-150	
27	DF80-35 bio 63-150	13468-07	-0.05939	-0.01053	0.023	87.3	394.80	12.08	12.71	63-150	
27	DF80-35 bio 63-150	13468-05	-0.05792	-0.01416	0.025	91.4	407.21	12.02	12.69	63-150	
27	DF80-35 bio 63-150	13468-06	-0.06813	0.02582	0.036	84.2	647.68	6.95	9.50	63-150	
28	DF80-20 bio	12745-01	0.12716	0.0002	5.663	99.3	365.60	0.83	3.75	> 150	35
28	DF80-20 bio	12745-03	0.01529	0.00218	1.823	99.6	367.49	0.90	3.78	> 150	
28	DF80-20 bio	12745-04	-0.00396	0.00072	0.442	96.9	373.81	1.16	3.91	> 150	
28	DF80-20 bio	12745-05	0.10674	0.00313	0.705	99.1	481.18	1.17	4.95	> 150	
28	DF80-20 bio	12745-06	-0.01116	0.00077	0.179	91.8	369.93	1.52	4.00	> 150	
28	DF80-20 bio	12745-07	0.13353	0.00216	0.497	98.9	364.13	1.04	3.79	> 150	
28	DF80-20 bio	12745-08	0.028	0.00303	3.33	98.6	484.77	1.13	4.98	> 150	
28	DF80-20 bio	12745-10	0.01783	0.00506	0.249	97.2	365.50	1.33	3.89	> 150	
28	DF80-20 bio	12745-11	0.00252	0.00246	0.778	98.1	367.67	0.83	3.77	> 150	
28	DF80-20 bio	12745-12	0.11154	0.00552	0.096	81	370.11	1.95	4.18	> 150	
28	DF80-20 bio	12745-13	0.18232	0.00191	0.425	79.2	335.96	1.15	3.55	> 150	
28	DF80-20 bio	12745-14	0.01903	-0.0012	0.268	94.4	360.51	1.16	3.79	> 150	
28	DF80-20 bio	12745-15	0.21791	0.0011	0.349	97.2	365.59	1.05	3.80	> 150	
28	DF80-20 bio	12745-16	0.05227	0.00349	0.128	93.2	367.53	1.48	3.96	> 150	
28	DF80-20 bio	12745-17	-0.00165	-0.00206	0.087	90.2	370.24	1.73	4.09	> 150	
28	DF80-20 bio	12745-18	0.36028	0.01837	0.104	43.6	277.74	2.64	3.83	> 150	
28	DF80-20 Bio	13193-01A	0.72396	0.01092	0.169	96.5	444.88	7.33	8.57	> 150	
28	DF80-20 Bio	13193-02A	0.27769	0.00334	0.726	100.2	1144.21	13.20	17.47	> 150	
28	DF80-20 Bio	13193-03A	0.07753	0.00055	4.713	99	412.01	6.16	7.41	> 150	
28	DF80-20 Bio	13193-04A	0.10887	-0.00425	0.749	100.1	738.92	9.45	12.00	> 150	
28	DF80-20 Bio	13193-05A	24.90623	0.51976	0.005	37.8	185.52	62.19	62.22	> 150	
28	DF80-20 Bio	13193-06A	0.0401	-0.01163	0.489	99.8	1061.70	12.77	16.61	> 150	
28	DF80-20 Bio	13193-07A	0.20474	0.00128	0.255	100.7	1058.20	12.42	16.31	> 150	
28	DF80-20 Bio	13193-08A	0.68414	0.0176	0.148	99.7	361.98	5.72	6.77	> 150	
28	DF80-20 Bio 63-150	13464-07	-0.04341	0.00273	0.104	100.5	363.21	3.12	4.79	63-150	

28	DF80-20 Bio 63-150	13464-08	0.01315	-0.00203	0.086	99.2	368.80	3.33	4.97	63-150
28	DF80-20 Bio 63-150	13464-11	-0.05927	0.00642	0.075	97.7	370.39	4.58	5.89	63-150
28	DF80-20 Bio 63-150	13464-01	0.21493	0.00822	0.042	94	370.43	8.22	9.02	63-150
28	DF80-20 Bio 63-150	13464-05	-0.06679	0.00573	0.066	101.7	376.43	5.42	6.60	63-150
28	DF80-20 Bio 63-150	13464-03	-0.07409	0.00346	0.056	94.1	376.55	4.74	6.06	63-150
28	DF80-20 Bio 63-150	13464-09	-0.03871	0.00704	0.064	98.4	380.43	5.49	6.68	63-150
28	DF80-20 Bio 63-150	13464-10	0.04895	-0.00785	0.05	98.1	386.85	6.23	7.34	63-150
28	DF80-20 Bio 63-150	13464-02	0.15531	0.00044	0.027	85.5	429.77	11.07	11.87	63-150
28	DF80-20 Bio 63-150	13464-04	-0.06367	0.05084	0.009	80.3	472.63	29.75	30.12	63-150
28	DF80-20 Bio 63-150	13464-06	-0.05728	0.01483	0.083	96	493.56	5.04	7.06	63-150

Chapter 3 Appendix D. Analyses by geographic sector (as defined in Table 2).

Droning Maud Land (Cores 1-14)

n= 754		***n= 675***		***n= 186***	
U Pb Z	± (Ma)	ArAr Hb	± (Ma)	ArAr Bio	± (Ma)
98.9	16.7	26.50	0.28	257.66	0.90
109.0	1.1	377.66	4.51	264.10	0.84
109.0	1.1	419.03	5.11	329.59	1.05
110.6	1.4	431.69	5.02	395.96	1.08
110.9	5.5	442.82	6.37	403.06	1.25
110.9	5.5	446.15	5.68	414.86	2.12
112.3	5.8	448.56	4.65	415.84	1.11
116.8	1.2	450.91	5.10	420.77	1.00
117.8	1.2	451.28	9.31	420.99	1.26
168.7	1.7	453.22	9.55	422.86	0.96
170.9	11.1	456.26	4.99	423.29	1.17
173.7	4.8	456.37	7.47	429.06	1.96
173.9	1.9	458.95	7.21	430.35	1.03
177.2	15.9	460.97	5.16	431.30	1.19
178.5	5.2	462.33	9.63	439.35	1.06
178.8	1.8	463.90	5.24	444.44	1.50
181.3	1.8	464.52	4.96	446.31	1.03
183.0	4.0	464.61	6.05	446.57	1.63
183.9	2.5	466.36	7.46	449.93	1.65
189.2	2.6	469.63	9.94	451.84	1.38
198.3	11.9	471.60	9.82	452.61	1.33
202.8	2.4	473.89	5.10	455.43	1.57
216.8	6.0	474.67	8.25	457.21	1.34
216.8	6.0	474.84	7.77	457.31	1.22
249.2	2.8	477.07	6.64	470.14	1.38
258.4	2.5	477.21	5.51	492.07	1.21
273.7	8.8	479.17	10.29	494.44	0.86
279.6	9.6	483.14	9.75	554.87	1.34
284.7	6.4	483.35	5.46	720.75	1.60
304.0	7.4	487.77	10.06	61.75	2.76
313.9	51.4	488.65	7.31	405.38	1.55
319.9	49.1	489.10	9.93	421.11	1.16
374.2	63.1	489.68	6.18	422.06	2.65
374.5	50.8	490.44	6.05	440.79	1.33
381.3	711.0	491.10	6.10	444.72	1.28
381.3	68.9	493.24	9.93	447.85	1.40
387.0	56.8	497.63	6.71	449.71	1.25
388.3	360.6	503.27	6.26	453.83	1.76
391.1	44.7	504.03	6.42	458.22	1.50
397.9	42.5	504.59	8.37	460.17	1.55
400.3	262.0	507.89	6.47	461.61	1.63
419.8	100.0	510.70	10.91	463.28	2.00
423.7	196.1	510.96	5.59	464.42	1.95

426.0	4.2	515.00	10.58	464.98	1.23
426.0	4.2	515.99	10.87	467.77	2.23
428.4	57.0	516.67	11.13	470.10	1.57
428.8	24.5	518.59	9.69	478.57	2.41
446.3	52.7	520.75	11.00	502.45	1.02
455.7	15.1	521.86	11.14	535.80	2.05
457.7	5.2	522.86	5.53	1822.48	3.14
461.6	19.6	547.49	7.15	487.57	1.21
461.7	102.8	561.87	11.90	153.74	1.27
461.9	20.3	563.86	12.03	211.26	0.68
464.8	68.0	600.69	12.84	250.95	7.28
466.4	19.4	646.25	13.28	310.23	15.07
467.3	82.0	1117.86	11.63	386.09	0.82
470.9	28.0	1240.19	16.14	413.33	1.16
470.9	87.7	397.33	5.26	422.07	1.98
471.4	137.3	426.40	7.14	428.29	1.50
472.0	109.9	461.82	5.97	429.39	0.98
472.1	40.6	467.83	7.34	434.61	1.06
473.5	27.2	467.90	6.40	441.13	0.83
474.1	20.4	468.86	8.76	450.03	1.39
474.5	4.6	469.36	5.22	452.25	1.08
474.6	8.1	471.63	6.97	458.33	1.10
475.4	28.2	476.31	5.98	470.70	1.90
477.2	44.6	481.94	5.69	472.50	1.54
477.2	44.6	482.38	8.38	475.33	0.97
478.9	54.4	485.99	5.73	502.19	1.02
479.3	86.5	487.12	6.00	566.81	1.27
479.9	8.7	494.62	6.15	155.96	0.75
480.4	44.4	495.46	7.82	204.39	8.95
481.0	5.9	502.56	6.08	219.86	1.07
481.1	58.3	535.50	7.98	235.67	2.89
481.2	61.9	572.96	7.19	487.02	1.72
482.4	35.0	594.39	6.62	494.21	1.48
486.2	22.7	701.71	12.49	1179.47	2.83
486.3	73.4	1203.69	16.08	1951.90	3.90
486.4	13.8	1349.12	17.75	160.80	0.57
490.4	2.9	1507.18	19.44	544.32	1.11
492.3	71.6	463.30	5.73	587.17	0.96
492.9	53.5	506.41	10.16	928.85	1.81
492.9	15.1	1008.36	12.03	938.98	1.36
494.2	8.2	1263.06	15.34	947.31	1.87
494.2	8.2	2889.84	32.47	957.18	2.11
494.9	11.6	2891.62	32.20	975.03	3.03
495.3	7.9	2907.14	32.45	998.74	3.32
496.7	18.6	3064.95	33.10	352.11	8.19
497.3	20.5	3091.28	38.19	479.26	1.35
497.4	26.7	3126.60	34.90	484.24	0.93
497.8	14.6	2733.60	32.40	1009.97	2.20
497.9	23.1	2820.81	31.92	450.92	1.08
498.1	6.4	2678.22	27.85	452.41	1.28

499.0	11.2	415.83	5.82	486.17	2.02
499.9	75.9	453.97	6.61	524.27	1.74
500.1	4.8	2894.20	36.39	593.05	3.14
500.5	30.5	409.01	5.34	761.55	4.70
500.7	75.0	2679.78	32.70	1033.51	8.93
501.1	4.8	2815.30	28.88	1070.08	3.12
501.6	14.6	470.65	6.98	1119.71	1.86
501.9	10.0	463.87	6.05	1220.28	23.08
503.9	9.7	515.89	9.25	2513.53	5.78
504.1	6.9	463.62	7.73	2545.66	3.63
504.2	20.9	117.94	2.46	2550.23	5.89
504.3	9.7	260.51	5.32	2599.11	4.28
504.5	6.8	339.90	6.95	2601.31	3.89
506.2	5.3	757.69	27.68	2617.48	4.42
507.0	16.8	1511.65	30.39	2631.71	5.03
507.4	76.7	2869.84	59.26	2642.48	3.17
507.5	5.7	12.58	2.40	2653.42	7.67
508.6	103.0	90.95	5.59	2655.73	4.99
508.8	12.5	152.56	3.36	2677.50	5.47
508.8	38.5	156.89	3.26	2682.16	6.62
509.3	5.0	183.82	3.75	2707.64	3.86
509.3	9.3	224.15	22.50	2714.68	3.78
509.4	4.9	232.06	4.82	2729.96	6.10
509.5	3.2	273.10	4.62	2806.35	4.89
509.7	4.9	301.93	6.29	2828.55	5.04
509.8	9.0	316.58	9.76	190.53	2.11
510.1	43.4	324.17	6.99	977.35	11.16
510.2	22.0	367.39	8.69	1010.29	10.41
510.3	7.4	379.62	8.31	347.72	3.54
510.4	22.4	442.01	8.89	914.61	9.93
510.5	4.9	446.54	6.07	1040.81	10.70
510.5	4.9	458.87	9.41	114.39	1.89
511.0	24.3	462.93	4.78	1110.68	11.78
511.0	24.3	467.48	5.14	615.74	6.47
511.3	6.9	476.38	5.63	196.20	4.15
511.4	10.4	477.41	5.43	969.19	9.99
511.5	12.1	477.60	5.80	250.59	14.55
511.5	7.8	478.14	6.34	467.14	5.53
511.9	8.6	481.50	5.93	479.99	6.56
511.9	36.6	487.73	5.11	886.25	9.45
512.6	7.7	487.87	5.92	942.66	9.72
512.8	13.1	490.89	6.15	964.63	10.07
513.7	18.2	494.35	6.12	966.69	9.83
513.9	14.4	496.28	6.14	967.73	10.06
514.1	6.2	496.82	5.06	968.25	10.02
514.6	22.4	504.55	6.03	973.76	10.88
515.2	5.0	504.74	6.25	978.91	10.27
515.7	23.1	507.62	6.93	979.92	10.04
515.8	22.4	519.38	5.37	1006.37	10.49
516.1	7.0	566.40	7.32	1009.59	10.30

516.2	7.6	602.32	7.80	1015.22	10.47
516.5	7.0	876.87	9.12	1021.84	10.68
517.0	35.7	897.06	18.27	1031.45	10.61
517.2	8.1	1005.98	12.16	1249.25	12.63
517.3	20.4	1064.56	21.36	2755.06	27.92
517.6	15.5	46.63	1.24	480.41	4.94
518.1	5.0	66.42	1.72	2891.78	29.70
518.1	5.0	66.44	1.37	2772.88	28.01
518.2	9.7	71.21	1.51	393.51	4.54
518.3	54.2	81.89	1.93	412.70	4.99
518.5	5.0	93.38	2.17	427.71	4.96
518.5	5.0	145.26	3.12	432.98	7.24
518.8	14.4	153.69	3.18	447.49	4.68
518.9	7.7	157.48	3.25	450.66	5.12
519.2	69.5	170.67	5.81	453.13	4.98
519.2	11.3	206.98	7.23	464.01	5.03
519.3	41.5	213.09	2.88	468.05	5.07
519.4	6.1	227.86	13.14	469.23	4.82
519.4	5.0	260.76	18.23	513.20	5.49
519.4	17.2	471.79	9.20	515.87	5.58
520.1	24.0	479.73	6.49	727.20	7.96
520.1	7.9	537.43	7.78	895.97	10.36
520.2	103.0	543.93	12.37	1151.92	11.73
520.4	9.7	730.21	13.70	1505.37	37.04
520.8	13.0	1985.07	22.26	1927.79	20.26
521.1	12.4	3156.85	34.89	2306.89	23.86
521.7	6.8	3320.82	38.47	2397.32	24.70
521.8	11.5	3681.81	41.47	2556.16	25.81
522.5	9.5	131.86	18.06	2663.99	30.31
522.6	16.6	180.19	3.80	2697.52	27.25
523.0	4.8	197.61	6.87	585.06	9.00
524.3	19.8	202.88	14.53	977.76	10.30
524.9	11.6	243.60	6.81	1003.31	11.89
524.9	11.6	288.36	6.48	1018.15	10.87
525.1	7.5	379.59	4.17	1025.81	11.21
525.4	16.8	441.01	10.46	1030.45	10.52
525.7	11.1	467.94	4.99	1032.24	11.17
525.7	5.3	474.36	9.85	1037.40	11.53
525.7	7.5	481.82	5.46	1038.12	11.98
525.8	14.8	486.69	10.67	1060.29	11.31
525.9	11.0	489.69	5.36	1061.27	11.73
526.0	66.6	496.19	5.13	1063.58	11.59
526.5	7.0	497.58	10.16	1064.51	12.15
526.8	64.1	502.14	10.42		
526.8	20.9	502.80	5.90		
526.8	5.9	507.75	6.26		
527.1	16.2	514.07	10.55		
527.8	13.2	517.70	10.58		
528.0	5.1	518.55	10.61		
528.3	32.0	521.57	5.31		

528.3	5.1	523.32	6.37
528.4	4.6	616.20	8.58
528.4	7.5	723.03	14.92
528.8	6.5	941.18	9.62
529.0	33.1	953.28	10.22
529.5	25.7	964.65	12.44
530.9	5.8	971.31	20.18
531.1	17.9	976.35	12.56
532.2	14.5	979.39	10.96
532.3	9.3	979.78	19.82
532.4	12.4	991.75	11.91
532.9	16.4	992.65	11.49
533.5	16.4	994.78	11.42
533.6	3.5	1000.71	11.66
533.9	52.0	1002.71	14.44
533.9	12.6	1010.72	13.64
534.2	7.0	1028.72	11.69
534.5	10.7	1035.98	21.14
534.5	10.7	1049.86	12.18
534.9	37.0	1058.78	12.15
535.3	21.6	1064.87	23.09
535.4	10.7	1086.51	21.87
535.4	7.6	493.01	10.15
535.8	20.0	479.54	9.96
536.0	4.9	1150.07	23.10
536.4	18.4	171.48	3.48
536.6	9.0	316.73	6.53
537.2	6.0	520.22	10.62
537.5	5.2	929.95	19.68
538.2	14.3	980.73	20.42
538.3	52.5	1064.65	21.46
538.4	32.4	508.35	10.27
538.6	9.0	820.22	16.85
539.2	25.5	191.00	3.44
539.9	7.2	517.27	6.94
540.3	6.0	478.90	6.61
540.3	6.0	169.68	2.08
540.5	10.7	603.23	27.27
540.9	12.9	185.45	2.98
541.0	95.3	225.85	2.99
541.3	28.1	465.51	7.03
541.6	15.6	275.83	54.38
542.0	36.4	279.31	3.44
543.4	5.2	174.21	2.04
543.8	16.7	168.54	6.20
544.1	59.3	180.40	6.08
544.4	74.8	463.76	9.84
544.4	8.2	472.94	9.57
544.4	8.2	507.22	10.48
544.5	14.0	509.50	10.25

545.4	18.6	740.61	15.72
545.5	10.5	947.52	19.41
545.5	10.5	1029.94	21.04
545.9	11.1	91.28	1.91
545.9	20.2	166.85	3.37
546.5	19.3	421.05	5.21
546.8	11.4	441.42	4.74
547.6	7.1	468.78	11.73
548.0	5.3	472.75	4.16
548.2	15.0	479.60	9.74
548.3	14.4	484.54	5.37
548.3	14.0	491.94	10.23
548.4	20.8	515.28	3.74
549.3	18.5	568.36	14.86
549.4	93.0	705.87	14.64
549.4	11.2	735.00	15.86
549.7	7.7	1128.51	25.37
550.3	105.0	1633.96	35.60
550.7	11.8	2530.67	50.71
551.2	9.2	2531.93	29.54
551.6	9.8	2687.99	59.91
551.8	5.3	2800.66	56.77
551.9	35.4	2831.41	57.22
552.0	7.1	2840.60	46.03
552.0	12.4	2875.58	7.21
552.3	6.6	2879.55	13.84
553.0	10.0	2885.45	39.37
553.4	95.3	2885.89	33.11
553.6	11.1	2924.37	15.41
554.0	6.0	2930.68	39.14
554.5	20.4	2935.77	32.64
554.5	83.8	2937.02	10.53
554.6	12.8	2961.45	59.61
554.8	7.3	2966.74	44.13
554.9	56.2	2997.20	7.64
555.7	15.6	3003.92	60.71
556.5	63.2	3006.79	60.58
556.9	7.1	3013.04	61.44
557.2	5.3	3018.45	38.80
557.3	8.7	3025.21	27.80
558.6	58.4	3025.71	34.89
558.8	11.8	3037.85	33.66
558.9	10.0	3054.23	61.67
560.9	6.1	3057.95	61.65
561.6	11.0	3065.17	61.75
562.1	19.4	3068.07	6.96
562.1	11.0	3205.14	6.66
562.3	6.1	3380.24	44.55
562.6	51.6	3527.88	70.85
563.2	8.4	17.72	67.07

563.9	26.1	167.46	13.05
564.5	26.0	189.15	3.82
565.5	17.6	197.05	6.24
565.6	9.2	202.48	13.42
565.6	9.2	346.39	12.39
565.8	18.3	439.82	12.64
566.0	10.6	446.79	12.20
566.1	62.3	451.84	52.76
566.1	17.6	463.23	18.63
566.1	11.3	469.50	11.16
567.2	5.4	471.05	5.93
567.3	5.5	472.15	6.14
567.5	5.4	475.93	50.72
567.5	5.4	477.00	7.21
567.9	40.7	478.69	15.68
567.9	40.7	481.45	7.47
568.0	56.6	481.90	8.26
568.8	6.5	483.30	55.58
569.1	19.4	485.92	6.40
569.3	42.4	486.93	8.56
569.6	78.4	488.55	5.17
569.7	7.0	489.43	5.17
570.0	7.9	489.71	5.23
570.4	8.2	490.39	39.00
570.4	6.1	491.60	5.60
571.1	25.3	492.28	6.19
572.3	5.4	492.46	11.29
572.4	5.7	493.12	5.71
572.8	12.3	493.28	24.54
573.3	8.8	498.30	8.23
573.9	18.4	498.40	6.45
573.9	9.3	498.96	6.93
574.0	5.5	499.71	9.00
575.1	16.7	501.09	7.45
575.4	6.8	501.56	6.72
575.7	10.1	503.13	12.33
576.7	4.3	507.26	6.04
577.0	9.9	508.12	5.62
577.5	10.6	508.17	6.78
579.2	20.8	509.55	6.33
579.8	5.1	509.93	8.17
580.1	7.7	510.23	5.93
580.7	60.1	512.57	10.33
581.6	38.2	513.67	9.17
582.4	9.2	516.06	8.44
582.9	7.7	519.19	22.32
583.0	5.6	525.00	6.49
584.9	15.3	525.35	8.86
585.1	10.0	528.48	5.57
585.4	19.2	529.41	6.17

586.4	12.6	530.75	10.33
586.6	8.5	535.83	5.93
586.7	11.0	539.90	6.44
586.7	33.3	552.35	7.25
588.1	12.4	554.25	6.48
588.4	18.4	561.52	7.19
588.9	22.1	567.69	9.74
589.4	7.5	587.86	8.31
589.4	12.3	590.69	7.07
589.4	12.3	638.67	9.89
590.4	25.9	696.41	8.70
591.5	5.7	698.66	9.67
591.5	5.7	825.58	9.02
592.3	10.2	932.35	23.38
593.3	5.7	1041.29	13.88
593.3	5.7	1082.89	21.57
593.5	8.0	1113.02	14.83
593.5	5.4	1203.54	22.61
593.7	19.8	1225.77	15.01
594.0	55.4	1268.19	14.71
594.7	8.1	176.35	68.22
595.4	12.0	346.74	61.34
595.6	13.9	481.92	4.85
595.8	174.2	489.50	7.58
596.3	32.8	490.24	5.93
596.5	2.8	893.69	23.22
598.7	13.5	73.06	86.12
599.1	10.5	495.89	6.57
599.4	14.4	498.39	7.13
599.9	20.0	499.40	6.59
602.1	8.5	505.72	6.05
602.7	12.2	505.77	5.16
603.6	33.5	509.29	6.74
603.9	28.9	512.89	7.16
604.4	71.2	516.65	6.16
604.4	8.4	518.15	5.38
604.6	21.5	518.24	6.82
605.6	17.9	520.06	5.64
606.4	5.8	524.12	5.54
606.8	6.7	526.33	5.62
607.9	16.2	531.49	6.35
609.3	11.6	555.96	7.15
609.4	57.9	558.81	12.78
609.9	13.8	596.92	8.95
610.2	11.8	598.12	7.47
611.7	10.6	599.27	14.83
612.3	18.4	724.71	9.46
612.3	18.4	727.75	37.65
613.9	58.7	757.83	37.57
614.6	7.0	773.39	9.59

614.7	82.7	920.95	12.27
615.2	56.6	989.82	9.98
616.1	22.4	993.62	10.53
617.4	54.6	994.27	10.32
618.0	8.9	995.34	11.58
619.9	25.2	998.48	10.08
620.2	9.9	1024.78	11.20
620.3	10.1	1026.38	11.97
620.5	89.9	1028.16	12.39
621.9	6.0	1034.12	14.13
623.6	7.3	1039.49	13.13
624.5	9.5	1042.65	10.89
624.8	14.7	1045.38	10.61
625.0	14.8	1047.35	10.59
626.1	17.1	1048.54	11.21
626.6	33.6	1049.06	10.57
626.8	94.6	1049.26	11.34
626.8	15.2	1055.29	11.01
627.3	9.8	1056.49	10.97
628.4	34.2	1063.18	11.58
628.8	17.1	1066.64	12.44
630.3	10.0	1090.30	10.83
630.8	9.6	517.98	13.36
630.9	13.4	666.56	29.03
631.5	18.2	773.94	15.29
634.4	12.7	773.97	44.68
635.6	16.3	851.36	20.69
637.2	23.9	881.91	10.33
637.4	8.5	900.84	31.80
637.8	10.6	909.46	18.42
639.5	36.8	940.90	10.15
640.6	24.6	971.02	19.46
642.5	4.7	973.58	9.97
644.5	6.1	977.32	13.49
644.5	12.9	979.49	13.91
646.2	18.1	983.55	19.79
646.2	25.4	995.16	11.73
646.7	27.7	995.34	13.00
647.6	8.0	995.39	15.85
648.7	11.2	997.76	22.39
650.1	22.3	1001.98	23.51
651.7	64.8	1003.70	31.86
652.4	10.9	1006.33	11.54
652.7	65.3	1008.96	15.23
652.9	8.3	1009.62	14.85
653.0	8.2	1010.51	10.11
653.5	11.8	1010.86	15.86
654.3	8.4	1011.74	16.85
656.9	6.2	1016.49	12.00
658.0	24.0	1017.06	13.69

658.2	18.2	1017.74	14.56
658.3	39.6	1018.57	12.04
659.2	20.0	1022.49	12.79
660.0	14.9	1025.52	17.12
660.6	19.7	1027.16	14.84
661.4	17.0	1031.78	10.95
662.5	13.7	1033.29	20.68
663.6	18.9	1033.91	10.97
665.1	6.7	1034.51	11.59
665.1	30.1	1036.72	13.35
667.0	8.0	1036.97	14.67
667.3	54.9	1038.77	12.68
667.4	292.4	1039.72	14.49
667.5	233.6	1039.81	11.41
670.9	72.6	1041.60	22.67
671.9	156.5	1043.02	18.28
671.9	68.3	1043.08	30.76
672.2	11.6	1048.24	19.86
674.9	53.8	1048.55	11.04
675.8	59.0	1052.26	16.52
675.9	6.5	1052.61	11.79
675.9	6.5	1054.36	12.16
679.8	26.5	1058.77	23.55
681.3	26.3	1058.93	13.46
683.8	5.5	1059.15	13.63
694.9	41.4	1059.96	13.85
696.4	59.1	1061.38	15.78
698.5	24.5	1063.15	11.91
701.0	8.5	1063.43	14.68
703.4	22.3	1064.04	15.45
706.9	51.1	1065.28	34.04
707.6	9.2	1066.72	13.31
716.7	25.8	1067.38	19.31
717.6	121.8	1067.82	13.74
722.5	41.9	1072.92	11.19
725.1	10.7	1072.92	15.83
731.1	36.1	1074.75	15.63
739.6	104.7	1074.84	16.91
746.0	20.8	1074.98	23.90
747.9	131.7	1075.93	13.60
748.2	78.4	1081.32	34.16
752.1	100.1	1081.87	11.87
754.2	7.1	1090.28	12.15
754.5	105.2	1092.30	14.44
754.5	8.4	1100.90	18.57
756.5	49.0	1101.66	15.20
757.6	53.8	1106.17	15.03
761.8	112.2	1106.17	20.65
769.5	44.4	1113.47	12.39
777.8	14.1	1114.95	16.79

779.2	58.5	1115.35	22.21
790.4	45.2	1125.97	13.62
795.7	47.3	1128.58	14.26
813.5	55.0	1138.24	14.39
814.7	64.1	1151.90	16.02
824.3	17.4	1154.58	19.31
830.6	88.8	1166.22	13.00
855.6	38.9	1171.16	23.34
858.8	131.8	1172.32	18.58
859.1	59.5	1181.03	14.01
866.5	52.1	1194.31	18.49
879.7	40.4	1205.48	25.25
879.7	40.4	1244.86	32.05
882.4	8.2	1267.03	23.51
906.5	33.4	1278.21	20.23
918.7	13.7	1318.78	16.77
923.8	57.1	1591.07	40.62
924.3	4.1	1700.07	29.40
925.9	22.2	33.22	8.92
940.2	190.6	57.23	1.67
945.2	12.6	60.90	1.66
985.8	50.1	63.43	3.39
987.8	26.8	69.77	4.26
989.2	33.8	87.34	3.66
989.6	54.8	93.38	6.30
989.9	25.4	125.71	1.35
992.5	100.4	131.20	3.20
994.3	24.5	238.42	3.57
998.9	78.5	286.42	7.57
1004.5	52.9	336.67	4.79
1006.0	119.7	353.73	5.38
1007.2	31.9	362.06	10.23
1008.9	29.8	385.98	5.79
1009.1	39.7	397.48	4.55
1011.3	14.4	402.82	10.65
1012.9	24.6	408.10	4.51
1016.8	70.0	414.32	4.75
1017.0	52.4	431.15	19.53
1018.6	35.4	431.17	14.10
1019.4	62.4	435.45	6.94
1021.2	18.3	443.43	4.77
1022.4	77.0	443.46	6.93
1022.6	44.7	451.25	19.30
1023.4	35.7	452.34	12.78
1023.8	17.3	453.28	6.26
1026.5	9.5	456.11	4.96
1029.4	13.6	462.90	11.15
1029.9	13.1	466.20	5.97
1030.8	15.1	468.81	6.18
1031.0	10.7	469.11	5.20

1033.7	15.4	474.88	9.44
1035.3	34.0	475.49	5.16
1035.8	11.7	478.87	6.93
1036.9	7.0	480.89	6.63
1037.1	27.0	480.89	5.22
1039.1	38.6	485.08	9.50
1042.5	50.5	486.53	5.57
1043.3	30.3	487.44	6.05
1044.0	48.9	487.71	6.08
1044.3	12.5	491.44	8.33
1045.0	41.7	492.08	6.54
1045.3	37.5	492.36	6.53
1046.6	97.8	493.04	5.14
1047.1	14.8	494.79	6.74
1048.4	15.3	495.29	14.02
1048.4	8.5	495.38	5.74
1048.5	122.1	495.92	6.95
1048.7	71.6	496.61	10.22
1053.2	10.5	497.86	6.70
1054.0	45.0	499.25	5.13
1054.7	16.2	500.68	5.41
1055.3	14.7	502.52	8.53
1055.8	7.4	505.15	7.71
1059.0	52.6	505.58	7.28
1059.7	24.5	506.21	10.16
1060.5	45.3	508.09	6.67
1061.1	37.9	508.42	11.51
1062.5	43.9	519.46	9.28
1064.6	20.9	520.57	7.96
1065.4	24.5	521.15	7.38
1066.7	71.3	523.03	6.59
1069.1	16.9	523.92	7.69
1069.2	11.8	531.38	5.63
1069.9	6.8	534.69	6.24
1071.8	88.0	535.46	9.17
1074.7	23.2	537.68	8.94
1074.9	23.2	593.25	10.08
1077.1	72.5	680.94	16.19
1078.2	19.0	768.32	7.69
1078.9	132.8	1005.27	12.61
1079.8	37.3	1683.94	16.60
1081.4	7.8	2535.93	36.37
1081.6	50.2	2634.81	26.47
1082.9	16.6	2843.52	41.44
1083.4	27.9	2874.80	31.51
1084.1	63.6	2905.22	35.54
1084.6	17.2	2927.88	30.52
1085.5	20.2	2971.54	31.30
1086.0	25.9	3000.00	39.82
1086.0	39.9	3050.93	34.12

1086.1	61.2	3062.66	32.89
1086.1	57.7	3069.37	31.94
1086.2	67.1	3071.21	32.36
1088.4	37.0	3102.91	32.45
1089.9	14.8	3103.85	31.18
1091.5	9.1	3105.47	33.62
1091.5	20.6	3114.34	31.17
1091.6	26.6	3121.72	41.19
1091.8	17.0	3141.83	42.44
1092.9	70.2	3144.12	31.57
1092.9	70.2	3146.63	32.14
1094.9	19.6	3156.13	33.64
1096.7	37.6	3175.13	40.13
1096.9	28.4	3207.18	36.15
1097.1	4.8	3322.22	37.66
1098.7	8.2	51.80	1.18
1101.1	25.7	89.00	2.34
1101.9	69.8	109.61	3.57
1102.2	31.7	113.89	6.07
1103.3	7.5	135.68	2.84
1103.7	38.4	174.75	12.97
1105.3	42.4	181.87	10.67
1105.4	33.7	343.97	34.72
1106.9	7.4	364.21	47.30
1109.4	107.9	672.39	13.72
1109.8	10.8	977.78	19.58
1110.5	120.6	978.93	9.92
1111.6	18.6	990.66	10.60
1111.8	16.5	993.12	12.90
1112.8	13.6	993.75	10.19
1114.8	65.4	1001.63	11.46
1115.1	70.2	1013.53	15.21
1115.6	61.4	1019.41	10.48
1116.6	14.7	1024.65	15.78
1121.4	14.0	1029.93	10.36
1122.9	47.1	1034.34	18.02
1124.0	66.2	1035.00	35.94
1124.0	66.2	1037.92	11.39
1124.4	30.1	1040.54	14.59
1124.7	26.5	1046.54	28.47
1125.9	102.9	1049.42	39.65
1126.2	96.5	1060.18	11.32
1127.5	37.3	1062.23	14.74
1128.5	51.5	1064.30	12.02
1129.1	16.6	1076.43	14.65
1129.9	16.7	1078.15	29.10
1130.7	107.7	1079.63	17.29
1131.4	79.0	1087.97	12.16
1131.5	6.8	1088.29	11.10
1132.6	62.4	1089.12	11.91

1133.5	38.4	1091.09	21.28
1139.3	149.7	1096.65	15.15
1140.4	69.0	1105.07	14.42
1144.2	12.3	1113.16	11.91
1144.7	22.6	1114.63	11.36
1145.9	13.9	1119.87	12.49
1148.7	29.9	1123.54	16.19
1149.7	49.5	1128.21	11.25
1155.2	34.3	1128.79	12.81
1159.1	9.3	1135.72	15.32
1160.7	33.0	1136.60	16.97
1162.6	111.5	1150.23	12.68
1170.3	70.3	1155.94	26.68
1170.3	70.3	1170.32	38.33
1176.0	20.3	1170.71	15.90
1177.0	67.2	1170.86	12.25
1181.0	102.2	1185.52	18.21
1181.2	42.2	1186.71	15.55
1183.0	60.9	1205.53	12.95
1188.4	78.0	1211.83	14.19
1188.5	8.3	1213.06	12.74
1195.4	95.6	1218.08	16.26
1198.1	34.1	1221.73	17.66
1202.8	39.3	1225.71	13.91
1216.8	160.5	1226.16	19.41
1218.4	56.4	1229.66	15.14
1219.1	120.7	1241.55	13.49
1219.1	120.7	1251.07	24.47
1219.8	70.7	1253.15	12.86
1226.6	70.3	1283.44	18.15
1236.2	64.7	1378.72	14.36
1241.8	139.3	1486.77	33.67
1244.7	686.1		
1249.2	45.7		
1291.9	173.5		
1321.7	16.3		
1323.6	83.7		
1345.0	52.2		
1383.5	257.4		
1385.2	65.9		
1402.8	13.3		
1458.5	15.0		
1513.7	61.6		
1594.4	95.5		
1621.9	47.3		
1630.9	674.5		
1638.5	185.4		
1642.4	1491.9		
1647.0	9.7		
1654.6	132.9		

1656.2	23.3
1700.7	22.2
1702.8	739.7
1718.7	49.4
1735.1	12.9
1737.2	49.6
1748.4	43.6
1748.4	43.6
1761.4	8.2
1763.6	1143.3
1772.5	96.3
1772.6	138.7
1777.4	96.2
1781.3	19.6
1792.7	20.5
1792.8	4.9
1852.3	15.6
1864.1	89.3
1864.3	145.4
1874.3	7.8
1886.8	12.2
1891.7	65.3
1891.7	65.3
1909.1	475.6
1963.7	68.7
1971.1	210.2
2015.5	39.1
2063.6	74.8
2352.8	140.7
2469.1	19.9
2503.9	9.7
2584.9	62.6
2587.3	5.7
2617.4	4.5
2633.8	127.8
2673.2	64.6
2681.0	36.7
2727.9	81.7
2729.9	8.7
2754.1	47.0
2758.1	47.0
2777.9	64.0
2806.2	75.6
2867.9	203.5
3111.5	67.7
3161.6	59.9
3196.8	61.2
3206.0	52.4
3294.8	189.1
3294.8	189.1

3333.2	73.5
3400.3	434.5
3430.5	60.0
3485.7	32.5
3523.9	39.7
3544.9	127.8
3627.5	64.3
3645.3	38.4
3681.0	32.1
3733.6	120.1
4404.7	970.0

Prydz Bay (Cores 15, 17-19)

n= 684		***n= 528***		***n= 105***	
U Pb Z	± (Ma)	ArAr Hb	± (Ma)	ArAr Bio	± (Ma)
350.9	27.3	185.38	97.76	503.20	5.17
398.4	11.7	507.87	5.10	383.51	4.46
406.5	22.8	528.17	7.62	479.25	4.86
417.9	10.5	540.58	5.67	506.74	5.15
426.4	19.0	660.15	64.80	488.96	5.01
444.3	27.3	821.59	15.09	525.96	5.39
455.9	12.7	918.87	11.62	457.22	4.70
463.8	8.3	1560.99	67.27	490.09	4.98
470.1	10.8	1595.05	57.10	499.73	5.08
471.6	17.9	2078.09	108.98	473.08	4.89
472.7	15.9	3082.73	56.61	482.02	4.90
472.8	29.5	3745.77	143.58	480.58	4.99
482.1	29.9	4658.10	81.08	399.41	4.13
482.8	20.2	40.12	6.72	797.05	8.13
483.6	10.4	151.37	8.54	485.61	4.93
487.9	8.1	155.78	13.48	489.53	4.98
487.9	16.0	187.50	6.76	510.81	5.22
491.7	5.0	248.28	24.07	485.58	5.09
494.4	15.9	264.23	22.44	482.31	4.93
494.6	25.9	289.72	5.08	434.80	4.42
495.5	15.7	329.23	3.34	406.79	4.16
496.2	14.1	395.80	4.15	483.15	5.08
496.3	8.5	399.69	4.33	451.62	5.10
502.8	9.2	404.26	4.86	519.52	5.47
504.8	8.1	405.91	4.81	461.89	4.89
506.0	9.2	410.07	4.39	417.19	4.75
508.1	14.7	414.10	4.99	451.45	5.08
509.2	42.8	418.56	4.32	438.77	4.67
510.5	14.1	421.24	4.52	453.40	4.89
512.0	16.1	424.32	5.03	568.51	5.94
514.7	7.2	427.97	4.38	500.72	5.19
515.4	13.0	429.90	4.70	490.69	5.29

516.5	8.4	448.08	4.84	489.37	5.15
517.0	11.0	450.74	4.78	498.67	5.28
517.2	6.7	455.26	5.61	485.86	5.06
517.8	11.8	457.50	4.74	475.17	4.97
518.3	6.8	460.18	5.67	361.86	5.17
519.2	10.5	460.79	4.83	487.78	5.22
520.3	7.1	461.16	5.17	560.24	5.83
520.4	13.1	463.59	5.03	453.78	4.73
520.9	12.0	463.59	4.73	497.05	5.12
521.2	12.7	466.37	5.59	503.87	5.15
522.0	19.0	466.76	4.90	527.20	5.40
522.7	9.1	466.80	4.86	528.48	5.42
523.0	5.6	466.94	4.76	528.49	5.46
523.6	22.5	467.73	4.95	530.66	5.43
523.6	12.0	468.54	4.82	553.77	5.66
523.6	10.8	468.91	5.03	670.50	6.84
523.7	10.7	469.06	5.75	449.51	4.59
524.1	11.9	469.87	4.80	503.08	5.14
524.6	21.5	470.87	4.83	510.54	5.22
524.8	23.7	471.29	4.97	519.73	5.31
524.9	6.2	471.36	4.91	520.28	5.32
525.5	16.9	471.90	5.05	560.72	5.73
526.7	11.4	472.42	4.82	477.76	5.04
526.8	14.3	472.72	4.82	481.80	5.48
527.5	8.1	472.74	4.87	483.07	5.39
528.0	17.8	473.91	4.87	487.67	5.55
528.5	12.2	474.16	5.67	501.62	5.28
528.6	18.8	475.32	4.79	502.53	5.21
528.9	18.5	475.79	4.90	504.63	5.36
529.0	5.1	475.82	4.87	506.94	5.46
529.2	8.5	476.06	5.13	512.42	5.31
529.3	16.1	476.32	4.92	526.11	5.54
529.4	7.4	476.36	4.85	539.25	5.66
529.6	17.5	476.47	4.91	555.48	5.76
530.0	18.9	476.74	4.87	576.45	6.43
530.6	6.8	477.07	5.14	639.14	6.57
530.7	11.0	477.10	5.68	216	33
530.9	32.4	477.15	5.17	400	1
531.0	13.8	477.79	5.10	342	1
531.1	5.8	477.82	4.94	501	1
531.5	8.2	478.23	5.24	516	3
532.3	7.7	478.33	4.85	617	2
532.4	11.9	478.91	4.87	529	2
532.4	8.8	479.43	4.87	528	6
532.5	6.5	479.76	4.94	552	2
533.3	25.0	480.34	4.89	314	8
533.9	12.1	481.67	4.92	499	1
534.1	7.0	481.80	4.87	580	2
534.2	6.5	482.46	5.06	560	2
535.2	14.8	482.55	4.93	500	3

535.5	8.1	482.86	5.00	585	52
535.6	10.5	483.10	5.01	553	6
536.3	19.1	483.12	5.01	492.44	5.08
536.5	5.5	484.01	4.89	487.41	5.12
536.7	38.4	484.05	4.89	497.59	5.11
537.5	18.5	484.78	4.92	204.99	2.92
537.6	12.0	484.97	5.00	492.11	5.04
537.6	11.2	485.02	5.02	474.85	4.87
537.9	14.8	485.13	4.89	476.79	4.93
538.3	14.3	485.15	4.97	484.69	4.96
538.3	8.1	485.74	4.93	498.98	5.20
538.5	8.0	485.97	5.16	478.46	4.93
538.6	8.7	486.23	4.94	504.47	5.18
538.7	19.4	486.51	5.23	1492.78	15.14
538.9	8.5	486.62	4.94	784.04	7.98
539.0	40.8	486.70	4.95	564.52	5.98
539.3	5.7	487.18	5.02	582.53	5.99
539.8	8.8	487.31	5.11	1093.08	11.11
541.0	14.5	487.52	4.90	617.44	6.33
542.1	9.4	487.80	5.01	538.17	5.50
542.9	5.2	487.88	5.06	525.56	5.39
543.3	15.6	488.52	4.98	548.47	5.60
543.4	15.9	488.54	5.23	583.81	5.97
544.7	9.5	488.95	5.02		
544.8	5.2	489.05	4.91		
545.7	10.9	489.19	5.10		
545.8	5.7	489.38	5.01		
547.0	38.4	489.56	4.93		
547.0	6.8	489.77	5.10		
547.1	12.3	489.93	4.98		
547.2	26.6	490.01	4.97		
547.3	6.1	490.13	5.16		
548.3	27.4	490.19	4.96		
548.7	9.0	490.94	4.97		
549.0	5.3	491.07	5.15		
549.2	24.1	491.27	5.38		
549.5	8.1	491.99	5.09		
550.0	11.0	492.01	5.18		
551.5	14.0	492.17	5.07		
551.9	20.7	492.31	4.99		
552.2	19.9	492.37	5.95		
552.3	5.3	492.52	5.01		
552.7	10.1	492.83	5.05		
553.0	23.2	492.85	5.10		
553.2	6.3	492.87	5.02		
553.5	32.1	492.90	6.01		
554.2	6.1	493.01	5.17		
554.8	5.9	493.10	4.96		
555.7	16.1	493.20	4.96		
555.8	15.0	493.86	5.09		

556.1	8.1	494.00	5.00
556.2	5.3	494.27	5.06
556.7	11.5	494.49	5.15
557.2	25.9	494.58	5.19
557.8	30.3	494.74	5.12
558.4	8.4	494.91	5.38
559.0	10.8	494.96	5.00
560.4	20.3	495.12	5.20
561.0	9.0	495.60	5.03
561.6	14.1	495.72	5.04
562.1	12.6	495.87	5.19
562.2	20.4	495.94	5.04
562.3	14.7	495.98	5.13
562.3	24.5	496.61	5.46
562.7	9.2	497.14	5.28
562.7	24.5	497.27	5.07
563.2	24.8	497.31	5.01
563.5	23.8	497.65	5.20
564.1	12.5	497.79	5.03
564.2	6.9	497.80	5.11
564.7	9.3	498.45	5.28
564.7	5.4	498.55	5.05
564.9	5.7	498.60	5.10
565.1	20.6	498.71	5.14
565.5	11.7	498.77	5.15
566.6	9.3	499.39	5.11
566.9	13.7	499.48	5.23
566.9	8.2	500.00	5.31
567.8	28.5	500.31	5.18
567.9	25.1	500.37	5.15
568.7	18.8	501.15	5.10
568.8	19.3	501.60	5.26
570.0	8.4	501.80	5.15
570.3	20.9	501.85	5.97
570.3	13.3	501.92	5.18
570.4	12.8	501.99	5.24
571.8	6.7	501.99	5.13
571.9	17.9	502.14	5.09
572.1	28.5	502.15	5.07
572.3	26.0	502.27	5.06
573.9	12.0	502.45	5.07
574.5	29.5	502.52	5.17
575.5	14.2	502.52	5.37
575.7	9.8	502.90	5.10
576.1	17.9	502.90	5.15
576.2	16.2	503.44	5.27
576.9	5.5	503.56	5.11
577.2	36.1	503.88	5.14
579.6	14.6	504.14	5.24
581.4	42.8	504.84	5.10

581.7	20.8	504.85	5.13
581.9	28.1	505.05	5.14
584.3	13.7	505.06	5.15
585.4	55.6	505.37	5.60
586.0	14.8	505.57	5.20
586.0	13.0	506.04	5.86
586.3	11.1	507.22	5.13
586.7	14.5	507.82	5.33
586.8	39.4	508.32	5.24
587.5	9.7	508.49	5.25
587.6	5.6	508.66	5.25
587.6	25.6	508.72	5.21
587.8	12.3	509.00	5.32
588.6	14.6	509.01	5.40
588.6	7.3	509.34	5.34
588.8	38.5	509.61	5.31
589.6	12.5	509.80	5.26
591.2	29.4	509.81	5.22
593.3	33.5	509.81	5.53
594.8	27.4	510.59	9.40
595.5	16.8	511.65	5.42
595.6	35.4	514.03	5.23
596.4	20.9	514.31	5.19
597.9	33.6	514.35	5.23
598.2	13.7	515.47	5.32
601.0	20.2	515.98	5.27
601.8	23.1	516.19	5.24
602.4	11.5	517.37	5.33
602.4	21.5	517.67	5.24
603.9	13.5	517.70	5.22
604.0	43.5	520.60	5.54
606.9	21.0	520.90	5.39
607.5	5.9	521.03	5.56
608.2	5.8	521.17	5.41
608.3	18.3	522.19	5.37
608.8	17.5	522.30	5.28
610.9	5.8	522.38	5.44
611.9	18.8	523.36	5.32
612.9	11.0	523.43	5.40
617.2	9.6	523.91	5.29
618.0	9.2	523.94	5.36
619.0	44.1	523.98	5.61
619.1	14.9	524.90	5.54
619.7	14.1	525.42	5.55
620.0	33.0	525.46	5.34
620.2	34.1	525.62	5.52
620.8	17.0	526.15	5.43
621.3	16.8	526.47	5.39
621.7	8.8	527.56	5.59
623.2	15.4	527.94	5.92

623.5	46.9	529.31	5.38
626.4	25.2	529.49	5.39
630.3	6.8	531.06	5.35
630.7	6.5	532.94	5.48
631.2	27.8	533.60	5.59
632.6	14.9	534.82	5.64
634.2	7.7	537.59	5.42
634.3	52.5	539.32	5.46
635.7	16.7	540.68	6.31
637.6	22.8	542.68	5.69
638.1	32.5	545.45	6.26
638.5	11.8	546.68	5.62
641.3	16.0	546.75	5.55
643.0	13.5	547.83	5.64
643.2	43.7	550.78	5.82
646.8	13.3	552.38	5.74
648.3	6.2	553.00	5.60
648.5	47.1	554.36	5.61
649.3	41.7	558.44	6.39
649.4	21.3	560.53	5.98
650.0	8.1	562.58	5.90
652.9	11.6	564.33	5.88
658.0	25.7	565.88	5.76
658.7	12.7	572.37	5.89
660.3	16.6	572.48	6.19
660.4	28.2	574.17	5.89
661.5	16.6	574.89	6.78
661.8	20.3	579.65	5.90
663.8	40.5	582.79	5.93
664.7	44.4	583.32	6.24
664.9	11.5	587.42	5.99
665.1	48.4	592.16	6.26
669.7	6.4	593.04	7.36
669.8	24.8	595.99	6.03
673.3	49.2	597.12	6.07
673.8	14.8	600.68	6.38
674.0	20.7	602.12	7.07
674.9	30.4	605.06	6.38
679.2	38.2	605.94	6.15
681.7	37.5	609.33	6.20
682.4	65.3	613.43	6.24
682.7	12.6	614.29	6.33
684.3	11.0	616.75	6.38
685.3	39.7	617.05	6.51
688.6	9.1	617.64	6.38
688.6	13.7	620.44	6.32
690.0	28.6	622.48	6.26
691.2	31.1	624.04	7.24
691.8	13.4	625.62	6.30
693.1	9.4	628.26	6.35

693.4	21.8	628.32	6.46
694.7	31.2	629.79	6.38
695.0	15.8	632.49	7.11
695.6	51.2	663.23	7.12
696.5	12.5	670.54	6.75
698.1	23.4	674.15	6.96
699.8	15.6	698.61	7.11
700.1	10.1	700.58	7.04
700.2	60.4	712.51	7.37
701.6	20.6	714.89	7.37
701.7	25.8	720.07	7.89
702.4	29.8	725.13	7.93
702.6	26.1	734.11	7.88
710.7	43.5	740.01	7.46
711.0	23.2	745.38	8.31
714.7	59.5	762.92	8.09
715.4	26.8	770.37	7.90
715.5	47.4	775.54	8.03
716.2	28.7	843.66	8.80
716.6	64.8	849.93	8.54
718.0	31.1	862.15	8.69
718.1	8.5	878.50	8.93
718.4	57.3	882.20	11.03
720.2	25.6	889.37	9.56
730.0	35.5	892.93	9.52
734.5	43.7	902.06	9.15
734.6	30.6	913.96	9.32
735.8	24.9	923.30	9.39
736.1	39.6	982.25	9.97
737.3	10.0	998.14	10.18
738.5	9.5	1025.63	10.41
743.1	43.1	1056.73	10.71
743.7	31.4	1072.12	11.68
745.8	18.2	1108.09	11.44
748.7	38.8	1123.53	11.36
750.4	40.3	1243.50	16.39
751.7	21.4	1250.04	14.66
753.4	17.7	1266.49	12.89
754.4	38.3	1274.91	13.38
755.0	32.6	1300.94	20.81
756.9	60.5	1323.77	13.45
758.1	69.0	1338.62	14.04
759.9	74.4	1396.06	14.35
762.7	32.8	1446.70	14.60
764.8	29.6	1472.84	15.55
765.5	55.3	1672.24	17.38
771.4	20.7	2164.01	21.84
773.2	16.2	2190.54	207.36
777.6	32.6	2205.08	22.32
783.6	43.7	414.99	6.26

785.0	21.3	418.71	7.42
787.4	33.4	419.59	5.19
790.4	57.7	421.05	14.34
794.0	23.5	421.86	30.58
798.2	14.5	436.69	7.92
800.3	10.5	449.58	5.49
801.1	21.9	458.02	5.27
803.8	36.5	460.98	4.71
803.9	9.7	465.33	5.30
808.6	67.9	469.93	5.20
810.4	12.9	471.83	4.95
812.9	20.9	472.15	5.64
813.1	25.3	473.08	16.00
814.0	26.6	473.14	43.89
816.6	28.3	474.16	5.53
816.7	15.6	476.15	5.13
823.1	14.5	477.05	5.23
827.5	13.6	477.58	5.21
830.0	63.4	478.41	5.02
831.2	28.7	478.78	10.01
831.7	49.1	478.85	5.32
838.9	39.9	479.57	4.96
840.4	60.7	481.57	5.07
842.5	21.0	482.25	5.91
843.9	9.3	482.82	4.92
847.2	21.5	483.09	23.65
848.8	25.2	483.43	5.14
850.6	29.5	484.48	6.57
851.2	20.6	485.08	6.31
852.8	44.7	485.83	5.14
854.7	8.3	486.28	5.68
856.2	23.5	486.73	5.80
856.3	46.6	486.91	5.18
857.2	33.3	486.98	5.04
857.3	68.7	487.17	5.14
858.8	15.2	487.22	5.12
859.2	23.8	487.41	7.59
860.0	26.7	487.88	5.20
860.4	16.8	488.01	9.61
860.5	17.5	488.58	5.28
860.9	17.0	489.51	5.67
861.6	19.1	489.84	5.08
863.2	20.5	490.21	6.98
863.3	29.8	491.02	5.38
864.7	9.2	491.57	4.97
864.7	38.2	491.83	6.56
865.0	22.2	492.34	7.12
865.9	36.0	492.89	4.98
868.5	13.5	493.21	5.13
868.6	25.7	493.90	5.70

869.7	14.8	494.27	5.87
872.6	28.7	494.59	6.22
875.0	43.1	495.10	5.61
878.8	14.4	495.31	5.06
879.9	9.3	495.69	5.12
881.8	21.2	495.77	5.77
882.7	52.5	496.09	5.20
882.8	14.4	496.31	5.38
883.3	18.9	496.34	5.93
883.3	34.3	496.37	5.31
884.0	30.3	497.19	5.03
884.6	30.3	497.43	5.16
884.8	51.8	498.09	5.58
885.3	36.9	498.10	5.32
886.8	13.6	498.21	5.25
887.5	34.1	498.24	5.27
888.0	11.5	498.61	5.68
888.1	31.8	498.77	5.45
888.6	24.3	499.38	5.17
889.0	23.0	499.46	11.33
889.5	84.0	499.46	5.87
889.9	8.3	500.12	5.23
891.2	9.9	500.17	8.59
892.2	48.8	500.59	5.99
894.1	13.2	500.81	5.30
894.4	22.9	503.08	5.46
894.8	24.2	503.83	6.71
894.9	8.4	503.90	5.14
895.9	24.1	504.21	5.08
897.2	48.7	504.45	5.30
898.5	17.8	504.52	6.10
899.6	17.0	504.64	5.39
900.1	19.9	504.78	5.23
901.1	26.5	505.26	5.18
901.1	87.5	505.93	20.97
901.9	29.3	506.83	5.95
903.1	20.2	506.86	5.22
903.5	18.7	507.67	5.27
903.6	11.9	507.67	6.38
904.8	8.9	507.85	5.37
905.4	15.4	507.92	5.75
908.2	35.7	508.29	5.31
909.7	20.1	508.65	5.13
910.2	24.8	508.76	5.35
911.1	55.0	508.86	5.67
912.5	16.2	509.27	8.80
914.8	13.2	509.54	5.60
915.0	16.4	509.74	5.58
915.4	18.9	510.54	5.86
915.6	53.6	511.37	7.84

916.9	8.5	511.71	5.78
917.2	29.3	513.30	5.70
917.7	19.3	515.49	6.07
918.2	27.1	515.86	6.06
919.9	19.4	516.27	5.31
920.2	12.5	516.78	6.89
920.5	28.5	516.87	8.84
921.1	28.2	520.26	8.98
921.2	13.3	520.45	5.67
923.1	9.7	520.81	6.66
923.6	32.0	521.20	7.32
924.0	14.8	521.76	5.49
924.0	11.7	522.69	5.80
925.6	22.5	525.44	6.99
927.2	57.7	526.37	5.49
927.3	24.1	527.08	5.50
928.4	70.7	529.10	6.91
928.5	10.6	531.66	7.54
930.7	18.4	531.94	9.71
931.4	14.9	533.76	7.05
931.6	41.7	536.20	5.59
932.3	18.1	538.76	5.76
932.4	37.5	538.79	5.67
932.8	30.7	545.59	6.66
932.9	52.4	549.74	5.57
933.1	15.7	550.17	7.16
933.2	35.9	553.05	7.30
933.4	61.7	570.20	8.08
933.9	13.2	574.63	8.58
934.1	26.5	578.20	6.03
934.1	10.6	581.78	6.24
934.6	43.7	589.45	6.84
937.6	24.0	589.62	6.38
938.5	13.4	593.56	6.31
939.5	40.9	594.87	6.10
939.6	70.9	600.08	11.58
940.5	70.5	603.80	11.74
941.3	28.2	609.35	9.84
941.8	27.8	620.75	6.27
942.9	12.3	638.65	6.47
943.0	53.0	640.05	6.47
943.1	53.8	646.13	6.76
944.3	40.8	660.60	40.28
944.9	25.5	669.52	7.10
944.9	39.4	675.71	7.63
946.2	40.5	681.21	6.93
946.4	40.0	689.00	8.02
946.7	8.8	691.14	7.27
946.8	19.4	698.97	7.46
949.5	35.6	741.77	8.05

950.9	19.7	742.55	11.25
950.9	32.5	799.31	8.16
951.2	69.8	828.29	9.51
952.2	17.3	832.29	10.66
953.7	95.2	1349.72	13.60
954.2	18.6	1526.67	16.37
954.4	20.6	1887.97	19.50
955.3	15.5	2411.93	24.50
955.7	22.4	3189.22	108.11
956.0	18.5	489.64	5.21
956.2	41.6	495.84	5.15
956.8	32.7	496.04	5.17
957.0	18.7	498.70	5.09
957.4	23.5	499.01	5.18
957.5	15.3	499.70	5.09
958.7	28.8	499.91	5.11
960.0	18.0	500.38	5.04
962.2	36.1	501.34	5.15
963.0	30.2	502.04	5.19
964.0	54.3	502.58	5.15
964.8	12.2	502.88	5.21
965.5	12.5	503.32	5.10
965.6	38.6	503.33	5.11
965.9	71.6	504.31	5.18
966.1	53.9	504.35	5.17
966.1	38.9	504.61	5.22
969.0	9.0	505.47	5.19
970.0	33.4	508.36	5.12
970.8	16.5	511.67	5.16
971.0	15.4	517.29	5.24
971.3	30.8	521.94	5.25
971.4	34.6	531.85	5.38
973.2	44.2	538.00	5.40
973.6	12.4	542.30	5.57
974.3	12.4	543.62	5.47
974.9	36.7	551.48	5.66
975.9	20.1	554.77	5.94
977.8	33.2	582.69	5.97
978.7	16.6	606.80	6.31
982.5	67.9	616.80	6.33
982.6	20.4	1423.21	15.83
982.8	67.2	1815.50	110.62
986.7	51.3	1863.95	82.04
987.7	34.5	2767.23	150.16
989.4	9.6	3015.56	131.64
992.0	40.9	4144.39	176.86
992.7	21.8		
993.6	52.2		
993.9	23.6		
994.1	9.2		

994.9	56.5
997.3	9.2
1000.1	15.1
1001.0	25.9
1001.6	21.9
1002.5	68.1
1004.4	19.3
1004.7	17.2
1006.8	34.4
1008.7	16.2
1009.3	21.0
1009.6	17.8
1010.6	16.9
1012.3	26.4
1012.4	64.5
1014.0	17.8
1014.6	54.9
1016.2	64.2
1022.7	28.8
1024.0	22.4
1025.2	14.2
1025.6	33.1
1026.0	64.3
1026.2	20.9
1026.2	43.2
1029.5	25.7
1030.3	17.2
1033.2	60.0
1035.3	58.6
1036.5	12.1
1038.6	32.7
1039.5	25.1
1040.2	20.7
1040.2	51.3
1042.0	35.2
1042.6	49.4
1045.9	53.6
1057.3	34.1
1063.0	27.5
1070.1	24.5
1074.2	29.0
1081.9	67.9
1083.1	81.3
1083.7	34.5
1087.4	45.7
1087.8	34.6
1088.2	19.4
1089.2	94.5
1094.5	69.2
1094.6	23.2

1099.3	23.9
1100.1	46.0
1103.5	95.0
1109.1	51.2
1117.3	34.8
1120.4	59.3
1133.2	47.8
1142.4	73.8
1149.8	67.4
1153.8	36.5
1161.3	68.6
1162.0	44.1
1170.8	114.9
1174.2	71.8
1175.8	56.2
1175.8	71.5
1179.7	69.7
1180.5	63.2
1195.3	31.6
1201.6	81.1
1226.2	85.0
1257.8	82.5
1258.5	60.2
1265.8	72.0
1275.6	77.1
1283.8	133.4
1322.9	116.9
1336.2	70.4
1339.4	19.4
1352.0	98.0
1389.5	42.1
1398.2	147.3
1452.6	54.2
1477.6	59.4
1504.7	45.3
1509.8	70.1
1563.2	40.1
1589.2	104.2
1637.1	29.5
1644.0	216.0
1647.0	74.8
1657.1	72.3
1657.8	346.7
1698.5	118.6
1715.9	29.5
1718.3	231.4
1722.3	106.8
1746.2	68.6
1769.5	76.4
1779.1	18.6

1798.5	162.3
1856.6	60.8
1868.2	55.5
1922.0	137.4
1931.5	51.4
2000.3	71.3
2001.5	58.3
2007.1	48.6
2023.3	31.9
2026.8	124.0
2032.2	35.9
2047.2	30.6
2057.3	32.0
2073.6	29.8
2092.6	70.7
2113.5	37.4
2155.4	67.9
2184.2	24.2
2295.2	33.7
2317.4	30.7
2396.1	66.0
2419.4	27.6
2444.1	45.5
2480.3	58.0
2494.6	65.2
2564.1	34.8
2678.5	152.2
2680.4	38.4
2682.3	47.3
2687.8	34.7
2715.4	36.9
2716.9	25.4
2722.4	22.1
2727.8	34.8
2734.2	79.2
2745.2	16.5
2748.1	43.2
2753.9	67.9
2781.2	52.6
2803.6	89.2
2856.4	56.0
2900.2	65.4
2994.9	43.0
3102.2	38.6
3110.7	61.2
3140.1	26.4
3199.1	34.5
3439.3	105.0
3454.1	15.5
3481.8	48.8

3496.2	97.2
3525.4	73.3

Wilkes Land (Cores 20-22)

n= 302		***n= 225***		***n= 116***	
U Pb Z	± (Ma)	ArAr Hb	± (Ma)	ArAr Bio	± (Ma)
111.2	4.5	661.15	7.02	1118.64	11.38
115.4	8.6	1135.28	13.45	1123.23	11.49
130.9	12.1	1150.81	11.89	1493.72	15.23
480.4	8.2	1155.78	11.90	1076.41	11.10
501.1	5.4	1164.09	12.10	1115.44	11.46
557.2	19.7	1172.68	11.95	1126.72	11.58
561.3	18.3	1364.59	13.90	1128.97	11.53
572.7	7.6	1477.64	16.28	1115.94	11.47
578.8	14.5	1164.88	12.45	1139.43	11.66
1095.1	46.3	3.49	5.20	1119.73	11.48
1095.8	43.4	1203.83	12.95	1157.96	11.92
1122.3	22.5	1163.85	12.55	1128.95	11.52
1127.2	11.4	582.21	7.53	1112.16	11.69
1129.0	28.9	1113.89	11.89	1121.64	11.46
1129.1	4.4	671.18	7.99	1121.45	11.56
1129.6	26.4	1242.90	13.98	1097.12	11.31
1130.1	75.7	798.07	8.61	1514.11	15.49
1130.5	35.5	1152.40	12.31	861.02	10.36
1131.5	56.8	23.52	5.90	1087.61	12.56
1131.7	12.2	1135.87	11.93	1091.56	11.67
1132.2	20.7	1138.62	11.84	1100.04	11.46
1132.6	30.9	1164.48	11.92	1101.33	18.67
1133.0	12.0	1172.05	12.03	1104.58	14.75
1135.4	53.6	1172.70	12.13	1105.80	14.48
1135.5	31.1	1180.25	12.10	1108.61	16.60
1136.1	15.4	1189.16	13.60	1111.74	13.51
1136.3	10.8	1169.11	17.03	1119.46	13.57
1136.4	27.5	1133.51	16.43	1121.06	14.30
1136.7	10.5	1190.81	17.71	1132.90	14.92
1137.0	33.8	1162.95	16.82	1109.10	11.40
1137.4	14.4	1147.23	16.85	1115.09	11.57
1137.7	18.4	1157.32	17.71	1137.77	11.62
1138.4	49.7	1265.49	18.15	1126.58	11.46
1140.0	9.3	1190.66	17.06	1117.68	11.48
1140.1	6.0	1250.07	12.81	1126.77	11.82
1141.4	13.3	1632.84	16.75	1120.47	11.67
1142.1	15.3	1302.18	13.50	829.41	8.92
1143.6	18.0	1194.11	13.51	1146.70	11.70
1144.6	13.7	2017.55	21.91	1119.21	11.63
1146.0	7.6	2309.63	23.94	1146.40	11.70
1146.9	35.8	1143.85	15.21	1141.36	11.64
1147.1	10.1	1497.16	17.31	1224.60	12.68

1147.6	9.0	1171.64	12.55	2156.93	21.90
1147.9	26.3	1197.80	12.44	1144.79	11.76
1148.0	15.1	1152.30	12.10	1106.67	11.55
1149.9	15.4	1250.00	15.64	1094.77	11.11
1149.9	17.7	1496.50	16.17	1144.80	11.95
1150.2	12.5	1481.72	15.39	1167.45	12.21
1150.3	22.2	1149.73	11.95	1107.49	11.37
1150.4	15.1	1155.49	11.90	1123.87	11.59
1150.6	34.0	1195.63	12.25	1102.29	11.73
1151.2	20.4	1330.53	15.38	1490.83	15.35
1151.7	14.5	1489.89	15.13	1141.51	11.79
1151.8	29.6	1549.89	15.84	1265.44	39.27
1152.7	37.1	2330.49	23.83	1113.06	11.41
1153.5	12.6	354.21	5.24	1111.21	13.91
1153.6	17.0	1128.40	12.41	1230.36	12.85
1154.7	21.4	1131.54	11.67	1150.86	11.95
1156.5	41.2	1131.66	11.63	1155.97	12.09
1156.6	16.5	1132.31	11.68	1115.91	15.96
1158.1	23.0	1136.43	11.76	1110.56	16.02
1158.1	22.1	1141.05	11.87	1161.58	16.78
1158.2	10.4	1144.09	11.70	1117.22	16.15
1158.2	13.0	1145.53	12.09	1304.94	18.66
1158.4	14.9	1147.65	11.92	1104.13	15.78
1158.8	42.0	1156.84	11.89	1131.00	16.19
1159.1	18.7	1158.13	11.93	1261.66	18.03
1159.6	27.2	1160.66	12.30	1144.29	16.38
1160.1	29.0	1162.95	11.96	1119.88	16.05
1161.0	23.7	1164.69	12.10	987.44	14.16
1161.7	17.4	1167.60	12.06	1097.45	15.70
1162.6	70.4	1167.65	12.16	1130.20	16.12
1162.9	13.6	1169.02	12.05	1106.18	15.87
1163.5	26.2	1174.08	12.56	1074.88	15.55
1165.0	32.9	1176.90	12.07	1208.59	17.52
1166.0	96.1	1199.60	12.28	387.36	17.18
1166.1	49.8	1215.96	12.56	938.30	20.97
1166.1	48.7	1273.31	13.19	1039.19	17.92
1170.9	16.8	1351.98	15.05	1098.66	15.29
1172.3	34.5	1405.44	14.49	1100.75	14.80
1172.9	58.3	1433.47	14.84	1108.44	13.04
1173.7	21.2	1456.67	14.93	1115.24	13.75
1173.8	76.9	1463.81	15.19	1123.05	13.52
1174.4	32.7	1479.88	15.68	1125.66	13.89
1174.5	19.4	1519.52	16.06	1159.67	15.00
1174.6	36.9	1528.19	16.44	1260.86	18.45
1174.6	53.4	1528.79	15.99	499.54	5.18
1174.7	68.8	1634.40	16.95	510.41	5.27
1176.9	50.9	1705.84	18.04	854.75	8.79
1176.9	10.0	1709.72	17.61	1075.20	11.03
1178.6	26.9	1711.30	17.73	1091.06	11.18
1178.7	40.5	1765.31	17.98	11.35	4.34

1180.2	32.7	1777.05	19.04	456.19	4.81
1180.2	26.0	1881.16	19.20	463.47	5.04
1181.4	34.1	1941.65	19.94	652.15	7.63
1184.6	54.7	1967.55	20.61	935.01	9.66
1190.2	63.1	2421.16	24.79	1085.08	11.08
1191.8	21.0	1114.94	11.31	1104.12	11.43
1192.0	70.9	1134.05	11.98	1111.97	11.41
1194.2	118.6	1136.08	11.80	480.13	8.73
1198.5	166.8	1140.21	11.81	487.90	8.50
1204.8	87.9	1141.29	11.85	921.00	16.96
1209.6	38.3	1142.67	11.80	400.31	11.21
1209.9	40.6	1148.37	13.11	478.21	11.81
1212.0	121.5	1149.30	12.15	428.01	9.08
1219.6	50.0	1159.79	12.76	1065.65	18.20
1219.8	86.6	1164.79	14.15	438.12	5.37
1220.7	83.0	1172.67	12.34	438.41	5.23
1221.7	120.0	1174.08	12.09	494.56	13.53
1224.1	59.8	1181.19	12.09	855.80	11.87
1239.6	141.8	1184.34	12.64	943.56	45.04
1240.7	102.7	1185.99	12.11	1083.44	11.52
1256.8	107.0	1196.78	12.20	1090.93	27.68
1262.1	60.9	1198.39	12.52	1138.72	22.40
1268.6	129.4	1200.63	12.38	1195.70	23.93
1271.8	201.3	1203.90	12.41	1339.83	15.96
1273.4	155.3	1211.60	12.89		
1282.8	118.5	1219.77	12.43		
1287.7	117.2	1224.28	13.03		
1292.3	113.3	1246.76	12.89		
1321.2	146.6	1290.41	13.91		
1323.2	148.6	1377.52	14.58		
1351.9	155.2	1404.74	15.16		
1367.6	133.8	1408.32	14.88		
1394.3	83.4	1424.27	14.54		
1401.7	78.2	1441.57	15.11		
1402.3	142.2	1463.05	15.47		
1416.9	99.5	1478.40	15.33		
1417.3	18.0	1480.46	15.84		
1422.2	116.1	1512.70	15.47		
1431.4	65.8	1571.96	16.19		
1437.3	20.7	1599.73	16.68		
1442.5	79.1	1608.50	17.57		
1447.6	59.2	1623.86	16.94		
1452.6	132.9	1909.37	23.64		
1461.7	89.7	1121.27	11.55		
1462.2	16.7	1128.57	11.58		
1466.6	20.7	1139.19	11.74		
1471.3	39.2	1179.44	12.17		
1478.1	71.5	1257.95	12.87		
1481.1	13.4	1114.88	11.55		
1483.6	15.1	1205.27	12.42		

1483.7	16.5	1128.56	11.67
1487.8	40.7	1447.51	14.93
1490.4	9.0	1363.31	14.34
1492.8	26.0	2055.67	44.83
1494.3	12.1	1225.68	12.87
1495.6	4.4	1125.53	11.54
1496.5	14.1	1293.45	43.27
1498.8	48.3	1216.49	13.79
1500.4	23.2	1127.20	11.82
1503.3	77.1	1386.57	15.59
1503.4	15.6	538.86	5.94
1505.6	6.9	1089.91	19.32
1506.8	23.3	1110.61	11.80
1506.9	84.3	1117.64	11.57
1507.0	8.3	1120.72	11.63
1507.8	7.5	1123.22	12.05
1509.9	5.8	1131.44	12.76
1509.9	15.9	1132.86	12.26
1510.3	8.7	1136.59	11.68
1510.8	47.2	1137.47	11.63
1512.0	16.2	1138.27	11.88
1512.9	20.4	1162.46	12.83
1513.1	21.5	1181.73	12.33
1516.1	66.4	2013.32	21.49
1516.6	12.1	1080.87	11.22
1518.9	17.7	1101.66	11.38
1519.3	15.2	1110.77	11.94
1519.4	81.6	1162.06	12.21
1519.8	14.2	1172.56	11.98
1520.0	14.9	1175.81	12.69
1523.5	29.1	1193.63	16.78
1524.2	44.7	1198.64	12.86
1525.7	12.7	1199.20	12.49
1526.4	48.6	1215.28	12.68
1526.5	59.7	1255.46	13.59
1526.6	5.8	1257.53	13.82
1527.2	13.7	1283.92	14.28
1528.8	98.4	1288.17	15.69
1529.0	11.3	1684.36	23.54
1532.1	21.5	1815.36	18.50
1534.1	22.6	1321.77	13.89
1534.6	13.0	1198.93	13.92
1535.1	12.8	1559.73	16.35
1535.2	20.7	1116.69	11.40
1535.4	27.3	1160.99	11.87
1537.9	26.6	1143.01	12.51
1538.4	38.8	418.11	4.93
1538.4	8.7	1174.07	12.79
1539.5	21.4	1253.57	13.12
1540.8	11.0	1062.59	11.19

1542.8	5.7	2752.20	28.78
1543.3	14.7	1151.77	11.98
1544.1	19.7	952.89	11.59
1544.2	23.7	954.39	11.35
1544.5	23.8	1170.33	12.18
1545.0	8.5	1345.95	13.75
1546.1	10.7	1110.72	11.84
1547.0	32.7	1107.00	11.31
1547.5	74.2	1116.08	11.62
1548.4	27.7	1059.18	10.95
1549.5	28.0	1142.17	11.76
1550.7	8.1	1284.20	13.07
1551.6	14.8	1150.40	11.80
1552.1	56.4	1128.27	12.75
1552.3	8.5	1144.21	12.08
1553.9	12.2	1152.68	12.06
1554.0	9.7	1064.73	11.88
1555.7	7.7	1107.84	12.17
1555.7	10.6	1085.39	11.82
1555.8	38.8	1118.47	11.54
1555.9	11.2	1120.20	11.60
1556.4	53.5	1494.71	16.19
1557.0	51.8	1252.39	12.74
1560.0	6.4	1204.24	12.81
1560.7	12.6	1351.01	15.05
1561.2	3.7	1131.44	12.05
1561.5	7.7	1116.00	11.71
1561.8	28.8	1010.27	10.42
1562.0	18.1	1376.48	14.07
1562.6	12.6	1302.40	13.40
1563.0	17.0	1449.42	16.97
1563.4	5.7	1432.81	14.77
1563.5	48.6	1146.33	14.49
1564.4	6.8		
1566.1	49.6		
1566.9	9.0		
1567.1	70.3		
1568.9	62.9		
1569.0	7.1		
1569.4	14.6		
1569.6	9.3		
1569.8	52.8		
1571.1	24.1		
1571.6	7.5		
1571.8	13.6		
1572.5	33.0		
1573.4	9.0		
1573.5	36.9		
1574.8	11.2		
1576.2	43.9		

1576.3	59.5
1577.3	87.0
1579.9	9.8
1580.6	36.3
1580.9	2.6
1581.0	37.6
1581.9	23.0
1582.0	14.8
1582.6	6.8
1583.1	45.8
1583.2	4.0
1584.9	12.4
1585.5	6.3
1586.1	24.8
1586.8	51.2
1587.8	4.2
1588.3	37.9
1589.2	4.6
1590.7	6.3
1590.8	19.9
1591.0	59.1
1592.2	55.6
1593.7	19.4
1593.8	12.2
1594.6	10.0
1595.3	16.1
1596.7	12.3
1599.4	19.5
1600.7	27.2
1600.8	58.1
1601.5	5.6
1601.9	54.0
1602.9	9.3
1606.2	31.2
1606.6	72.9
1607.2	8.3
1607.6	25.8
1607.8	63.0
1609.1	25.7
1610.1	17.9
1610.3	87.4
1610.8	64.8
1615.1	35.6
1624.9	68.7
1625.9	22.6
1627.0	28.3
1637.4	47.6
1637.8	123.1
1638.4	53.3
1655.4	32.8

1673.2	54.1
1706.9	11.0
1716.4	566.9
1734.7	13.7
1764.7	35.8
1774.8	5.0
1825.9	130.2
2411.0	609.1
2641.3	15.9
2811.6	2.6

Adélie Land (Cores 23-28)

n= 254		***n= 267***		***n= 217***	
U Pb Z	± (Ma)	ArAr Hb	± (Ma)	ArAr Bio	± (Ma)
508.6	9.9	1715.69	18.38	429.50	9.73
604.6	12.5	1429.27	15.53	436.90	10.78
607.0	12.0	1287.67	13.76	462.78	10.87
707.7	40.2	1609.36	17.03	488.27	6.69
1604.5	62.9	1660.62	18.55	492.83	12.42
1655.3	213.8	1874.23	19.70	495.08	12.59
1770.7	83.7	1547.56	16.34	535.89	17.99
1969.5	162.7	98.82	1.57	547.15	9.39
2441.7	83.2	4.25	0.36	712.11	17.72
2521.0	123.0	127.65	2.59	1385.58	28.37
55.0	3.0	132.07	2.32	365.60	3.75
132.3	2.2	301.62	7.16	367.49	3.78
489.0	12.8	894.37	10.89	373.81	3.91
497.0	7.5	1448.51	15.37	481.18	4.95
509.0	27.4	1495.99	15.61	369.93	4.00
514.0	4.9	1583.04	17.06	364.13	3.79
532.2	18.1	1681.20	17.14	484.77	4.98
549.0	15.8	1690.03	17.50	365.50	3.89
554.8	13.8	1748.56	19.15	367.67	3.77
569.2	31.7	1755.44	19.16	370.11	4.18
577.8	5.0	1768.87	18.25	335.96	3.55
577.8	9.8	1785.31	18.21	360.51	3.79
587.5	6.0	1841.73	19.55	365.59	3.80
593.1	22.8	4063.12	65.06	367.53	3.96
594.2	14.5	115.51	2.19	370.24	4.09
652.4	24.3	539.00	8.47	277.74	3.83
861.8	32.3	128.60	5.24	444.88	8.57
1088.6	22.4	1659.30	21.81	1144.21	17.47
1102.2	11.5	1531.21	32.42	412.01	7.41
1105.4	28.6	1693.48	21.77	738.92	12.00
1140.3	80.2	1789.98	23.53	185.52	62.22
1161.5	6.5	1651.45	28.20	1061.70	16.61
1173.3	103.8	1707.68	22.97	1058.20	16.31
1599.9	11.9	1785.69	24.88	361.98	6.77

1629.2	7.9	1778.57	23.90	363.21	4.79
1739.4	24.5	1794.48	25.53	368.80	4.97
1793.1	5.7	1676.81	22.69	370.39	5.89
1900.7	7.5	1687.60	23.91	370.43	9.02
2373.8	3.1	1783.25	25.18	376.43	6.60
2442.1	36.5	1894.38	25.04	376.55	6.06
2455.0	2.9	1592.35	23.83	380.43	6.68
2474.6	26.4	493.27	7.92	386.85	7.34
2716.0	16.8	1712.31	24.97	429.77	11.87
3207.1	3.1	1761.06	24.11	472.63	30.12
2433.9	40.5	1595.23	23.08	493.56	7.06
2452.0	79.8	482.65	11.67	105.20	1.13
2462.6	53.4	537.29	5.68	127.39	1.48
2942.2	45.3	1477.50	15.93	303.00	3.22
1748.2	5.7	1506.14	15.53	376.73	3.87
2473.7	47.3	1536.30	15.72	446.65	4.80
2224.3	62.9	1611.67	16.41	473.08	4.82
2439.7	2.8	1651.82	17.33	483.97	4.94
1806.6	313.3	1695.06	17.28	488.76	4.99
1771.8	15.9	1697.05	17.84	491.19	5.58
2394.0	16.8	2214.30	25.47	497.64	5.06
1712.0	3.6	219.20	2.42	501.15	5.11
1617.2	9.7	355.93	4.05	521.42	5.35
1603.4	13.8	530.98	6.05	523.60	5.48
445.4	15.4	1262.30	13.76	561.69	5.75
2396.7	34.9	1265.39	13.78	895.14	9.14
1774.4	14.1	1346.88	14.24	1126.86	11.66
519.3	19.1	1611.75	16.54	516.23	10.93
319.4	28.6	1668.36	17.01	367.34	6.85
501.2	4.8	1650.51	17.81	489.12	13.28
514.4	29.3	1729.90	18.17	84.99	4.73
516.4	5.9	1704.86	17.30	345.38	20.11
532.0	20.8	2212.65	25.61	477.01	11.54
552.8	5.3	1506.80	38.62	983.84	16.31
561.4	5.4	1431.76	14.46	369.83	6.57
574.2	5.5	1613.05	16.58	389.56	6.65
597.7	5.7	1091.91	11.05	394.96	7.08
599.2	5.7	1729.59	18.22	401.24	4.77
610.7	5.8	1546.05	15.91	428.89	23.90
628.5	6.0	1726.78	19.00	466.90	5.98
804.3	8.9	1756.08	18.33	496.42	15.22
1135.9	61.4	1420.01	14.98	510.72	13.01
1930.1	94.1	1757.43	17.74	527.16	9.18
2361.0	58.2	1696.20	17.11	633.15	11.88
3305.4	25.1	3248.97	32.89	374.14	3.88
266.9	5.1	1158.37	11.73	372.74	3.84
364.8	10.9	1579.50	15.94	363.41	3.73
394.2	14.7	1929.63	19.57	474.86	5.02
489.7	52.2	1708.95	17.51	374.94	3.95
529.6	11.7	2002.07	20.51	414.16	4.40

534.0	15.3	1687.44	17.16	352.13	3.86
539.4	19.1	1754.11	17.76	355.18	3.75
540.6	15.3	1752.28	17.90	362.41	4.13
541.6	60.1	1613.82	16.39	356.48	3.75
548.4	7.9	1743.42	17.67	375.11	4.12
559.7	69.7	1829.16	19.12	380.48	4.29
560.4	12.8	2282.94	24.26	310.44	6.30
562.7	49.1	1895.70	19.38	348.52	8.62
563.1	15.9	1651.09	17.13	361.24	9.50
565.9	12.7	1578.70	15.98	362.98	7.30
566.6	18.1	1665.35	16.95	371.12	31.88
570.5	13.4	1821.41	18.71	376.06	5.26
572.0	14.7	1943.71	19.71	381.01	8.79
575.4	30.9	1754.90	17.80	385.70	8.78
576.1	51.8	1433.78	14.46	394.80	12.71
576.3	18.8	1566.18	15.84	407.21	12.69
576.6	25.8	2888.19	32.15	647.68	9.50
577.7	25.6	2463.99	26.63	111.29	1.36
578.7	9.4	1667.74	16.92	459.80	4.84
579.2	17.2	1568.37	16.14	487.55	5.11
580.2	10.2	2078.62	22.77	489.99	5.23
581.0	7.8	1477.08	15.02	490.03	5.15
586.4	13.3	1602.77	16.42	495.06	4.99
589.3	10.2	1542.40	15.68	499.77	5.06
589.8	30.4	1689.76	17.12	1479.01	14.93
593.4	44.2	1676.27	17.06	1493.07	16.43
599.9	14.5	2541.76	27.04	1559.09	15.75
603.7	17.2	1712.19	18.00	1590.40	16.75
604.6	15.2	2285.84	23.57	1647.52	17.20
637.3	5.4	1819.36	18.50	1670.83	17.64
890.5	31.9	1784.25	19.07	1698.71	18.61
902.6	102.9	2454.30	25.02	481.45	5.09
941.1	18.0	1458.82	15.46	491.55	5.18
961.2	23.4	180.01	3.99	493.08	5.27
1033.7	106.5	431.69	66.52	493.11	5.30
1048.4	13.3	494.82	7.86	496.37	5.15
1054.0	165.3	514.84	6.12	500.73	5.11
1122.5	33.1	517.76	5.72	512.22	5.30
1146.3	65.8	599.15	35.83	1628.08	19.52
1170.8	64.8	613.47	7.19	1668.48	18.19
1181.7	40.0	1041.39	12.58	1679.27	18.94
1210.8	32.4	1474.84	15.24	1707.45	18.30
1234.0	50.5	4.97	4.76	1734.03	19.55
1426.8	89.6	247.33	47.42	1744.95	19.12
1455.0	17.7	490.53	5.62	1767.14	19.31
1476.4	35.3	1520.61	27.35	53.63	1.55
1584.2	13.0	1649.56	18.53	97.64	1.09
1598.6	5.8	485.65	5.40	438.55	4.78
1610.5	10.1	557.22	5.79	457.01	5.17
1617.3	20.4	1089.09	11.20	463.15	4.94

1687.1	10.7	1129.54	11.60	466.83	4.86
1722.1	3.6	1231.46	12.89	492.55	5.08
2509.6	25.8	1426.46	14.77	493.67	5.08
2510.5	27.5	1435.37	14.80	494.76	5.09
2514.0	6.7	1460.30	15.69	1393.71	14.28
2712.1	9.6	1476.42	15.37	1554.62	15.98
2714.0	6.0	1555.43	16.54	1575.93	16.03
3080.5	12.2	1741.76	18.04	1604.52	16.38
3359.7	5.6	1881.66	19.95	1630.59	16.86
479.3	9.0	3299.22	47.90	1562.81	16.26
560.0	12.7	529.71	9.99	459.54	5.00
1714.2	172.9	1430.01	23.11	517.58	5.59
284.3	3.7	1191.49	16.81	481.12	5.12
549.6	7.7	505.74	8.45	493.42	5.26
510.2	18.8	477.10	7.50	489.41	5.44
1636.9	7.9	556.63	10.06	474.51	5.11
528.4	47.8	492.11	9.28	1706.73	17.98
527.8	3.7	500.63	8.20	485.08	5.12
1219.7	20.7	1530.10	21.13	495.55	5.28
1040.4	19.2	1708.85	27.60	493.63	5.21
1013.0	24.2	511.54	9.18	399.55	4.21
1118.4	17.2	1700.70	22.56	526.54	5.75
597.4	17.0	1378.56	19.61	328.27	3.49
3433.8	15.8	1682.18	21.93	523.64	5.61
586.5	7.2	517.35	10.34	504.53	5.42
526.8	30.5	518.58	10.50	1666.70	17.38
1596.6	90.4	1469.94	19.26	512.56	5.47
1227.7	11.8	423.21	7.99	102.08	1.11
1614.6	13.6	1988.63	26.18	510.09	8.38
515.7	52.7	410.35	4.37	503.95	8.43
618.6	18.0	474.62	5.64	480.57	8.01
548.5	7.4	481.41	5.80	479.72	7.75
186.4	3.2	492.57	5.15	526.71	8.38
357.5	3.5	510.28	5.44	512.89	9.19
442.9	27.7	605.44	7.68	527.97	8.96
484.2	5.8	1029.77	10.91	427.28	7.96
488.1	43.0	1077.43	11.09	493.31	8.42
495.7	4.8	1080.00	12.08	1204.77	19.23
498.3	4.8	1170.27	13.61	531.87	8.87
502.6	4.8	1181.31	12.87	503.22	12.95
521.8	14.3	1265.22	18.40	1595.01	25.27
555.1	7.6	1270.94	14.13	505.16	8.35
824.0	21.7	1370.10	14.96	497.00	8.36
849.7	21.7	1442.74	16.05	229.49	5.43
870.0	14.7	1455.73	15.70	475.27	7.77
1032.1	58.5	1574.13	16.38	481.87	16.23
1414.8	68.6	1705.61	17.65	501.05	8.84
1434.8	135.5	0.79	1.01	1113.04	13.99
2701.1	50.8	6.28	1.78	1527.53	29.36
50.2	2.8	8.75	7.71	1560.71	20.30

110.8	2.1	8.89	1.26	1567.05	22.40
277.4	5.1	10.69	4.06	1568.10	20.11
364.4	18.4	12.02	164.97	1644.10	24.38
364.9	36.7	57.63	7.34	1733.04	28.14
365.9	5.5	205.65	103.34	1683.21	18.01
371.5	6.0	817.50	44.29	1594.16	16.74
374.5	20.8	1141.44	12.73	1709.11	17.28
378.2	8.2	1159.74	12.57	1655.07	17.29
381.5	5.6	2.92	0.21	1634.58	17.33
386.4	16.6	3.75	0.27	1656.97	17.38
387.2	19.9	9.40	0.92	1618.98	16.47
387.6	4.3	497.37	5.82	1608.34	17.19
391.5	8.5	499.14	5.81	1624.18	16.65
391.9	60.6	83.48	5.59	1686.12	17.05
392.3	9.7	125.18	5.74	1635.44	16.50
393.3	19.8	416.98	4.65	1580.25	16.08
397.2	34.2	478.95	5.82	1583.01	15.98
399.2	17.3	482.47	6.05	1799.91	20.47
408.3	9.2	483.71	5.33	1581.00	16.04
423.7	10.9	489.74	5.67	1592.50	21.00
459.2	14.0	491.64	6.33	1594.74	16.31
459.8	24.7	492.43	6.58	1598.26	16.26
475.3	6.7	502.77	5.33	1602.40	16.45
475.4	38.0	528.24	5.81	1607.13	16.45
479.2	43.7	628.91	44.29	1617.25	16.87
488.1	20.6	914.75	40.98	1618.66	17.08
492.2	8.8	1179.68	12.23	1619.78	16.89
494.3	13.7	1901.25	24.09	1624.88	16.55
495.7	12.8	501.30	9.06	1635.41	16.74
499.0	19.6	541.80	8.35	1640.17	17.13
501.0	10.2	495.14	12.66	1659.98	17.37
506.8	7.7	447.92	14.53	1674.24	17.47
506.9	21.2	439.83	9.60	1698.25	17.19
510.2	20.9	34.56	0.64		
522.6	8.7	48.79	1.38		
522.8	44.6	84.99	1.22		
523.0	4.7	87.68	4.87		
525.4	18.3	204.56	2.61		
525.8	37.5	285.38	4.03		
527.4	20.4	472.42	5.01		
536.4	5.7	490.93	5.11		
538.9	23.3	2310.67	24.56		
539.5	88.1	2594.96	27.08		
540.9	61.3	3.03	11.28		
547.4	13.7	5.71	1.45		
560.8	24.2	16.08	1.46		
561.9	22.5	23.15	1.24		
563.0	8.5	9.63	0.13		
563.9	18.2	0.77	0.35		
571.5	18.5	2.69	0.76		

572.7	32.8	4.10	0.25
572.9	9.5	6.78	2.03
577.6	7.9	11.44	1.04
579.9	76.6	98.78	1.06
582.3	11.6	6.80	0.69
589.9	21.0	8.37	1.97
592.1	14.7	10.13	1.82
598.6	29.1	10.38	0.27
974.3	76.6	83.57	12.23
1042.7	15.6	330.55	3.96
1046.4	34.5	333.58	18.60
1063.5	63.8	476.50	5.34
1134.2	18.0	477.86	10.10
1137.5	14.3	485.42	5.75
1181.8	175.1	18.40	0.51
1203.5	10.3	28.46	1.11
1233.8	10.7	9.10	0.28
1324.4	104.0	2.49	0.48
1785.5	8.0	3.08	0.55
1803.7	25.8	155.76	1.98
		111.83	1.28
		15.06	0.53
		0.78	0.39
		5.34	0.27
		2.25	0.30
		31.00	13.92
		126.15	4.78
		243.96	15.69
		476.95	5.31
		504.20	8.92
		372.94	5.70
		362.89	7.84
		363.12	4.67

Chapter 3. Appendix E. References for onland ages plotted in figures 5 A –C. $^{40}Ar/^{39}Ar$ compilations for Prydz Bay, Wilkes Land and Adélie land taken from Williams *et al.* [2010].

Onland U-Pb Zircon Ages				
Long	Lat	Age (Ma)	Study	Geographic Location
75.00	-72.75	543	Liu, 2007	Grove Mountains
68.00	-70.87	990	Boger, 2000	Northern Prince Charles Mountainrs
68.00	-70.87	936	Boger, 2000	Northern Prince Charles Mountainrs
68.00	-70.87	942	Boger, 2000	Northern Prince Charles Mountainrs
68.00	-70.87	954	Boger, 2000	Northern Prince Charles Mountainrs
68.00	-70.87	955.5	Boger, 2000	Northern Prince Charles Mountainrs
67.60	-70.60	980	Kinny et al., 1997	Northern Prince Charles Mountainrs
66.70	-71.50	984	Kinny et al., 1997	Northern Prince Charles Mountainrs
65.20	-70.85	517	Carson et al 2000	Northern Prince Charles Mountainrs
65.20	-70.85	910	Carson et al 2000	Northern Prince Charles Mountainrs
65.20	-70.85	991	Carson et al 2000	Northern Prince Charles Mountainrs
73.00	-70.00	533	Liu et al., 2007	McKaskie Hills
98.90	-66.50	516	Black 1992	Denman Glacier/Bunger Hills
98.90	-66.50	567	Black 1992	Denman Glacier/Bunger Hills
100.75	-66.25	1521	Sheraton 1992	Denman Glacier/Bunger Hills
100.75	-66.25	1171	Sheraton 1992	Denman Glacier/Bunger Hills

100.75	-66.25	1170	Sheraton 1992	Denman Glacier/Bunger Hills
100.75	-66.25	1151	Sheraton 1992	Denman Glacier/Bunger Hills
100.75	-66.25	1190	Sheraton 1992	Denman Glacier/Bunger Hills
110.50	-66.30	1275	Oliver et al., 1983	Windmill Islands
110.50	-66.33	1156	Post via Moller et al. 2002	Windmill Islands
110.50	-66.33	1137	Post via Moller et al. 2002	Windmill Islands
0.37	-72.50	1040	Board et al. (2005)	Sverdrupfjella
0.37	-72.50	1070	Board et al. (2005)	Sverdrupfjella
0.37	-72.50	1135	Board et al. (2005)	Sverdrupfjella
0.37	-72.50	1765	Board et al. (2005)	Sverdrupfjella
0.37	-72.50	480	Board et al. (2005)	Sverdrupfjella
-50.60	83.30	183.9	Minor and Mikasa (1997)	Sonora Bluff
-50.60	83.30	182.7	Minor and Mikasa (1997)	Sonora Bluff
-11.33	-74.50	1075	Jacobs et al. (2003b)	Sverdrupfjella
-11.33	-74.50	500	Jacobs et al. (2003b)	Sverdrupfjella
3.50	-72.00	525	Jacobs et al. (2003a)	Sverdrupfjella
-65.23	-68.17	236	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
-104.20	-82.68	180	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
-64.00	-66.78	182	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
-56.51	-83.91	517	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
-0.06	-72.17	186	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
-9.63	-74.28	1150	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
-12.78	-75.10	1150	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land

1.48	-72.10	520	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
1.48	-72.11	520	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
1.22	-72.10	1150	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
1.28	-72.26	1150	Unpub from Flowerdew et al (2011)	West Antarctica to Droning Maud Land
-64.42	-69.94	260	Millar et al. (2002)	West Antarctica
-54.81	-83.57	512	Curtis et al. (2004)	Pensacola Mountains
-62.33	-72.17	105	Vaughan et al. (2002)	West Antarctica
-70.34	-75.94	107	Vaughan et al. (2002)	West Antarctica
-34.90	-77.80	112	Gose et al. (1997)	Shackleton Range
-6.21	-72.60	3060	Marschall et al. (2010)	Dronning Maud Land
-6.21	-72.60	3060	Marschall et al. (2010)	Dronning Maud Land
-6.21	-72.60	3060	Marschall et al. (2010)	Dronning Maud Land
-29.37	-80.42	530	Zeh et al. (1999)	Shackleton Range
-2.25	-73.10	980	Jackson (1999)	Central Kirwangeggen Southwest
-2.25	-73.10	1011	Jackson (1999)	Central Kirwangeggen Southwest
-2.25	-73.10	1081	Jackson (1999)	Central Kirwangeggen Southwest
-2.25	-73.10	1074	Jackson (1999)	Central Kirwangeggen Southwest
-2.25	-73.10	1134	Jackson (1999)	Central Kirwangeggen Southwest
-2.25	-73.10	1143	Jackson (1999)	Central Kirwangeggen Southwest
-2.25	-73.10	475	Harris et al. (1995)	Northern Kirwanveggen
-2.25	-73.10	585	Harris et al. (1995)	Northern Kirwanveggen
-2.25	-73.10	1061	Harris et al. (1995)	Northern Kirwanveggen

-2.25	-73.10	1103	Harris et al. (1995)	Northern Kirwanveggen
-2.25	-73.10	1127	Harris et al. (1995)	Northern Kirwanveggen
-2.25	-73.10	1131	Harris et al. (1995)	Northern Kirwanveggen
-2.25	-73.10	1139	Harris et al. (1995)	Northern Kirwanveggen
2.60	-72.15	483	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	487.3	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	497	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	500	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	504	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	529	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	570	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	1070	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	1104	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	1124	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	1133	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	1163	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	1130	Bisnath et al. (2006)	Gjelsvikfjella
2.60	-72.15	1140	Bisnath et al. (2006)	Gjelsvikfjella
3.10	-72.00	486.9	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.10	-72.00	523	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.10	-72.00	521	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.10	-72.00	528	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.10	-72.00	558	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.00	-72.00	1061	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.00	-72.00	1096	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.00	-72.00	1115	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.00	-72.00	1123	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
3.00	-72.00	1137	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet

3.00	-72.00	1142	Jacobs et al. (2003 a,b,d)	Festninga/Risemedet
10.00	-71.83	527	Jacobs et al. (2003 a,b,d)	Central Droning Maud Land Northeast
10.00	-71.83	530	Jacobs et al. (2003 a,b,d)	Central Droning Maud Land Northeast
10.00	-71.83	570	Jacobs et al. (2003 a,b,d)	Central Droning Maud Land Northeast
10.10	-71.83	1080	Jacobs et al. (2003 a,b,d)	Central Droning Maud Land Northeast
10.10	-71.83	1076	Jacobs et al. (2003 a,b,d)	Central Droning Maud Land Northeast
10.10	-71.83	1130	Jacobs et al. (2003 a,b,d)	Central Droning Maud Land Northeast
3.00	-74.00	507	Jacobs et al. (2008)	Gjelsvikfjella
3.00	-74.00	1098	Jacobs et al. (2008)	Gjelsvikfjella
11.00	-73.00	499	Jacobs et al. (2008)	Otto von Gruber Gebirge
13.00	-72.00	501	Jacobs et al. (2008)	Otto von Gruber Gebirge
3.00	-71.80	495	Paulsson and Austrehein (2003)	Gjelsvikfjella
3.00	-71.80	504	Paulsson and Austrehein (2003)	Gjelsvikfjella
3.00	-72.20	1163	Paulsson and Austrehein (2003)	Gjelsvikfjella
22.90	-71.80	1009	Shiriashi et al. (2008)	Sør Rondane Mountains
23.90	-71.70	1013	Shiriashi et al. (2008)	Sør Rondane Mountains
24.10	-71.80	951	Shiriashi et al. (2008)	Sør Rondane Mountains
23.50	-72.00	571	Shiriashi et al. (2008)	Sør Rondane Mountains
24.40	-72.10	920	Shiriashi et al. (2008)	Sør Rondane Mountains
26.10	-72.30	1138	Shiriashi et al. (2008)	Sør Rondane Mountains
27.60	-72.10	549	Shiriashi et al. (2008)	Sør Rondane Mountains
27.50	-72.30	601	Shiriashi et al. (2008)	Sør Rondane Mountains
23.40	-72.10	564	Shiriashi et al. (2008)	Sør Rondane Mountains
25.10	-71.60	1125	Shiriashi et al. (2008)	Sør Rondane Mountains
35.90	-71.00	539	Shiriashi et al. (2003)	Yamato-Belgica Complex
33.00	-71.00	663	Shiriashi et al. (2003)	Yamato-Belgica Complex

36.00	-71.00	532	Shiriashi et al. (2003)	Yamato-Belgica Complex
37.00	-70.00	1000	Shiriashi et al. (2003)	Yamato-Belgica Complex
38.00	-70.00	533	Shiriashi et al. (2003)	Lützo-Holm Complex
39.90	-69.90	521	Shiriashi et al. (2003)	Lützo-Holm Complex
40.00	-69.70	1006	Shiriashi et al. (2003)	Lützo-Holm Complex
39.00	-69.50	532	Shiriashi et al. (2003)	Lützo-Holm Complex
41.00	-69.30	518	Shiriashi et al. (2003)	Lützo-Holm Complex
43.00	-69.10	1017	Shiriashi et al. (2003)	Lützo-Holm Complex
44.00	-69.10	553	Shiriashi et al. (2003)	Lützo-Holm Complex
-34.53	-77.92	1113	Gose et al. (1997)	Coats Land/Bertrab Nunataks
-34.33	-77.88	1112	Gose et al. (1997)	Coats Land/ Littlewood Nunataks
12.33	-71.58	512	Mikhalsky et al. (1997)	Wohlthatmassiv
25.00	-72.00	520	Pasteels and Michot (1970)	Sør Rondane Mountains
1.00	-72.00	1112	Moyes and Barton (1990)	Sverdrupfjella
1.00	-72.00	1107	Moyes and Barton (1990)	Sverdrupfjella
1.00	-72.00	1045	Moyes and Barton (1990)	Sverdrupfjella
59.47	-67.42	913	Kelly et al. (2002)	Kemp Land/ Stillwell Hills
57.54	-66.97	924	Kelly et al. (2002)	Kemp Land/ Oygarden Group
57.54	-66.97	929	Kelly et al. (2002)	Kemp Land/ Oygarden Group
57.54	-66.97	904	Kelly et al. (2002)	Kemp Land/ Oygarden Group
57.54	-66.97	844	Kelly et al. (2002)	Kemp Land/ Oygarden Group
57.54	-66.97	1600	Kelly et al. (2002)	Kemp Land/ Oygarden Group
57.54	-66.97	931	Kelly et al. (2002)	Kemp Land/ Oygarden Group
23.10	-72.23	524	Craddock 1972	Mt Nils Larsen

23.10	-72.23	512	Craddock 1972	Mt Nils Larsen
24.00	-71.52	555	Craddock 1972	Romnaes Mountain
24.00	-71.52	555	Craddock 1972	Romnaes Mountain
24.00	-71.52	510	Craddock 1972	Romnaes Mountain
24.00	-71.52	508	Craddock 1972	Romnaes Mountain
Onland Ar/Ar Hornblende Ages				
Long	Lat	Age (Ma)	Study	Geographic Location
66.22	-73.10	517	Phillips et al., 2007	Prydz Bay
66.91	-73.52	645	Phillips et al., 2007	Prydz Bay
76.39	-69.37	514	Zhao et al., 1997	Prydz Bay
76.39	-69.37	1036	Laixi Tong, 1998	Prydz Bay
76.39	-69.37	554	Laixi Tong, 1998	Prydz Bay
77.92	-68.85	500.3	Wilson et al, 2007	Prydz Bay
77.92	-68.85	563.3	Wilson et al, 2007	Prydz Bay
39.53	-69.03	546	Takigami et al., 1992	Dronning Maud Land
144.20	-67.38	1540	Duclaux et al., 2007	Adélie Land
143.37	-66.85	1750	Duclaux et al., 2007	Adélie Land
141.32	-66.84	1720	Duclaux et al., 2007	Adélie Land
140.92	-66.73	1685	Duclaux et al., 2007	Adélie Land

143.77	-66.93	1681	Di Vincenzo et al., 2007	Adélie Land
144.20	-67.38	1900	Di Vincenzo et al., 2007	Adélie Land
144.23	-67.58	1635	Di Vincenzo et al., 2007	Adélie Land
143.37	-67.10	1710	Di Vincenzo et al., 2007	Adélie Land
140.92	-66.75	1682	Duclaux et al., 2008	Adélie Land
140.92	-66.75	1678	Duclaux et al., 2008	Adélie Land
140.92	-66.75	1691	Duclaux et al., 2008	Adélie Land
140.50	-66.72	1651	Duclaux et al., 2008	Adélie Land
163.50	-71.75	487.8	Goodge Dallmeyer, 1996	George V Land
155.00	-82.75	534.4	Goodge Dallmeyer, 1996	George V Land
155.00	-82.75	510.7	Goodge Dallmeyer, 1996	George V Land
155.00	-82.75	510.8	Goodge Dallmeyer, 1996	George V Land
0.37	-72.50	520	Board et al. (2005)	Dronning Maud Land
0.37	-72.50	488	Board et al. (2005)	Dronning Maud Land
-50.60	-83.295833	175	Minor and Mukasa (1997)	Coats Land
-50.93	-83.2375	179	Minor and Mukasa (1997)	Coats Land
-11.33	-74.5	500	Jacobs et al. (1995,1997,1999)	Coats Land
Onland Ar/Ar Biotite Ages (K-Ar ages are indicated)				
Long	Lat	Age (Ma)	Study	Geographic Location
66.28	-73.08	486	Phillips et al., 2007	Prydz Bay

66.64	-75.27	524	Phillips et al., 2007	Prydz Bay
66.82	-74.29	486	Phillips et al., 2007	Prydz Bay
66.91	-73.52	530	Phillips et al., 2007	Prydz Bay
76.39	-69.37	495	Zhao et al., 1997	Prydz Bay
76.39	-69.37	552	Tong et al., 2002	Prydz Bay
77.92	-68.85	497.9	Wilson et al, 2007	Prydz Bay
77.92	-68.85	498.6	Wilson et al, 2007	Prydz Bay
77.92	-68.85	494	Wilson et al, 2007	Prydz Bay
77.92	-68.85	500.6	Wilson et al, 2007	Prydz Bay
77.92	-68.85	497.775	Wilson et al, 2007	Prydz Bay
66.70	-67.78	450	Takigami et al., 1992	Dronning Maud Land
25.00	-72.00	498.5	Takigami and Funaki, 1991	Dronning Maud Land
110.42	-66.35	960	Tingey, 1991, reporting Cameron et al 1960	
110.42	-66.35	1130	Tingey, 1991, reporting Cameron et al 1960	
110.42	-66.35	1060	Tingey, 1991, reporting Cameron et al 1960	
110.42	-66.35	1110	Tingey, 1991, reporting Cameron et al 1960	
-66.35	110.42	1080	Tingey, 1991, reporting Webb et al 1964	
110.42	-66.35	1120	Tingey, 1991, reporting Webb et al 1964	
110.42	-66.35	1090	Tingey, 1991, reporting Webb et al 1964	

110.42	-66.35	1060	Tingey, 1991, reporting Webb et al 1964	
110.42	-66.35	1150	Tingey, 1991, reporting Webb et al 1964	
110.42	-66.35	1140	Tingey, 1991, reporting Webb et al 1964	
110.42	-66.35	1060	Tingey, 1991, reporting Webb et al 1964	
110.42	-66.35	1070	Tingey, 1991, reporting Webb et al 1964	
110.42	-66.35	1120	Tingey, 1991, reporting Webb et al 1964	
110.42	-66.35	1088.5	Tingey, 1991, reporting Webb et al 1964	
144.20	-67.38	1560	Duclaux et al., 2007	Adélie Land
143.37	-66.85	1700	Duclaux et al., 2007	Adélie Land
141.32	-66.84	1690	Duclaux et al., 2007	Adélie Land
140.92	-66.73	1653	Duclaux et al., 2007	Adélie Land
140.52	-66.72	1628	Duclaux et al., 2007	Adélie Land
140.02	-66.67	1567	Duclaux et al., 2007	Adélie Land
140.02	-66.67	1577	Duclaux et al., 2007	Adélie Land
144.56	-67.03	1537	Duclaux et al., 2008	Adélie Land
143.89	-66.98	1612	Duclaux et al., 2008	Adélie Land
143.89	-66.98	1509	Duclaux et al., 2008	Adélie Land
143.54	-66.85	1702	Duclaux et al., 2008	Adélie Land
141.56	-66.78	1700	Duclaux et al., 2008	Adélie Land
141.40	-66.81	1681	Duclaux et al., 2008	Adélie Land
141.40	-66.81	1687	Duclaux et al., 2008	Adélie Land

141.40	-66.81	1678	Duclaux et al., 2008	Adélie Land
140.92	-66.75	1643	Duclaux et al., 2008	Adélie Land
140.92	-66.75	1664	Duclaux et al., 2008	Adélie Land
140.50	-66.72	1606	Duclaux et al., 2008	Adélie Land
139.98	-66.66	1567.2	Duclaux et al., 2008	Adélie Land
143.77	-66.93	1641	Di Vincenzo et al., 2007	Adélie Land
144.20	-67.38	1502	Di Vincenzo et al., 2007	Adélie Land
144.23	-67.58	1536	Di Vincenzo et al., 2007	Adélie Land
146.20	-67.65	486.3	Di Vincenzo et al., 2007	George V Land
157.08	-69.15	465	Adams et al., 2006	Northern Victoria Land
156.95	-69.23	472	Adams et al., 2006	Northern Victoria Land
157.98	-69.18	476	Adams et al., 2006	Northern Victoria Land
157.98	-69.18	465	Adams et al., 2006	Northern Victoria Land
157.72	-69.20	475	Adams et al., 2006	Northern Victoria Land
158.07	-69.97	412	Adams et al., 2006	Northern Victoria Land
158.22	-69.43	463	Adams et al., 2006	Northern Victoria Land
157.67	-69.48	466	Adams et al., 2006	Northern Victoria Land
157.72	-69.20	468	Adams et al., 2006	Northern Victoria Land
158.10	-69.52	484	Adams et al., 2006	Northern Victoria Land
158.25	-69.23	473	Adams et al., 2006	Northern Victoria Land
158.25	-69.23	464	Adams et al., 2006	Northern Victoria Land
158.78	-69.28	482	Adams et al., 2006	Northern Victoria Land
160.15	-70.50	477	Adams et al., 2006	Northern Victoria Land
159.85	-70.57	476	Adams et al., 2006	Northern Victoria Land
159.73	-70.55	462	Adams et al., 2006	Northern Victoria Land
159.67	-70.38	463	Adams et al., 2006	Northern Victoria Land
160.05	-70.22	497	Adams et al., 2006	Northern Victoria Land

160.67	-70.12	507	Adams et al., 2006	Northern Victoria Land
161.00	-70.47	509	Adams et al., 2006	Northern Victoria Land
161.25	-70.48	513	Adams et al., 2006	Northern Victoria Land
161.08	-70.37	485	Adams et al., 2006	Northern Victoria Land
161.00	-70.38	502	Adams et al., 2006	Northern Victoria Land
164.07	-70.55	367	Adams et al., 2006	Northern Victoria Land
163.52	-70.33	366	Adams et al., 2006	Northern Victoria Land
160.27	-72.97	467	Adams et al., 2006	Northern Victoria Land
160.32	-73.05	488	Adams et al., 2006	Northern Victoria Land
163.97	-74.45	495	Adams et al., 2006	Northern Victoria Land
163.97	-74.45	472	Adams et al., 2006	Northern Victoria Land
163.98	-74.47	495	Adams et al., 2006	Northern Victoria Land
163.25	-74.25	472	Adams et al., 2006	Northern Victoria Land
163.98	-74.38	482	Adams et al., 2006	Northern Victoria Land
163.97	-74.38	481	Adams et al., 2006	Northern Victoria Land
163.65	-74.62	483	Adams et al., 2006	Northern Victoria Land
163.75	-74.63	475	Adams et al., 2006	Northern Victoria Land
164.22	-74.63	473	Adams et al., 2006	Northern Victoria Land
164.07	-74.70	468	Adams et al., 2006	Northern Victoria Land
168.03	-73.40	328	Adams et al., 2006	Northern Victoria Land
166.45	-73.05	385	Adams et al., 2006	Northern Victoria Land
166.10	-72.85	375	Adams et al., 2006	Northern Victoria Land
0.37	-72.50	488	Board et al. (2005)	Sverdrupfjella
-11.80	-74.6	504.5	Jacobs et al. (1995)	Sverdrupfjella
-14.33	-74.55	974	Jacobs et al. (1995)	Sverdrupfjella
-12.83	-75.15	812	Jacobs et al. (1995)	Sverdrupfjella

11.50	-70.75	475	Verma et al. (2006) (K-Ar biotite)	Humboldt
-56.00	-83.5		Craddock 1972 (K-Ar Biotite)	Neptune Range
-64.50	-84.716667	224	Craddock 1972 (K-Ar Biotite)	Patuxet, Coats Land
-64.50	-84.716667	219	Craddock 1972 (K-Ar Biotite)	Patuxet, Coats Land
-62.33	-84.87	233	Craddock 1972 (K-Ar Biotite)	Mt Wanous
-5.00	-72		Craddock 1972 (K-Ar Biotite)	Giaever
-5.00	-72	1	Craddock 1972 (K-Ar Biotite)	Giaever
47.87	-67.97	530	Craddock 1972 (K-Ar Biotite)	Mt Christensen
47.87	-67.97	490	Craddock 1972 (K-Ar Biotite)	Mt Christensen
57.54	-66.98		Craddock 1972 (K-Ar Biotite)	Oygarden Group
Onland Ar/Ar Muscovted Ages (K-Ar ages are indicated)				
Long	Lat	Age (Ma)	Study	Geographic Location
66.97	-73.56	489	Phillips et al., 2007	Prydz Bay
66.98	-73.60	496	Phillips et al., 2007	Prydz Bay
65.13	-73.45	503	Phillips et al., 2007	Prydz Bay
63.67	-73.17	491	Phillips et al., 2007	Prydz Bay
157.73	-69.23	471	Adams et al., 2006	Prydz Bay
160.27	-72.97	491	Adams et al., 2006	Prydz Bay
163.67	-74.42	472	Adams et al., 2006	Prydz Bay
142.34	-66.95	1585	Duclaux et al., 2008	Adélie Land
139.90	-66.69	1576.8	Duclaux et al., 2008	Adélie Land
149.62	-68.32	593.4	Di Vincenzo et al., 2007	George V Land

-11.30	-74.5	973.5	Jacobs et al. (1995) (K-Ar muscovite)	Coats Land
8.33	-72.93	515	Craddock, 1972 (K-Ar muscovite)	Sverdrupfjella
Onland K/Ar Whole Rock ages				
Long	Lat	Age (Ma)	Study	Geographic Location
-53.50	-82.80	168	Craddock, 1972	Cordiner Peak
-25.00	-80.50	457	Craddock, 1972	Shackleton Range
-25.00	-80.50	1446	Craddock, 1972	Shackleton Range
-25.00	-80.50	297	Craddock, 1972	Shackleton Range
-53.50	-80.50	161	Craddock, 1972	Mt Faraway
-53.50	-80.50	154	Craddock, 1972	Mt Faraway
-53.50	-80.50	169	Craddock, 1972	Mt Faraway
-53.50	-80.50	161	Craddock, 1972	Mt Faraway
-53.50	-80.50	164	Craddock, 1972	Mt Faraway
-53.50	-80.50	162	Craddock, 1972	Mt Faraway
-14.17	-73.33	400	Craddock, 1972	Kraul Mountain
-14.17	-73.33	220	Craddock, 1972	Kraul Mountain
-14.17	-73.33	172	Craddock, 1972	Kraul Mountain
-14.17	-73.33	168	Craddock, 1972	Kraul Mountain
-11.00	-74.58	259	Craddock, 1972	Heimefront Range
-11.00	-74.58	256	Craddock, 1972	Heimefront Range
-11.00	-74.58	580	Craddock, 1972	Heimefront Range
-11.00	-74.58	547	Craddock, 1972	Heimefront Range
12.42	-75.03	458	Craddock, 1972	Tottan Hills
12.42	-74.03	452	Craddock, 1972	Tottan Hills

12.42	-73.03	179	Craddock, 1972	Tottan Hills
12.42	-72.03	173	Craddock, 1972	Tottan Hills
12.42	-71.03	173	Craddock, 1972	Tottan Hills
12.42	-70.03	172	Craddock, 1972	Tottan Hills
12.42	-69.03	164	Craddock, 1972	Tottan Hills
-3.50	-72.50	860	Craddock, 1972	Borg Massif
-3.50	-72.50	515	Craddock, 1972	Borg Massif
-0.25	-72.17	340	Craddock, 1972	Gborek Peaks
-0.25	-72.17	260	Craddock, 1972	Gborek Peaks
-0.25	-72.17	330	Craddock, 1972	Gborek Peaks
-0.25	-72.17	225	Craddock, 1972	Gborek Peaks
-45.00	-72.62	475	Craddock, 1972	Roots Heights
-45.00	-72.62	450	Craddock, 1972	Roots Heights
-45.00	-72.62	425	Craddock, 1972	Roots Heights
-45.00	-72.62	400	Craddock, 1972	Roots Heights
2.60	-72.15	510	Craddock, 1972	Gjelsvilk Mountains
2.60	-72.15	475	Craddock, 1972	Gjelsvilk Mountains
2.60	-72.15	460	Craddock, 1972	Gjelsvilk Mountains
2.60	-72.15	420	Craddock, 1972	Gjelsvilk Mountains
2.60	-72.15	480	Craddock, 1972	Gjelsvilk Mountains
5.33	-72.00	455	Craddock, 1972	Hofman Mountains
5.33	-72.00	445	Craddock, 1972	Hofman Mountains
5.33	-72.00	420	Craddock, 1972	Hofman Mountains
5.33	-72.00	315	Craddock, 1972	Hofman Mountains
5.33	-72.00	425	Craddock, 1972	Hofman Mountains
5.33	-72.00	405	Craddock, 1972	Hofman Mountains
5.33	-72.00	410	Craddock, 1972	Hofman Mountains
5.33	-72.00	410	Craddock, 1972	Hofman Mountains
9.00	-72.00	540	Craddock, 1972	Orvin Mountains
9.00	-72.00	450	Craddock, 1972	Orvin Mountains

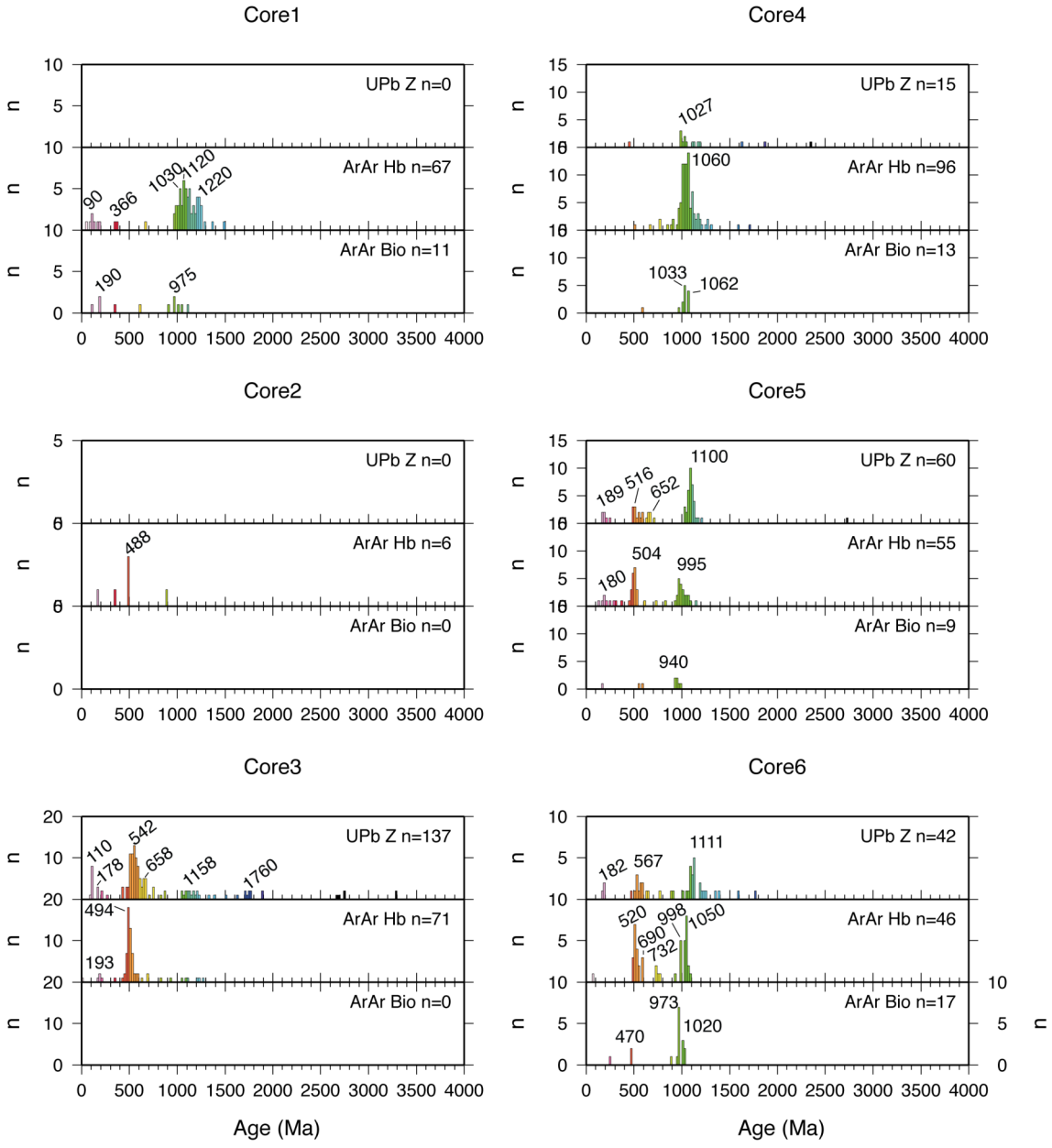
9.00	-72.00	435	Craddock, 1972	Orvin Mountains
9.00	-72.00	15	Craddock, 1972	Orvin Mountains
9.00	-72.00	365	Craddock, 1972	Orvin Mountains
10.33	-71.72	480	Craddock, 1972	Mt Dallman
10.33	-71.72	450	Craddock, 1972	Mt Dallman
10.33	-71.72	420	Craddock, 1972	Mt Dallman
10.33	-71.72	410	Craddock, 1972	Mt Dallman
15.50	-71.50	480	Craddock, 1972	Vorposten Peak
15.50	-71.50	475	Craddock, 1972	Vorposten Peak
15.50	-71.50	460	Craddock, 1972	Vorposten Peak
15.50	-71.50	420	Craddock, 1972	Vorposten Peak
23.10	-72.23	350	Craddock, 1972	Mt Nils Larsen
24.00	-71.52	380	Craddock, 1972	Romnaes Mountain
24.00	-71.52	475	Craddock, 1972	Romnaes Mountain
47.87	-67.97	465	Craddock, 1972	Mt Christensen
47.87	-67.97	460	Craddock, 1972	Mt Christensen
57.54	-66.98	620	Craddock, 1972	Oygarden Group
57.54	-66.98	611	Craddock, 1972	Oygarden Group
62.81	-67.81	650	Craddock, 1972	Masson Range
62.81	-67.81	555	Craddock, 1972	Masson Range
62.81	-67.81	535	Craddock, 1972	Masson Range
62.81	-67.81	490	Craddock, 1972	Masson Range
-14	-73.16667	171	Furnes et al. 1987	Vestfjella
-14	-72.9	180	Peters et al. 1991	northern Vestfjella
89.20	-66.80	20	Ravich 1964	na
154.17	-68.90	175	Ravich 1964	na
149.62	-68.32	195	Ravich 1964	na

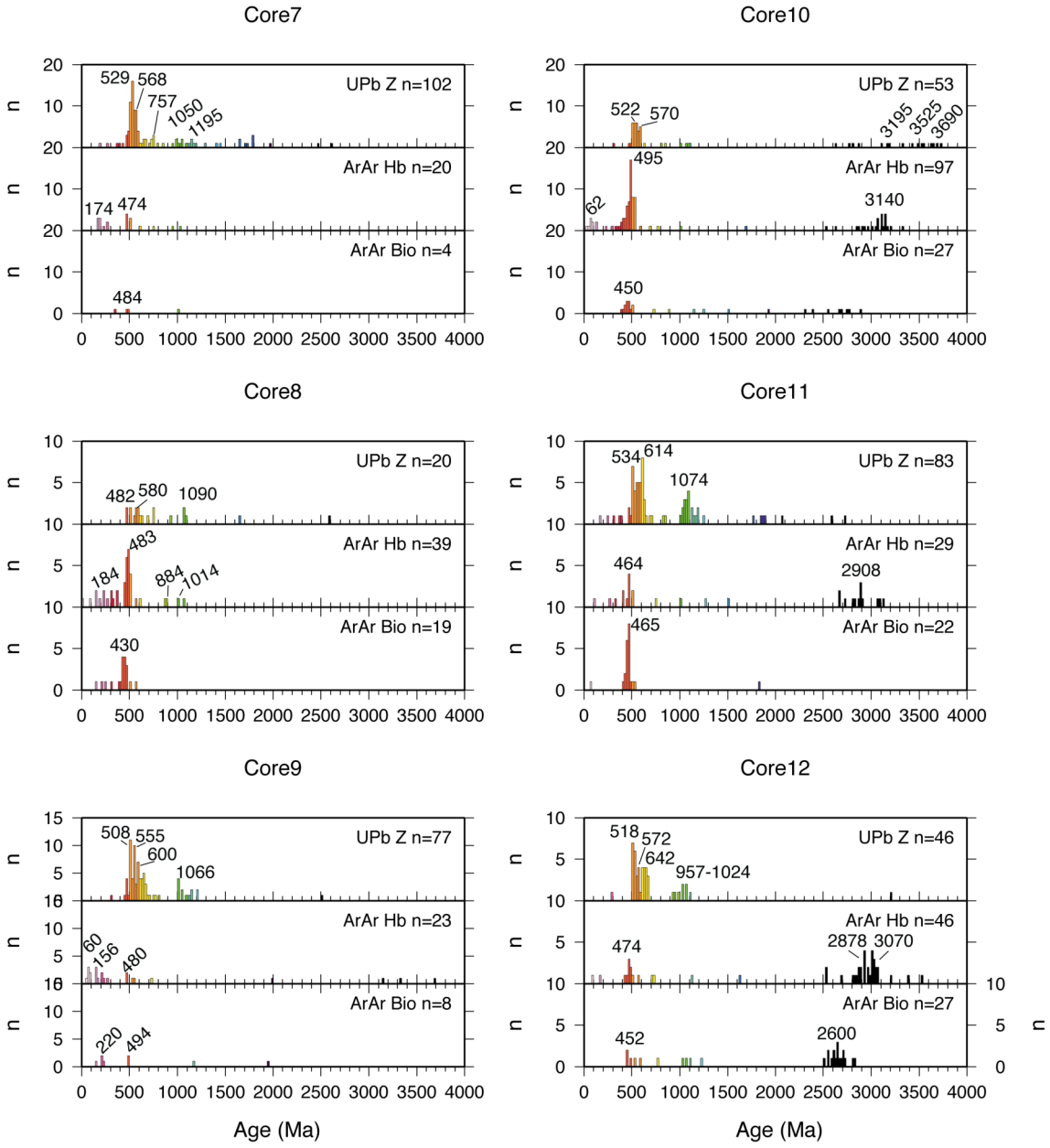
163.33	-70.33	325	Ravich 1964	na
98.78	-66.42	330	Ravich 1964	na
161.85	-70.23	330	Ravich 1964	na
93.00	-66.57	415	Ravich 1964	na
72.55	-70.20	420	Ravich 1964	na
76.22	-69.40	420	Ravich 1964	na
164.80	-70.57	425	Ravich 1964	na
93.00	-66.52	430	Ravich 1964	na
164.80	-70.57	435	Ravich 1964	na
158.50	-69.67	450	Ravich 1964	na
93.00	-66.57	455	Ravich 1964	na
93.00	-66.57	460	Ravich 1964	na
98.78	-66.42	460	Ravich 1964	na
93.00	-66.57	470	Ravich 1964	na
98.78	-66.42	470	Ravich 1964	na
146.87	-67.87	470	Ravich 1964	na
92.97	-66.55	475	Ravich 1964	na
146.87	-67.87	475	Ravich 1964	na
146.87	-67.87	475	Ravich 1964	na
146.87	-67.87	475	Ravich 1964	na
158.50	-69.67	475	Ravich 1964	na
93.00	-66.52	480	Ravich 1964	na
146.58	-67.73	480	Ravich 1964	na
156.07	-69.22	480	Ravich 1964	na
158.50	-69.67	480	Ravich 1964	na
62.87	-67.60	490	Ravich 1964	na
146.58	-67.73	505	Ravich 1964	na
93.00	-66.52	520	Ravich 1964	na
156.07	-69.22	530	Ravich 1964	na
57.53	-66.97	535	Ravich 1964	na

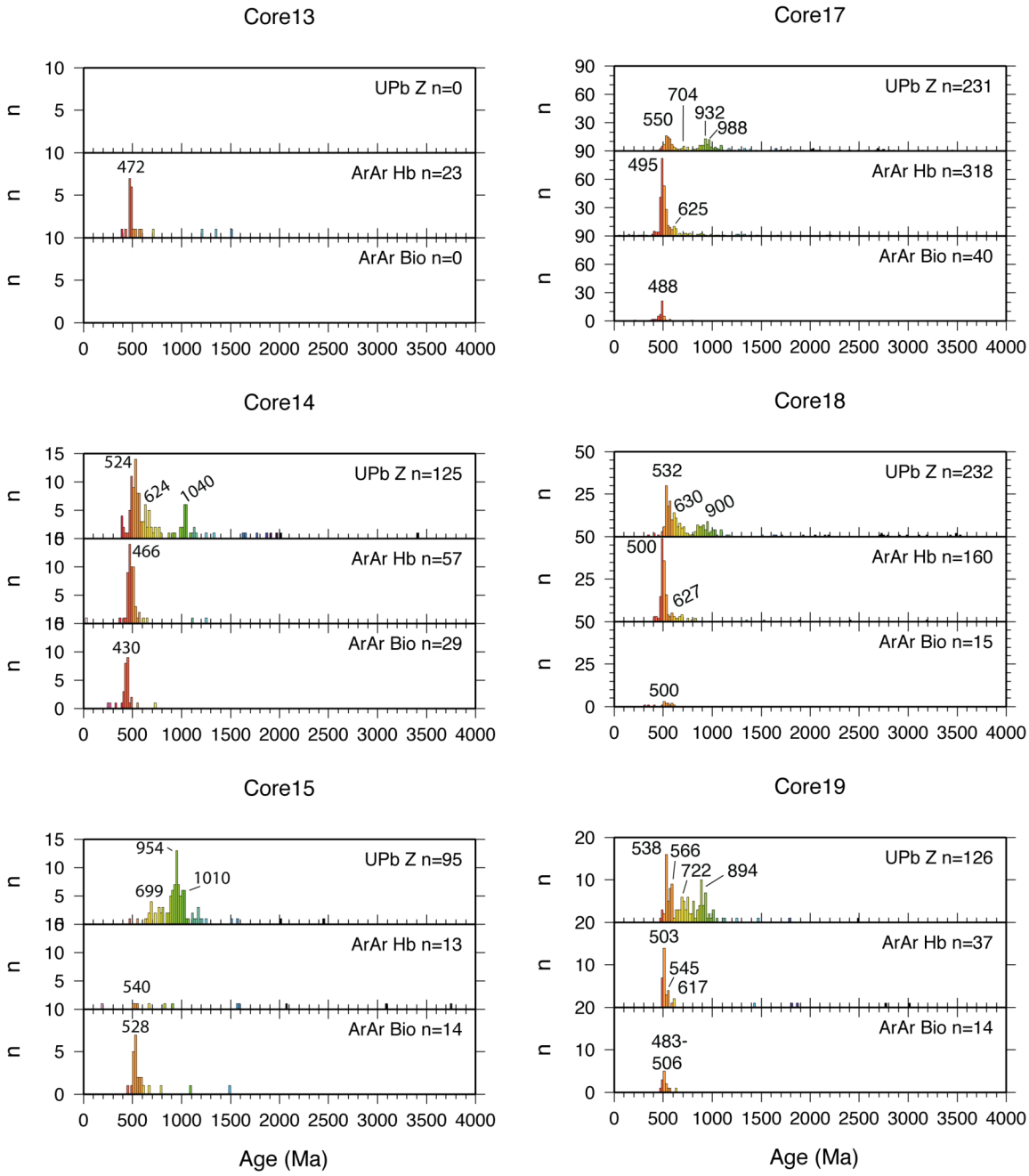
62.87	-67.60	535	Ravich 1964	na
76.22	-69.40	540	Ravich 1964	na
99.77	-66.58	545	Ravich 1964	na
93.00	-66.52	550	Ravich 1964	na
62.87	-67.60	555	Ravich 1964	na
98.78	-66.42	560	Ravich 1964	na
101.07	-66.10	570	Ravich 1964	na
101.22	-66.10	585	Ravich 1964	na
99.20	-67.42	605	Ravich 1964	na
100.37	-67.37	610	Ravich 1964	na
57.53	-66.97	615	Ravich 1964	na
57.53	-66.97	620	Ravich 1964	na
101.00	-66.20	635	Ravich 1964	na
100.75	-66.27	640	Ravich 1964	na
62.87	-67.60	650	Ravich 1964	na
100.98	-66.27	650	Ravich 1964	na
62.37	-68.08	700	Ravich 1964	na
100.55	-66.42	700	Ravich 1964	na
101.07	-66.10	700	Ravich 1964	na
120.98	-66.78	700	Ravich 1964	na
99.20	-67.42	710	Ravich 1964	na
101.02	-66.12	715	Ravich 1964	na
100.88	-66.17	730	Ravich 1964	na
100.77	-66.23	735	Ravich 1964	na
100.88	-66.17	740	Ravich 1964	na
101.22	-66.10	745	Ravich 1964	na
100.83	-66.17	750	Ravich 1964	na
120.63	-66.88	755	Ravich 1964	na
100.75	-66.27	775	Ravich 1964	na
100.75	-66.27	775	Ravich 1964	na

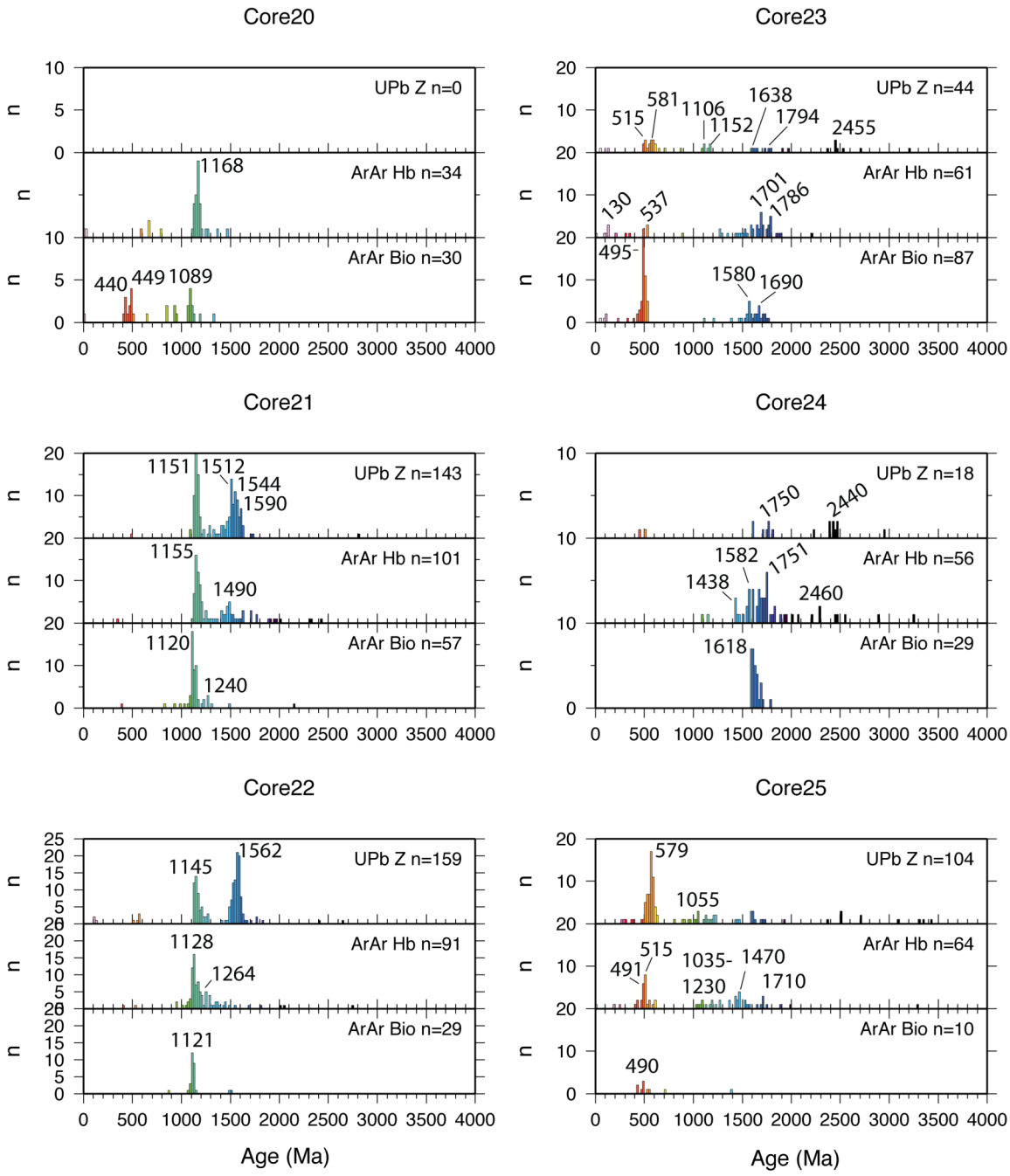
100.58	-66.10	800	Ravich 1964	na
110.42	-66.33	880	Ravich 1964	na
110.42	-66.33	895	Ravich 1964	na
110.42	-66.33	945	Ravich 1964	na
99.20	-67.42	980	Ravich 1964	na
101.02	-66.12	995	Ravich 1964	na
100.75	-66.27	1000	Ravich 1964	na
126.75	-66.47	1000	Ravich 1964	na
100.75	-66.27	1005	Ravich 1964	na
100.80	-66.30	1050	Ravich 1964	na
100.88	-66.17	1075	Ravich 1964	na
110.42	-66.33	1080	Ravich 1964	na
100.75	-66.27	1130	Ravich 1964	na
99.77	-66.58	1135	Ravich 1964	na
101.02	-66.22	1175	Ravich 1964	na
78.25	-68.55	1185	Ravich 1964	na
101.02	-66.12	1265	Ravich 1964	na
78.25	-68.55	1350	Ravich 1964	na
78.25	-68.55	1460	Ravich 1964	na
78.25	-68.55	1475	Ravich 1964	na
78.25	-68.55	1525	Ravich 1964	na
			Ravich 1964	na

Chapter 3. Appendix F. Histograms of individual core data.




Core7
UPb Z n=102
529 568 757 1050 1195
ArAr Hb n=20
174 474
ArAr Bio n=4
484
Core10
UPb Z n=53
522 570 3195 3525 3690
ArAr Hb n=97
62 495 3140
ArAr Bio n=27
450
Core8
UPb Z n=20
482 580 1090
ArAr Hb n=39
184 483 884 1014
ArAr Bio n=19
430
Core11
UPb Z n=83
534 614 1074
ArAr Hb n=29
464 2908
ArAr Bio n=22
465
Core9
UPb Z n=77
508 555 600 1066
ArAr Hb n=23
60 156 480
ArAr Bio n=8
220 494
Core12
UPb Z n=46
518 572 642 957-1024
ArAr Hb n=46
474 2878 3070
ArAr Bio n=27
452 2600
n
Age (Ma)


Core13
UPb Z n=0
ArAr Hb n=23
472
ArAr Bio n=0
Core17
UPb Z n=231
704
550
932
988
ArAr Hb n=318
495
625
ArAr Bio n=40
488
Core14
UPb Z n=125
524
624
1040
ArAr Hb n=57
466
ArAr Bio n=29
430
Core18
UPb Z n=232
532
630
900
ArAr Hb n=160
500
627
ArAr Bio n=15
500
Core15
UPb Z n=95
954
699
1010
ArAr Hb n=13
540
ArAr Bio n=14
528
Core19
UPb Z n=126
538
566
722
894
ArAr Hb n=37
503
545
617
ArAr Bio n=14
483-
506
n
0 500 1000 1500 2000 2500 3000 3500 4000
Age (Ma)


Core20
UPb Z n=0
ArAr Hb n=34
1168
ArAr Bio n=30
440
449
1089
Core23
UPb Z n=44
515
581
1106
1152
1638
1794
2455
ArAr Hb n=61
130
537
1701
1786
ArAr Bio n=87
495
1580
1690
Core21
UPb Z n=143
1151
1512
1544
1590
ArAr Hb n=101
1155
1490
ArAr Bio n=57
1120
1240
Core24
UPb Z n=18
1750
2440
ArAr Hb n=56
1438
1582
1751
2460
ArAr Bio n=29
1618
Core22
UPb Z n=159
1145
1562
ArAr Hb n=91
1128
1264
ArAr Bio n=29
1121
Core25
UPb Z n=104
579
1055
ArAr Hb n=64
491
515
1035-
1230
1470
1710
ArAr Bio n=10
490
n
0 500 1000 1500 2000 2500 3000 3500 4000
Age (Ma)

Chapter 4. Appendix A. Core sampling intervals, weight % measurements, # of hornblende grains measured, and εNd values for IODP U1356 samples.

Integrated Ocean Driling Program Site U1356

Latitude (˚)	-63.31
Longitude (˚)	136.00
Water Depth (m)	4003

Sample ID (Site,Hole,Core,Section, interval)	**depth (meters below surface)**	**~ Age (Ma)**	**Clast Count**	**MS**	**Wt %> 1mm**	**Wt %> 150µm**	**Wt % 63-150µm**	**Wt % < 63 µm**	**# HB**	**εNd**	**% ArAr ages 1400-1550**	**total number of clasts > 1mm**
U1356A-1R-1 0/2	0.01	modern	**0**	**5.9**	**0.00**	**0.27**	0.47	99.26	**0**	**-14.5**	**-**	**0**
U1356A-11R-1 134/136	96.75	12.6	0	53.1	0.00	**1.55**	0.50	97.95	5	-14.8	80.0	9
U1356A-11R-1 144/146	96.88	12.6	1	31.5	0.00	**1.37**	0.37	98.26	0	-14.9	-	14
U1356A-11R-2 14/16	97.05	12.6	1	66.7	1.12	**1.06**	0.50	98.44	6	-14.9	67.0	13
U1356A-11R-2 24/26	97.15	12.6	0	54.9	1.26	**0.41**	0.40	99.19	5	-14.5	**40.0**	3
U1356A-12R-1 34/36	105.25	13.0	1	168.1	1.13	**0.12**	0.06	99.82	11	-11.5	32.0	0
U1356A-12R-1 94/96	105.85	13.0	1	55.7	0.77	**0.06**	0.43	99.51	0	-11.9	**-**	3
U1356A-12R-2 44/46	106.85	13.0	1	52	0.22	**1.76**	1.62	96.62	29	-8.6	**33.0**	8
U1356A-12R-2 74/76	107.15	13.0	1	63	0.03	**2.21**	2.68	95.11	24	-10.2	**21.0**	**12**
U1356A-12R-2 94/96	107.35	13.0	1	64.5	0.04	**1.52**	2.70	95.78	28	-10.9	39.0	**6**
U1356A-12R-2 144/146	107.85	13.0	1	58.6	0.14	**0.21**	0.78	99.01	6	-13.4	**55.0**	0
U1356A-12R3 10/12	108.02	13.0	1	70.3	0.32	**0.18**	0.49	99.33	4	-14.2	25.0	0
U1356A-12R-3 44/46	108.35	13.0	4	140.3	0.15	**2.94**	1.87	95.20	36	-15.0	64.0	**18**
U1356A-12R-3 84/86	108.75	13.0	6	127.1	0.00	**17.25**	3.04	79.71	35	-13.6	57.0	**99**
U1356-12R-3 104/106	108.95	13.0	4	126.4	0.00	**13.69**	3.18	83.13	44	-13.5	**59.0**	119
U1356 A-12R-CC 4/6	109.23	13.0	6	215.4	1.31	**40.26**	1.92	57.82	43	-12.1	**63.0**	106
U1356A-15R-6 14/16	140.95	13.5	0	40.3	12.36	**0.02**	0.52	99.46	0	-15.2	-	0
U1356A-15R-6 24/26	141.05	13.5	6	96.7	8.50	**0.17**	0.19	99.64	0	-16.5	-	0
U1356A-15R-6 34/36	141.15	13.5	5	72.5	36.87	**1.40**	7.80	90.80	28	-15.3	79.0	18
U1356A-19R-1 60/62	172.71	13.8	9	90.9	0.00	**6.29**	0.65	93.06	16	**-14.1**	81.0	31
U1356A-19R-1 90/92	173.01	13.8	18	254.2	0.00	**10.86**	0.49	88.65	31	**-13.3**	**58.0**	18
U1356A-19R-2 10/12	173.71	13.8	2	59.7	0.30	**2.47**	0.42	97.11	0	**-10.9**	-	5

U1356A-19R-3 85/87	175.96	13.9	21	109.15	2.27	**22.27**	8.33	69.39	44	**-12.8**	57.0	18
U1356A-19R-4 10/12	176.71	13.9	2	52.8	0.02	**1.63**	6.88	91.48	12	**-11.8**	**75.0**	2
U1356A-19R-4 140/142	178.01	13.9	1	71.1	0.75	**1.61**	2.00	96.39	25	**-11.5**	**64.0**	4
U1356A-19R-5 10/12	178.22	13.9	6	90.1	0.10	**1.81**	4.19	94.01	34	**-11.9**	**71.0**	6
U1356A-19R-5 25/27	178.37	13.9	16	70	9.69	**10.96**	3.12	85.91	30	**-11.6**	**73.0**	4
U1356A-20R-1 48/50	182.19	13.9	3	38.1	0.72	**0.79**	1.87	97.35	3	**-16.4**	**100.0**	2
U1356A-20R-1 122/124	182.93	13.9	2	45.4	6.79	**6.82**	0.03	93.15	0	**-15.7**	-	5
U1356A-20R-1 135/137	183.06	13.9	1	52	0.00	**0.01**	0.01	99.98	0	**-15.3**	-	0
U1356A-20R-2 15/17	183.36	13.9	44	123.8	13.84	**13.87**	0.03	86.10	0	**-15.9**	-	29
U1356A-20R-2 38/40	183.59	13.9	3	65.2	0.27	**0.29**	0.01	99.70	0	**-16.0**	-	1
U1356A-21R-1 129/131	192.6	14.0	23	49.8	1.12	**5.09**	2.13	92.77	37	**-14.0**	**44.0**	12
U1356A-21R-1 140/142	192.71	14.0	19	76.9	0.15	**1.69**	1.31	97.00	36	**-12.5**	**75.0**	8
U1356A-21R-2 28/30	193.09	14.0	1	72.5	0.00	**0.10**	0.19	99.71	1	**-15.6**	**-**	0
U1356A-22R-1 3/5	200.94	14.1	0	57.7	0.00	**0.01**	0.04	99.95	0	**-15.6**	-	0
U1356A-22R-1 26/28	201.17	14.1	0	106.6	4.11	**6.47**	2.92	90.61	44	**-14.3**	**64.0**	53
U1356A-22R-1 57/59	201.48	14.1	0	53.5	0.02	**1.21**	0.71	98.08	44	**-8.4**	**59.0**	1
U1356A-22R-2 5/7	202.46	14.1	0	51.3	0.00	**0.03**	0.02	99.94	0	**-14.9**	**-**	0
U1356A-28R-CC 10/12	258.51	14.7	6	81	53.83	**7.87**	3.70	88.43	28	-15.5	64.0	**72**

Chapter 4. Appendix B. $^{40}Ar/^{39}Ar$ hornblende data. $^{40}Ar/^{39}Ar$ analyses were performed at the Lamont-Doherty Earth Observatory AGES Lab.

Sample	Run ID	Ca/K	Cl/K	Mol 39Ar	%40 Ar*	Age (Ma)	Internal ± Age	Total ± Age
total # grains	5							
11R-1 134/136	14473-05A	32.72983	0.05342	0.002	97.2	1476.08	13.78	20.20
11R-1 134/136	14473-01A	38.24789	0.2324	0.001	93.9	1476.96	26.54	30.37
11R-1 134/136	14473-02A	42.61738	0.09514	0.002	10.1	101.08	13.08	13.12
11R-1 144/146	14475-01A	10.2473	0.03972	0.008	99.5	1464.84	6.80	16.15
11R-1 144/146	14475-02A	13.42542	0.00448	0.013	98.1	1418.78	5.15	15.09
total # grains	6							
11R-2 14/16	14472-07A	1.88874	0.04282	0.008	91.2	1534.66	6.23	16.56
11R-2 14/16	14472-15A	9.20842	0.00295	0.102	99.6	1489.10	2.31	15.07
11R-2 14/16	14472-18A	10.95172	0.04581	0.006	87.3	1312.56	7.79	15.26
11R-2 14/16	14472-17A	11.03351	0.01344	0.015	98.8	1499.35	5.06	15.83
11R-2 14/16	14472-02A	11.27374	0.01373	0.076	98.2	960.61	1.99	9.81
11R-2 14/16	14472-09A	13.63444	0.04911	0.005	99.4	1438.87	8.64	16.79
total # grains	5							
11R-2 24/26	14471-02A	1.03444	0.00435	0.037	88.2	512.43	1.85	5.45
11R-2 24/26	14471-07A	1.23079	0.0069	0.032	97.4	1412.32	3.14	14.47
11R-2 24/26	14471-03A	6.35119	0.03778	0.009	90.5	1240.22	5.41	13.53
11R-2 24/26	14471-01A	9.72977	0.03608	0.006	89.6	1605.64	7.86	17.88
11R-2 24/26	14471-05A	11.19805	0.03923	0.006	97.4	1408.67	7.33	15.88
total # grains	11							
12R-1 34/36	14469-03A	4.26383	0.01918	0.011	95.2	1462.90	6.03	15.82
12R-1 34/36	14469-07A	6.00445	0.01752	0.03	99.6	1440.90	3.33	14.79
12R-1 34/36	14469-25A	6.95715	0.04481	0.008	99.4	1498.01	6.93	16.51
12R-1 34/36	14469-17A	7.32854	0.0087	0.06	99.8	1487.11	2.62	15.10
12R-1 34/36	14469-23A	7.52259	0.0327	0.028	99.8	1472.44	3.55	15.15
12R-1 34/36	14469-26A	9.04926	0.01317	0.034	99.8	1511.73	3.78	15.58
12R-1 34/36	14469-04A	9.82556	0.017	0.007	98.7	1388.81	6.40	15.29
12R-1 34/36	14469-08A	10.33166	0.08044	0.004	95.7	1493.74	11.27	18.71
12R-1 34/36	14469-22A	10.73661	0.04881	0.005	89.9	1487.63	10.73	18.34
12R-1 34/36	14469-12A	11.76904	0.02633	0.006	91.9	1403.51	8.85	16.59
12R-1 34/36	14469-05A	21.49654	-0.03062	0.002	96.8	1374.07	17.76	22.45
total # grains	6							
12R-2 144/146	14467-03A	2.34396	0.00495	0.045	91	205.03	0.73	2.18
12R-2 144/146	14467-01A	3.14254	0.01519	0.011	89.7	182.07	1.41	2.31
12R-2 144/146	14467-09A	4.98066	0.0485	0.009	96.7	1482.40	5.80	15.92
12R-2 144/146	14467-07A	6.62425	0.04773	0.015	99.5	1126.76	3.97	11.95
12R-2 144/146	14467-13A	7.24978	0.01376	0.017	97.9	1442.29	4.75	15.19

12R-2 144/146	14467-12A	29.96763	0.11172	0.001	88.7	1593.65	16.30	22.80
total # grains	29							
12R-2 44/46	14465-17	48.41143	-0.09871	0.001	8.7	117.51	19.43	19.47
12R-2 44/46	14465-08	10.07997	0.05201	0.01	90	508.19	3.04	5.92
12R-2 44/46	14465-21	2.34878	0.01216	0.04	98.6	956.13	2.48	9.88
12R-2 44/46	14465-02	6.3939	0.02432	0.013	93	1016.36	3.66	10.80
12R-2 44/46	14465-34	11.28848	0.04492	0.004	95.2	1095.51	9.60	14.57
12R-2 44/46	14465-20	9.03201	0.06396	0.005	97.9	1442.96	7.88	16.44
12R-2 44/46	14465-28	18.00022	0.11102	0.004	93.8	1467.83	9.57	17.52
12R-2 44/46	14465-07	20.5211	0.04099	0.003	95.4	1471.17	10.53	18.09
12R-2 44/46	14465-16	24.42244	0.03569	0.004	97	1474.66	10.65	18.19
12R-2 44/46	14465-18	9.53939	0.02464	0.009	99.6	1476.55	6.32	16.06
12R-2 44/46	14465-29	11.32523	0.04163	0.008	99.5	1483.37	6.78	16.31
12R-2 44/46	14465-35	12.85061	0.01933	0.009	99.8	1485.87	5.42	15.82
12R-2 44/46	14465-09	16.05026	0.10851	0.008	98.8	1496.15	6.70	16.39
12R-2 44/46	14465-32	9.34963	0.04866	0.006	98.3	1500.29	7.91	16.96
12R-2 44/46	14465-03	7.17404	0.01856	0.024	99.6	1505.00	3.89	15.54
12R-2 44/46	14465-22	8.06479	0.03724	0.008	99.9	1510.18	6.87	16.59
12R-2 44/46	14465-11	14.89315	0.13422	0.004	99.2	1514.28	10.07	18.18
12R-2 44/46	14465-25	8.49994	0.0081	0.025	98.9	1525.00	3.93	15.75
12R-2 44/46	14465-10	16.98061	0.07276	0.003	98.1	1543.98	12.41	19.81
12R-2 44/46	14465-27	37.86829	0.01506	0.007	99.3	1546.95	7.57	17.22
12R-2 44/46	14465-14	19.18284	0.05537	0.005	97.6	1548.04	9.57	18.20
12R-2 44/46	14465-01	7.41095	0.00443	0.129	98.4	1553.67	2.62	15.76
12R-2 44/46	14465-24	18.91132	0.01575	0.004	93.3	1574.94	11.93	19.76
12R-2 44/46	14465-05	8.61174	0.01549	0.013	99.4	1594.00	5.74	16.94
12R-2 44/46	14465-26	9.09616	0.05052	0.01	99.6	1603.56	6.25	17.21
12R-2 44/46	14465-06	6.77734	0.0588	0.009	93.3	1646.11	7.30	18.01
12R-2 44/46	14465-04	14.30714	0.07562	0.008	99.8	1657.38	7.92	18.37
12R-2 44/46	14465-13	7.46754	0.04618	0.013	99.9	1659.34	5.60	17.51
12R-2 44/46	14465-19	17.7002	0.10599	0.003	98.8	2133.04	13.85	25.43
total # grains	24							
12R-2 74/76	14466-23A	1.24686	0.01811	0.01	72.3	171.67	1.80	2.48
12R-2 74/76	14466-09A	1.89471	0.02222	0.047	77.7	802.94	2.69	8.47
12R-2 74/76	14466-17A	2.12514	0.16444	0.003	35.4	453.47	8.36	9.51
12R-2 74/76	14466-27A	2.24905	0.10549	0.001	1.2	34.02	40.42	40.42
12R-2 74/76	14466-08A	6.38057	0.00812	0.03	90.7	1166.92	3.29	12.12
12R-2 74/76	14466-16A	7.85947	0.03437	0.013	88.1	629.29	3.02	6.98
12R-2 74/76	14466-10A	7.90252	0.04716	0.008	99.4	1461.50	6.35	15.93
12R-2 74/76	14466-24A	8.71377	0.0291	0.02	79	315.03	1.66	3.56
12R-2 74/76	14466-05B	9.01453	0.05331	0.012	99	1382.31	4.65	14.58
12R-2 74/76	14466-32A	9.05687	0.04981	0.005	88.2	551.94	4.56	7.16
12R-2 74/76	14466-13A	9.07128	0.01202	0.014	95.3	1318.70	4.83	14.04
12R-2 74/76	14466-01	9.35503	0.06877	0.004	99.8	1449.18	9.51	17.33
12R-2 74/76	14466-06A	10.16847	0.01114	0.007	68.8	496.23	3.62	6.14
12R-2 74/76	14466-14A	10.20712	0.0603	0.009	97.8	1591.18	5.85	16.95
12R-2 74/76	14466-20A	10.98	0.02466	0.005	94.7	465.92	3.62	5.90

12R-2 74/76	14466-28A	11.35138	0.03612	0.009	99.3	1480.55	5.46	15.78
12R-2 74/76	14466-21A	14.57559	0.04121	0.006	90.5	538.09	3.60	6.47
12R-2 74/76	14466-22A	14.99149	0.00528	0.21	99	1591.57	2.13	16.06
12R-2 74/76	14466-02B	19.16789	0.09806	0.004	97.1	1454.66	8.90	17.05
12R-2 74/76	14466-18A	20.74097	0.04307	0.008	98.2	1577.07	7.07	17.28
12R-2 74/76	14466-29A	26.32077	0.0717	0.003	94.9	1331.77	10.43	16.91
12R-2 74/76	14466-11A	29.5081	0.11608	0.004	97.9	1026.66	8.34	13.23
12R-2 74/76	14466-15A	33.55381	0.0012	0.03	98.3	1877.98	4.06	19.21
12R-2 74/76	14466-30A	82.53345	0.11782	0.001	90	1457.61	23.54	27.69
total # grains	28							
12R-2 94/96	14468-31A	1.0446	0.03907	0.003	78.3	1470.90	11.26	18.52
12R-2 94/96	14468-02A	2.13971	0.01098	0.04	99	1209.87	2.87	12.43
12R-2 94/96	14468-27A	4.9948	0.04916	0.007	99.2	1527.74	6.87	16.75
12R-2 94/96	14468-14A	6.70808	0.02668	0.025	98	1496.46	3.59	15.39
12R-2 94/96	14468-19A	7.25036	0.08749	0.006	86.7	1347.92	6.67	15.04
12R-2 94/96	14468-18A	7.36635	0.01638	0.008	97.1	1549.66	6.87	16.95
12R-2 94/96	14468-09A	8.90526	0.03331	0.008	98	1175.17	5.34	12.91
12R-2 94/96	14468-32A	9.65234	0.06025	0.004	97	1424.12	8.95	16.82
12R-2 94/96	14468-24A	10.53286	0.09479	0.005	97.6	1599.45	8.76	18.24
12R-2 94/96	14468-28A	10.58298	0.01045	0.006	99	1476.35	6.76	16.24
12R-2 94/96	14468-01A	10.80379	0.01593	0.016	99.7	1523.24	4.36	15.84
12R-2 94/96	14468-08A	12.46091	0.0708	0.004	95.7	1575.14	10.24	18.78
12R-2 94/96	14468-05A	12.82667	0.01868	0.029	99.1	1397.46	3.41	14.38
12R-2 94/96	14468-22A	13.30193	0.02241	0.006	48.8	1060.68	9.43	14.20
12R-2 94/96	14468-11A	13.85912	0.03483	0.009	98.8	1584.79	6.87	17.27
12R-2 94/96	14468-29A	15.20492	0.0722	0.004	97.5	1592.88	10.38	19.01
12R-2 94/96	14468-20A	15.47885	0.04159	0.01	97.6	1542.77	6.06	16.58
12R-2 94/96	14468-12A	19.34842	0.17122	0.002	88	1179.85	14.05	18.35
12R-2 94/96	14468-15A	20.04489	0.01597	0.013	96.7	1304.02	4.28	13.73
12R-2 94/96	14468-06A	21.53851	0.03445	0.01	97.1	1550.41	5.70	16.52
12R-2 94/96	14468-16A	23.98108	0.01105	0.019	99.2	1483.00	4.83	15.60
12R-2 94/96	14468-26A	28.61312	0.05001	0.008	99.3	1575.91	7.43	17.42
12R-2 94/96	14468-17A	29.13817	0.03251	0.039	97.9	1545.79	3.12	15.77
12R-2 94/96	14468-07A	29.92724	0.12795	0.003	96.3	1588.66	12.54	20.24
12R-2 94/96	14468-10A	30.08007	0.09111	0.002	90.7	1335.87	13.34	18.88
12R-2 94/96	14468-23A	34.69998	0.08773	0.002	86.9	858.30	13.07	15.64
12R-2 94/96	14468-25A	38.46214	0.03985	0.007	98.6	1482.16	6.43	16.16
12R-2 94/96	14468-04A	118.6235 3	-0.07894	0.002	74.7	2606.44	20.67	33.27
total # grains	4							
12R-3 10/12	14458-07	4.53583	0.02594	0.022	99.5	1571.33	4.66	16.39
12R-3 10/12	14458-08	9.16397	0.08374	0.006	99.2	1879.18	9.57	21.09
12R-3 10/12	14458-03	11.56942	0.0717	0.01	99.6	1676.10	6.67	18.04
12R-3 10/12	14458-02	12.37081	0.04862	0.005	99.5	1480.44	9.42	17.55
total # grains	36							
12R-3 44/46	14457-36	2.23383	0.0359	0.011	99.2	1291.56	5.36	13.98

12R-3 44/46	14457-05	4.62801	0.00913	0.027	97.9	971.70	3.17	10.22
12R-3 44/46	14457-25	4.8299	0.32683	0.001	93.8	1313.98	44.22	46.13
12R-3 44/46	14457-31	5.88959	0.03967	0.008	82.6	1327.53	8.56	15.80
12R-3 44/46	14457-32	5.97425	0.03594	0.012	99.6	1313.28	5.51	14.24
12R-3 44/46	14457-30	7.24216	0.06789	0.005	99.4	1477.90	9.50	17.57
12R-3 44/46	14457-18	7.33793	0.01392	0.04	99.8	1458.95	3.93	15.11
12R-3 44/46	14457-29	7.53351	0.03509	0.01	99.7	1483.25	5.99	16.00
12R-3 44/46	14457-14	7.77981	0.03882	0.009	99.6	1470.47	6.27	15.98
12R-3 44/46	14457-28	8.4787	0.00733	0.009	99.8	1483.84	6.84	16.34
12R-3 44/46	14457-10	9.55075	0.05579	0.008	98.8	1514.00	7.92	17.09
12R-3 44/46	14457-11	9.57901	0.01577	0.009	98.2	1533.84	6.88	16.81
12R-3 44/46	14457-24	9.76964	0.03118	0.009	96.8	1560.13	7.83	17.45
12R-3 44/46	14457-37	10.01302	0.12594	0.005	98.2	1417.41	8.92	16.75
12R-3 44/46	14457-21	10.08605	0.04903	0.009	99.1	1586.51	5.80	16.89
12R-3 44/46	14457-26	10.70268	0.0132	0.005	98.8	1339.75	7.85	15.53
12R-3 44/46	14457-01	12.51132	0.04065	0.017	95.6	1515.78	5.20	16.03
12R-3 44/46	14457-06	12.57788	0.03229	0.019	99.2	1529.08	5.02	16.09
12R-3 44/46	14457-33	13.2286	0.01797	0.148	99.8	1484.86	2.98	15.14
12R-3 44/46	14457-03	13.30711	0.08659	0.006	99.5	1474.55	9.42	17.50
12R-3 44/46	14457-23	13.34411	0.02976	0.013	99.5	1514.17	5.74	16.19
12R-3 44/46	14457-19	14.12529	0.05691	0.005	97.5	1494.70	10.00	17.99
12R-3 44/46	14457-34	14.14473	0.12672	0.002	98	2147.39	25.85	33.61
12R-3 44/46	14457-15	14.44574	0.00668	0.023	99.5	1429.65	4.36	14.95
12R-3 44/46	14457-08	17.85967	0.0309	0.01	99.1	1539.06	6.41	16.67
12R-3 44/46	14457-04	17.88619	0.05222	0.006	96.6	1530.44	7.86	17.21
12R-3 44/46	14457-07	20.10644	0.02185	0.033	99.7	1476.16	4.01	15.30
12R-3 44/46	14457-38	22.2648	0.25266	0.002	98.2	1502.87	16.31	22.18
12R-3 44/46	14457-12	22.27671	0.00588	0.039	96.7	1603.78	4.16	16.57
12R-3 44/46	14457-17	26.12455	0.01512	0.01	99.6	1491.58	6.53	16.28
12R-3 44/46	14457-35	26.34431	0.02819	0.014	97	1553.04	5.58	16.50
12R-3 44/46	14457-09	26.42236	-0.00259	0.041	99.6	1549.51	4.06	16.02
12R-3 44/46	14457-16	26.99161	0.02056	0.011	98.9	1559.77	6.02	16.72
12R-3 44/46	14457-27	32.85609	0.10959	0.001	99.4	1537.50	21.86	26.72
12R-3 44/46	14457-13	36.10894	0.16434	0.003	97.4	1418.25	13.13	19.33
12R-3 44/46	14457-22	77.45129	-0.0016	0.004	80	607.89	7.39	9.57
total # grains	35							
12R-3 84/86	14456-20	1.42186	0.00573	0.067	97.7	368.74	1.18	3.87
12R-3 84/86	14456-29	1.6659	0.00483	0.108	94.1	197.14	0.69	2.09
12R-3 84/86	14456-07	1.79448	0.08699	0.002	91.9	469.50	7.07	8.49
12R-3 84/86	14456-09	5.20814	0.01259	0.046	99.2	876.76	2.51	9.12
12R-3 84/86	14456-06	7.2135	0.03695	0.018	99.2	1510.20	5.26	15.99
12R-3 84/86	14456-27	7.35164	0.04727	0.01	99.6	1450.74	5.84	15.64
12R-3 84/86	14456-01	7.36737	0.01184	0.033	99.8	1499.13	4.04	15.53
12R-3 84/86	14456-18	8.36228	0.05012	0.013	98.6	1496.11	6.19	16.19
12R-3 84/86	14456-23	8.39814	0.01064	0.056	100	1521.95	3.56	15.63
12R-3 84/86	14456-13	8.53522	0.02385	0.09	99.6	1499.67	3.28	15.35
12R-3 84/86	14456-02	9.00475	0.00864	0.022	99	1515.23	4.86	15.91
12R-3 84/86	14456-28	9.11874	0.04872	0.008	99.4	1420.91	7.34	15.99

12R-3 84/86	14456-32	9.54634	0.00854	0.025	99.2	2097.19	5.49	21.68
12R-3 84/86	14456-08	9.84171	0.0107	0.07	99.7	1506.85	3.44	15.46
12R-3 84/86	14456-05	10.0446	0.03165	0.011	99.2	1499.10	6.13	16.20
12R-3 84/86	14456-10	10.19792	0.03767	0.013	99	1586.23	6.12	17.00
12R-3 84/86	14456-15	10.8179	0.00032	0.102	99.7	1526.49	3.30	15.62
12R-3 84/86	14456-21	11.18961	0.04736	0.007	98.4	2010.80	9.49	22.23
12R-3 84/86	14456-39	11.95034	0.04125	0.006	99.5	1489.84	8.65	17.23
12R-3 84/86	14456-36	12.34794	0.02218	0.01	99.1	1458.98	5.92	15.75
12R-3 84/86	14456-30	13.22368	0.03997	0.008	97.1	1458.72	6.81	16.10
12R-3 84/86	14456-16	13.98766	0.08532	0.004	99	1473.52	9.51	17.54
12R-3 84/86	14456-26	14.72898	0.01067	0.049	99.3	1513.87	3.83	15.62
12R-3 84/86	14456-33	16.28117	0.03907	0.01	99.4	1492.06	6.78	16.39
12R-3 84/86	14456-25	17.42641	0.04501	0.008	97.6	1619.49	7.67	17.92
12R-3 84/86	14456-19	18.04147	0.0663	0.006	97.5	1628.51	9.05	18.63
12R-3 84/86	14456-34	18.84403	0.19348	0.002	90	1487.95	14.07	20.48
12R-3 84/86	14456-24	22.27924	0.11943	0.004	89.3	1563.95	11.69	19.52
12R-3 84/86	14456-17	22.2861	0.13769	0.004	98.4	1464.21	11.97	18.91
12R-3 84/86	14456-38	22.49219	0.04978	0.004	95.7	1664.90	12.40	20.76
12R-3 84/86	14456-35	25.47253	0.01093	0.019	96	1505.10	4.88	15.82
12R-3 84/86	14456-12	34.93758	0.05921	0.003	96.8	1837.75	12.41	22.17
12R-3 84/86	14456-04	41.77191	0.10839	0.004	97.9	1688.30	12.27	20.87
12R-3 84/86	14456-22	45.1443	-0.01269	0.013	99.2	1556.15	5.53	16.51
12R-3 84/86	14456-37	50.83316	-0.00718	0.006	93.7	1629.06	9.00	18.61

total # grains	44							
12R-3 104/106	14459-39	1.54939	0.00597	0.161	99.1	1031.42	1.90	10.49
12R-3 104/106	14459-45	2.29167	0.01095	0.041	97.2	478.70	1.43	5.00
12R-3 104/106	14459-26	3.23128	0.00783	0.24	98.3	1301.65	2.11	13.19
12R-3 104/106	14459-17	4.86737	0.02093	0.028	99.1	1438.01	3.83	14.88
12R-3 104/106	14459-33	4.97678	0.02335	0.021	99.3	536.71	2.27	5.83
12R-3 104/106	14459-36	6.02828	0.06369	0.015	91.7	1668.12	5.41	17.54
12R-3 104/106	14459-15	7.79759	0.01545	0.02	96.9	1533.85	4.23	15.91
12R-3 104/106	14459-32	8.03889	0.02746	0.038	99.6	1487.30	3.25	15.22
12R-3 104/106	14459-35	8.06523	0.01674	0.018	66.6	1213.68	6.14	13.60
12R-3 104/106	14459-06	8.09948	0.00077	0.056	99.2	1520.78	2.78	15.46
12R-3 104/106	14459-28	8.9504	0.06071	0.015	97.4	1501.12	5.41	15.96
12R-3 104/106	14459-22	9.07603	0.03949	0.024	99.7	1472.56	3.86	15.22
12R-3 104/106	14459-20	9.67431	0.08969	0.007	94	1514.93	7.68	16.98
12R-3 104/106	14459-23	9.79139	0.02024	0.019	96.5	1244.14	3.83	13.02
12R-3 104/106	14459-42	9.96946	0.04292	0.02	99.3	1480.42	4.00	15.34
12R-3 104/106	14459-04	10.25025	0.00126	0.2	98.1	1194.94	1.99	12.11
12R-3 104/106	14459-07	10.30615	0.02091	0.062	99.3	1525.15	2.98	15.54
12R-3 104/106	14459-27	10.51227	0.01085	0.089	98.3	1268.36	2.35	12.90
12R-3 104/106	14459-11	10.55092	0.02736	0.027	98.5	1491.65	3.75	15.38
12R-3 104/106	14459-25	11.06297	0.00281	0.077	99.6	1502.11	2.54	15.23
12R-3 104/106	14459-18	11.22881	0.04812	0.011	95	1507.00	6.08	16.25
12R-3 104/106	14459-03	11.29015	0.00549	0.084	99.5	1460.97	2.55	14.83

12R-3 104/106	14459-41	11.48279	0.03117	0.013	99.2	1509.72	6.35	16.38
12R-3 104/106	14459-31	12.68963	0.03895	0.011	98.6	1537.08	6.65	16.75
12R-3 104/106	14459-37	12.83575	0.02343	0.014	98	1481.91	5.44	15.79
12R-3 104/106	14459-19	13.75405	0.01495	0.009	97.7	1030.43	4.70	11.33
12R-3 104/106	14459-29	14.21337	0.04116	0.013	99.4	1526.15	5.35	16.17
12R-3 104/106	14459-44	14.2245	0.09469	0.006	95.6	1605.28	10.24	19.04
12R-3 104/106	14459-34	14.50333	0.02588	0.019	99.4	1533.76	4.64	16.02
12R-3 104/106	14459-05	14.59493	0.01198	0.032	98.9	1524.58	3.54	15.65
12R-3 104/106	14459-13	15.88731	0.00732	0.023	98.8	1498.11	4.23	15.57
12R-3 104/106	14459-30	15.97356	0.05012	0.009	98.7	1502.67	7.19	16.66
12R-3 104/106	14459-14	16.28573	0.014	0.022	97.1	1548.24	4.28	16.06
12R-3 104/106	14459-01	16.44555	0.00638	0.016	98.7	1628.39	5.42	17.16
12R-3 104/106	14459-21	16.63781	0.02038	0.012	99	1492.06	6.10	16.12
12R-3 104/106	14459-10	16.98998	0.00467	0.031	95.9	1561.53	4.27	16.19
12R-3 104/106	14459-09	18.01149	0.00356	0.044	99.1	1383.80	2.99	14.16
12R-3 104/106	14459-24	18.52489	0.00628	0.046	99	1591.48	3.35	16.26
12R-3 104/106	14459-43	18.87665	0.05744	0.006	95.8	1018.27	7.41	12.59
12R-3 104/106	14459-08	21.94024	0.00848	0.038	99	1460.80	3.46	15.01
12R-3 104/106	14459-16	22.65832	0.0372	0.008	96.8	1476.94	6.84	16.28
12R-3 104/106	14459-12	24.86939	0.04894	0.007	96.3	1428.87	8.28	16.52
12R-3 104/106	14459-40	26.90338	0.05401	0.006	96.2	1607.94	8.77	18.32
12R-3 104/106	14459-38	48.37878	0.11092	0.003	82	1295.95	14.58	19.51

total # grains	43							
12R-CC 4/6	14460-34	1.5206	0.00948	0.07	86.6	256.64	0.93	2.73
12R-CC 4/6	14460-28	3.43627	0.01109	0.033	94.8	406.00	1.46	4.32
12R-CC 4/6	14460-40	3.39739	0.00741	0.032	96.4	460.64	1.77	4.93
12R-CC 4/6	14460-47	2.80921	0.41502	0.001	22	554.15	33.49	33.94
12R-CC 4/6	14460-25	2.26408	0.00736	0.047	98	600.88	1.62	6.22
12R-CC 4/6	14460-31	3.02268	0.01677	0.041	97.3	643.09	1.79	6.67
12R-CC 4/6	14460-37	2.53116	0.00925	0.054	98.1	837.89	2.00	8.61
12R-CC 4/6	14460-44	3.25777	0.02234	0.041	99.1	965.55	2.32	9.93
12R-CC 4/6	14460-01	7.92058	0.00241	0.428	99.1	1158.93	1.88	11.74
12R-CC 4/6	14460-12	19.10505	0.03819	0.006	96.7	1166.92	8.50	14.44
12R-CC 4/6	14460-38	9.28667	0.17275	0.003	95.8	1304.91	15.12	19.97
12R-CC 4/6	14460-04	8.23582	0.00339	0.143	99.6	1447.39	2.30	14.65
12R-CC 4/6	14460-27	16.13713	0.01622	0.015	98.2	1455.39	5.36	15.51
12R-CC 4/6	14460-33	6.26698	0.03073	0.015	99.5	1456.23	4.94	15.38
12R-CC 4/6	14460-22	21.06219	0.03432	0.009	98.1	1458.37	7.23	16.28
12R-CC 4/6	14460-18	22.54104	0.02228	0.012	96.3	1461.13	5.70	15.68
12R-CC 4/6	14460-19	9.81665	0.02844	0.015	98.4	1464.46	5.50	15.64
12R-CC 4/6	14460-55	7.72511	0.06358	0.006	98.3	1465.12	8.49	16.94
12R-CC 4/6	14460-43	14.85105	0.04322	0.008	98.5	1471.81	7.97	16.74
12R-CC 4/6	14460-20	8.51041	0.01223	0.031	99.5	1473.76	3.71	15.20
12R-CC 4/6	14460-24	45.29114	0.0695	0.005	95.9	1474.84	9.74	17.68
12R-CC 4/6	14460-51	9.0524	0.03336	0.009	98.7	1478.03	6.85	16.29
12R-CC 4/6	14460-21	12.30449	0.03435	0.014	97.8	1483.47	5.47	15.81
12R-CC 4/6	14460-10	6.34846	0.01547	0.05	99.3	1485.87	3.04	15.17
12R-CC 4/6	14460-50	43.41038	0.02317	0.001	83.7	1497.72	65.20	66.90

12R-CC 4/6	14460-53	4.91392	0.01663	0.028	99.5	1499.35	3.54	15.41
12R-CC 4/6	14460-07	34.75947	0.00693	0.014	96.7	1503.44	5.35	15.96
12R-CC 4/6	14460-08	12.30449	0.01754	0.025	99.3	1511.98	3.93	15.62
12R-CC 4/6	14460-32	10.31256	0.03025	0.017	98.8	1514.12	5.31	16.05
12R-CC 4/6	14460-17	8.5636	0.02397	0.025	97.7	1516.60	4.50	15.82
12R-CC 4/6	14460-41	16.52316	0.0688	0.005	99	1517.80	10.46	18.43
12R-CC 4/6	14460-35	7.4737	0.00233	0.012	98.4	1518.02	6.29	16.43
12R-CC 4/6	14460-03	35.36024	0.03568	0.021	97.5	1526.04	4.81	16.00
12R-CC 4/6	14460-46	7.42684	0.02293	0.023	99.3	1529.12	4.90	16.06
12R-CC 4/6	14460-13	20.42193	0.01818	0.009	98.2	1530.40	7.04	16.84
12R-CC 4/6	14460-06	20.49684	0.02701	0.019	97.7	1539.93	5.22	16.26
12R-CC 4/6	14460-16	17.22381	0.01581	0.028	98.9	1547.06	4.08	16.00
12R-CC 4/6	14460-14	27.21121	0.01473	0.007	99.4	1547.63	10.47	18.68
12R-CC 4/6	14460-15	9.9147	0.00633	0.1	99.7	1568.18	2.67	15.91
12R-CC 4/6	14460-02	12.20731	0.01633	0.156	99.5	1580.11	2.44	15.99
12R-CC 4/6	14460-26	9.007	0.04017	0.011	98.4	1591.00	6.20	17.07
12R-CC 4/6	14460-29	8.65741	0.04134	0.027	99	1718.26	4.02	17.65
12R-CC 4/6	14460-49	84.75105	0.0582	0.002	96.6	2167.67	21.90	30.81
total # grains	28							
15R-6 34/36	14461-32	1.25289	0.00965	0.041	99.7	1442.27	3.03	14.74
15R-6 34/36	14461-33	1.84275	0.01154	0.034	99.4	1464.80	3.45	15.05
15R-6 34/36	14461-10	2.90374	0.02746	0.013	89.4	312.10	1.97	3.69
15R-6 34/36	14461-27	4.02425	0.04156	0.003	98.9	1475.98	10.46	18.09
15R-6 34/36	14461-21	4.69045	0.03799	0.007	95.4	1412.94	6.71	15.64
15R-6 34/36	14461-36	4.74262	0.05007	0.004	96.3	1521.29	9.37	17.87
15R-6 34/36	14461-12	5.96676	0.01165	0.01	83	541.51	3.17	6.28
15R-6 34/36	14461-13	6.29739	0.03439	0.006	99.6	1458.46	7.29	16.30
15R-6 34/36	14461-34	6.56498	0.02853	0.007	99.4	1452.16	6.00	15.71
15R-6 34/36	14461-16	6.63912	-0.02213	0.001	95.2	1464.33	28.02	31.62
15R-6 34/36	14461-19	6.89562	0.06232	0.002	98.3	1438.70	13.27	19.57
15R-6 34/36	14461-29	6.96528	0.03755	0.008	99.5	1496.66	6.05	16.14
15R-6 34/36	14461-01	7.76509	0.00989	0.106	99.8	1518.24	2.43	15.38
15R-6 34/36	14461-07	8.23266	0.03961	0.004	98.5	1418.50	10.20	17.47
15R-6 34/36	14461-08	8.31681	0.04899	0.015	99.1	1454.48	5.08	15.41
15R-6 34/36	14461-09	9.76215	0.02474	0.01	99	1505.99	6.59	16.44
15R-6 34/36	14461-24	9.93701	0.05297	0.006	98.5	1393.28	6.41	15.34
15R-6 34/36	14461-02	10.34706	0.00198	0.201	99.8	1494.02	2.15	15.09
15R-6 34/36	14461-30	10.98815	0.12036	0.002	98.2	1452.75	12.28	19.02
15R-6 34/36	14461-23	11.03536	0.07729	0.003	98.4	1507.67	10.98	18.65
15R-6 34/36	14461-28	14.66767	0.05068	0.006	98.9	1494.11	7.93	16.91
15R-6 34/36	14461-25	18.35086	0.01402	0.004	97.2	1432.60	9.32	17.09
15R-6 34/36	14461-03	23.51559	0.01465	0.006	95.6	1382.10	9.72	16.90
15R-6 34/36	14461-20	36.66321	0.01187	0.001	97.7	1504.06	21.70	26.40
15R-6 34/36	14461-35	36.68025	0.08151	0.002	89.8	1499.03	15.70	21.71
15R-6 34/36	14461-15	41.24148	0.02569	0.001	86.1	1334.13	15.43	20.40
15R-6 34/36	14461-04	44.83664	0.06417	0.002	90.9	1419.13	25.79	29.44
15R-6 34/36	14461-17	79.28162	-0.0574	0.001	88.9	1327.55	27.78	30.79

total # grains	16							
19R1 60/62	13936-25	4.93512	0.05141	0.003	99.3	1432.8	9.0	43.9
19R1 60/62	13936-02	5.39858	0.00241	0.044	99.6	1496.8	4.7	45.1
19R1 60/62	13936-03	5.5307	0.01945	0.026	99.6	1486.1	4.1	44.8
19R1 60/62	13936-07	5.64543	0.03102	0.014	99.7	1463.4	6.3	44.3
19R1 60/62	13936-05	5.73118	0.0458	0.015	99	1446.2	4.2	43.6
19R1 60/62	13936-18	6.57552	0.07488	0.007	97.3	1709.4	6.8	51.7
19R1 60/62	13936-21	7.43136	0.14943	0.004	97.8	1612.9	9.9	49.4
19R1 60/62	13936-13	8.64185	0.11106	0.003	98.7	1512.7	13.3	47.3
19R1 60/62	13936-01	9.76961	0.02203	0.019	99.3	1464.7	4.2	44.1
19R1 60/62	13936-17	10.08546	0.05059	0.006	98.7	1440.2	7.1	43.8
19R1 60/62	13936-09	10.20083	0.01804	0.039	99.3	1479.1	3.7	44.5
19R1 60/62	13936-04	10.24866	0.01886	0.034	98.9	1499.9	5.0	45.3
19R1 60/62	13936-24	10.69705	0.11376	0.003	95.5	1437.8	15.8	45.9
19R1 60/62	13936-15	13.13566	0.0536	0.008	97.8	1465.7	6.3	44.4
19R1 60/62	13936-19	13.31417	0.21242	0.003	98.5	1514.3	12.8	47.2
19R1 60/62	13936-23	18.07568	0.13908	0.003	99.9	1611.4	10.4	49.5

total #grains	30							
19R1 90/92	13937-10	1.38524	0.15928	0.002	88.2	948.2	14.4	31.9
19R1 90/92	13937-04	3.69501	0.00786	0.054	96.8	1041.8	2.7	31.4
19R1 90/92	13937-02	5.59303	0.08561	0.009	96.5	1459.5	7.9	44.5
19R1 90/92	13937-01	6.68428	0.02167	0.032	98.1	1289.6	4.4	38.9
19R1 90/92	13937-12	7.40912	0.11564	0.003	98.9	1452.2	11.1	44.9
19R1 90/92	13937-29	7.71324	0.04214	0.007	99	1533.9	6.0	46.4
19R1 90/92	13937-15	7.81824	0.06273	0.006	98.7	1340.1	6.8	40.8
19R1 90/92	13937-33	7.83848	0.01916	0.003	98.8	533.2	8.4	18.1
19R1 90/92	13937-23	8.07816	0.08693	0.005	99	1465.4	12.3	45.6
19R1 90/92	13937-11	8.13216	0.09988	0.004	99.4	1502.3	9.7	46.1
19R1 90/92	13937-18	8.47479	0.04578	0.006	99.4	1556.7	8.0	47.4
19R1 90/92	13937-25	10.40435	0.03367	0.006	97.7	1528.0	6.5	46.3
19R1 90/92	13937-27	10.54092	0.08142	0.003	99	1601.4	18.3	51.4
19R1 90/92	13937-09	11.16922	0.09567	0.003	98	1494.9	10.5	46.1
19R1 90/92	13937-17	11.41448	0.12826	0.003	98.8	1532.7	11.3	47.3
19R1 90/92	13937-26	11.52592	0.02799	0.007	99.3	1478.6	6.5	44.8
19R1 90/92	13937-13	11.86775	0.07735	0.004	98.1	1541.6	15.0	48.6
19R1 90/92	13937-31	12.70771	0.03933	0.002	97	1449.0	18.7	47.3
19R1 90/92	13937-34	12.82964	0.03881	0.003	98.4	1492.4	9.1	45.7
19R1 90/92	13937-28	13.23281	-0.00113	0.001	98.5	1503.0	15.0	47.5
19R1 90/92	13937-16	13.45206	0.13287	0.003	97.2	1367.8	16.0	44.0
19R1 90/92	13937-05	14.96091	0.08721	0.002	99.8	1270.2	19.9	43.0
19R1 90/92	13937-21	15.07427	0.08591	0.005	95.4	1374.1	7.1	41.8
19R1 90/92	13937-07	17.6133	0.05636	0.002	98	1445.2	14.9	45.8
19R1 90/92	13937-14	17.93958	0.0356	0.011	98.2	1450.8	5.6	43.9
19R1 90/92	13937-06	18.53138	0.01451	0.033	97.9	1529.4	5.2	46.2
19R1 90/92	13937-22	18.96596	0.12596	0.003	99.1	1389.0	13.4	43.8
19R1 90/92	13937-08	19.51055	0.15607	0.002	96.6	1495.3	16.9	47.9
19R1 90/92	13937-03	19.5917	0.11359	0.002	99.1	1511.7	19.8	49.5
19R1 90/92	13937-32	22.15608	0.12491	0.001	91.3	1306.1	48.8	62.6

total #grains	42							
19R3 80/87	13938-15	8.11344	-0.01095	0.019	57.1	891.4	8.1	27.9
19R3 80/87	13938-34	0.13444	0.07157	0.004	92.6	1195.7	8.0	36.8
19R3 80/87	13938-28	10.31031	0.01333	0.006	98.3	1197.3	6.1	36.4
19R3 80/87	13938-43	10.86343	0.0829	0.002	96.2	1298.6	16.0	42.1
19R3 80/87	13938-13	10.13212	0.08478	0.004	97.2	1338.2	13.4	42.3
19R3 80/87	13938-16	4.39411	0.12817	0.003	97.8	1363.7	13.7	43.1
19R3 80/87	13938-10	8.87208	0.07872	0.004	93.9	1371.1	9.8	42.3
19R3 80/87	13938-44	7.18088	0.01546	0.003	94.8	1383.3	9.6	42.6
19R3 80/87	13938-33	13.62946	0.08722	0.002	101.5	1398.4	12.6	43.8
19R3 80/87	13938-48	10.69951	0.08422	0.002	97.6	1408.0	10.7	43.6
19R3 80/87	13938-04	8.9365	0.03074	0.01	97.9	1435.5	6.0	43.5
19R3 80/87	13938-22	7.77648	0.04245	0.006	99.2	1438.0	7.0	43.7
19R3 80/87	13938-42	8.78483	0.03908	0.006	99.1	1441.4	7.2	43.8
19R3 80/87	13938-40	3.82104	0.06376	0.009	99	1442.9	6.2	43.7
19R3 80/87	13938-25	14.89008	0.1127	0.003	96.3	1448.5	10.3	44.7
19R3 80/87	13938-46	10.27072	0.04706	0.007	98.4	1452.6	10.0	44.7
19R3 80/87	13938-12	14.14084	0.04195	0.011	97.2	1452.7	5.2	43.9
19R3 80/87	13938-27	6.21739	0.04296	0.006	99.3	1454.1	5.9	44.0
19R3 80/87	13938-38	18.88	0.279	0.002	95.9	1454.7	23.5	49.6
19R3 80/87	13938-09	4.76053	0.02951	0.009	99.2	1455.6	9.1	44.6
19R3 80/87	13938-32	5.10297	0.03427	0.015	99.6	1463.4	4.4	44.1
19R3 80/87	13938-37	25.75992	0.10147	0.004	97.4	1467.5	14.3	46.3
19R3 80/87	13938-06	5.47045	0.11863	0.005	97.9	1474.2	9.5	45.2
19R3 80/87	13938-29	7.30386	0.08027	0.003	99.7	1479.5	16.8	47.5
19R3 80/87	13938-08	5.99969	0.05677	0.01	99.8	1483.2	6.2	44.9
19R3 80/87	13938-03	9.22765	0.02249	0.001	99.1	1492.4	19.2	48.7
19R3 80/87	13938-26	29.84075	0.10035	0.002	95.3	1506.0	27.0	52.6
19R3 80/87	13938-02	16.39911	0.10463	0.005	96.7	1507.7	8.3	46.0
19R3 80/87	13938-36	0.04083	0.01536	0.048	99.6	1509.5	3.7	45.4
19R3 80/87	13938-23	3.75284	0.01711	0.046	99.5	1514.6	4.9	45.7
19R3 80/87	13938-39	8.31915	0.04465	0.005	98.7	1526.3	7.6	46.4
19R3 80/87	13938-35	6.99997	0.1072	0.004	99.5	1526.9	8.4	46.6
19R3 80/87	13938-05	5.31467	0.0263	0.017	99	1547.1	6.7	46.9
19R3 80/87	13938-07	7.07346	0.02356	0.018	99.5	1548.6	4.7	46.7
19R3 80/87	13938-01	8.84591	0.03859	0.016	98.8	1552.7	5.0	46.8
19R3 80/87	13938-45	5.41044	0.03349	0.01	99.6	1555.5	5.5	47.0
19R3 80/87	13938-21	16.70974	0.08591	0.006	97.4	1583.0	8.0	48.2
19R3 80/87	13938-24	6.77522	0.02008	0.015	99	1593.6	7.3	48.4
19R3 80/87	13938-11	6.24911	0.08449	0.007	99.6	1610.6	6.9	48.8
19R3 80/87	13938-41	10.44328	0.01787	0.004	96.9	1614.8	11.4	49.8
19R3 80/87	13938-31	28.69643	0.0507	0.01	93.1	1631.9	6.5	49.4
19R3 80/87	13938-17	11.25277	0.09496	0.005	98.4	1646.9	7.4	50.0

total #grains	12							
19R4 10/12	13939-05	21.95012	0.22628	0.001	94.5	1427.4	33.9	54.6
19R4 10/12	13939-06	7.0096	0.08965	0.006	99	1434.4	10.5	44.3

19R4 10/12	13939-09	7.99292	0.06891	0.007	99.3	1452.5	10.4	44.8
19R4 10/12	13939-04	4.18336	0.03168	0.012	99.2	1460.6	4.9	44.1
19R4 10/12	13939-07	10.50636	0.0393	0.009	98.7	1467.3	9.0	44.9
19R4 10/12	13939-03	5.18409	0.02816	0.042	99.8	1470.0	3.5	44.2
19R4 10/12	13939-08	7.80825	0.0626	0.007	99.1	1561.2	7.1	47.4
19R4 10/12	13939-02	5.0525	0.03576	0.014	99.7	1596.6	7.5	48.5
19R4 10/12	13939-15	13.52093	0.11501	0.001	100	1433.0	24.0	49.2
19R4 10/12	13939-14	5.32978	0.19763	0.001	90.9	1494.0	37.8	58.7
19R4 10/12	13939-10	25.2525	0.01858	0.001	97.7	1523.4	22.7	51.0
19R4 10/12	13939-11	14.11628	0.11246	0.003	93.2	1936.8	11.2	59.2
total # grains	24							
19R4 140/142	13940-25	1.34669	-0.01809	0.001	84.5	518.4	10.1	18.6
19R4 140/142	13940-01	2.67168	0.05415	0.004	96	524.5	6.3	16.9
19R4 140/142	13940-16	3.46595	0.01843	0.02	97.6	1024.5	4.4	31.0
19R4 140/142	13940-11	4.21902	0.1497	0.004	97.5	1620.3	9.4	49.5
19R4 140/142	13940-23	5.67082	0.02043	0.009	98.2	1469.3	5.3	44.4
19R4 140/142	13940-20	5.72021	0.0059	0.046	98.9	1510.4	3.9	45.5
19R4 140/142	13940-06	5.79585	0.03887	0.008	98.8	1462.5	5.3	44.2
19R4 140/142	13940-24	5.961	0.01567	0.016	99.5	1489.4	4.5	44.9
19R4 140/142	13940-02	6.64047	0.0755	0.006	99	1520.6	6.4	46.1
19R4 140/142	13940-22	6.85134	0.04235	0.004	99.5	1436.0	9.6	44.1
19R4 140/142	13940-26	7.1022	0.01639	0.027	95	1437.7	5.0	43.4
19R4 140/142	13940-10	7.13885	0.21207	0.001	96.7	1415.0	22.7	48.1
19R4 140/142	13940-27	7.3974	0.08818	0.008	99.4	1415.5	8.0	43.2
19R4 140/142	13940-28	8.25166	0.08145	0.003	98.2	1417.1	9.7	43.6
19R4 140/142	13940-07	8.47744	0.12565	0.001	82.1	1423.3	23.5	48.7
19R4 140/142	13940-14	8.96185	-0.01966	0.002	99.5	1419.6	13.6	44.7
19R4 140/142	13940-12	9.14771	0.09582	0.004	99.2	1406.1	13.2	44.2
19R4 140/142	13940-21	11.10879	-0.05225	0.003	96.8	481.2	4.4	15.1
19R4 140/142	13940-04	13.01002	0.04406	0.019	99.5	2096.4	4.5	63.1
19R4 140/142	13940-18	15.11748	0.03429	0.006	99.8	1462.4	7.5	44.5
19R4 140/142	13940-08	18.59005	0.12263	0.001	96.5	2299.1	27.7	74.3
19R4 140/142	13940-09	22.65469	0.1493	0.002	97.9	1378.1	14.6	43.9
19R4 140/142	13940-13	29.27214	0.1882	0.002	97.2	1448.8	12.1	45.1
19R4 140/142	13940-05	35.44707	-0.02496	0.001	71.1	1311.6	22.5	45.3
total # grains	34							
19R5 10/12	13941-20	4.08157	0.02701	0.02	99.7	1451.8	4.3	43.8
19R5 10/12	13941-13	5.09607	0.02488	0.015	97.9	1443.1	6.7	43.8
19R5 10/12	13941-06	5.17736	0.01529	0.024	99.8	1453.0	4.7	43.8
19R5 10/12	13941-08	5.26463	0.03975	0.013	99.5	1465.3	4.0	44.1
19R5 10/12	13941-14	5.70943	0.04945	0.006	99.3	1413.3	6.4	42.9
19R5 10/12	13941-03	5.76085	0.01024	0.024	99.1	1464.4	3.6	44.1
19R5 10/12	13941-11	5.9135	0.1328	0.001	99.4	1450.7	19.4	47.7
19R5 10/12	13941-05	5.92435	0.03336	0.012	99.2	1411.5	4.4	42.6

19R5 10/12	13941-22	6.00707	-0.04237	0.001	91.8	1272.9	22.8	44.5
19R5 10/12	13941-10	6.48215	0.01386	0.035	99.6	1563.1	4.6	47.1
19R5 10/12	13941-01	6.77942	0.02658	0.015	99.6	1485.5	4.2	44.8
19R5 10/12	13941-16	6.86914	0.07936	0.008	98	1742.0	7.8	52.8
19R5 10/12	13941-15	6.90183	0.01755	0.021	98.5	482.4	1.6	14.6
19R5 10/12	13941-17	8.00039	0.06737	0.007	94.6	1512.2	6.3	45.8
19R5 10/12	13941-07	8.24687	0.0556	0.009	99.1	1462.5	7.8	44.6
19R5 10/12	13941-30	8.49675	0.03992	0.008	98.6	1422.7	9.3	43.7
19R5 10/12	13941-31	8.53087	0.05568	0.004	99.4	1415.8	13.5	44.6
19R5 10/12	13941-12	8.81434	0.01878	0.014	99.6	1531.7	3.9	46.1
19R5 10/12	13941-33	9.27108	0.05002	0.008	99.9	1478.1	6.0	44.7
19R5 10/12	13941-04	10.12016	0.03869	0.008	98.6	1480.5	9.3	45.4
19R5 10/12	13941-21	10.66808	0.08904	0.004	99.5	1508.7	7.2	45.8
19R5 10/12	13941-25	10.87965	0.04045	0.003	100.3	1435.3	20.2	47.5
19R5 10/12	13941-32	12.25068	0.02294	0.002	97.6	1459.6	13.4	45.8
19R5 10/12	13941-27	12.48308	0.06152	0.008	98.4	1450.6	9.3	44.5
19R5 10/12	13941-18	12.53995	0.01896	0.02	99	1206.7	3.4	36.4
19R5 10/12	13941-35	13.81405	0.17224	0.002	96.4	1380.3	27.6	49.8
19R5 10/12	13941-29	15.23957	0.13027	0.001	97.3	1651.2	31.2	58.5
19R5 10/12	13941-19	15.37346	0.04118	0.006	97.1	1504.8	8.9	46.0
19R5 10/12	13941-26	15.58984	0.01544	0.009	99.3	1600.6	9.6	49.0
19R5 10/12	13941-34	15.60612	0.05954	0.008	98.9	1473.0	9.2	45.1
19R5 10/12	13941-24	15.99399	0.04004	0.004	97.7	1515.1	12.9	47.2
19R5 10/12	13941-09	20.73058	0.18759	0.002	91.1	1903.1	14.5	58.9
19R5 10/12	13941-28	22.27499	0.17243	0.002	98.1	1402.1	13.5	44.2
total # grains	30							
19R5 25/27	13942-09	0.00882	0.00369	0.44	99.8	1476.5	2.1	44.3
19R5 25/27	13942-04	0.13888	0.01556	0.048	99.5	1169.3	3.1	35.2
19R5 25/27	13942-12	0.29914	0.01781	0.025	97.2	905.7	2.7	27.3
19R5 25/27	13942-07	4.21493	0.01961	0.031	97.5	1485.2	5.1	44.8
19R5 25/27	13942-14	5.56357	0.02464	0.044	99.8	1579.8	4.1	47.6
19R5 25/27	13942-08	5.69533	0.0288	0.026	99.5	1496.2	3.1	45.0
19R5 25/27	13942-03	5.80265	0.00775	0.179	99.8	1470.0	2.6	44.2
19R5 25/27	13942-15	6.25052	0.02598	0.03	98.6	1450.7	3.5	43.7
19R5 25/27	13942-22	6.30393	0.05306	0.007	98.6	1444.8	7.1	43.9
19R5 25/27	13942-17	6.30505	0.103	0.006	97.8	1394.9	6.8	42.4
19R5 25/27	13942-33	6.3681	0.0871	0.006	99	1391.8	10.6	43.1
19R5 25/27	13942-01	6.40656	0.10319	0.005	99.6	1441.0	7.7	43.9
19R5 25/27	13942-10	6.97114	0.03401	0.01	98.5	1500.7	4.9	45.3
19R5 25/27	13942-35	7.08327	0.07529	0.006	99.7	1439.5	7.8	43.9
19R5 25/27	13942-06	8.15762	0.05992	0.009	99.5	1468.2	8.3	44.8
19R5 25/27	13942-02	9.14773	0.00776	0.048	99.4	1486.4	2.9	44.7
19R5 25/27	13942-26	9.33642	0.03575	0.019	99.4	1538.3	6.1	46.6
19R5 25/27	13942-16	9.40047	0.02252	0.021	99.5	1447.1	4.3	43.6
19R5 25/27	13942-28	9.42887	0.06519	0.005	98.8	1440.8	11.1	44.6
19R5 25/27	13942-32	9.70105	0.08157	0.008	98.6	1472.3	11.3	45.6
19R5 25/27	13942-31	11.14021	0.02851	0.009	99.4	1469.5	5.3	44.4

19R5 25/27	13942-34	11.75356	0.0927	0.008	98.7	1488.4	6.1	45.1
19R5 25/27	13942-29	12.10054	-0.00233	0.023	83.1	1539.5	4.7	46.4
19R5 25/27	13942-13	14.48139	0.0554	0.006	98.9	1431.5	6.6	43.4
19R5 25/27	13942-25	14.86178	0.08507	0.006	98	1417.1	7.2	43.1
19R5 25/27	13942-27	15.66964	0.09677	0.002	98.4	1457.7	20.0	48.1
19R5 25/27	13942-19	16.15245	0.04115	0.01	98.4	1429.4	5.7	43.3
19R5 25/27	13942-05	18.22647	0.20246	0.002	87.9	1308.1	13.5	41.5
19R5 25/27	13942-20	24.04133	0.27917	0.001	96.1	2573.6	28.0	82.1
19R5 25/27	13942-11	24.34697	0.05711	0.006	91	1769.8	8.5	53.8
Total # grains	3							
20R1 48/50	13943-01	5.00819	0.03539	0.01	98.1	1453.6	4.9	43.9
20R1 48/50	13943-03	4.68649	0.01052	0.03	99	1474.4	2.9	44.3
20R1 48/50	13943-04	8.86144	0.0546	0.005	99.4	1506.5	9.2	46.1
Total # grains	33							
21R1 129/131	13944-23	4.29807	0.08473	0.006	95.9	1126.8	9.9	35.2
21R1 129/131	13944-31	4.60964	0.04346	0.009	99.6	1629.4	5.0	49.1
21R1 129/131	13944-21	5.25442	0.01706	0.026	99.7	1492.3	3.9	44.9
21R1 129/131	13944-14	5.27524	0.01265	0.02	98.6	1469.8	3.5	44.2
21R1 129/131	13944-05	6.33237	0.01623	0.034	99.7	1464.6	2.9	44.0
21R1 129/131	13944-15	6.39358	0.00869	0.061	99.2	1138.4	2.2	34.2
21R1 129/131	13944-18	6.49282	0.02862	0.02	98.9	1473.0	6.7	44.7
21R1 129/131	13944-03	6.53901	0.3387	0.001	91.1	1378.1	24.1	47.9
21R1 129/131	13944-35	6.85751	0.03381	0.016	99.3	1583.8	8.1	48.2
21R1 129/131	13944-20	7.7116	0.03323	0.01	98.8	1459.7	5.5	44.1
21R1 129/131	13944-09	7.9218	0.05868	0.009	98.9	1444.8	8.7	44.2
21R1 129/131	13944-12	8.44587	0.02472	0.012	99.2	1491.4	4.2	44.9
21R1 129/131	13944-25	8.88749	0.02551	0.005	98.5	1697.7	8.8	51.7
21R1 129/131	13944-17	9.00765	0.02956	0.012	98.3	1548.8	4.8	46.7
21R1 129/131	13944-24	9.09602	0.06409	0.005	91.2	1312.0	11.0	40.9
21R1 129/131	13944-04	10.01548	0.04609	0.009	98.8	1181.7	4.5	35.7
21R1 129/131	13944-32	10.12078	-0.00029	0.001	101.9	1506.7	27.8	53.1
21R1 129/131	13944-36	11.20521	0.09038	0.002	96.7	1456.5	20.3	48.2
21R1 129/131	13944-06	11.64002	0.08285	0.004	97.5	482.1	3.9	15.0
21R1 129/131	13944-13	12.31581	0.12658	0.003	98.1	1610.9	10.9	49.6
21R1 129/131	13944-19	13.41476	0.03339	0.012	98.4	1593.2	6.7	48.3
21R1 129/131	13944-30	17.30635	0.12806	0.004	96.7	1415.8	8.0	43.2
21R1 129/131	13944-07	20.78954	0.02338	0.011	93.4	1325.6	5.2	40.1
21R1 129/131	13944-37	21.76915	0.08404	0.003	89.7	1495.6	12.9	46.7
21R1 129/131	13944-28	22.18801	0.12762	0.001	95	1864.8	56.8	79.7
21R1 129/131	13944-01	23.48071	0.0858	0.015	99	1525.2	4.4	46.0
21R1 129/131	13944-33	23.58275	0.10796	0.003	99.1	1240.4	12.3	39.2
21R1 129/131	13944-29	27.01034	0.13615	0.005	97.2	1595.7	7.3	48.4
21R1 129/131	13944-16	28.14314	0.13066	0.002	79.3	1429.6	13.2	44.9
21R1 129/131	13944-08	36.46265	-0.00686	0.016	90.8	1465.5	4.4	44.2
21R1 129/131	13944-11	36.71929	0.17948	0.002	95.8	2062.1	17.5	64.3

21R1 129/131	13944-22	42.76241	0.23606	0.001	90.1	1271.3	24.3	45.2
21R1 129/131	13944-34	127.5274 8	0.21473	0.001	95.3	1295.6	25.8	46.7
total # grains	31							
21R1 140/142	13945-28	4.37233	0.00744	0.026	99.4	1507.0	3.1	45.3
21R1 140/142	13945-15	4.62099	0.0232	0.016	99.4	1529.7	5.0	46.2
21R1 140/142	13945-18	5.3388	0.01513	0.03	98.2	481.8	2.1	14.6
21R1 140/142	13945-11	5.37933	0.05008	0.006	99.4	1431.5	7.5	43.6
21R1 140/142	13945-29	5.41347	0.01915	0.009	99.5	1468.5	5.2	44.4
21R1 140/142	13945-12	5.51544	0.00754	0.041	99.6	1496.4	2.9	45.0
21R1 140/142	13945-16	5.6156	0.02944	0.018	99.7	1474.3	3.6	44.4
21R1 140/142	13945-20	5.63772	0.00788	0.039	99.5	1453.4	2.8	43.7
21R1 140/142	13945-26	5.91207	0.01648	0.024	99.1	1496.1	3.8	45.0
21R1 140/142	13945-33	5.98268	0.01879	0.012	98.9	1431.5	7.9	43.7
21R1 140/142	13945-10	6.05775	0.01861	0.115	99.1	1567.5	2.6	47.1
21R1 140/142	13945-35	7.03355	0.05807	0.006	99.8	1513.7	12.5	47.1
21R1 140/142	13945-04	7.94503	0.02128	0.186	99.4	1667.4	2.3	50.1
21R1 140/142	13945-24	8.51154	0.08231	0.002	94.8	1356.8	16.8	44.0
21R1 140/142	13945-34	8.54649	0.05464	0.003	99.4	1441.5	14.8	45.7
21R1 140/142	13945-01	8.79952	0.04515	0.012	99.7	1485.1	7.8	45.2
21R1 140/142	13945-31	9.09034	0.06333	0.005	98.7	1419.2	11.1	44.0
21R1 140/142	13945-22	9.2348	0.01855	0.014	97.9	1528.8	4.3	46.1
21R1 140/142	13945-17	9.24534	0.03308	0.008	99.4	1493.0	6.6	45.3
21R1 140/142	13945-05	9.65493	0.03932	0.018	99.2	1672.4	4.3	50.4
21R1 140/142	13945-08	10.05418	0.00693	0.016	99.4	1491.5	4.2	44.9
21R1 140/142	13945-21	10.46637	0.03409	0.01	97.5	1464.4	10.3	45.1
21R1 140/142	13945-13	11.8442	0.10904	0.003	100. 5	1472.1	19.2	48.2
21R1 140/142	13945-14	11.88279	0.05212	0.006	98.1	1506.9	7.8	45.9
21R1 140/142	13945-02	12.96623	0.22204	0.001	97.5	1405.2	27.3	50.3
21R1 140/142	13945-19	14.23308	0.06793	0.003	98.4	1549.5	10.4	47.6
21R1 140/142	13945-06	14.30101	0.06075	0.005	97.2	1507.1	14.2	47.4
21R1 140/142	13945-27	15.32528	0.02303	0.009	98.4	1457.4	7.5	44.4
21R1 140/142	13945-32	17.07072	0.03439	0.002	97.6	1586.3	19.2	51.3
21R1 140/142	13945-03	26.0713	0.01618	0.013	94.7	1781.0	7.2	53.9
21R1 140/142	13945-30	27.78745	0.07014	0.004	98.8	1446.3	12.6	45.2
total # grains	1							
21R2 28/30	13946-01	4.64374	0.0438	0.008	98.6	1045.8	7.4	32.2
total # grains	43							
22R1 26/28	13947-40	5.67829	0.04549	0.009	94.8	991.8	4.5	30.1
22R1 26/28	13947-01	5.60955	0.0163	0.046	99.8	1499.8	2.8	45.1
22R1 26/28	13947-08	5.68348	0.01229	0.03	98.5	1399.9	4.2	42.2
22R1 26/28	13947-34	5.75491	0.08796	0.008	99.5	1539.0	6.6	46.6
22R1 26/28	13947-20	5.78609	0.03399	0.014	98.7	1627.5	5.0	49.1
22R1 26/28	13947-02	5.96629	0.03352	0.012	99.1	1514.1	6.0	45.8
22R1 26/28	13947-45	6.29822	0.05318	0.009	99.1	1576.9	5.1	47.6
22R1 26/28	13947-22	6.4276	0.03106	0.008	98.3	1422.6	6.0	43.1

22R1 26/28	13947-41	6.45047	0.04853	0.004	99.5	1496.4	8.7	45.7
22R1 26/28	13947-09	6.5397	0.04739	0.003	96.7	1405.6	15.6	45.0
22R1 26/28	13947-42	6.68072	0.05226	0.017	99.8	1471.0	3.3	44.3
22R1 26/28	13947-11	6.79734	0.02251	0.011	97.3	1394.5	5.9	42.3
22R1 26/28	13947-19	6.83583	0.01441	0.032	99.6	1517.3	2.9	45.6
22R1 26/28	13947-47	7.50047	0.10392	0.005	99.9	1463.8	8.8	44.8
22R1 26/28	13947-23	8.01932	0.06235	0.006	99.4	1455.9	7.0	44.2
22R1 26/28	13947-43	8.05962	0.0454	0.008	99.5	1535.8	9.5	47.0
22R1 26/28	13947-29	8.35174	0.04068	0.008	99	1439.9	6.5	43.7
22R1 26/28	13947-03	8.43162	0.01613	0.022	99.4	1506.5	4.2	45.4
22R1 26/28	13947-17	8.55529	0.05903	0.006	98.6	1435.2	9.2	44.0
22R1 26/28	13947-27	8.89866	0.03562	0.02	98.8	1589.8	3.6	47.8
22R1 26/28	13947-35	9.32149	0.03751	0.013	97.7	1479.0	4.8	44.6
22R1 26/28	13947-21	9.39704	0.04491	0.01	99.6	1568.8	5.2	47.4
22R1 26/28	13947-31	9.56492	0.04422	0.01	98.3	1482.3	5.6	44.8
22R1 26/28	13947-36	9.80445	0.04311	0.012	99.2	1393.5	6.7	42.3
22R1 26/28	13947-16	10.36268	0.0734	0.005	93.9	1403.4	7.6	42.8
22R1 26/28	13947-28	11.41514	0.11599	0.004	99.4	1383.4	13.0	43.5
22R1 26/28	13947-33	11.80509	0.09714	0.006	97.9	1556.2	7.0	47.2
22R1 26/28	13947-10	12.26502	-0.00287	0.02	99.4	1458.1	5.6	44.1
22R1 26/28	13947-38	12.5782	0.04233	0.003	99.1	1426.0	9.7	43.9
22R1 26/28	13947-15	12.58166	0.06924	0.008	98.9	1087.2	4.3	32.9
22R1 26/28	13947-30	12.89541	0.03288	0.008	99	1480.7	7.0	45.0
22R1 26/28	13947-25	13.09038	0.0408	0.007	98.7	1460.7	6.2	44.3
22R1 26/28	13947-32	15.34598	0.27497	0.002	98	1303.6	12.7	41.1
22R1 26/28	13947-44	15.70652	0.07962	0.003	98.6	1639.3	17.6	52.2
22R1 26/28	13947-05	16.92073	0.073	0.004	99.4	1382.5	8.7	42.4
22R1 26/28	13947-13	18.75656	0.0607	0.005	97.8	1480.7	7.9	45.1
22R1 26/28	13947-14	18.93671	0.0137	0.003	90.2	1311.8	8.0	40.2
22R1 26/28	13947-37	20.91435	0.08848	0.004	96.6	1471.8	11.1	45.5
22R1 26/28	13947-46	21.0319	0.08304	0.005	99.2	1427.8	7.4	43.5
22R1 26/28	13947-12	23.0111	0.1239	0.003	94.2	1444.2	11.2	44.7
22R1 26/28	13947-06	40.64466	0.07195	0.003	97.2	1643.6	10.1	50.3
22R1 26/28	13947-04	61.81936	0.14154	0.004	91.3	1464.0	9.0	44.8
22R1 26/28	13947-24	85.49546	0.11177	0.001	93.6	1445.0	17.3	46.7
total # grains	42							
22R1 57/59	13948-42	4.31639	0.06722	0.009	99.7	1124.5	4.2	34.0
22R1 57/59	13948-30	4.72175	0.03382	0.01	99.7	1485.6	4.9	44.8
22R1 57/59	13948-10	4.98159	0.01988	0.028	99.8	1501.8	2.7	45.1
22R1 57/59	13948-03	5.19005	0.01287	0.022	99.9	1453.5	5.4	43.9
22R1 57/59	13948-31	5.5361	0.05632	0.008	99	1458.5	5.7	44.1
22R1 57/59	13948-39	5.571	0.06374	0.006	99.6	1648.2	9.0	50.3
22R1 57/59	13948-40	6.29271	0.15916	0.002	98.9	1322.4	19.0	44.0
22R1 57/59	13948-44	6.72644	0.02814	0.005	99.6	1461.6	7.3	44.5
22R1 57/59	13948-13	6.83292	0.01684	0.059	99.8	1501.8	2.5	45.1
22R1 57/59	13948-14	6.94158	0.02111	0.036	97.3	1186.4	3.8	35.8
22R1 57/59	13948-02	7.06483	0.04008	0.013	99.7	1202.8	4.0	36.3
22R1 57/59	13948-32	8.10978	0.02042	0.021	99.1	1324.7	3.5	39.9

22R1 57/59	13948-33	8.2954	0.05008	0.005	99.5	1428.0	12.8	44.7
22R1 57/59	13948-06	8.76628	0.05013	0.004	100	1502.8	9.2	46.0
22R1 57/59	13948-04	8.87672	0.05218	0.021	98.8	1562.1	3.8	47.0
22R1 57/59	13948-23	9.43832	0.03562	0.103	98	1569.3	2.6	47.1
22R1 57/59	13948-34	9.69399	0.13001	0.004	99.6	1424.7	9.3	43.7
22R1 57/59	13948-27	10.08208	0.08497	0.003	99.2	1369.5	17.7	44.7
22R1 57/59	13948-43	10.09695	0.05352	0.004	100.4	1375.0	8.0	42.0
22R1 57/59	13948-05	10.43852	0.0425	0.009	99.4	1508.5	9.8	46.3
22R1 57/59	13948-01	10.44263	0.03433	0.005	99	1382.4	7.6	42.2
22R1 57/59	13948-41	10.54722	0.05476	0.005	98.9	1462.6	8.0	44.6
22R1 57/59	13948-17	10.66451	0.09637	0.005	99.5	1531.9	7.8	46.6
22R1 57/59	13948-07	10.99194	0.01221	0.033	99.7	1477.7	3.1	44.4
22R1 57/59	13948-29	11.46168	0.0514	0.009	98.7	1474.0	6.5	44.7
22R1 57/59	13948-38	11.50632	0.02154	0.012	98.5	1511.3	6.0	45.7
22R1 57/59	13948-26	12.03391	0.01809	0.007	97.9	1564.4	6.2	47.3
22R1 57/59	13948-12	12.30715	0.11923	0.003	97.7	1156.6	8.2	35.6
22R1 57/59	13948-18	12.61214	0.08788	0.004	98.5	1460.7	12.6	45.6
22R1 57/59	13948-15	12.6249	0.06828	0.007	99.2	1508.7	7.5	45.9
22R1 57/59	13948-25	12.79127	-0.00223	0.079	96.8	1670.9	2.4	50.2
22R1 57/59	13948-35	12.93936	0.03431	0.013	98.7	1500.0	4.7	45.2
22R1 57/59	13948-28	13.9204	0.12384	0.005	99.1	1444.5	7.0	43.9
22R1 57/59	13948-19	16.64972	0.14925	0.002	98.1	1527.5	19.4	49.8
22R1 57/59	13948-22	17.12493	0.03281	0.012	89.8	1410.7	5.1	42.6
22R1 57/59	13948-36	18.9876	0.10044	0.003	97.6	1427.0	14.4	45.2
22R1 57/59	13948-21	19.71155	0.20448	0.003	98.4	1478.5	12.9	46.2
22R1 57/59	13948-16	29.86406	0.14506	0.003	97.1	1611.0	11.7	49.7
22R1 57/59	13948-08	32.37468	0.0398	0.005	98.4	1434.9	8.3	43.8
22R1 57/59	13948-37	33.24607	0.18923	0.003	98.1	1441.2	20.1	47.7
22R1 57/59	13948-24	39.3963	0.09879	0.002	91.4	1856.8	28.4	62.5
22R1 57/59	13948-09	67.6577	0.18856	0.001	83.5	3031.4	31.5	96.2
total # grains	28							
28R-CC 10/12	14464-07	3.60587	0.00447	0.049	99.3	922.34	2.22	9.49
28R-CC 10/12	14464-21	6.05201	0.01443	0.033	98.7	1526.96	3.27	15.62
28R-CC 10/12	14464-14	6.65531	0.039	0.014	90.5	558.95	3.02	6.35
28R-CC 10/12	14464-22	7.0367	0.0248	0.012	98.8	1641.09	5.22	17.22
28R-CC 10/12	14464-35	7.51839	0.0185	0.018	99.2	2088.49	5.27	21.54
28R-CC 10/12	14464-28	8.70119	0.01863	0.03	99	1485.79	3.49	15.26
28R-CC 10/12	14464-27	8.76781	0.03725	0.011	96.8	1517.84	6.26	16.42
28R-CC 10/12	14464-19	8.92017	0.00499	0.05	99.1	1212.81	2.94	12.48
28R-CC 10/12	14464-05	10.13847	0.01343	0.026	98.4	1506.26	3.61	15.49
28R-CC 10/12	14464-37	11.33161	0.03097	0.006	99.1	1537.48	7.41	17.07
28R-CC 10/12	14464-15	12.43794	0.01498	0.01	98.6	1602.81	6.20	17.18
28R-CC 10/12	14464-25	13.1163	0.00936	0.046	99.8	1540.52	2.92	15.68
28R-CC 10/12	14464-32	15.97267	0.01476	0.011	96.8	1505.43	5.61	16.07
28R-CC 10/12	14464-13	16.45746	0.06279	0.007	98.4	1486.74	7.98	16.87
28R-CC 10/12	14464-17	17.0678	0.02536	0.017	94.9	1531.10	4.69	16.01
28R-CC 10/12	14464-33	17.84648	0.0094	0.009	98.3	1508.52	5.93	16.21

28R-CC 10/12	14464-09	18.93063	0.08812	0.004	96.3	1631.39	11.08	19.72
28R-CC 10/12	14464-34	20.90517	0.08659	0.003	66.1	1324.33	13.36	18.81
28R-CC 10/12	14464-10	21.19921	0.02024	0.008	97.5	1507.66	6.59	16.45
28R-CC 10/12	14464-06	21.34175	0.04331	0.005	95.7	1507.48	7.63	16.89
28R-CC 10/12	14464-03	22.60445	0.00364	0.025	99.6	1513.76	4.41	15.77
28R-CC 10/12	14464-16	23.60778	0.02259	0.011	99.4	1502.46	4.92	15.81
28R-CC 10/12	14464-24	32.5476	0.06031	0.003	97.2	2036.01	14.32	24.89
28R-CC 10/12	14464-31	32.72911	0.0014	0.007	98.9	1567.06	6.75	17.06
28R-CC 10/12	14464-02	34.65672	0.11135	0.003	95	1519.08	12.84	19.89
28R-CC 10/12	14464-30	37.23258	0.06728	0.005	99.2	1450.81	8.12	16.63
28R-CC 10/12	14464-26	42.43486	0.07499	0.003	95.5	1409.32	12.50	18.84
28R-CC 10/12	14464-23	46.59974	0.0419	0.004	99.8	1481.20	10.00	17.87

Chapter 4. Appendix C. Neodymium data.

Sample	143Nd/144Nd corrected	± 2σ S.E.	εNd	± 2σ S.D.	Session
19R4 10/12	0.512035	0.000008	-11.8	0.35	1
19R5 10/12	0.512026	0.000020	-11.9	0.35	1
19R5 25/27	0.512046	0.000009	-11.6	0.35	1
20R1 122/124	0.511796	0.000010	-16.4	0.35	1
20R1 135/137	0.511831	0.000011	-15.7	0.35	1
20R1 48/50	0.511854	0.000009	-15.3	0.35	1
20R2 38/40	0.511816	0.000005	-16.0	0.35	1
21R2 28/30	0.511839	0.000006	-15.6	0.35	1
22R1 26/28	0.511840	0.000010	-15.6	0.36	1
22R2 5/7	0.511874	0.000008	-14.9	0.32	1
19R1 60/62	0.511918	0.000008	-14.1	0.29*	2
19R1 90/92	0.511954	0.000007	-13.3	0.24	2
19R2 10/12	0.512077	0.000004	-10.9	0.33*	2
19R3 85/87	0.511981	0.000007	-12.8	0.23	2
19R4 140/142	0.512047	0.000007	-11.5	0.23	2
20R2 15/17	0.511823	0.000006	-15.9	0.23	2
21R1 140-142	0.511998	0.000006	-12.5	0.24*	2
22R1 3/5	0.511906	0.000007	-14.3	0.29*	2
21R1 129-131	0.511918	0.000007	-14.0	0.22	3
15R6 24/26	0.511853	0.000007	-15.3		4
11R2 14/16	0.511875	0.000006	-14.9		4
1R3 7476	0.511808	0.000006	-16.2		4
12R3 44/46	0.511871	0.000006	-15.0		4
12R3 84/86	0.511939	0.000006	-13.6		4
12R3 10/12	0.511909	0.000005	-14.2		4
15R6 34/36	0.511793	0.000004	-16.5		4
12R2 44/46	0.512198	0.000005	-8.6		4
11R2 24/26	0.511894	0.000005	-14.5		4
12R2 94/96	0.512080	0.000006	-10.9		4
15R6 14/16	0.511861	0.000008	-15.2		4
12R1 34/36	0.512051	0.000006	-11.5		4
12R3 104/106	0.511946	0.000006	-13.5		4
12R1 94/96	0.512030	0.000007	-11.9		4
12R2 74/76	0.512117	0.000007	-10.2		4
11R1 134/136	0.511880	0.000007	-14.8		4
12R2 144/146	0.511950	0.000045	-13.4		4
12RCC 4/6	0.512020	0.000006	-12.1		4
28RCC 10/12	0.511841	0.000005	-15.5		4
11R1 144/146	0.511874	0.000006	-14.9		4
1R1 0/2	0.511966	0.000005	-14.5	0.3	5
22R1 57-59	0.512166	0.000009	-8.4	0.30	5

ANALYTICAL SESSION #1 (May 2011): All reported 143Nd/144Nd ratios are corrected to a JNdi value of 0.512115 (Tanaka et al., 2000). Average JNdi values for two analytical sessions were 0.511948 ± 0.000018 (n=27) and 0.512122 ± 0.000016 (n=13). εNd values were calculated using a present day 143Nd/144Nd (CHUR) of 0.512638 (Jacobsen and Wasserburg, 1980). The error reported represents the external 2σ SD of the analytical session, which in one case had to be propagated for taking into account a smaller beam size for the sample than for the standard.

ANALYTICAL SESSION #2 (June 2011) All reported 143Nd/144Nd ratios are corrected to a JNdi value of 0.512115 (Tanaka et al., 2000). Average JNdi values for two analytical sessions were 0.512081 ± 0.000012 (n=23) and 0.512150 ± 0.000012 (n=7). εNd values were calculated using a present day 143Nd/144Nd (CHUR) of 0.512638 (Jacobsen and Wasserburg, 1980). The error reported represents the external 2σ SD of the analytical session, which in four cases (*) had to be propagated for taking into account a sllightly different beam size for the sample than for the standards.

ANALYTICAL SESSSION #3 (August 2011): Reported 143Nd/144Nd ratios are corrected to a JNdi value of 0.512115 (Tanaka et al., 2000). Average JNdi values for analytical session was 0.512079 ± 0.000011 (n=16). εNd values were calculated using a present day 143Nd/144Nd (CHUR) of 0.512638 (Jacobsen and Wasserburg, 1980). The error reported represents the external 2σ SD of the analytical session.

ANALYTICAL SESSSION #4 February 2012: Noticed a drift in the Jndi. Reported 143Nd/144Nd ratios are corrected to a JNdi value of 0.512115 (Tanaka et al., 2000). Bracketed samples by the standards. 2 analytical sessions. Average JNdi values for two analytical sessions were 0.512191 ± 0.000035 (n=25) and 0.512153 ± 0.000019 (n=26).Blank values associated with these samples were found to be in excess of 1% (24 and 45 ng of Nd) of the total sample (up to 5%). When full blank corrections were applied to the BCR-2 rock standards, the measured values then fell within the published values for this standard, leading us to feel confident in appying full blank corrections to each of our samples in this analytical session.

Full Blank correction* (session 4 samples): The amount of Nd (ng) and the isotopic composition of both Blanks were measured. A full blank correction was applied using the following equation: blank corrected εNd = [measured 143/144 in sample - (% blank measured in sample x 143/144 measured in blank)] / [% of Nd measured from sample]. Subsequent tests were performed on both sets of columns, the Fe solution used for spikign the blank, and the lithium metaborate flux in order to ascertain what was the source of Nd in the blank. These tests showed that the lithium metaborate had elevated levels of Nd (~60 ng).

ANALYTICAL SESSSION #5 June 2012: All reported 143Nd/144Nd ratios are corrected to a JNdi value of 0.512115 (Tanaka et al., 2000). Average JNdi values during analytical session are 0.512185 ± 0.000018 (n=22). εNd values were calculated using a present day 143Nd/144Nd (CHUR) of 0.512638 (Jacobsen and Wasserburg, 1980). The error reported represents the external 2σ SD of the analytical session.

*table of blank correction process for session #4 samples:

sample name	corr 143/144	corr 2s SE	corr eNd	ng Nd in sample	% blk	% sample	blk corrected 143Nd/144Nd	εNd
Blank 2	0.511313	0.000000	-25.84	24				
BCR-2-B	0.512631	0.000005	-0.14	1113	0.02	0.98	0.512659	0.41
15R-6 24-26	0.511835	0.000007	-15.67	680	0.03	0.97	0.511853	-15.30

11R-2 14-16	0.511863	0.000006	-15.12	1085	0.02	0.98	0.511875	-14.89
1R-3 74-76	0.511795	0.000006	-16.45	867	0.03	0.97	0.511808	-16.19
12R-3 44-46	0.511855	0.000006	-15.27	845	0.03	0.97	0.511871	-14.96
12R-3 84-86	0.511918	0.000006	-14.05	695	0.03	0.97	0.511939	-13.64
12R-3 10-12	0.511895	0.000005	-14.50	1020	0.02	0.98	0.511909	-14.23
15R-6 34-36	0.511782	0.000004	-16.70	986	0.02	0.98	0.511793	-16.48
12R-2 44-46	0.512179	0.000005	-8.96	1070	0.02	0.98	0.512198	-8.58
11R-2 24/26	0.511884	0.000005	-14.70	1375	0.02	0.98	0.511894	-14.51
12R-2 94/96	0.512058	0.000006	-11.32	805	0.03	0.97	0.512080	-10.88
Blank 1	0.511324	0.000000	-25.64	45				
BCR-2-A	0.512619	0.000007	-0.37	1738	0.03	0.97	0.512654	0.31
15R-6 14-16	0.511836	0.000008	-15.64	998	0.05	0.95	0.511861	-15.16
12R-1 34/36	0.512013	0.000006	-12.20	862	0.05	0.95	0.512051	-11.45
12R-3 104-106	0.511918	0.000006	-14.05	1015	0.04	0.96	0.511946	-13.51
12R-1 94-96	0.512000	0.000007	-12.45	1066	0.04	0.96	0.512030	-11.87
12R-2 74/76	0.512082	0.000007	-10.86	1004	0.05	0.95	0.512117	-10.15
11R-1 134/136	0.511859	0.000007	-15.19	1207	0.04	0.96	0.511880	-14.78
12R-2 144/146	0.511922	0.000045	-13.96	1020	0.04	0.96	0.511950	-13.42
12R-CC 4-6	0.511987	0.000006	-12.69	965	0.05	0.95	0.512020	-12.05
28R-CC 10/12	0.511822	0.000005	-15.93	1182	0.04	0.96	0.511841	-15.54
11R-1 144-146	0.511849	0.000006	-15.39	1000	0.05	0.95	0.511874	-14.91

Chapter 4. Appendix D. Pebble Lithologies.

	Igneous				**Metamorphic**				**Sedimentary**		**mineral**	**?**	*can't tell if mm or ig		
Sample ID	Felsic	Interm.	Mafic	Ext.	Qtzite	Foliated	Non-foliated	Meta-sed	SS/SS	Mud/Claystone		applies to minerals	*HB,P,Q	TOTAL	**Total-minearls**
11R-1 134/136	2	2	0	0	0	1	2	0	0	0	3			10	**7**
11R-1 144/146	3	4	0	0	0	0	2	0	0	0	4		4	17	**13**
11R-2 14/16	3	2	0	0	0	1	2	0	0	0	5			13	**8**
11R-2 24/26	0	0	0	0	0	0	0	0	0	0	3	2		5	**2**
12R-1 34/36														0	**0**
12R-1 94/96	0	2	0	0	0	0	0	0	0	0	1			3	**2**
12R-2 44/46	0	2	0	0	0	1	0	0	0	0	5			8	**3**
12R-2 74/76	1	3	0	0	3	2	0	0	0	0	3			12	**9**
12R-2 94/96	0	1	0	0	1	0	0	0	0	0	2			4	**2**
12R-2 144/146														0	
12R3 10/12														0	
12R-3 44/46	3	3	0	0	0	0	0	1	0	0	6	2	2	17	**11**
12R-3 84/86	5	0	0	0	0	15	0	0	0	0	34	5	24	83	**49**
12R-3 104/106	5	13	0	0	0	11	0	3	0	0	55	40	10	137	**82**

12R-CC 4/6	6	16	0	0	0	14	12	0	0	0	42	16	9	115	**73**
15R-6 14/16														0	
15R-6 24/26														0	
15R-6 34/36	1	0	0	0	0	3	0	0	0	0	13	0		17	**4**
19R-1 60/62	0	5	0	0	2	8	2	0	0	0	11	3		31	**20**
19R-1 90/92	1	2	0	0	4	3	2	0	1	0	6	0		19	**13**
19R-2 10/12	0	0	0	0	2	2	0	0	0	0	0	1		5	**5**
19R-3 85/87	2	1	0	0	1	2	0	0	1	0	7	2		16	**9**
19R-4 10/12	0	0	0	0	0	0	1	0	0	0	1	0		2	**1**
19R-4 140/142	0	0	0	0	0	2	1	1	0	0	0	0		4	**4**
19R-5 10/12	1	5	0	0	0	0	0	0	0	0	0	0	1	7	**7**
19R-5 25/27	0	0	0	0	0	2	5	0	0	0	1	1	1	10	**9**
20R-1 48/50	1	1	0	0	0	0	0	0	0	0	0	0		2	**2**
20R-1 122/124	0	2	0	0	0	3	0	0	0	0	0	0		5	**5**
20R-1 135/137														0	

20R-2 15/17	2	5	0	0		2	5	5	0	0	2	2	3	26	**24**
20R-2 38/40	0	0	0	0	0	0	1	0	0	0	0	0		1	**1**
21R-1 129/131	2	1	0	0	0	0	0	0	0	0	4	1	5	13	**9**
21R-1 140/142	0	0	0	0	0	2	2	0	0	0	3	0	2	9	**6**
21R-2 28/30															
22R-1 3/5															
22R-1 26/28	1	4	0	0	0	4	5	0	0	0	30	10	3	57	**27**
22R-1 57/59	0	0		0	0	0	0	0	0	0	1	0		1	**0**
22R-2 5/7															
28R-CC 10/12	4	22	0	0	0	3	0	0	1	0	28	9		67	**39**

Chapter 4. Appendix E. Summary of DSDP/ODP/IODP cores used for making Figures 2 and 3.

Timescales used in DSDP/OPD/IODP Reports:

Abbreviation	Source	Early Mio.	Mid Mio.	Late Mio
G 2004	Gradstein et al (2004)	23.03 - 15.97	15.97 - 11.61	11.61 - 5.33
B 1995	Berggren et al (1995)	23.7 - 16.6	16.6 - 11.2	11.2 - 5.3
B 1985	Berggren et al (1985)	23.7 - 16.5	16.5 - 10.4	10.4 - 5.3
C 1975 ?	Cieleski (1975)	23 - 16	16 - 10.5	10.5 - 5

Site Classification:

Sites without Miocene

Sites with Miocene and without IRD

Sites with Miocene and with IRD

Sites with Mid-Miocene, IRD, good age control/recovery

Miocene Sediment In DSDP/ODP/IODP Cores around East Antarctica

Geographic Location:	Leg/Site	Early/Lower	IRD?	Middle	IRD?	Upper/Late	IRD?	Time Scale used?	Year Drilled	*Composite Core Recovery (%)	*Water Depth (mbsl)
Weddell Sea:											
	ODP 113							B 1985	1987		
	Site 689	-		**yes**		yes				97%	2088
	Site 690	yes		**yes**		yes				88-100	2916

	Site 691	-		**-**		-	-				
	Site 692	-		**-**		-	-				
	Site 693	yes		**yes**		yes				44-59	2369
	Site 694	-		**yes**		yes				37	4603
	Site 695	-		**-**		yes				80	1305
	Site 696	-		**yes**		yes				16	650
	Site 697	-		**-**		-	-				
Prydz Bay:	**ODP Leg 119**							B 1985	1988		
	Site 736	-	-	**-**	-	-	-				
	Site 737	-	-	**-**	-	yes	**-**	53.5	570		
	Site 738	-	-	**-**	-	yes	y	10	2260	95	2260
*diamict	Site 739	-	-	**-**	-	yes	-			34	412
	Site 740	-	-	**-**	-	-	-				
	Site 741	-	-	**-**	-	-	-				
	Site 742	-	-	**-**	-	-	-				
	Site 743	-	-	**-**	-	-	-				
	Site 744	yes		**yes**	Y	yes	**y**			95	2400
	Site 745	-	-	**-**	-	yes	-			99	4093
	Site 746	-	-	**-**	-	yes	y			33	4350
	ODP Leg 188							B 1995	2000		
	Site 1165	yes	y	**yes**	y	yes	**y**			15-80	3350
	Site 1166	-	-	**-**	-	-	-				
	Site 1167	-	-	**-**	-	-	-				
	ODP Leg 183							B 1995	1999		
*no IRD in any	Site 1135	-	-	**-**	-	-	-				

	Site 1136	-	-	**-**	-	-	-				
	Site 1137	yes	-	**yes**	-	yes	-			54	1005
	Site 1138	yes	-	**yes**	-	yes	-			50	1411
	Site 1139	yes	-	**yes**	-	-	-			52	1427
	Site1140	yes	-	**yes**	-	-	-			45	2394
Wilkes Land:											
	IODP Exp. 318							G (2004)	2010		
	Site 1355	-	-	**-**	-	-	-				
	Site 1356	yes	y	**yes**	y	yes	**y**			0/99	4003
	Site1357	-	-	**-**	-	-	-				
	Site 1358	-	-	**-**	-	-	-				
	Site 1359	-	-	**-**	-	yes	y			80	3009
	Site 1360	-	-	**-**	-	-	-				
	Site 1361	-	-	**-**	-	yes	y			87/100	3454
Ross Sea to Wilkes Land:											
	DSDP Leg 28							C (1975) ?	1973		
*near Australia; exluded	Site 264	-	-	**-**	-	yes	**-**				
	Site 265	-	-	**yes**		yes				64	3581
	Site 266	yes	-	**yes**	-	yes	**y**			66	4173
	Site 267	yes	y	**yes**	y	yes	y			45	3043
	Site 268	yes	y	**-**		yes	y			35	344
	Site 269	yes	-	**yes**	-	yes	-			42	4285
	Site 270	yes	y	**-**	-	-	-			62	634
	Site 271	-	-	**-**	-	yes	**-**			7	554
	Site 272	-	-	**yes**	y	yes	y			37	629

Site 273	-	-	**yes**	y	yes	**y**		25	495
Site 274	yes	y	**-**	-	yes	y		66	3326

Chapter 4. Appendix F. All U1356A Data plotted versus depth. Wt % > 150µm – weight percent greater than 150µm, εNd = epsilon neodymium.

