Provenance of zircon in heavy mineral sand deposits, western Murray Basin

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Provenance of zircon in heavy mineral sand deposits, western Murray Basin

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Provenance of zircon in heavy mineral sand deposits, western Murray Basin

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ABSTRACT

The Murray Basin in southeastern Australia contains significant economic resources of heavy minerals (ilmenite, zircon, rutile) in coastal strandlines of a prograding sandplain that formed during marine regression in Late Miocene – Early Pliocene time. Deposits in New South Wales, Victoria and South Australia have been mined or continue as a source of heavy mineral supply. Previous work showed the provenance of zircon in heavy mineral deposits varied across the basin. This has implications for reconstruction of coastal environments and is a probable factor in the variation in composition and quality of heavy minerals between deposits. The provenance of heavy minerals in stranded coastal sands of the western Murray Basin in South Australia was assessed in this study using zircon geochronology. Ten sites along and across strandlines between Loxton and Karoonda, were selected for analysis with the samples supplied from recent company drilling of various heavy mineral prospects, and from mining operations at Mindarie. Zircons were analysed using laser ablation-inductively coupled plasma mass spectrometry (LA-ICPMS) and the crystallisation age was determined from the uranium/lead isotope ratios. Likely source regions and dispersion pathways for heavy minerals were interpreted from the age profile of zircon grains for each sample. All samples contained a high proportion of post Delamerian-age zircons, younger than c. 480 Ma, that originated from primary and secondary sources located to the north and east of the basin. These were transported to the coast by rivers draining those regions. For the majority of samples, the dominant fluvial input was from the southeast with a high proportion of zircons aged 350–440 Ma sourced from Lachlan Orogen granitoids. This is consistent with early establishment of an ancestral River Murray drainage system. A smaller zircon contribution from the north included a wide range of ages from various sources that reflect the confluence of an extensive drainage network, comparable to that of the present-day Darling River system. The proximal western basin margin of Adelaide Fold Belt metasediments and granite with pockets of Permian fluvio-glacial sediments was a less significant contributor of zircon. Samples with higher proportion of zircons from this source region were possibly deposited either during times of low fluvial input, or following a period of tectonic uplift on the western basin margin and increased erosion of the basement rocks. The source inputs of zircon in heavy mineral deposits in the southwestern region of the Murray Basin were both numerous and varied. This is expected to be reflected also in increased complexity and less predictable variation in the composition and quality of heavy minerals between strandline deposits.

INTRODUCTION

During Late Miocene to Early Pliocene time (~7.2–5 Ma) an extensive fluvial and coastal sandplain developed across the Murray Basin as the result of marine regression combined with gentle tectonic uplift initiated by compressional stresses that developed during Late Miocene time (Sandiford, Wallace and Coblentz 2004). Sand ridges preserved across the sandplain record coastal shorelines formed at periods of highstand and stillstand during overall retreat of the sea (Fig. 1). The paleo-coastal beach dunes and associated shallow offshore sands have been a focus of exploration for heavy mineral (HM) deposits since discovery, in 1983, of large resources of fine-grained (50–80 µm mean particle size) heavy minerals at WIM 150, near Horsham, Victoria, followed in the mid-1990s by discovery of commercial grades of coarse-grained (180–220 µm mean particle size) heavy mineral sands at Wemen, Woornack and Kulwin, southeast of Mildura, Victoria (Dickson 1999; Popp 2005). In 1989, heavy mineral discoveries were made in the South Australian portion of the basin at Mindarie and Perponda (Ferris 1999). The Mindarie deposits were subsequently developed by Australian Zircon NL (2007–09) and Murray Zircon Pty Ltd (2012–15); the latter on the back of high zircon prices during 2011–12. Combined resources (measured, indicated and inferred), across 11 deposits reported by Murray Zircon to July 2014, totalled 249 Mt @ 3.1% (total HM), with HM composition averaging 17.4% zircon, 7.4% leucoxene, 4.9% rutile and 44.7% ilmenite (Murray Zircon Pty Ltd 2014). Mining operations at Mindarie were suspended in March 2015 as a consequence of lower prices for zircon and rutile, and depletion of heavy mineral resources within economic pumping distance of the primary concentration plant, located 1.5 km north of Mindarie township. Resumption of operations would be assisted by discovery of shallower or higher-grade heavy mineral deposits in the district that offer improved economics of operation under prevailing commodity prices. Determining the source of heavy minerals can assist with reconstructing the paleo-coastal setting and establishing variation in source inputs as the coastal plain evolved. Sand supply and paleo-coastal environment are primary controls on sites of heavy mineral concentration and paleo-geographic reconstructions can assist with refining exploration strategies. To this end, Murray Zircon Pty Ltd was approached and agreed to collaborate on a study to determine the age profile of zircon grains from the Mindarie site and from other heavy mineral strandlines within their exploration tenements.

Zircon grains typically comprise only a minor component of the HM suite (10–30%) but are most durable and can be dated by U/Pb isotope geochronology. The relative proportion of grains from various age populations within a sample provides information on the source regions, or provenance, of zircon that can be used to track variation in the sediment inputs over time. Previous work dating zircons from sites across the central zone of the Murray Basin (Fig. 1) showed variation in zircon populations from northeast to southwest across the basin (Sircombe 1999). Samples from the north recorded a high component of zircons originating from the Whitsunday Volcanic Province and New England Orogen in Queensland and New South Wales, compared with Lachlan Orogen as the dominant primary source area for zircons in the most southerly sample, from the WIM 150 deposit. From investigations in the New South Wales portion of the basin, Whitehouse and Roy (1999) proposed a model where growth faults, synchronous with progradational shoreline development, were a significant process leading to concentration of heavy minerals on transient beach headlands developed on uplifted fault blocks. The source of sand and heavy minerals was interpreted as being derived primarily from offshore reworking of older fluvial sands that either formed the sea floor or were exposed to marine erosion by uplift along faults (Roy and Whitehouse 1999).

Heavy mineral inputs from separate fluvial systems draining different source areas and at different times affect the composition and characteristics of associated heavy mineral deposits; these are factors that also affect commercial viability. Analysing zircon populations from paleo-strandline deposits in South Australia can assist with reconstructing the depositional environment in the western Murray Basin and in identifying source effects. In particular, significant contribution of heavy minerals from the southern Adelaide Fold Belt, Nackara Arc and Curnamona Province, forming the western basin margin, would be expected to differ in mineralogy and physical characteristics compared with sources from eastern regions of the Australian continent. Variation in the relative contribution from source areas might be expected also to change over time, e.g. in response to Neogene episodic uplift along range-front faults. Previous reconstructions of the evolution of the basin have emphasised Early Pliocene development of an ancestral River Murray fluvial system that drained from east to west, broadly following the present-day drainage valley and with an outlet to the sea south of Morgan (Twidale, Lindsay and Bourne 1978; Stephenson and Brown 1989; Pufahl et al. 2004). In this scenario, heavy mineral input would likely include a significant contribution of zircon from easterly bedrock sources. This model was revised in a review by Bowler, Kotsonis and Lawrence (2006) and substantially modified in McLaren et al. (2009, 2011), from studies on the timing and distribution of Neogene sediments in the western portion of the basin. Both revisions reduce or eliminate inputs of sand from an ancestral River Murray at the time of formation of the sandplain south of Loxton. Identifying the South Australian sites of sand input has implications for sediment reworking and maturity of the heavy mineral component. Refinement of coastal reconstructions provides a basis for ongoing re-evaluation of potential sites where wave action and longshore drift were most effective in separating and concentrating heavy minerals as lag (residual) deposits on the prograding paleo-shorelines.

GEOLOGICAL SETTING

The Murray Basin is an intracratonic basin covering more than 300 000 km^2 of southeastern Australia across three mainland states to include western New South Wales, northwest Victoria and southeast South Australia (Fig. 1). The basin is approximately 850 km from east to west and 750 km from north to south and contains a thin package of flat-lying Cenozoic sediments. Maximum sediment thickness of ~600 m is recorded in the deepest depocentre in the central western part of the basin, to the east of Renmark. Terrestrial sedimentation began during the Paleocene and Early Eocene as fluvial and swamp deposits of the Lower Renmark Group (Brown and Stephenson 1991). Major marine incursion commenced in the Late Oligocene (c. 29 Ma) as a shallow sea that spread inland behind the Padthaway Ridge, a linear cluster of early Paleozoic granite intrusions (Lukasik et al. 2000; Foden et al. 2002). Marine calcareous clay and marl of the Ettrick Formation interfingered with marginal marine dark bioturbated muds of Geera Clay (Fig. 2). Onshore deposits included fluvial sands of Olney Formation of upper Renmark Group. From Late Oligocene to Middle Miocene time, cool water ‘Murray Group carbonates’, were accumulated under open marine conditions in the western basin and formed thick deposits of bryozoan-rich calcisiltite and calcarenite (Lukasik et al. 2000). Retreat of the sea commenced after the Middle Miocene Climatic Optimum when global climatic conditions changed from warm and wet to cooler and dryer (McGowran et al. 2004). In the Murray Basin, upper formations of the Murray Group carbonates were the last marine sediments to be deposited. These contain a fossil assemblage equivalent to low-latitude Miocene planktonic foraminiferal zone M6, possibly extending into zone M7, equivalent to c. 13.5 Ma (Gallagher and Gourley 2007). The break in marine sedimentation lasted around 6 Ma. Over this period Middle Miocene sediments were exposed to weathering and erosion, particularly in the western portion of the basin.

A second major marine inundation commenced in the Late Miocene with deposits of Bookpurnong Formation clayey silt, fine-grained sand and micaceous marl containing abundant bivalve shell fragments. These were mostly thin, offshore marine deposits (average thickness 15 m) distributed across the central-western Murray Basin (Brown and Stephenson 1991). They are absent over the Padthaway High but extended east for a maximum of ~400 km (Brown and Stephenson 1991); the full extent of marine inundation, some 500 km inland of the present coastline, is marked by the most easterly and northerly coastal beach and dune deposits of Loxton Sand (the term Loxton Sand as used in this report includes Loxton and Parilla Sands in deference to the reasons advanced by Robson and Webb (2011) for discontinued use of the commonly used term Loxton-Parilla Sands). Bivalve shell fragments from Bookpurnong Formation at the Loxton Caravan Park have been dated using strontium isotope ratios ($^{87}Sr/^{86}Sr$); the earliest date obtained indicated marine sedimentation had commenced by c. 7.2 Ma (Miranda, Wallace and McLaren 2009).

Figure 1. Murray Basin showing the extent of basin sediments (inset) and the approximate distribution of Late Miocene Loxton Sand including coastal strandline traces from topographic data (modified from earlier strandline plots by Kotsonis (1995) and Miranda, Wallace and McLaren (2009)).

By Late Miocene – Early Pliocene time, interactions along the Australian–Pacific plate boundary had established an approximate E-W to SE-NW oriented compressional stress field across southeastern Australia (Sandiford et al. 2009). The stress regime initiated faulting within the basin sediments and reactivated faults along the basin margin. Tectonic uplift and fluctuating global sea levels combined to affect overall retreat of the sea across the basin. Water depth and sand supply were sufficient for persistent long wavelength wave action to develop extensive shorelines of quartz-rich sandy beaches and dunes. Coastal and offshore heavy mineral concentrations formed during this time. The sandplain that emerged as the sea retreated eventually covered an area of more than 135 000 km^2 (Miranda 2007). Sea highstands and stillstands were marked by coastal strandline ridges that are evident in regional topographic data. Over 600 individual ridges have been mapped across the Murray Basin representing a minimum 214 parallel records of preserved sea level stands (Miranda, Wallace and McLaren 2009; Fig. 1). The width of sand ridges varies from tens of metres to 3 km and individual strandlines are traceable over 100s of metres to >100 km (Miranda, Wallace and McLaren 2009). Sand thickness ranges from a few metres to over 100 m, averaging around 60 m (Brown and Stephenson 1991). Coastal sand deposits and associated backshore dunes are broadly defined as Loxton Sand; sand deposited in rivers inland of the coast and which later transgressed the margins of the sandplain, as the sea retreated, are included in Calivil Formation. Throughout much of the basin history, the central southwestern region was a depocentre for sedimentation and a broad estuary developed along the western margin at the point where several river systems coalesced. The extent of estuarine conditions is indicated by the distribution of Norwest Bend Formation which unconformably overlies Murray Group carbonates and consists of a sandy lower unit that grades laterally into Loxton Sand, and an upper coquina member dominated by oyster shells (Pufahl et al. 2004; Miranda, Wallace and McLaren 2008).

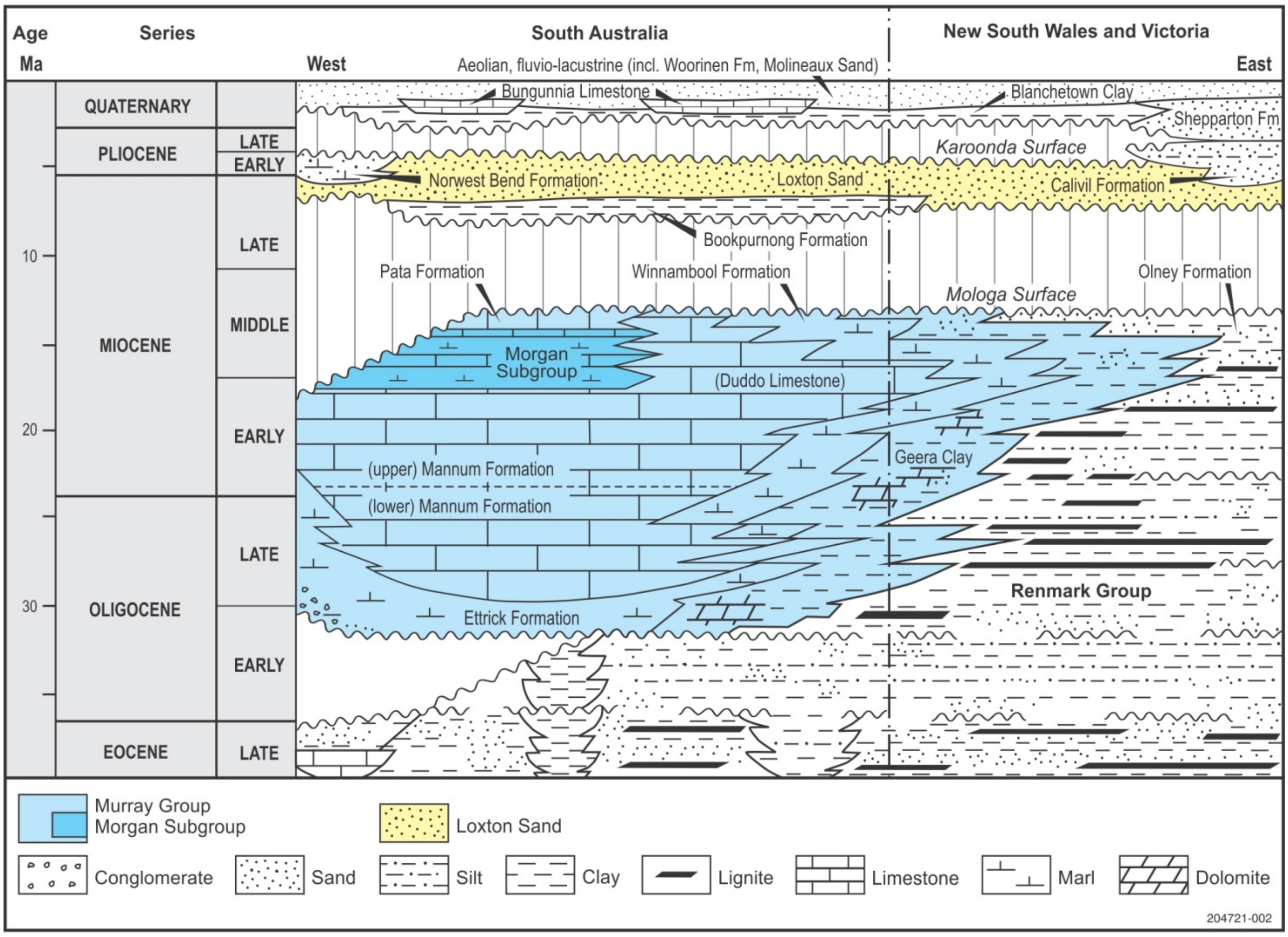


Figure 2. Generalised Cenozoic stratigraphy of the western Murray Basin (based on Brown and Stephenson 1991, with adaptions by Cowley and Barnett 2007 and revised Neogene timeframes summarised in McLaren et al. 2011).

In the southeast, strandlines extending to the north of Hamilton, on the Dundas Tableland, were buried beneath basalt flows, dated at c. 4 Ma (McDougall, Allsopp and Chamalaun 1966). Further south, younger strandlines, delineated by curvilinear magnetic anomalies and the presence of sandy soils with pisoliths, possibly overlie the basalt surface (Paine et al. 2004), although Wallace et al. (2005) argued that these are mostly in areas of thin or absent basalt cover and more likely reflect the remnants of strandlines formerly buried by basalt. McLaren et al. (2011) used strontium isotopic data from brachiopod shells collected from Loxton Sand at Bow Hill and Ponde to determine that the youngest preserved strandlines at the western end of the Marmon–Jabuk dune complex were formed by c. 5.4 Ma.

Tectonic uplift of the basin sediments continued throughout the Late Pliocene, accelerated in the southwest along the Gambier axis where uplift was accompanied by basaltic volcanism (Fig. 3). Differential uplift and a drier climate resulted in reduced fluvial discharge to the sea and increased coastal erosion, with cliff development along the line of the Kanawinka Escarpment (Miranda, Wallace and McLaren 2009). Progradation and progressive strandline development had probably ceased by c. 5 Ma — based on the strontium isotope age from brachiopod shells at Ponde. At this time, the Murray Basin sandplain was exposed to weathering resulting in widespread development of the Karoonda Surface, represented at the top of Loxton Sand by ferruginous and siliceous duricrust to 2 m thickness. The major river outlet to the sea in the southwest was subsequently blocked by dense coastal sand barriers which formed at the western end of the Marmon–Jabuk sand range (Belperio and Bluck 1990), possibly in response to uplift on the Padthaway High (McLaren et al. 2011). Surface water was ponded inland to form a large shallow intracontinental lake, Lake Bungunnia, with an overflow outlet to the coast in the southeast, probably along lowlands of the Douglas Depression (Bowler, Kotsonis and Lawrence 2006). Drainage to the southeast was later defeated by uplift on the Gambier axis resulting in flow in the Douglas river valley to be reversed inland. At its height, Lake Bungunnia covered an area of over 50 000 km^2 (Fig. 3) and sediments accumulated to 40 m thickness, dominantly clay (Blanchetown Clay) with basal sand lenses, (Chowilla Sand) and a restricted, thin upper limestone (Bungunnia Limestone; McLaren et al. 2009, 2011). Paleomagnetic analysis of 20 samples down a 30 m thick section of Blanchetown Clay at Nampoo Station indicated the sediment package was deposited entirely within the Matuyama Reversed Chron (McLaren et al. 2009). The correlation of a 3.3 m-thick interval of normal magnetic polarity with the Olduvai Normal Chron (1.945–1.778 Ma), together with extrapolation of estimated rates of sedimentation, produced a timeline of 2.4–1.2 Ma for the lake history (McLaren et al. 2009). The lake drowned paleo-coastal strandlines to the south and west of Loxton. On the northeastern lake margins, shoreline dunes developed that are discordant with the paleo-coastal sand ridges (Fig. 3).

Lower sea levels, during Pleistocene glacial episodes, likely initiated progressive headward recession of restricted local drainage occupying the lower Murray valley (Twidale, Lindsay and Bourne 1978). The effect of headwater erosion was eventual breakthrough of sand barriers in the region of Swan Reach to capture waters held in the Morgan sub-basin of an already drying Lake Bungunnia. The reconnection of Murray Basin surface drainage with the coast contributed to deepening the Murray Gorge downstream of Overland Corner, eventually draining the lowlands of Lake Bungunnia and uniting the ancestral Darling and Murray River systems to form a drainage pattern broadly similar to that of the present day.

In mid-Pleistocene time (c. 800 ka) the Coorong – Mount Gambier coastal plain was covered by sea that extended to the Kanawinka Escarpment. Uplift and regression combined to affect overall retreat of the sea. Highstand shoreline deposits developed during sea level fluctuations and were preserved as the sea retreated. The siliceous to dominantly calcareous paleo-coastal dunes are up to 30 m high and 10 km apart and form long, sub-parallel ‘sand ranges’ between the Kanawinka Escarpment and the present coastline (Murray-Wallace et al. 2001). The sand ridges extend offshore as the result of sea levels lower than today. Fluvial inputs of fine- to medium-grained quartz sand from coastal outlets were swamped by calcarenite derived from Murray Group carbonates on the floor of the Lacepede Shelf (Hill et al. 2009), which extends ~180 km offshore and was repeatedly exposed to erosion and reworking during periods of low sea level. Inland, the Late Miocene – Early Pliocene sandplain and strandlines of Loxton Sand were variably reworked by westerly winds to form linear dunes of Woorinen Formation and areas of extensive sub-parabolic siliceous dune fields (Molineaux Sand) forming the Sunset, Big, and Little Deserts in the Mallee region of South Australia and Victoria (Bowler, Kotsonis and Lawrence 2006; Lomax, Hilgers and Radtke 2011).

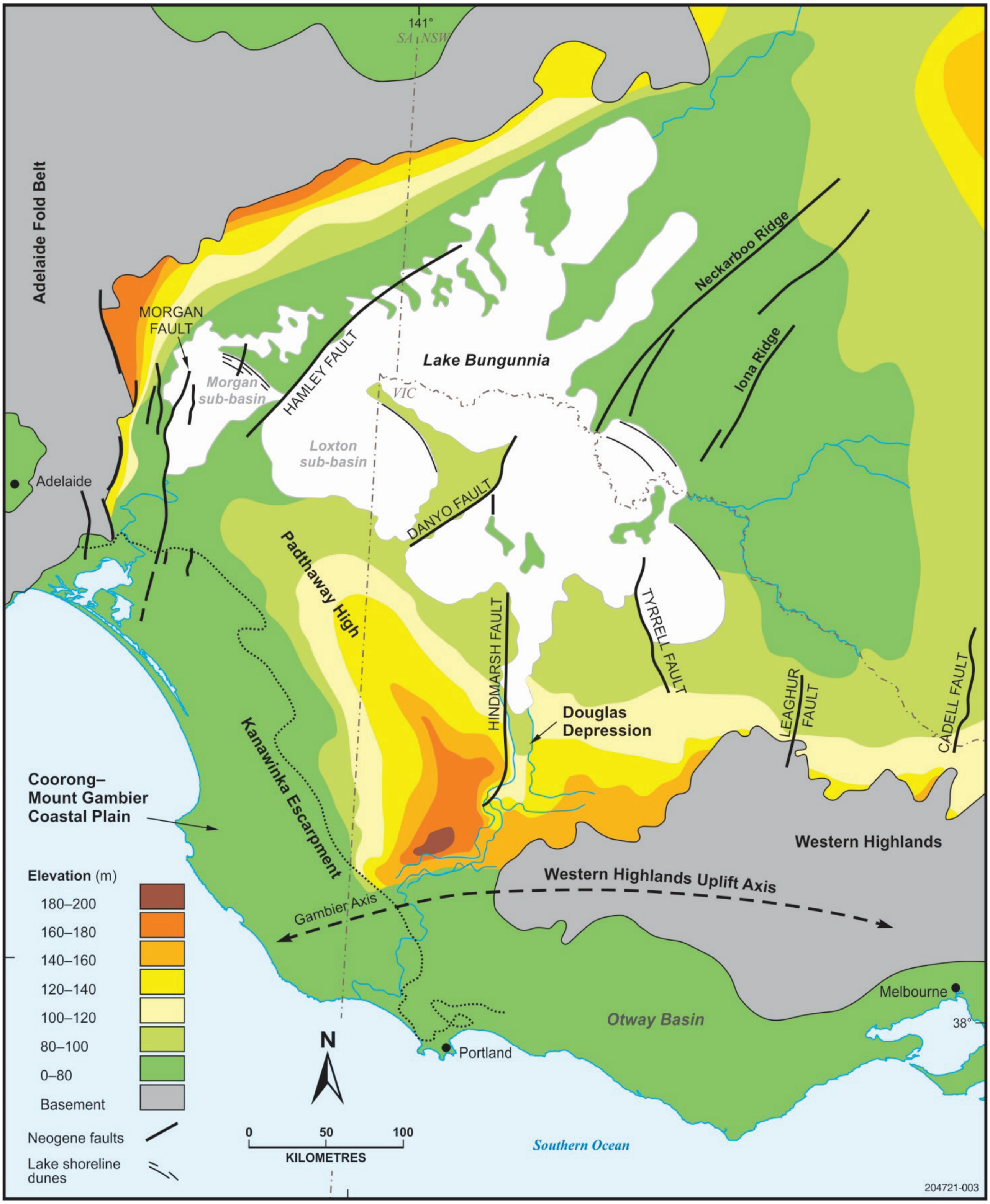


Figure 3. Elevation and neo-tectonic features of the Murray Basin, with maximum extent of lacustrine sediments and floodplain of Pleistocene Lake Bungunnia (modified from McLaren et al. 2011).

SAMPLES AND METHODS

The site of investigation covered parallel strandlines of Loxton Sand between the townships of Loxton and Karoonda, an area 30 x 80 km centred on the heavy mineral sand mining operations at Mindarie (Fig. 4). Samples for zircon separation and analysis were selected in consultation with Murray Zircon Pty Ltd, based on company analyses of reverse circulation drill samples from strandlines containing anomalous heavy mineral content (Table 1). Five samples were from the Wunkar series of strands, southwest of Loxton. These included three samples (2017301, 2017304, 2017305) from a strandline/offshore complex, incorporating Wunkar 1–3, taken ~8 km apart along the trace of the paleo-coastline, to test for multiple fluvial source inputs. Two samples were from progressively younger Wunkar strandlines 5 and 7 (2017302-303), to test variation in source inputs over a comparatively short depositional timeframe. Zircon product (2017306) representative of strandline ‘A2’ at Mindarie was provided from a reference sample produced when the mineral separation plant was in operation at the Mindarie Mine. Two samples (2017307 and 2017308) were collected from the open pit mining operation at Mindarie C strandline and represent beach and overlying dune facies, respectively. From near Karoonda, ~40 km southwest of Mindarie, one sample each was provided as representative of anomalous heavy mineral intersections in the Nindethana (2017309) and Balmoral South (2017310) strandlines (Fig. 4). These represented the southerly extent of exploration activity by Murray Zircon, as at August 2013.

Table 1. Loxton–Karoonda heavy mineral sample details.

R number	Sample_Ref	Sample_Type	Site	Strandline	HM (%)	Zircon (%) in HM fraction	MGA East	MGA North	Zone	RL
2017301	548883R	RC drill cutting	MZX0733	Wunkar #2	2.69		434505	6181455	54	46
2017302	548792R	RC drill cutting	MZX0712	Wunkar #5	1.53		433116	6179714	54	46
2017303	548810R	RC drill cutting	MZX0720	Wunkar #7	1.21		432280	6178049	54	46
2017304	548692R	RC drill cutting	MZX0689	Wunkar #1	1.53		441900	6180180	54	35
2017305	WL-1	HM composite	Composite	Wunkar #3-1a	1.23	13.8	450885	6174962	54	31
2017306	Mindarie AZ	HM zircon concentrate	Composite	Mindarie A2	4.0	26.6	428510	6148704	54	60
2017307	Mindarie C-Strand	HM concentrate	Composite	Mindarie C	5.2	23.5	427427	6150625	54	62
2017308	Mindarie C-Dune	HM concentrate	Composite	Mindarie C	1.1		427427	6150625	54	64
2017309	556937R	RC drill cutting	MZK0246	Nindethana	2.08		398266	6123125	54	42
2017310	BS-2	HM composite	Composite	Balmoral South	3.10	18.6	407020	6113748	54	35

Zircon U-Pb data for geochronology was collected using analytical facilities at Adelaide Microscopy, University of Adelaide. Zircons were separated from sand samples at MinSep Laboratories (Denmark, WA) using standard density and magnetic techniques, before being mounted in epoxy discs and polished so as to expose the grains at the surface. The zircons were photographed under transmitted plain polarised light, and the internal structure of the grains imaged via cathodoluminescence using a Gatan detector attached to a Phillips XL-30 scanning electron microscope (SEM).

U-Pb analyses were obtained on one of two laser ablation-inductively coupled plasma mass spectrometry (LA-ICPMS) instruments at Adelaide Microscopy. Samples 2017307 and 2017308 were analysed using a New Wave 213 nm Nd–YAG laser ablation unit coupled to an Agilent 7500 quadrupole ICPMS. The remaining samples were analysed using a 193 nm Resonetics laser ablation unit coupled with an Agilent 7300 quadrupole ICPMS. In each case, the methodology utilised was identical and analytical conditions were very similar. Both laser ablation systems were run using a 30 µm spot size and a 5 Hz repetition rate. The ICPMS units both analysed for time-resolved signals of $^{204, 206, 207, 208}$Pb, ^{232}Th and ^{238}U and were processed using the GLITTER software (Griffin et al. 2008). Values of ^{235}U were calculated assuming ^{235}U = ^{238}U/137.88. Where the ^{207}Pb/^{206}Pb age is <1000 Ma the ^{206}Pb/^{238}U age was used as the preferred crystallisation age for the analysis. In a small number of analyses, however, zircons were observed with ^{207}Pb/^{206}Pb ages >1000 Ma and $^{206}Pb/^{238}U$ ages that were much younger. In most of these instances total ^{207}Pb counts are observed to be very low, which suggests that the older age may be influenced by the presence of some unquantified amount of non-radiogenic Pb. In cases where ^{207}Pb counts are very low, a small increase in non-radiogenic ^{207}Pb will have a significant effect on the apparent $^{207}Pb/^{206}Pb$ age. In such cases, therefore, the $^{206}Pb/^{238}U$ age was taken as the age of the zircon.

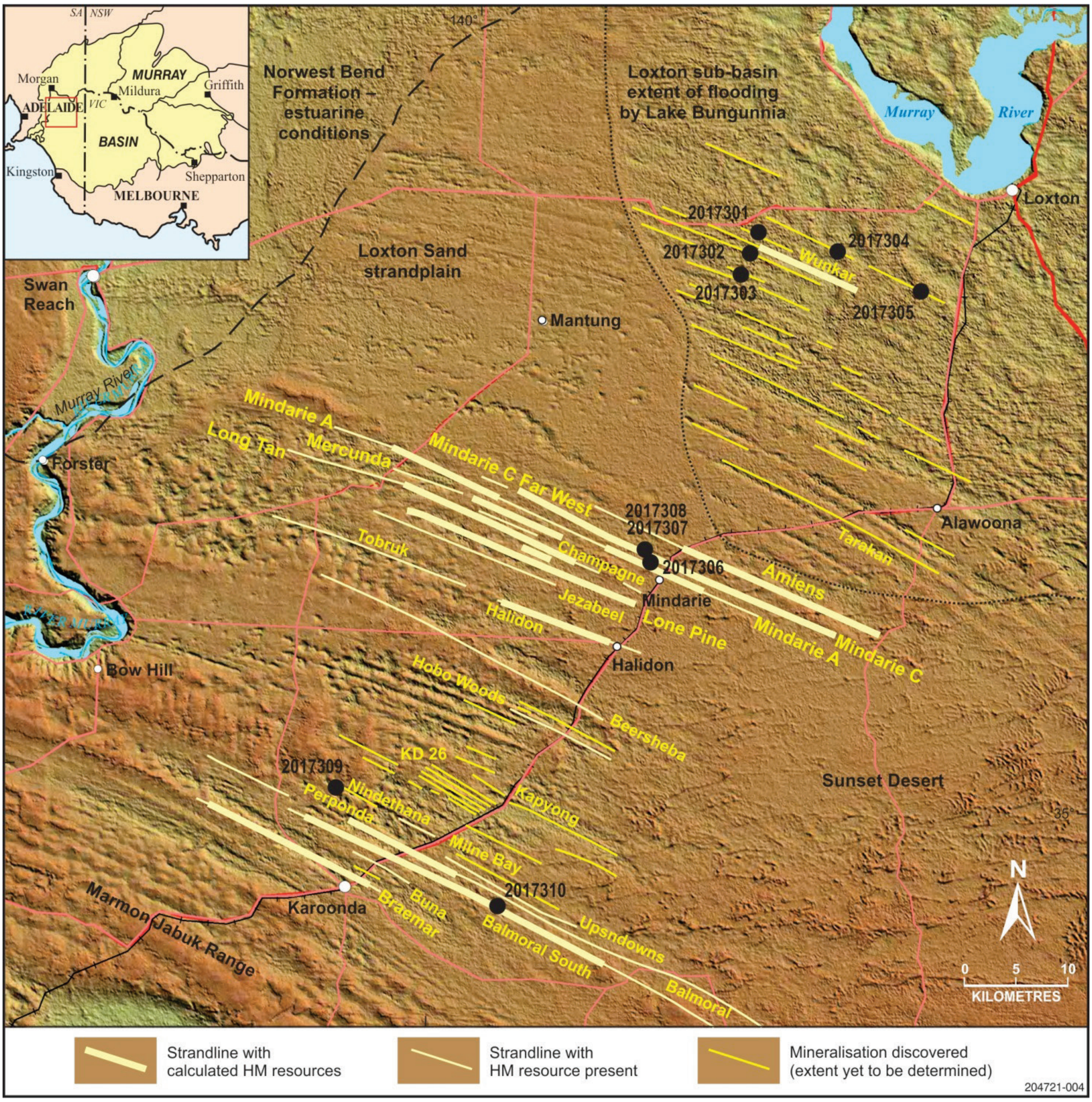


Figure 4. Sample locations, strandlines, and HM resources in the Loxton–Karoonda area.

The standard zircon GJ was used to calibrate Pb/U fractionation (Jackson et al. 2004), and data quality was monitored by analysing zircon standards QGNG ($^{207}Pb/^{206}Pb$ age = 1851.6 ± 0.6 Ma; Black et al. 2003) and Plešovice (337.13 ± 0.37 Ma; Sláma et al. 2007). Weighted mean ages obtained for these standards were within uncertainty of reported ages (Appendix 1). Data for ^{204}Pb is compromised by interference from ^{204}Hg, a trace contaminant in the Ar–He carrier gas, and low sensitivity for this isotope; nevertheless ^{204}Pb was monitored during the analytical process in order to give an indication of zircons which may contain elevated non-radiogenic Pb. In most cases ^{204}Pb remained at background values, and no correction for non-radiogenic Pb has been applied to the data. Isoplot v3 (Ludwig 2003) was used for weighted mean age calculations, and probability density distributions were constructed using AgeDisplay (Sircombe 2004).

RESULTS

The number of zircon grains analysed per sample ranged from 49 to 100 and the age distribution of grains for each sample was prepared as probability plots (Fig. 5) from full data given in Appendix 2. The results were used to establish various zircon populations and possible primary and secondary source regions were identified (Fig. 6). Indicative age ranges were assigned for these regions based on zircon age data presented in reviews by Sircombe (1999) and Champion et al. (2009). For each sample, zircons were classified based on the selected age ranges that had relevance to possible source regions. The results were tabulated (Table 2) and plotted as pie charts (Fig. 7). Previous data for four samples of Murray Basin zircon from Sircombe (1999) were classified in the same manner and the charts included for comparison (Fig. 7). Data presented in this way were used to compare individual samples with regard to variation in possible source regions, estimates of the relative contribution of source inputs, and the identification of likely dispersion routes.

SOURCE OF ZIRCON, REWORKING AND MIXING

The Late Miocene – Early Pliocene sandplain and associated coastal beach ridges in the area between Loxton and Karoonda developed by southwards progradation over either Bookpurnong Formation shallow marine clayey silt or the eroded surface of Mid-Miocene marine Murray Group carbonates (Brown and Stephenson 1991). In this region of the Murray Basin, older Miocene fluvial sands of Renmark Group were covered by thick carbonates and therefore not accessible as an offshore source of quartz sand and heavy minerals for Late Miocene strandline development. This differs from the northeastern sector of the basin where Roy et al. (2000) concluded that offshore Miocene sands of Olney Formation exposed to marine erosion on upfaulted blocks, such as the Neckarboo Ridge, were the most probable source of heavy minerals. Any contribution from this source in the Loxton–Karoonda area would have been transported to the coast by Late Miocene – Early Pliocene rivers, as sand derived from streambank erosion along channels incised in near-surface mid-Miocene sands further inland. At the coast, longshore drift appears to have played an important role in the redistribution and supply of sand for beach and dune formation. This follows from the lack of offshore sedimentary sand sources combined with long lengths of strandlines showing relatively few gaps indicating fluvial channels with coastal outflows. Direction of longshore drift was essentially from west to east, based on indicators of rainfall and vegetation that are consistent with a climate pattern during the Late Miocene – Early Pliocene similar to that prevailing today with dominant westerly to south-westerly weather systems (Kemp 1978; Macphail 2007). This dominant weather direction is reflected also in the pattern of paleocurrents determined from cross-bed dip directions in prograding sandy deltas of Norwest Bend Formation (Pufahl et al. 2004).

Possible non-fluvial inputs for strandline development in the southwestern Murray Basin include products of coastal erosion from offshore islands to the southwest of Karoonda, and the western basin margin and headland of southern Adelaide Fold Belt rocks, with pockets of Permian glaciogene sediments. The offshore islands and western bedrock, south of Morgan, are predominantly Early Cambrian Kanmantoo Group metasandstone and schist intruded by Mid-Cambrian to Early Ordovician granite and associated mafic rocks of the Ross-Delamerian Orogeny (514–485 Ma; Foden et al. 2002). Thick deposits of glaciogene sediments of Cape Jervis Formation are restricted to Permian glacial valleys toward the southern end of Fleurieu Peninsula (Alley and Bourman 1995). Unconsolidated fluvial fine-grained sand and diamictite would have been readily eroded where exposed at the paleocoast. Glaciogene sediments in this part of the Troubridge Basin have been interpreted as the product of decay of a late Paleozoic icesheet from a single continent-scale glaciation (Alley, Bourman and Milnes 2013). Based on pebble lithology and heavy mineral composition, Alley, Bourman and Milnes (2013) concluded that the sediment was largely derived from local sources, predominantly Cambrian metasandstone, with some contribution from the southwest, mostly granitic rocks of the southern Fleurieu Peninsula and Padthaway Ridge.

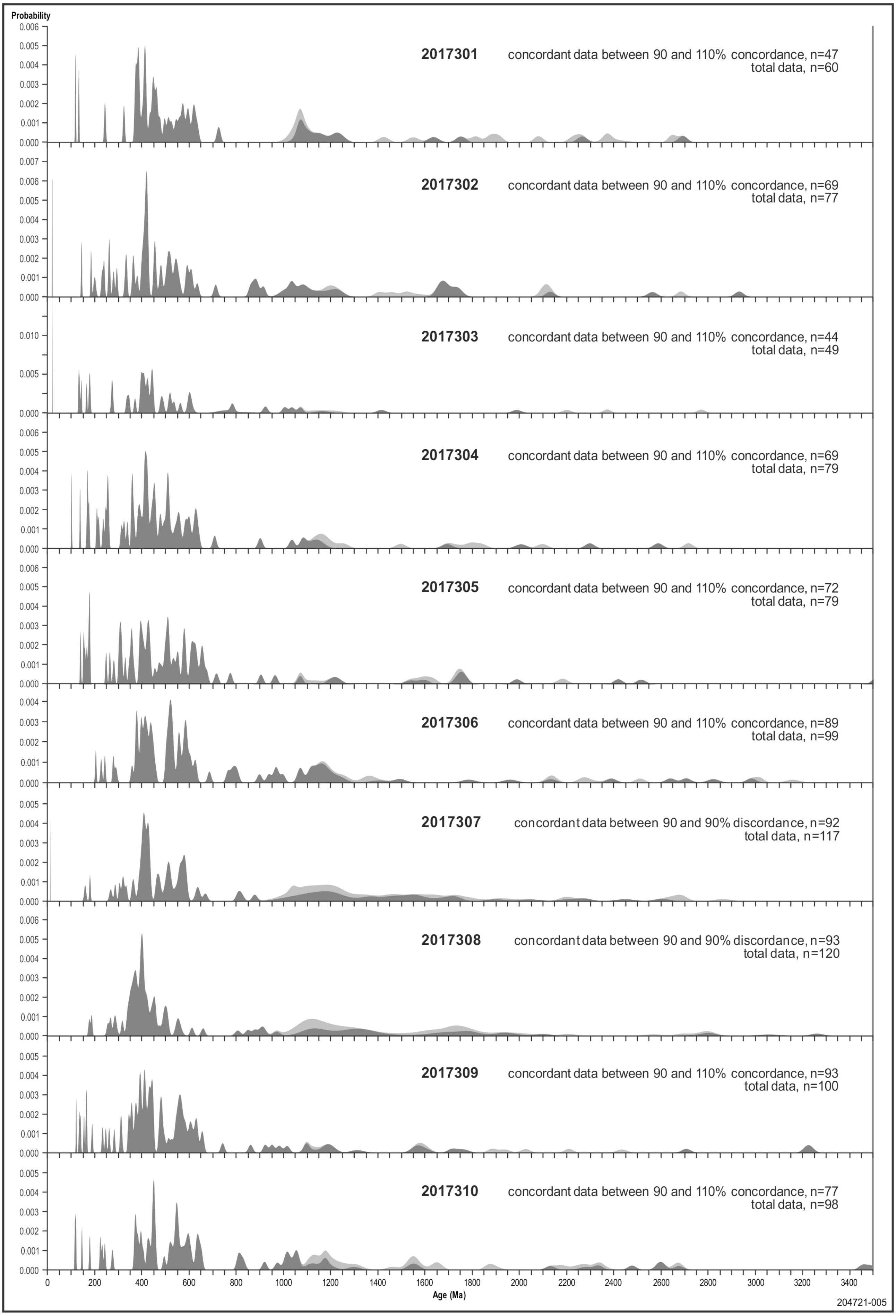


Figure 5. Zircon age probability plots.

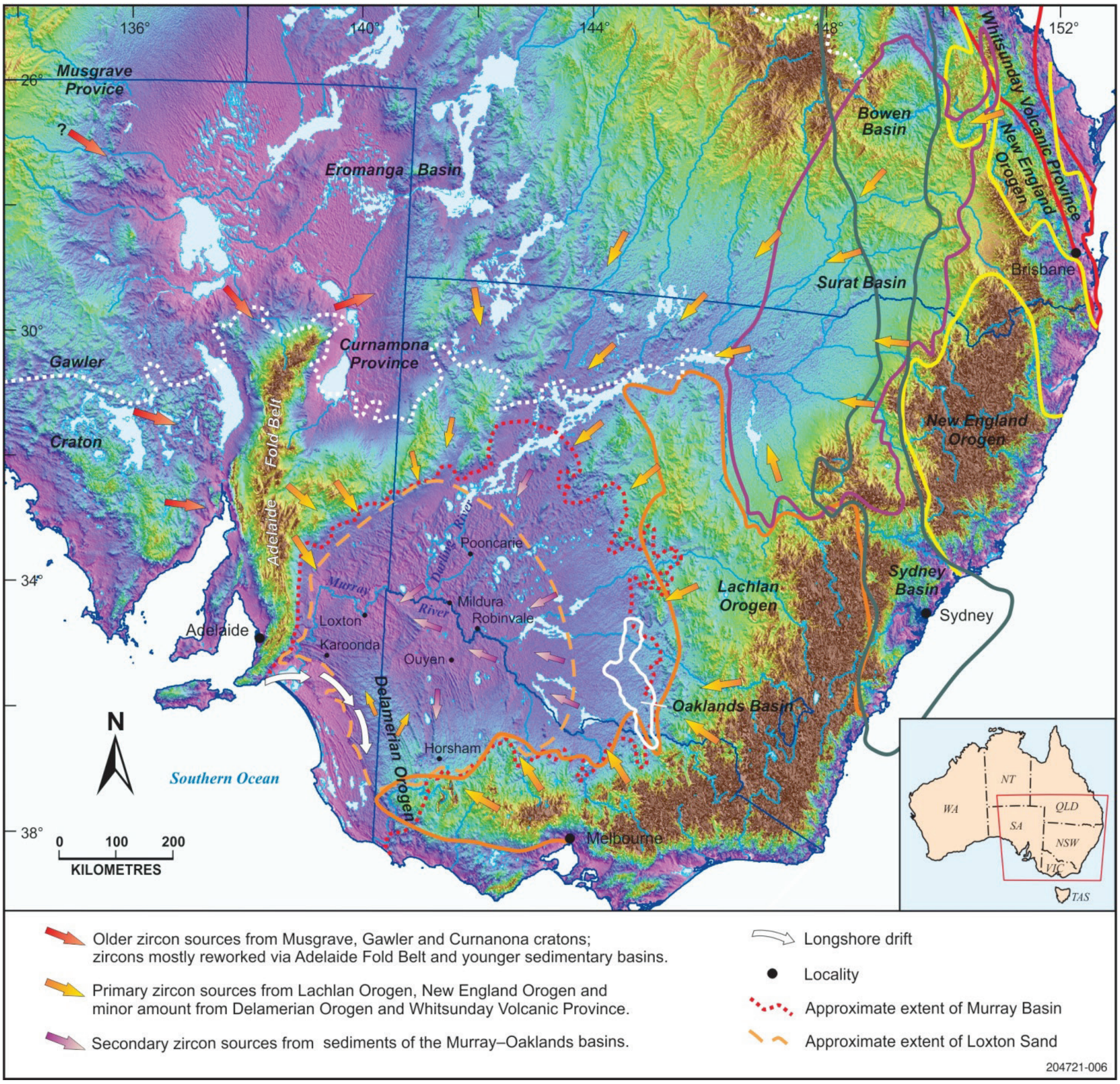


Figure 6. Zircon source regions — main orogenic belts and basins in the Murray Basin catchment.

In consideration of the above, there is low probability that any zircon derived from non-fluvial inputs would be younger than c. 480 Ma, i.e. post the Ross-Delamerian Orogeny and equivalent to the time of cooling and exhumation following post-tectonic intrusion of A-type granites at c. 485 Ma (Foden et al. 2002). Zircon dating showed the relative proportion of zircon grains younger than 480 Ma ranged from 31 and 54% (Table 2); this reflects the minimum contribution from fluvial inputs.

Table 2. Percentage zircon grains for various age ranges related to possible provenance region and intermediary sedimentary host.

Igneous / Metamorphic Provenance	**Miocene alkali basalts**	**Whitsunday Volcanic Province**	**Southern New England Orogen**	**New England Orogen**	**Lachlan Orogen granites**	**Southern New England Orogen**	**Delamerian igneous activity**	**Pacific Gondwana, Antarctica**	**Unknown source**	**Grenville-age Antarctica, Musgrave**	**Gawler Craton, Musgrave, Antarctica**	**Various possible sources**	**Gawler / Curnamona / Antarctica**
Possible Intermediary Sedimentary Host	***Renmark Group, Murray Basin***	***Southeastern Queensland, Surat Basin, Eromanga Basin***	***Renmark Group, Murray Basin***	***Renmark Group, Murray Basin***	***Renmark Group, Murray Basin***	***Renmark Group, Murray Basin***	***Cape Jervis Formation***	***Kanmantoo Group, Lachlan Ordovician turbidites, Hawkesbury Sandstone***		***Kanmantoo Group, Umberatana Group, Wilpena Group***	***Kanmantoo Group, Burra Group, GAB***		***Kanmantoo Group, Adelaidean, Curnamona metasediments***
Age Range (Ma)	**25-12**	**175-100**	**225-175**	**350-225**	**440-350**	**480-440**	**530-480**	**700-530**	**900-700**	**1200-900**	**2100-1200**	**2700-2100**	**>2700**
2017301	0	3	2	7	20	10	7	18	2	10	13	8	0
2017302	1	3	3	11	19	6	8	11	8	13	11	5	1
2017303	2	10	2	10	25	5	5	12	7	12	8	0	2
2017304	0	6	2	11	25	8	11	18	1	9	6	3	0
2017305	0	6	2	11	20	3	10	24	3	5	13	3	1
2017306	1	0	1	4	22	3	13	18	6	18	8	3	3
2017307	1	2	1	7	22	3	7	13	5	16	17	5	1
2017308	0	1	1	12	27	5	3	7	5	19	16	2	2
2017309	0	6	1	8	26	7	6	22	3	9	8	1	3
2017310	0	3	2	5	14	8	6	21	6	17	9	7	2

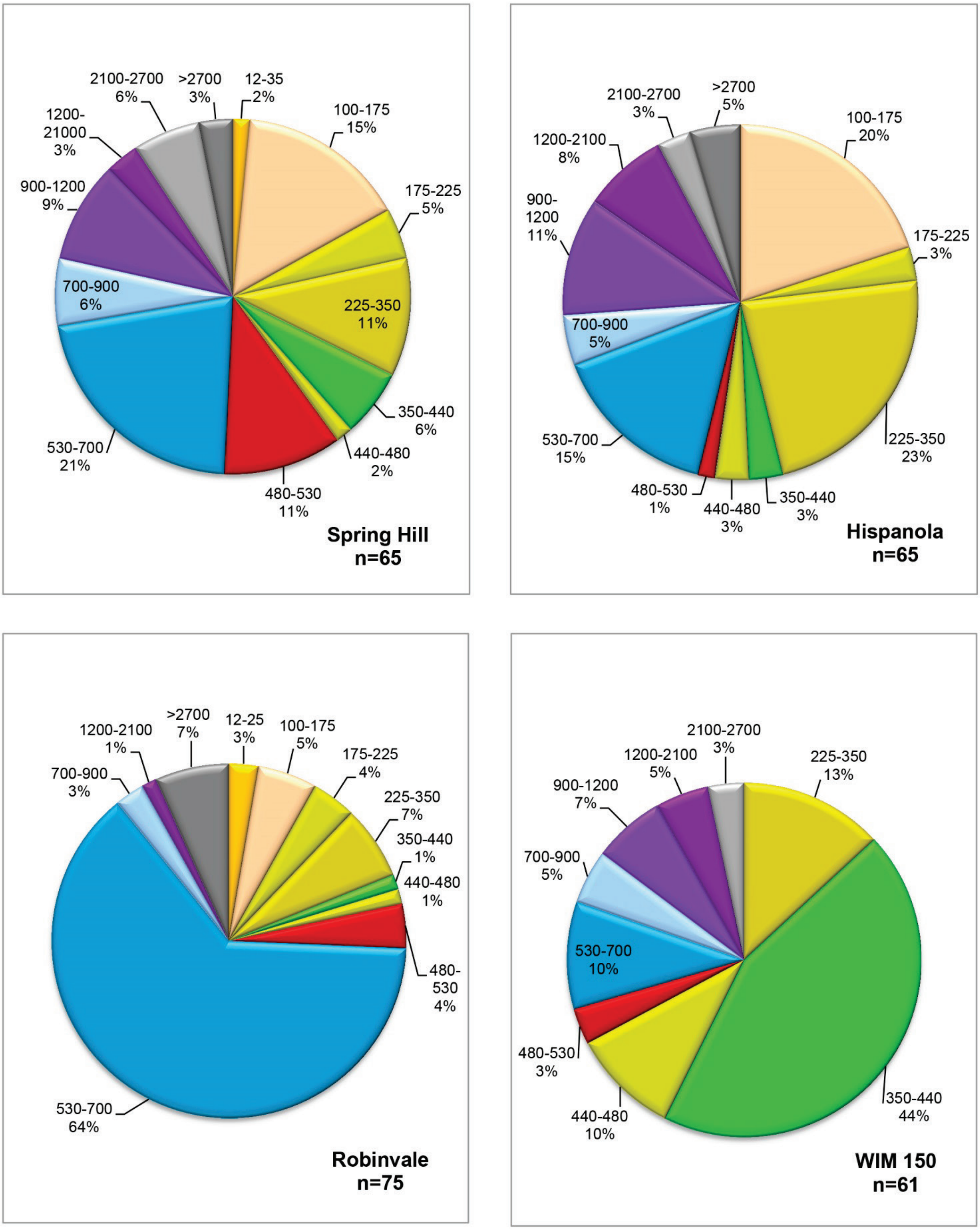


Figure 7. Murray Basin heavy mineral samples — pie diagram plots of percentage zircon grains for age groupings related to possible source regions.

(These 4 samples were compiled from supplementary data accompanying Sircombe (1999)).

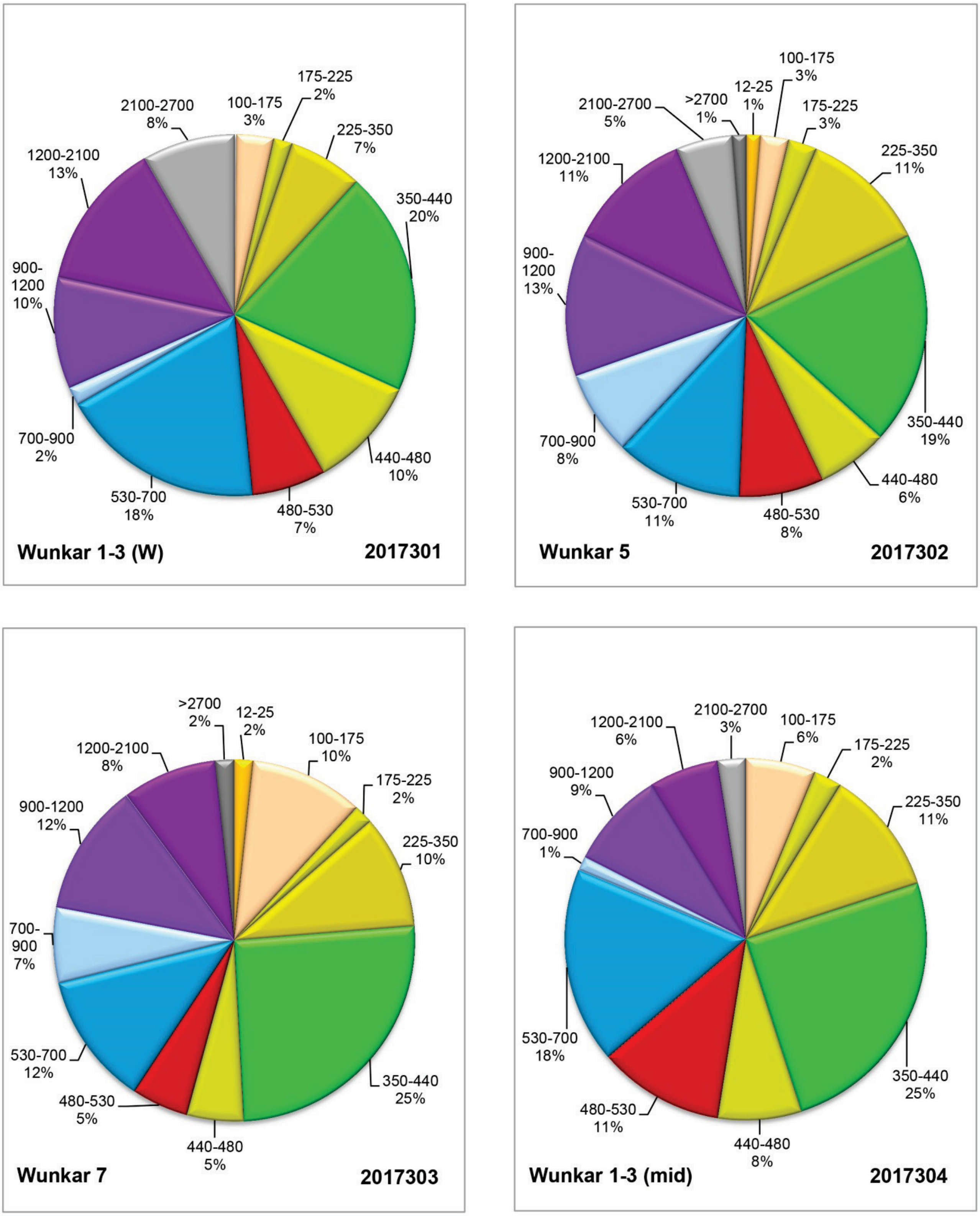


Figure 7 cont. Murray Basin heavy mineral samples — pie diagram plots of percentage zircon grains for age groupings related to possible source regions.

(Refer to Table 2 for data for these samples).

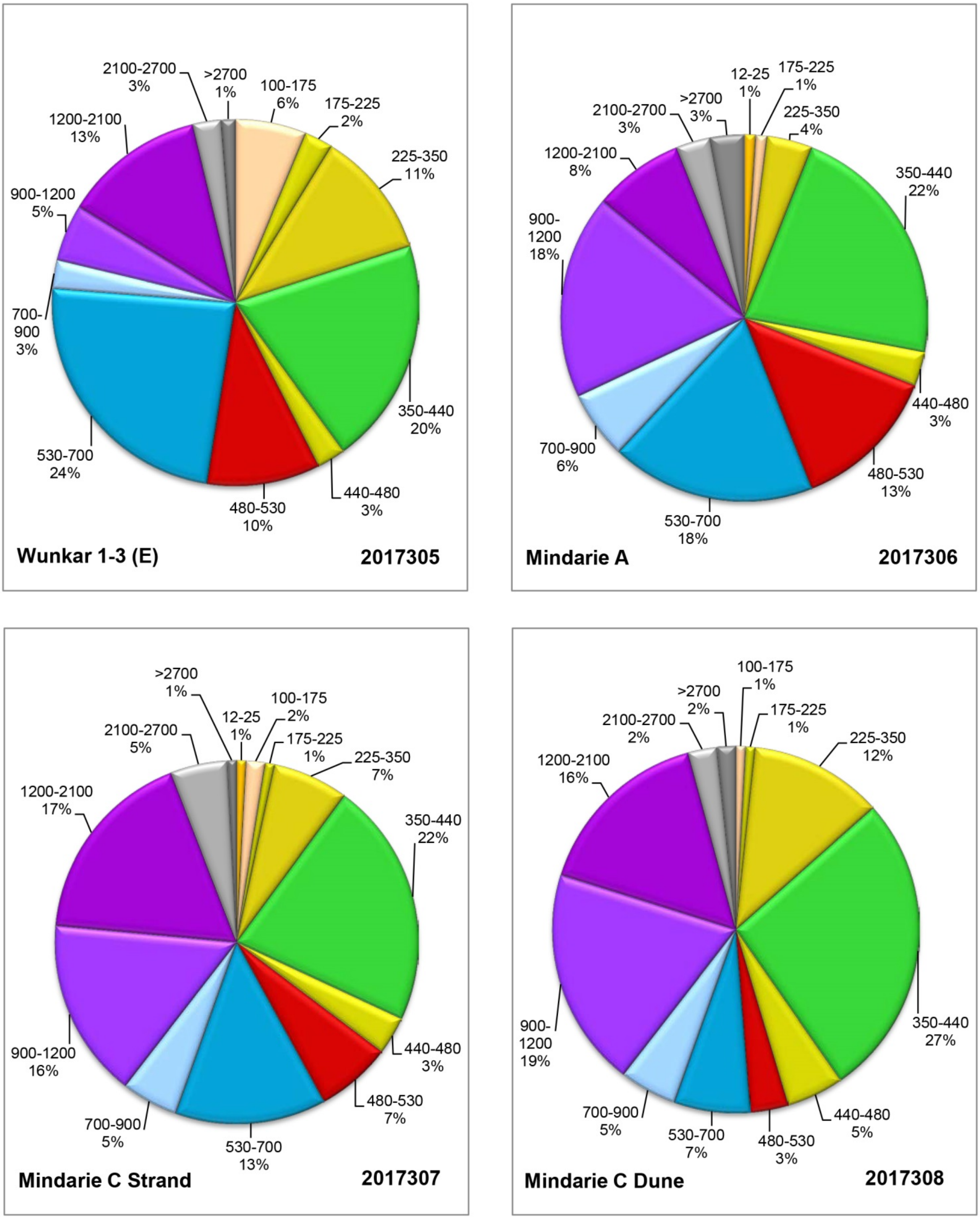
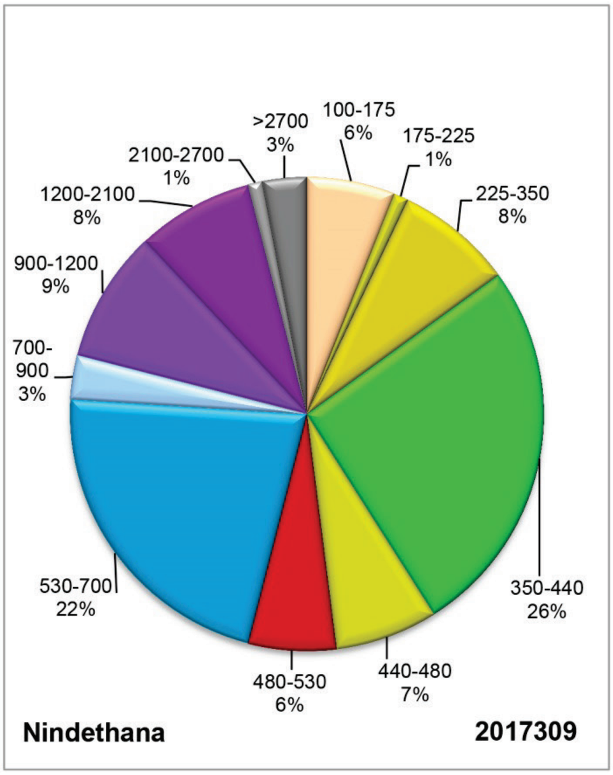


Figure 7 cont. Murray Basin heavy mineral samples — pie diagram plots of percentage zircon grains for age groupings related to possible source regions.

(Refer to Table 2 for data for these samples).



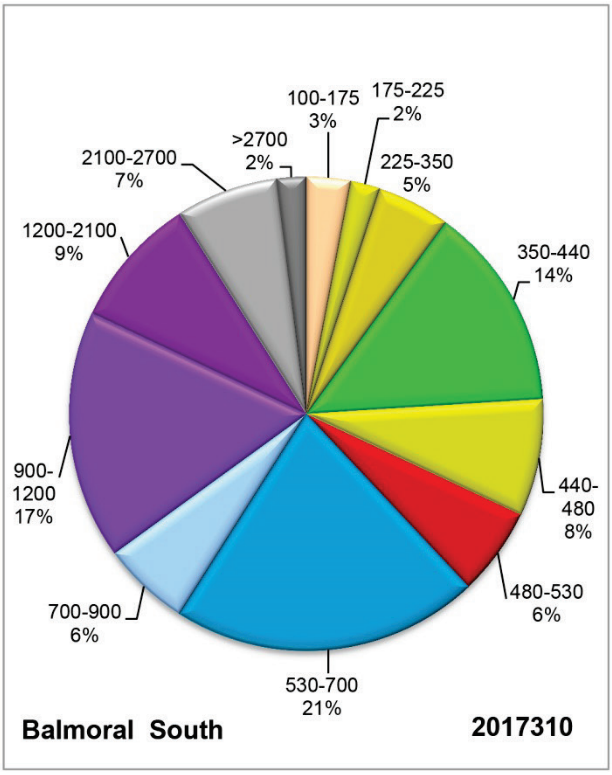


Figure 7 cont. Murray Basin heavy mineral samples — pie diagram plots of percentage zircon grains for age groupings related to possible source regions.

(Refer to Table 2 for data for these samples).

ADELAIDE FOLD BELT

Kanmantoo Group metasandstones are characterised by a main zircon population between 500–700 Ma, with a subordinate population between 900–1200 Ma and scattered older zircon ages of 2000–3500 Ma (Ireland et al. 1998). This grouping differs from Adelaidean rocks which show a significant zircon population between 1550–1900 Ma and a significant group between 2100–2700 Ma. The contribution of zircon grains from coastal headlands of Kanmantoo Group and offshore Delamerian granite sources might be gauged, therefore, by an increase in the zircon population between 500–700 Ma coupled with an increase for 900–1200 Ma zircons, and a contribution from Delamerian granites at 480–530 Ma. Two samples possibly show this pattern, Mindarie A (217306) and Balmoral South strandline (217310); both samples recorded the lowest percentage of zircons younger than 480 Ma at 31% and 32% respectively.

Zircon contribution from Neoproterozoic Adelaidean sedimentary rocks of the southern Adelaide Fold Belt would necessarily be as fluvial inputs, principally from the northwest. Based on data from Ireland et al. (1998) the dominantly Umberatana Group sediments would contribute a zircon population centred on ~1140 Ma coupled with zircons from age groupings 1550–1900 Ma and 2100–2700 Ma. Some contribution from this combination of ages is evident in most of the strandline samples but at a lower proportion than might be expected, given the proximity of these rocks to the western basin margin. The contribution of 1550–1900 Ma zircons ranges from 2 to 10% and 2100–2700 Ma zircons from 1 to 7% (Table 3); the 1140 Ma population is present also in Kanmantoo Group and, in isolation, is not diagnostic of source. Overall, Neoproterozoic rocks contributed probably <30% of the strandline zircons, with significant inputs restricted to the western end of Wunkar strandlines 1 and 5 and the Nindethana strandline, and possibly during formation of the Mindarie C dune. The Balmoral South strandline has a low content of 1550–1900 Ma zircons (2%) but a moderately high proportion of 900–1200 Ma zircons (17%), which was more likely contributed by Kanmantoo Group, as discussed above. A relatively small fluvial contribution from the Adelaide Fold Belt is consistent with the limited stream development and associated small catchments along the eastern range front, compared with more extensive westerly and southwesterly flows into Gulf St Vincent (Tokarev and Gostin 2005). The relative proportion of zircons from various age populations in all samples indicates significant contributions of zircon from distant sources to the east and north; these substantially diluted the smaller contribution from the western ranges.

Table 3. Proportion of zircons for selected Proterozoic age groupings.

Sample	2017301	2017302	2017303	2017304	2017305	2017306	2017307	2017308	2017309	2017310
	Wunkar 1-3 W	*Wunkar 5*	*Wunkar 7*	*Wunkar 1-3 (mid)*	*Wunkar 1-3 E*	*Mindarie A*	*Mindarie C strand*	*Mindarie C dune*	*Nindeth-ana*	*Balmoral South*
1550–1900 Ma (%)	8	8	3	3	5	3	5	10	6	2
2100–2700 Ma (%)	5	5	2	2	3	4	5	3	1	7
Total (%)	13	13	5	5	8	7	10	13	7	9
900–1200 Ma (%)	10	13	12	9	5	18	16	19	9	17

PACIFIC GONDWANA 530–700 Ma

The Robinvale (Wemen) sample analysed by Sircombe (1999) contained zircons with a high proportion of grains in the age range 530–700 Ma (64%); this population is represented in all the Loxton–Karoonda strandline zircons (7–24%). The provenance of the 500–700 Ma zircons in the Robinvale sample was the subject of consideration by Veevers et al. (2006) who concluded that the zircons originated from a now ice-covered Antarctic provenance and had been widely dispersed into Paleozoic and Mesozoic basin sediments including Early Cambrian Kanmantoo Group metasandstone, Ordovician turbidite of the Lachlan Fold Belt and Triassic Hawkesbury Sandstone of the Sydney Basin. The Robinvale sample has a very low proportion of 350–440 Ma zircons (1%), as does the Hawkesbury Sandstone (Veevers et al. 2006). This is in contrast to the more southerly Murray Basin WIM 150 sample (Sircombe 1999) where 530–700 Ma zircons accounted for ~10% of the zircon population, while the dominant contribution was from 350–440 Ma zircons (44%), sourced from southern Lachlan Fold Belt granitoids (Table 2). The location of the Robinvale sample is in an area of paleo-shoreline that might be expected to integrate various fluvial inputs of ancestral rivers of the Lachlan, Murrumbidgee and Murray, all of which have catchments in regions of the Lachlan Fold Belt. Large volumes of zircon-bearing granites were intruded throughout the Lachlan Fold Belt during 450–320 Ma (Veevers et al. 2006; Champion et al. 2009) and this population should be well represented, had the 530–700 Ma zircons been derived from Ordovician turbidites of the Lachlan Fold Belt. As there is no obvious Late Miocene fluvial link between the Sydney and Murray basins (Veevers et al. 2006) the source contributing the high percentage of 530–700 Ma zircons at Robinvale remains unclear but the explanation is possibly local reworking of earlier basin sediments that underlie the Murray Basin. In particular, this could include reworked Triassic Jerilderie Formation sandstone and conglomerate, as the youngest deposit of the Oaklands Basin, which underlies Olney and Calivil Formations of the Murray Basin beneath the course of the present day Murrumbidgee River, ~75 km east of Hay, NSW (Davidson and Fahey 2014). The 530–700 Ma zircons in the Loxton–Karoonda samples are a significant contribution. The widespread occurrence of zircons of this age group, however, does not assist in identifying preferential input from either the north or east, or from coastal Kanmantoo Group metasandstones.

LACHLAN OROGEN 350–440 Ma

All the South Australian strandline samples contained a significant proportion of zircons (14–27%) in the age grouping 350–440 Ma. This population was dominant in the WIM 150 sample (44%) but a relatively minor component (1–6%) of more northerly samples analysed by Sircombe (1999). The source of the zircons was attributed to the largely igneous second phase of the Lachlan Orogen which produced granitoids over the period 360–440 Ma (Sircombe 1999). Zircons of this age at WIM 150 were sourced from southern central Victoria and were accompanied by input of southern

New England Orogen zircons with ages 440–480 Ma. The proportion of zircons from these two age groupings in the South Australian samples is higher than that reported for northerly and westerly Murray Basin samples from Spring Hill, Hispanola and Robinvale (Sircombe 1999; Table 2; Fig. 7). A high content of 350–440 Ma zircons (14–27%) was present in all samples along with significant relative content of 440–480 Ma zircons (3–10%). This provides the clearest evidence of fluvial transport from the southeast toward the western Murray Basin margin. Such a fluvial system was most likely the Miocene beginnings of an ancestral Murray River that developed as the sea retreated. This implies that the southwestern central region of the Murray Basin, a long-lived depocentre for the basin, remained as a regional topographic low in the landscape. The supply of zircon grains originating from Victoria continued to be contributed or recycled throughout the period of sandplain progradation between Loxton and Karoonda. An alternative explanation of a more southerly coastal river outlet (McLaren et al. 2011) with longshore drift to the northwest is not supported by the interpreted weather pattern for the Miocene (Kemp 1978) or by the geomorphology of reconstructed paleo-coastal features (Belperio and Bluck 1990; Pufahl et al. 2004).

NEW ENGLAND OROGEN 225–350 Ma

Zircons in the age range 225–350 Ma originated mainly from felsic igneous rocks of the New England Orogen in areas of eastern Queensland and northeastern New South Wales (Champion et al. 2009). All Murray Basin strandline samples contain some zircon formed during this period; the group makes up the largest population (23%) in the Hispanola sample and is a significant component of the WIM 150 zircons (13%). The presence of 225–350 Ma zircons in the Loxton–Karoonda strandlines is indicative of fluvial input but is not specific as to whether this was derived from northerly or easterly drainage. Samples with the lowest proportion of this grouping were Wunkar 1-3W (2017301), Mindarie A (2017306) and Balmoral South (2017310), each of which appears to have increased input from probable Kanmantoo or Adelaidean bedrock sources.

WHITSUNDAY VOLCANIC PROVINCE 100–175 Ma

The population of Jurassic to Early Cretaceous (100–175 Ma) zircons is correlated with extensive volcanic arc activity of the Whitsunday Volcanic Province, mostly during the period 95 to 132 Ma along the eastern Queensland coast (Ewart, Shön and Chappell 1992; Sircombe 1999; Bryant et al. 2012). Zircons in weathered detritus from volcanic deposits were extensively dispersed during the Cretaceous by westerly and south-westerly flowing rivers that deposited sediment in the Surat and Eromanga Basins (Veevers 1984; Bryant et al. 2012). The sediments were later reworked by early Cenozoic rivers, including southerly flows into the northern Murray Basin. During the Miocene, tributaries of the ancestral Darling River transported zircon directly from Queensland volcanics and also recycled zircon from earlier basin sediments. Early Cretaceous age zircons were not recorded in the WIM 150 Miocene sands, in the southern Murray Basin, but were present in the Robinvale sample and made up a significant contribution in the Spring Hill (16%) and Hispanola (20%) samples. Zircons of this age grouping were clearly transported by rivers entering the Murray Basin from the north. In the case of Spring Hill, Hispanola and Robinvale these may have been reworked from earlier fluvial deposits of Renmark Group, Olney Formation, possibly eroded offshore and transported to the beaches by wave action. In the case of the Loxton–Karoonda strandlines, however, these zircons must have been derived from fluvial inputs of Late Miocene rivers. Given that 100–175 Ma zircons were not reported in WIM 150 and were only a minor component at Robinvale (5%), then the proportion of <175 Ma zircons relative to half the proportion of 350–440 Ma zircons (approximately twice the volume of zircons of this age were present in the WIM 150 sample) was used here as a guide to the relative fluvial components from ancestral Darling and Murray rivers to the Loxton–Karoonda Late Miocene coastline (Table 4). Within the limitations of the assumptions outlined above, the ratios indicate that an ancestral Murray River mostly dominated over the ancestral Darling River as a source of fluvial zircons in the Loxton–Karoonda strandlines. The exception is Wunkar 7, which has the highest percentage of 100–175 Ma zircons (10%) indicative of dominant northerly fluvial input.

Table 4. Estimated ratio of relative fluvial zircon inputs from ancestral Darling and Murray rivers.

Sample	2017301 *Wunkar 1-3 W*	2017302 *Wunkar 5*	2017303 *Wunkar 7*	2017304 *Wunkar 1-3 (mid)*	2017305 *Wunkar 1-3 E*	2017306 *Mindarie A*	2017307 *Mindarie C strand*	2017308 *Mindarie C dune*	2017309 *Nindethana*	2017310 *Balmoral South*
[1]Ratio Darling : Murray	0.3:1	0.23:1	1.16:1	0.57:1	0.56:1	0:1	0.27:1	0.07:1	0.46:1	0.5:1
[2]Adelaide Fold Belt inputs (%)	18	19	14	9	13	22	30	30	11	22

[1]Ratio calculation: ([12–25 Ma]+[100–175 Ma])/(350–440 Ma/2)
Rationale: 20% <175 Ma = 100% Darling; 44% 350–440 Ma = 94% Murray
[2]Adelaide Fold Belt input estimated from zircon percentage (∑900–2100 Ma – (<480 Ma x 0.15))

MIOCENE ZIRCONS 18–22 Ma

The eastern portion of Wunkar strandlines 5 and 7 (samples 2017302 and 2017303) each returned one zircon grain dated at ~19 Ma. While the Early Miocene-age zircons were comparatively rare, their presence is significant in that they were from a source that crystallised during the timeframe of active sedimentation in the Murray Basin, i.e. during the latter stages of the first marine inundation. To reach the Wunkar strandline, the zircons were either reworked from uppermost Remark Group fluvial deposits (deposited after 19 Ma) or were transported to the coast by late Miocene rivers that drained directly from the source area in which the zircons formed. Two zircons of similar age (18.1 ± 1.1 and 21.9 ± 1.2 Ma) were reported in the Robinvale sample analysed by Sircombe (1999), from the Wemen strandline (Whitworth 2003). Possible source rocks include minor zircon-bearing alkali basalt, rhyolite and trachyte associated with shield volcanic centres in southern Queensland and northeastern New South Wales, specifically the Tweed Volcano (23–21 Ma), Belmore Volcanic Province (21–19.5 Ma), Ebor-Dorrigo shield (20–19 Ma) or Nandewar Volcano (20–17 Ma) (Sutherland 2003; Sutherland et al. 2005). The broader catchment and drainage networks peripheral to the Murray Basin were established throughout the early Cenozoic (Brown and Stephenson 1991). Individual drainage channels continuously evolved, and flow directions were altered in response to tectonic and later volcanic activity (e.g. Ollier and Pain 1994; Sharp 2004). It is likely, however, that drainage toward the Murray Basin from any of the possible source Miocene shield volcanic centres in southern Queensland and northeast New South Wales would ultimately have linked with the ancestral Darling River system and flowed south through the region of Menindee. While the volcanic deposits in this region are a recognised source of detrital zircon (Hollis and Sutherland 1985) other potential source regions for Early Miocene-age zircons are known within the Murray Basin catchment. The Snowy Mountains basalt province (15–27 Ma) is the identified source of alluvial deposits containing sapphire, garnet and zircon, from which zircons have been dated at around 20 Ma (Sutherland et al. 2002). Miocene basalt flows near Tumbarumba may have been eroded into the ancestral Murray, while further north on Section Ridge near Tumut, 20 Ma basalts likely shed detritus into a modified Murrumbidgee River system (Sharp 2004). To the south, basaltic fields of the Melbourne Subprovince (18–23 Ma) northwest and west of Melbourne possibly erupted mugearite and nepheline mugearite alkalic flows, reported from other basaltic centres in the region as a source of minor zircon (Hollis and Sutherland 1985). Northward drainage from areas of basalt west and northwest of Melbourne during the Late Miocene-Early Pliocene possibly eroded Melbourne Subprovince basalt into fluvial networks that ultimately linked to an ancestral River Murray. The presence of c. 20 Ma zircon in the Wunkar strandlines is an indicator of fluvial transport from eastern Australia, but given the distribution of possible sources this may have been by rivers with a either a northerly or south-easterly catchment.

A single zircon grain from Mindarie C strandline (2017307) was dated at 12.4 Ma, which post-dated deposition of Renmark Group and was most probably a component of fluvial input directly from the source region. In this case, the source region was likely central eastern New South Wales, possibly from zircon-bearing peralkaline rhyolite or similar extrusive rocks associated with the Canobolas Volcanic Complex (11–13 Ma), near the township of Orange.

VARIATION IN THE MIXING OF ZIRCON FROM DIFFERENT SOURCES

The pattern of zircon age data across the Loxton–Karoonda strandlines is consistent with the area receiving zircon grains that were representative of most of the fluvial inputs into the basin during the Late Miocene. These were reworked and intermixed in the prograding coastal deposits from which the western strandlines were developed. Separate rivers possibly supplied sand for the Wunkar coastline, with the western end receiving greater inputs from rivers draining Adelaidean catchments, but with increasing input from ancestral Murray and Darling rivers easterly along the coastline. This is consistent with the presence of a northerly river channel incised at the top of Murray Group carbonates along the western basin margin (Miranda, Wallace and McLaren 2008). As the coast prograded seaward, the relative dominance of input sources of zircon varied. Whether this was in response to changes in landscape or climate is not clear from the relatively few samples analysed from selected strandlines. The comparatively high proportion of 100–175 Ma zircons in Wunkar 7 is the only sample where input from the Darling probably exceeded that from the Murray, which appears to have been the overall dominant fluvial contributor. High fluvial inputs of eastern Australian zircons are recorded for samples from the eastern half of the Wunkar strandlines 1-3 and from Nindethana. Reduced fluvial input is most evident in Mindarie A and Balmoral South strandlines, which recorded a high proportion of zircons probably sourced from the coastal headland or offshore islands. Mindarie A strandline is relatively narrow with heavy minerals concentrated in two discontinuous zones (Murray Basin Minerals NL 1999). Heavy mineral grade and zircon content were moderately high, which might reflect increased winnowing as the result of reduced sand supply from rivers during the time of formation. Further investigation is indicated to map out the various river inputs and test for correlation with HM grade and content. The results from this study, however, clearly point to several significant separate input sources being incorporated into the paleo-coastline in this region of the basin, which has resulted in a greater mix of HM grains with higher source variability than would be expected in other strandline deposits within the basin.

CONCLUSION

Ten samples of Loxton Sand with anomalous heavy mineral content, taken from paleo-coastal strandlines in the region between Loxton and Karoonda in South Australia, all contained significant proportion of zircons (31–54%) with ages that postdate Delamerian igneous activity (530–480 Ma). In this area of the Murray Basin, Loxton Sand prograded over shallow offshore marine Bookpurnong Formation clay and silt and Miocene Murray Group marine carbonate. The presence of post-Delamerian zircons indicates fluvial input from the north or east, as opposed to offshore reworking of earlier Murray Basin sandy sediments, or source rocks to the west. Age profiles of post-480 Ma zircon populations across the samples are broadly similar and are consistent with significant fluvial transport of zircons derived from primary source regions in Queensland, New South Wales and Victoria. A proportion of zircons was likely reworked from older sedimentary basins within the river catchments, including earlier Murray Basin fluvial deposits of upper Renmark Group.

Zircon age populations favour transport to the western Murray Basin Late Miocene – Early Pliocene coastline by a combination of paleo-drainage networks involving the ancestral Darling and Murray river systems. Sediment from the southeast mostly dominated over that from the north. River discharge corresponded with a large estuary that formed to the east and south of Morgan, as in part reflected by the distribution of Norwest Bend Formation. It is likely that an ancestral Murray River was established and discharged sand in this area during coastal strandline development between Loxton and Karoonda.

Significant but subordinate fluvial input is indicated for drainage from Adelaide Fold Belt rocks forming the western basin margin. Samples from strandlines Mindarie A and Balmoral South contain a higher proportion of zircons from age populations consistent with additional inputs from Kanmantoo Group meta-sandstones or Cape Jervis Formation eroded from coastal headlands or offshore islands, which may reflect periods of low river flows or reactivated fault activity on the western basin margin.

The Late Miocene – Early Pliocene coast south of Loxton was a region of the Murray Basin where zircons from a wide range of sources were mixed and reworked. The relative inputs from source regions varied over time, as the coastal sandplain prograded. The small number of samples from this study was, however, insufficient to determine whether this evolved from random or systematic processes. Reduction in river inputs might be correlated with narrower strandlines showing higher HM grade, with higher proportion of zircon. The wide mix of zircon sources and fluctuation in source inputs with time is expected to be reflected also in variation in the characteristics and quality of zircon product and associated heavy minerals.

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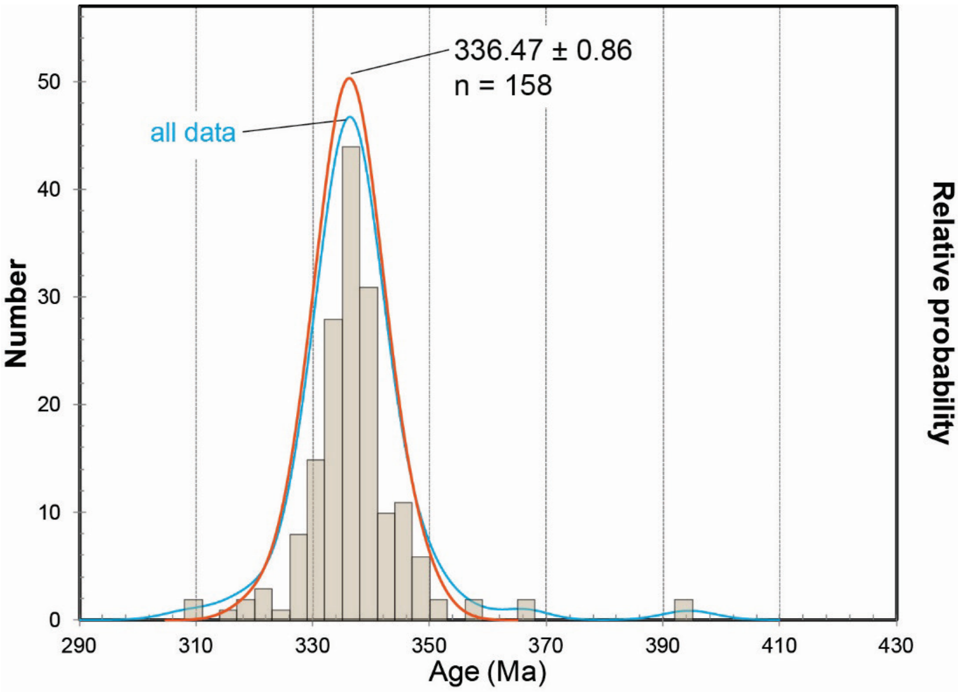
APPENDIXES

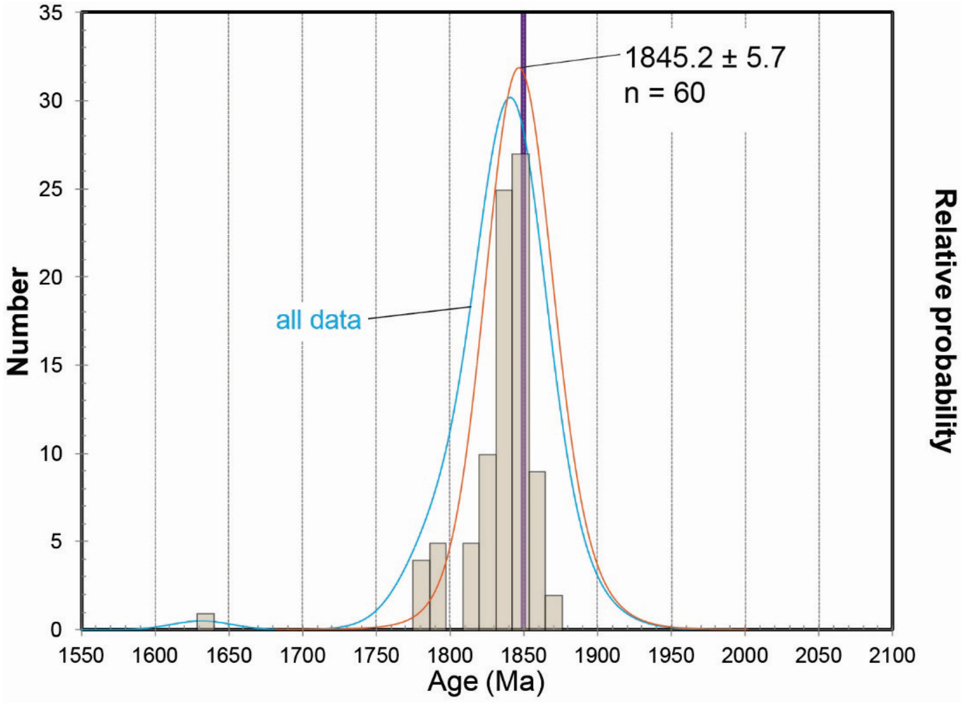
1. SUMMARY OF LA-ICPMS RESULTS OBTAINED FROM STANDARD ZIRCONS DURING THIS STUDY

Summary of LA-ICPMS results from standard zircons analysed during the course of this study.

Standard	**$^{207}Pb/^{206}Pb$ age** (Ma)	**MSWD**	**n**	**$^{206}Pb/^{238}U$ age** (Ma)	**MSWD**	**n**
Plešovice – all data	345 ± 18	16	170	336.9 ± 1.4	5.5	170
Excluding outliers				336.47 ± 0.86	2.0	158
Slama et al. 2007				337.13 ± 0.37		
QGNG – all data	1831.7 ± 6.7	2.0	88			
Excluding outliers	1845.2 ± 5.7	0.11	60	1872 ± 16	15	86
Black et al. 2003	1851.6 ± 0.6					



Probability distribution for $^{206}Pb/^{238}U$ ages from analyses of Plešovice standard zircon. Purple bar indicates reference age given by Slama et al. (2007).



Probability distribution for $^{206}Pb/^{207}Pb$ ages from analyses of QGNG standard zircon. Purple bar indicates reference age given by Black et al. (2003).

2. SUMMARY OF LA-ICPMS ZIRCON U-PB DATA FOR LOXTON–KAROONDA SAMPLES

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
Sample 2017301														
301-05	0.1549	0.0044	0.0307	0.0005	0.655	0.017	119	5330	0.0218	2401	48	195	3	8
301-27	0.1107	0.0013	0.0454	0.0005	0.694	0.009	545	111690	0.0049	1811	21	286	3	16
301-34	0.0745	0.0009	0.0478	0.0006	0.491	0.006	232	73222	0.0032	1055	25	301	3	29
301-07	0.0898	0.0011	0.0890	0.0011	1.102	0.015	259	118312	0.0022	1422	23	549	7	39
301-48	0.0647	0.0010	0.0510	0.0006	0.455	0.007	212	64558	0.0033	766	31	321	3	42
301-29	0.0513	0.0010	0.0181	0.0002	0.128	0.002	137	11745	0.0115	253	44	115	1	46
301-38	0.0653	0.0009	0.0590	0.0007	0.531	0.008	166	46587	0.0036	783	29	369	4	47
301-46	0.0739	0.0014	0.0803	0.0010	0.819	0.015	120	11032	0.0108	1039	38	498	6	48
301-40	0.0652	0.0008	0.0612	0.0007	0.551	0.007	182	74315	0.0024	782	26	383	4	49
301-42	0.0654	0.0009	0.0659	0.0008	0.594	0.008	179	51552	0.0035	789	27	411	5	52
301-32	0.0508	0.0012	0.0203	0.0003	0.142	0.003	124	8671	0.0141	232	55	129	2	56
301-18	0.0960	0.0013	0.1499	0.0019	1.984	0.029	188	183061	0.0010	1547	24	901	11	58
301-37	0.0744	0.0012	0.1051	0.0013	1.078	0.017	138	15544	0.0088	1051	32	644	7	61
301-10	0.0545	0.0011	0.0380	0.0005	0.285	0.006	122	13325	0.0091	392	46	240	3	61
301-15	0.0638	0.0008	0.0738	0.0008	0.649	0.008	138	73772	0.0019	733	26	459	5	63
301-54	0.1146	0.0013	0.2144	0.0025	3.387	0.041	165	293212	0.0006	1874	20	1252	13	67
301-06	0.0587	0.0010	0.0600	0.0008	0.485	0.008	136	20712	0.0065	554	36	375	5	68
301-60	0.1400	0.0019	0.2864	0.0033	5.526	0.076	124	241131	0.0005	2227	23	1623	17	73
301-35	0.0577	0.0009	0.0614	0.0007	0.488	0.008	118	17127	0.0068	519	35	384	4	74
301-45	0.0575	0.0011	0.0609	0.0007	0.483	0.009	132	11835	0.0110	509	40	381	5	75
301-01	0.0709	0.0009	0.1186	0.0014	1.159	0.016	143	29942	0.0048	954	27	722	8	76
301-11	0.0660	0.0009	0.1029	0.0013	0.935	0.014	138	48802	0.0028	805	29	631	8	78
301-44	0.0575	0.0009	0.0661	0.0008	0.524	0.009	163	55377	0.0029	511	35	413	5	81
301-43	0.1168	0.0013	0.2751	0.0031	4.432	0.054	155	89940	0.0017	1909	20	1567	16	82
301-50	0.0571	0.0008	0.0651	0.0008	0.512	0.008	162	33082	0.0049	494	32	407	5	82

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
301-24	0.0613	0.0008	0.0876	0.0010	0.740	0.011	134	32771	0.0041	650	29	541	6	83
301-55	0.0618	0.0009	0.0924	0.0011	0.787	0.011	140	38521	0.0036	668	29	570	6	85
301-04	0.1791	0.0019	0.4186	0.0050	10.335	0.126	228	716370	0.0003	2644	18	2254	23	85
301-16	0.1285	0.0015	0.3169	0.0036	5.616	0.069	139	181265	0.0008	2078	20	1775	18	85
301-53	0.0579	0.0008	0.0722	0.0008	0.576	0.008	135	48254	0.0028	524	29	449	5	86
301-33	0.1520	0.0016	0.3879	0.0044	8.130	0.095	145	367640	0.0004	2369	18	2113	20	89
301-08	0.0610	0.0009	0.0928	0.0012	0.780	0.012	152	63519	0.0024	640	31	572	7	89
301-22	0.0584	0.0007	0.0795	0.0009	0.640	0.009	151	53287	0.0028	545	27	493	5	90
301-49	0.1841	0.0022	0.4649	0.0053	11.799	0.149	134	113072	0.0012	2690	20	2461	23	91
301-02	0.0555	0.0011	0.0636	0.0008	0.487	0.009	132	12012	0.0109	434	42	397	5	92
301-57	0.1430	0.0018	0.3819	0.0045	7.526	0.099	143	74453	0.0019	2263	21	2085	21	92
301-47	0.0586	0.0013	0.0844	0.0011	0.682	0.015	123	7182	0.0168	553	48	523	6	95
301-41	0.1070	0.0013	0.2984	0.0034	4.401	0.055	132	52215	0.0025	1749	21	1683	17	96
301-13	0.0757	0.0009	0.1764	0.0022	1.842	0.025	154	200078	0.0008	1088	24	1048	12	96
301-20	0.0815	0.0012	0.2031	0.0026	2.282	0.036	125	258164	0.0005	1234	28	1192	14	97
301-25	0.0608	0.0013	0.1002	0.0013	0.841	0.017	125	7832	0.0157	634	44	616	8	97
301-17	0.0560	0.0007	0.0711	0.0008	0.549	0.007	148	71243	0.0021	451	28	443	5	98
301-09	0.0784	0.0013	0.1939	0.0025	2.095	0.035	138	15539	0.0088	1156	32	1143	13	99
301-14	0.0576	0.0007	0.0821	0.0009	0.651	0.009	95	55428	0.0017	513	28	508	6	99
301-03	0.0559	0.0009	0.0712	0.0009	0.548	0.009	141	18198	0.0077	447	36	443	5	99
301-52	0.0756	0.0010	0.1818	0.0021	1.894	0.026	123	41909	0.0029	1084	26	1077	12	99
301-56	0.0749	0.0010	0.1811	0.0021	1.869	0.026	113	94767	0.0012	1065	26	1073	12	101
301-21	0.0596	0.0008	0.0968	0.0011	0.796	0.011	126	49197	0.0026	589	27	596	7	101
301-58	0.0585	0.0008	0.0899	0.0010	0.725	0.010	128	70563	0.0018	547	29	555	6	101
301-59	0.1005	0.0013	0.2939	0.0034	4.072	0.054	119	95312	0.0012	1633	24	1661	17	102
301-28	0.0552	0.0007	0.0690	0.0008	0.526	0.007	120	54198	0.0022	422	29	430	5	102
301-51	0.0538	0.0008	0.0592	0.0007	0.439	0.007	141	19747	0.0071	362	35	371	4	102
301-26	0.0810	0.0010	0.2142	0.0025	2.393	0.031	126	51598	0.0024	1222	24	1251	13	102
301-36	0.0598	0.0008	0.1004	0.0012	0.828	0.012	130	58659	0.0022	598	28	617	7	103

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
301-31	0.0545	0.0007	0.0656	0.0008	0.493	0.007	136	48618	0.0028	392	29	410	5	105
301-30	0.0587	0.0008	0.0956	0.0011	0.773	0.011	122	55032	0.0022	554	29	589	7	106
301-39	0.0779	0.0010	0.2075	0.0025	2.228	0.031	113	34622	0.0033	1144	26	1215	13	106
301-12	0.0722	0.0013	0.1800	0.0023	1.792	0.032	130	17351	0.0074	991	35	1067	13	108
301-23	0.0552	0.0007	0.0762	0.0009	0.580	0.008	134	43286	0.0031	421	29	473	5	113
301-19	0.0540	0.0009	0.0738	0.0009	0.550	0.009	349	18959	0.0181	371	37	459	5	124
Sample 2017302														
302-15	0.0661	0.0048	0.0029	0.0001	0.026	0.002	129	745	0.1476	809	144	19	0	2
302-74	0.1096	0.0014	0.0239	0.0003	0.361	0.005	286	62737	0.0045	1792	23	152	2	9
302-24	0.0782	0.0010	0.0412	0.0005	0.445	0.006	220	58774	0.0037	1152	24	261	3	23
302-59	0.0973	0.0020	0.0635	0.0008	0.851	0.017	143	10565	0.0134	1573	37	397	5	25
302-04	0.0890	0.0010	0.0665	0.0008	0.815	0.010	461	155723	0.0030	1404	21	415	5	30
302-73	0.0584	0.0008	0.0289	0.0004	0.232	0.003	134	34237	0.0039	546	31	183	2	34
302-31	0.0703	0.0015	0.0525	0.0008	0.509	0.011	151	18607	0.0080	936	43	330	5	35
302-57	0.0600	0.0010	0.0377	0.0005	0.312	0.006	125	64934	0.0019	602	36	239	3	40
302-35	0.0712	0.0009	0.0636	0.0007	0.624	0.008	217	73494	0.0029	963	26	397	4	41
302-75	0.0619	0.0013	0.0442	0.0006	0.377	0.008	139	16109	0.0086	670	45	279	4	42
302-32	0.0663	0.0009	0.0579	0.0007	0.529	0.008	178	59156	0.0030	817	27	363	4	44
302-70	0.0683	0.0013	0.0668	0.0009	0.628	0.013	138	17286	0.0079	877	40	417	6	48
302-11	0.0631	0.0010	0.0578	0.0009	0.503	0.009	206	89308	0.0023	710	34	362	5	51
302-44	0.0681	0.0012	0.0732	0.0009	0.687	0.012	137	12533	0.0108	872	36	455	6	52
302-62	0.0660	0.0009	0.0678	0.0009	0.617	0.009	162	47948	0.0034	806	29	423	5	53
302-23	0.0542	0.0042	0.0313	0.0008	0.234	0.017	117	3933	0.0289	379	164	199	5	53
302-27	0.0682	0.0021	0.0769	0.0011	0.724	0.021	124	5027	0.0241	876	62	478	7	55
302-40	0.0945	0.0012	0.1379	0.0017	1.797	0.024	156	99600	0.0016	1518	23	833	9	55
302-56	0.0915	0.0011	0.1339	0.0016	1.689	0.022	125	98211	0.0013	1457	22	810	9	56
302-02	0.0549	0.0016	0.0364	0.0006	0.275	0.008	147	41396	0.0035	408	63	231	4	57
302-05	0.0616	0.0008	0.0671	0.0008	0.570	0.008	156	53939	0.0029	660	26	419	5	63

	Isotopic ratio						Counts per second			Age				
Analysis	^{207}Pb/ ^{206}Pb	1σ	^{206}Pb/ ^{238}U	1σ	^{207}Pb/ ^{235}U	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	^{207}Pb/ ^{206}Pb	1σ	^{206}Pb/ ^{238}U	1σ	% Conc.
302-41	0.0615	0.0008	0.0728	0.0009	0.616	0.008	157	59967	0.0026	655	26	453	5	69
302-78	0.0634	0.0014	0.0807	0.0011	0.705	0.015	142	23845	0.0059	721	45	500	7	69
302-03	0.0534	0.0009	0.0412	0.0006	0.304	0.005	155	30460	0.0051	347	37	261	3	75
302-45	0.0622	0.0010	0.0845	0.0010	0.724	0.012	138	17631	0.0078	681	33	523	6	77
302-69	0.0579	0.0008	0.0649	0.0008	0.518	0.008	153	58046	0.0026	525	32	405	5	77
302-72	0.1310	0.0014	0.2976	0.0036	5.374	0.067	195	353984	0.0006	2112	19	1679	18	80
302-34	0.0799	0.0009	0.1626	0.0019	1.791	0.022	175	167417	0.0010	1194	22	971	11	81
302-58	0.0537	0.0009	0.0464	0.0006	0.343	0.006	131	19895	0.0065	358	37	292	3	82
302-71	0.1301	0.0015	0.3071	0.0037	5.507	0.069	136	76601	0.0018	2099	20	1727	18	82
302-14	0.0602	0.0011	0.0824	0.0011	0.684	0.012	129	59764	0.0022	611	37	511	7	84
302-47	0.0611	0.0007	0.0868	0.0010	0.730	0.009	135	142119	0.0009	641	25	537	6	84
302-26	0.0545	0.0011	0.0530	0.0007	0.399	0.008	132	9572	0.0136	393	45	333	4	85
302-13	0.0600	0.0011	0.0839	0.0011	0.693	0.013	139	11386	0.0121	602	39	519	6	86
302-08	0.0721	0.0010	0.1427	0.0017	1.418	0.020	122	39683	0.0031	988	27	860	10	87
302-61	0.0563	0.0009	0.0647	0.0009	0.502	0.009	129	48441	0.0027	462	34	404	5	87
302-01	0.0626	0.0009	0.0991	0.0013	0.854	0.013	166	96532	0.0017	693	29	609	8	88
302-12	0.1834	0.0020	0.4434	0.0051	11.207	0.136	137	170201	0.0008	2684	18	2366	23	88
302-77	0.0522	0.0011	0.0412	0.0006	0.296	0.007	145	15854	0.0091	293	49	260	3	89
302-55	0.0793	0.0011	0.1807	0.0022	1.976	0.029	138	23427	0.0059	1181	28	1071	12	91
302-43	0.0652	0.0009	0.1167	0.0014	1.049	0.016	113	32969	0.0034	782	30	712	8	91
302-66	0.0598	0.0009	0.0888	0.0011	0.731	0.012	141	19436	0.0072	595	33	549	7	92
302-60	0.0559	0.0010	0.0664	0.0009	0.511	0.010	109	25772	0.0042	448	40	414	5	93
302-64	0.0775	0.0009	0.1779	0.0021	1.901	0.025	109	86814	0.0013	1135	24	1055	12	93
302-39	0.0708	0.0009	0.1476	0.0018	1.441	0.020	134	59642	0.0022	952	26	888	10	93
302-50	0.1705	0.0021	0.4524	0.0056	10.630	0.146	122	174640	0.0007	2563	20	2406	25	94
302-21	0.0560	0.0007	0.0679	0.0008	0.524	0.007	138	51546	0.0027	451	27	423	5	94
302-52	0.0752	0.0009	0.1706	0.0020	1.767	0.023	117	67629	0.0017	1073	24	1016	11	95
302-25	0.0731	0.0009	0.1611	0.0019	1.623	0.021	128	131247	0.0010	1016	24	963	10	95
302-51	0.0605	0.0007	0.0960	0.0011	0.799	0.010	128	149685	0.0009	620	25	591	6	95

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
302-65	0.0555	0.0007	0.0671	0.0008	0.513	0.007	117	73409	0.0016	434	27	418	5	96
302-10	0.0554	0.0008	0.0658	0.0008	0.502	0.008	131	31326	0.0042	426	32	411	5	96
302-33	0.1323	0.0015	0.3770	0.0047	6.879	0.088	133	580953	0.0002	2129	19	2062	22	97
302-68	0.1021	0.0012	0.2837	0.0034	3.992	0.052	128	217539	0.0006	1662	21	1610	17	97
302-17	0.2133	0.0025	0.5605	0.0065	16.481	0.207	147	113192	0.0013	2931	19	2869	27	98
302-38	0.0701	0.0009	0.1523	0.0018	1.472	0.020	136	85323	0.0016	931	27	914	10	98
302-49	0.1061	0.0013	0.3028	0.0035	4.426	0.056	133	168757	0.0008	1733	22	1705	17	98
302-53	0.1025	0.0012	0.2956	0.0034	4.176	0.052	130	116559	0.0011	1670	21	1670	17	100
302-16	0.0726	0.0010	0.1689	0.0021	1.690	0.025	122	28216	0.0043	1003	28	1006	12	100
302-29	0.0583	0.0008	0.0878	0.0010	0.706	0.010	141	94528	0.0015	541	29	543	6	100
302-76	0.1037	0.0012	0.3016	0.0038	4.313	0.057	171	215181	0.0008	1692	21	1699	19	100
302-07	0.0752	0.0009	0.1838	0.0022	1.907	0.026	127	70426	0.0018	1075	24	1088	12	101
302-63	0.0573	0.0011	0.0824	0.0010	0.651	0.012	99	11808	0.0083	504	41	510	6	101
302-42	0.0758	0.0009	0.1869	0.0022	1.953	0.024	135	118790	0.0011	1090	23	1104	12	101
302-20	0.1064	0.0013	0.3155	0.0038	4.627	0.063	144	131882	0.0011	1738	23	1768	19	102
302-54	0.0815	0.0010	0.2150	0.0026	2.414	0.032	149	72747	0.0020	1233	24	1255	14	102
302-19	0.1029	0.0014	0.3039	0.0036	4.309	0.061	133	31827	0.0042	1676	25	1711	18	102
302-18	0.0807	0.0014	0.2129	0.0028	2.367	0.042	132	9838	0.0132	1213	34	1244	15	103
302-30	0.0539	0.0009	0.0606	0.0008	0.450	0.008	141	30084	0.0047	367	39	379	5	103
302-48	0.0561	0.0009	0.0774	0.0009	0.598	0.010	135	22919	0.0059	456	34	480	6	105
302-09	0.0712	0.0009	0.1741	0.0021	1.707	0.024	135	80117	0.0017	962	27	1035	12	108
302-36	0.0663	0.0008	0.1457	0.0017	1.331	0.018	98	64545	0.0015	815	26	877	10	108
302-28	0.0594	0.0008	0.1032	0.0013	0.845	0.013	127	32032	0.0039	581	30	633	7	109
302-06	0.0550	0.0008	0.0728	0.0009	0.552	0.008	144	37620	0.0038	412	30	453	5	110
302-46	0.0585	0.0009	0.0987	0.0012	0.796	0.013	136	28218	0.0048	550	33	607	7	110
302-37	0.0541	0.0009	0.0671	0.0008	0.500	0.008	137	22276	0.0061	375	35	419	5	112
302-67	0.0562	0.0017	0.0904	0.0013	0.700	0.020	117	4086	0.0278	458	64	558	8	122
302-22	0.0554	0.0007	0.0957	0.0011	0.731	0.010	130	57028	0.0023	428	29	589	7	138
302-79	0.0481	0.0010	0.0224	0.0003	0.149	0.003	122	12123	0.0100	102	47	143	2	140

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
Sample 2017303														
303-03	0.1397	0.1745	0.0256	0.0084	0.492	0.594	166	75	0.6888	2223	1318	163	53	7
303-30	0.3581	0.1119	0.0681	0.0124	3.363	0.863	123	87	0.5857	3742	408	425	75	11
303-07	0.2950	0.1139	0.0930	0.0170	3.780	1.299	119	59	0.6685	3444	498	573	100	17
303-26	0.1525	0.0242	0.0635	0.0034	1.335	0.202	115	161	0.4167	2374	248	397	20	17
303-35	0.0652	0.0017	0.0221	0.0003	0.198	0.005	111	5318	0.0204	779	52	141	2	18
303-16	0.1071	0.0178	0.0546	0.0029	0.806	0.128	122	312	0.2811	1751	277	343	18	20
303-27	0.1643	0.1740	0.0899	0.0249	2.036	2.085	109	54	0.6687	2500	1155	555	148	22
303-25	0.0870	0.0059	0.0569	0.0014	0.683	0.044	118	797	0.1290	1361	125	357	9	26
303-11	0.0810	0.0013	0.0555	0.0007	0.619	0.010	196	29736	0.0065	1221	32	348	4	29
303-17	0.0563	0.0021	0.0209	0.0003	0.163	0.006	104	3825	0.0265	464	83	134	2	29
303-02	0.1126	0.0163	0.1378	0.0073	2.138	0.294	117	410	0.2220	1842	241	832	41	45
303-46	0.0581	0.0014	0.0430	0.0006	0.345	0.008	111	8802	0.0125	533	51	272	4	51
303-06	0.0656	0.0011	0.0677	0.0009	0.612	0.011	151	26317	0.0057	792	36	422	5	53
303-18	0.1060	0.1272	0.1646	0.0306	2.405	2.854	129	46	0.7371	1731	1342	982	169	57
303-47	0.1377	0.0016	0.2343	0.0028	4.448	0.057	120	146800	0.0008	2199	20	1357	14	62
303-34	0.0618	0.0008	0.0713	0.0008	0.607	0.008	129	66407	0.0019	667	27	444	5	67
303-22	0.0510	0.0014	0.0257	0.0003	0.180	0.005	127	6053	0.0206	240	60	163	2	68
303-23	0.0569	0.0010	0.0546	0.0007	0.428	0.008	133	13191	0.0100	485	39	343	4	71
303-45	0.0589	0.0008	0.0652	0.0008	0.529	0.007	144	52331	0.0027	562	28	407	5	73
303-19	0.0614	0.0008	0.0770	0.0009	0.652	0.009	140	47980	0.0029	653	29	478	5	73
303-29	0.0510	0.0012	0.0280	0.0004	0.197	0.005	130	14061	0.0092	240	53	178	2	74
303-38	0.0613	0.0009	0.0785	0.0010	0.663	0.010	115	52775	0.0022	650	30	487	6	75
303-28	0.1302	0.0180	0.2803	0.0161	5.032	0.658	120	354	0.2532	2101	225	1593	81	76
303-33	0.1931	0.0021	0.3900	0.0045	10.382	0.127	507	428778	0.0012	2769	18	2123	21	77
303-48	0.0581	0.0009	0.0654	0.0008	0.524	0.009	126	36371	0.0035	532	34	409	5	77
303-15	0.0575	0.0008	0.0630	0.0007	0.499	0.007	127	34968	0.0036	510	30	394	4	77
303-52	0.1521	0.0015	0.3298	0.0038	6.068	0.060	140	400818	0.0003	2370	17	1837	18	78

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
303-12	0.0708	0.0008	0.1289	0.0015	1.258	0.015	155	95980	0.0016	953	23	781	8	82
303-24	0.0581	0.0008	0.0709	0.0008	0.568	0.008	139	61111	0.0023	532	29	442	5	83
303-43	0.0636	0.0034	0.0986	0.0020	0.865	0.045	110	2134	0.0490	729	110	606	12	83
303-50	0.0579	0.0008	0.0706	0.0008	0.563	0.008	117	57241	0.0020	526	31	440	5	84
303-21	0.0761	0.0010	0.1536	0.0018	1.612	0.022	132	63727	0.0021	1098	27	921	10	84
303-44	0.0681	0.0100	0.1231	0.0054	1.155	0.164	100	577	0.1477	870	278	748	31	86
303-60	0.0567	0.0012	0.0672	0.0009	0.525	0.011	116	18876	0.0061	479	45	419	6	87
303-40	0.0559	0.0009	0.0629	0.0008	0.484	0.008	135	30302	0.0044	448	35	393	5	88
303-42	0.0765	0.0012	0.1660	0.0021	1.750	0.029	163	17331	0.0093	1108	32	990	11	89
303-55	0.0894	0.0010	0.2224	0.0026	2.273	0.022	155	168478	0.0009	1413	20	1295	13	92
303-08	0.0499	0.0016	0.0274	0.0004	0.188	0.006	142	4936	0.0280	189	74	174	3	92
303-04	0.0786	0.0012	0.1872	0.0025	2.029	0.034	172	44411	0.0039	1163	31	1106	14	95
303-09	0.0587	0.0007	0.0863	0.0010	0.698	0.009	156	100578	0.0015	555	27	534	6	96
303-41	0.0550	0.0009	0.0643	0.0008	0.488	0.008	121	43771	0.0028	413	36	402	5	97
303-49	0.0517	0.0018	0.0430	0.0006	0.306	0.010	102	3255	0.0304	274	78	271	4	99
303-36	0.1221	0.0014	0.3578	0.0042	6.021	0.076	121	78003	0.0015	1986	21	1972	20	99
303-37	0.0728	0.0009	0.1683	0.0020	1.690	0.022	117	102356	0.0011	1009	24	1003	11	99
303-39	0.0595	0.0008	0.0970	0.0011	0.796	0.011	107	69549	0.0015	587	27	597	7	102
303-20	0.0529	0.0010	0.0532	0.0007	0.388	0.007	120	28563	0.0042	324	40	334	4	103
303-31	0.0732	0.0009	0.1804	0.0021	1.821	0.023	112	73186	0.0015	1020	24	1069	11	105
303-05	0.0647	0.0306	0.1330	0.0120	1.185	0.552	88	249	0.2611	764	770	805	69	105
303-57	0.0713	0.0008	0.1739	0.0021	1.374	0.014	150	66318	0.0023	966	23	1034	11	107
303-10	0.0567	0.0009	0.0837	0.0009	0.654	0.010	123	23214	0.0053	478	35	518	6	108
303-14	0.0576	0.0008	0.0908	0.0011	0.721	0.010	131	26317	0.0050	514	31	561	6	109
303-32	0.0528	0.0009	0.0588	0.0007	0.428	0.007	112	17730	0.0063	319	36	369	4	116
303-56	0.0480	0.0010	0.0203	0.0003	0.135	0.003	119	18274	0.0065	101	47	130	2	129
303-53	0.0547	0.0008	0.0831	0.0010	0.535	0.007	110	32517	0.0034	398	32	514	6	129
303-13	0.0554	0.0010	0.0980	0.0013	0.748	0.014	139	19788	0.0070	427	39	603	7	141
303-51	0.0523	0.0009	0.0701	0.0009	0.452	0.008	105	12931	0.0081	299	40	437	5	146

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
303-54	0.0509	0.0010	0.0639	0.0009	0.448	0.009	111	17021	0.0065	237	47	399	5	168
303-59	0.0507	0.0008	0.0677	0.0008	0.364	0.005	133	29132	0.0045	226	35	422	5	187
303-58	0.0455	0.0024	0.0030	0.0001	0.019	0.001	95	2831	0.0325	0	93	19	0	19200
Sample 2017304														
304-01	0.2845	0.0042	0.0502	0.0007	1.968	0.030	502	18638	0.0262	3388	23	316	4	9
304-50	0.1861	0.0022	0.0624	0.0007	1.601	0.020	1194	121292	0.0097	2708	19	390	4	14
304-24	0.0577	0.0017	0.0253	0.0004	0.201	0.006	116	3801	0.0296	517	64	161	2	31
304-35	0.0522	0.0016	0.0146	0.0002	0.105	0.003	100	7384	0.0134	296	69	93	1	32
304-61	0.0798	0.0012	0.0619	0.0008	0.681	0.011	203	40642	0.0050	1192	30	387	5	33
304-75	0.0930	0.0011	0.0842	0.0010	1.080	0.014	277	88957	0.0031	1489	22	521	6	35
304-41	0.0561	0.0020	0.0251	0.0004	0.194	0.007	142	3822	0.0358	454	79	160	3	35
304-15	0.0660	0.0009	0.0525	0.0006	0.478	0.007	156	53846	0.0029	806	29	330	4	41
304-80	0.0788	0.0010	0.0787	0.0009	0.856	0.012	130	84545	0.0015	1168	25	489	6	42
304-30	0.0821	0.0010	0.0982	0.0011	1.110	0.014	245	148132	0.0017	1247	23	604	7	48
304-38	0.0652	0.0008	0.0626	0.0007	0.563	0.008	189	66708	0.0028	782	27	392	4	50
304-19	0.0684	0.0008	0.0752	0.0009	0.708	0.009	163	82023	0.0020	880	25	467	5	53
304-23	0.0591	0.0013	0.0485	0.0007	0.395	0.009	139	18591	0.0074	572	48	305	4	53
304-28	0.0526	0.0015	0.0263	0.0004	0.191	0.005	129	6566	0.0193	312	64	167	2	54
304-48	0.0649	0.0014	0.0688	0.0010	0.616	0.013	207	91170	0.0023	772	46	429	6	56
304-76	0.0548	0.0008	0.0375	0.0004	0.284	0.004	131	39113	0.0033	405	31	238	3	59
304-53	0.0643	0.0009	0.0711	0.0009	0.630	0.010	154	35034	0.0044	750	31	443	5	59
304-32	0.0645	0.0011	0.0722	0.0010	0.642	0.012	140	75553	0.0018	757	36	450	6	59
304-37	0.0616	0.0012	0.0646	0.0009	0.549	0.011	100	25118	0.0040	660	42	404	5	61
304-33	0.0591	0.0008	0.0558	0.0007	0.455	0.007	106	32772	0.0032	572	29	350	4	61
304-20	0.1120	0.0015	0.2017	0.0024	3.114	0.044	133	123943	0.0011	1832	23	1184	13	65
304-54	0.0524	0.0012	0.0316	0.0004	0.228	0.005	111	7634	0.0143	303	50	201	3	66
304-07	0.0598	0.0009	0.0644	0.0008	0.531	0.008	143	43673	0.0033	598	32	403	5	67
304-67	0.0498	0.0011	0.0203	0.0003	0.139	0.003	122	9214	0.0131	184	49	130	2	70

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
304-51	0.0522	0.0017	0.0328	0.0005	0.236	0.007	109	6090	0.0176	295	71	208	3	71
304-11	0.1061	0.0018	0.2134	0.0028	3.120	0.053	151	7635	0.0194	1733	31	1247	15	72
304-77	0.0579	0.0010	0.0612	0.0008	0.489	0.009	93	64274	0.0014	527	39	383	5	73
304-03	0.0638	0.0010	0.0885	0.0012	0.778	0.012	147	52654	0.0028	734	31	546	7	74
304-63	0.0567	0.0009	0.0596	0.0007	0.466	0.007	138	23569	0.0058	480	34	373	4	78
304-36	0.0522	0.0013	0.0359	0.0005	0.258	0.006	133	22336	0.0059	292	54	228	3	78
304-06	0.0651	0.0008	0.1029	0.0012	0.923	0.012	158	101757	0.0016	777	26	631	7	81
304-29	0.0556	0.0007	0.0573	0.0007	0.439	0.006	155	63686	0.0024	435	28	359	4	83
304-47	0.0749	0.0009	0.1486	0.0017	1.535	0.020	133	89180	0.0015	1067	24	893	10	84
304-31	0.0568	0.0008	0.0648	0.0008	0.507	0.007	133	38073	0.0035	483	30	405	5	84
304-45	0.0521	0.0019	0.0387	0.0006	0.278	0.010	95	2928	0.0314	290	82	245	4	85
304-59	0.0569	0.0009	0.0659	0.0008	0.517	0.008	129	29492	0.0044	487	34	412	5	85
304-40	0.0612	0.0008	0.0897	0.0011	0.757	0.011	129	57964	0.0022	646	29	554	6	86
304-58	0.0565	0.0009	0.0647	0.0008	0.504	0.008	137	22304	0.0061	470	35	404	5	86
304-39	0.1294	0.0017	0.3229	0.0037	5.759	0.076	136	41902	0.0032	2089	23	1804	18	86
304-60	0.0618	0.0010	0.0939	0.0011	0.800	0.013	133	27164	0.0049	667	33	579	6	87
304-78	0.0566	0.0011	0.0665	0.0008	0.519	0.010	117	10300	0.0112	477	44	415	5	87
304-69	0.0597	0.0013	0.0834	0.0011	0.686	0.014	130	13897	0.0093	591	45	517	7	87
304-71	0.0782	0.0012	0.1694	0.0021	1.825	0.029	135	13393	0.0100	1151	31	1009	11	88
304-05	0.1093	0.0013	0.2759	0.0032	4.159	0.053	153	124985	0.0012	1788	21	1571	16	88
304-65	0.0547	0.0011	0.0559	0.0007	0.422	0.008	126	14979	0.0083	399	43	351	4	88
304-68	0.0573	0.0010	0.0716	0.0009	0.566	0.010	122	16605	0.0073	502	37	446	5	89
304-42	0.0545	0.0008	0.0558	0.0006	0.419	0.006	131	37308	0.0035	390	30	350	4	90
304-21	0.0535	0.0008	0.0503	0.0006	0.371	0.006	131	25464	0.0051	350	33	316	4	90
304-04	0.0586	0.0009	0.0811	0.0010	0.655	0.010	140	44327	0.0031	554	33	503	6	91
304-25	0.0551	0.0009	0.0608	0.0008	0.462	0.008	143	39719	0.0036	418	36	381	5	91
304-49	0.0607	0.0009	0.0930	0.0012	0.779	0.012	125	65929	0.0019	630	31	574	7	91
304-55	0.0516	0.0007	0.0389	0.0005	0.277	0.004	107	47891	0.0022	269	31	246	3	91
304-79	0.1229	0.0017	0.3289	0.0039	5.572	0.079	136	24593	0.0055	1999	24	1833	19	92

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
304-66	0.0581	0.0017	0.0794	0.0012	0.636	0.019	95	7246	0.0129	534	65	493	7	92
304-52	0.1034	0.0013	0.2744	0.0030	3.909	0.049	166	84574	0.0020	1685	23	1563	15	93
304-34	0.0574	0.0008	0.0759	0.0009	0.601	0.009	113	43845	0.0026	508	31	472	5	93
304-64	0.0558	0.0009	0.0661	0.0008	0.508	0.008	123	19838	0.0062	444	34	413	5	93
304-72	0.0583	0.0009	0.0811	0.0009	0.651	0.010	138	23270	0.0059	539	35	503	6	93
304-09	0.0577	0.0009	0.0780	0.0009	0.620	0.010	139	25780	0.0054	516	34	484	5	94
304-46	0.1723	0.0020	0.4561	0.0054	10.834	0.137	133	46480	0.0029	2580	19	2422	24	94
304-18	0.0590	0.0008	0.0860	0.0010	0.699	0.010	119	36665	0.0032	566	30	532	6	94
304-17	0.0636	0.0009	0.1147	0.0013	1.006	0.014	138	38002	0.0036	730	28	700	8	96
304-16	0.0778	0.0010	0.1865	0.0021	2.000	0.025	135	83448	0.0016	1142	25	1102	11	97
304-44	0.0578	0.0008	0.0810	0.0010	0.645	0.009	122	31846	0.0038	520	30	502	6	97
304-02	0.0609	0.0008	0.1010	0.0011	0.848	0.011	145	94403	0.0015	635	27	621	7	98
304-74	0.0587	0.0010	0.0880	0.0011	0.712	0.013	134	13776	0.0096	556	38	544	6	98
304-22	0.0605	0.0011	0.0995	0.0013	0.831	0.015	88	27909	0.0031	623	37	612	7	98
304-62	0.0600	0.0007	0.0965	0.0011	0.799	0.010	99	110162	0.0009	604	26	594	6	98
304-26	0.0607	0.0008	0.1009	0.0012	0.844	0.011	102	72558	0.0014	628	27	620	7	99
304-70	0.0738	0.0011	0.1728	0.0021	1.757	0.027	120	57814	0.0021	1035	29	1027	11	99
304-27	0.0558	0.0008	0.0710	0.0009	0.545	0.009	144	45607	0.0031	442	33	442	5	100
304-10	0.0762	0.0010	0.1861	0.0021	1.955	0.027	130	108282	0.0012	1101	26	1100	12	100
304-12	0.0752	0.0010	0.1813	0.0023	1.878	0.026	139	77035	0.0018	1073	25	1074	12	100
304-43	0.1452	0.0017	0.4272	0.0049	8.551	0.105	141	79828	0.0018	2290	20	2293	22	100
304-13	0.0551	0.0009	0.0666	0.0008	0.506	0.008	136	29864	0.0045	415	35	416	5	100
304-57	0.0775	0.0012	0.1976	0.0024	2.112	0.033	131	30491	0.0043	1135	30	1162	13	102
304-56	0.0551	0.0009	0.0695	0.0008	0.528	0.008	121	26845	0.0045	417	34	433	5	104
304-08	0.0590	0.0009	0.0959	0.0011	0.780	0.012	101	36995	0.0027	567	31	590	7	104
304-14	0.0561	0.0008	0.0808	0.0009	0.625	0.009	135	42800	0.0031	457	30	501	5	109
304-73	0.0503	0.0009	0.0396	0.0005	0.275	0.005	122	12657	0.0095	211	43	250	3	119

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
Sample 2017305														
305-18	0.0728	0.0016	0.0237	0.0003	0.238	0.005	139	7560	0.0181	1008	45	151	2	15
305-07	0.1339	0.0073	0.0626	0.0016	1.157	0.058	132	797	0.1421	2150	92	392	10	18
305-42	0.0575	0.0014	0.0216	0.0003	0.172	0.004	115	5115	0.0220	512	53	138	2	27
305-03	0.0573	0.0017	0.0271	0.0004	0.214	0.006	118	3641	0.0314	501	63	172	2	34
305-70	0.0615	0.0012	0.0390	0.0005	0.331	0.006	154	10621	0.0143	658	41	247	3	37
305-67	0.0681	0.0011	0.0521	0.0006	0.489	0.008	160	56551	0.0028	872	32	328	4	38
305-28	0.0755	0.0010	0.0654	0.0009	0.681	0.010	275	93732	0.0029	1081	27	409	5	38
305-09	0.0975	0.0018	0.1016	0.0014	1.366	0.025	151	10046	0.0148	1576	34	624	8	40
305-11	0.0544	0.0018	0.0259	0.0004	0.194	0.006	148	6936	0.0209	389	73	165	3	42
305-32	0.0546	0.0012	0.0279	0.0004	0.210	0.004	137	8312	0.0162	395	46	177	2	45
305-04	0.0612	0.0011	0.0485	0.0007	0.409	0.008	139	25229	0.0055	645	39	306	4	47
305-50	0.0672	0.0011	0.0728	0.0010	0.675	0.012	183	64037	0.0028	844	34	453	6	54
305-02	0.0646	0.0013	0.0656	0.0009	0.584	0.012	128	16233	0.0078	761	40	409	5	54
305-19	0.0777	0.0011	0.0999	0.0013	1.071	0.017	217	72087	0.0030	1140	29	614	8	54
305-08	0.0619	0.0012	0.0578	0.0008	0.494	0.010	158	37275	0.0042	671	40	362	5	54
305-60	0.0643	0.0009	0.0672	0.0008	0.596	0.009	139	28626	0.0048	751	31	419	5	56
305-29	0.0623	0.0011	0.0627	0.0008	0.538	0.010	121	10442	0.0115	684	39	392	5	57
305-46	0.0596	0.0010	0.0550	0.0007	0.452	0.008	137	43749	0.0031	588	34	345	4	59
305-76	0.0573	0.0007	0.0478	0.0006	0.378	0.005	136	54684	0.0025	503	28	301	3	60
305-01	0.0666	0.0015	0.0827	0.0012	0.759	0.017	164	12762	0.0127	825	47	512	7	62
305-72	0.1364	0.0017	0.2356	0.0028	4.431	0.058	134	31456	0.0042	2182	21	1364	15	62
305-62	0.0680	0.0008	0.0892	0.0010	0.836	0.011	177	67379	0.0026	869	26	551	6	63
305-75	0.0584	0.0008	0.0566	0.0006	0.456	0.006	150	73238	0.0020	544	29	355	4	65
305-66	0.0650	0.0008	0.0823	0.0010	0.737	0.010	151	47885	0.0031	774	27	510	6	66
305-55	0.0705	0.0008	0.1063	0.0012	1.033	0.013	219	213130	0.0010	944	23	651	7	69
305-24	0.1005	0.0012	0.1916	0.0022	2.655	0.033	266	134407	0.0020	1634	21	1130	12	69
305-68	0.0732	0.0012	0.1172	0.0016	1.182	0.020	232	188286	0.0012	1019	31	714	9	70

	Isotopic ratio						Counts per second			Age				
Analysis	**$^{207}Pb/^{206}Pb$**	**1σ**	**$^{206}Pb/^{238}U$**	**1σ**	**$^{207}Pb/^{235}U$**	**1σ**	**^{204}Pb**	**^{206}Pb**	**Net ^{204}Pb**	**$^{207}Pb/^{206}Pb$**	**1σ**	**$^{206}Pb/^{238}U$**	**1σ**	**% Conc.**
305-79	0.0685	0.0008	0.1016	0.0012	0.960	0.013	182	99340	0.0018	885	25	624	7	71
305-35	0.0582	0.0009	0.0630	0.0008	0.505	0.008	148	47323	0.0031	538	34	394	5	73
305-63	0.0509	0.0010	0.0276	0.0004	0.194	0.004	117	10683	0.0108	237	44	176	2	74
305-41	0.0723	0.0008	0.1274	0.0015	1.270	0.016	94	94492	0.0010	994	23	773	9	78
305-33	0.0583	0.0009	0.0686	0.0008	0.552	0.008	100	24449	0.0041	541	33	428	5	79
305-61	0.0596	0.0008	0.0756	0.0009	0.621	0.009	129	45877	0.0028	589	27	470	5	80
305-23	0.0607	0.0008	0.0821	0.0010	0.687	0.009	148	50770	0.0029	629	27	508	6	81
305-12	0.1059	0.0011	0.2425	0.0028	3.540	0.042	180	227983	0.0008	1730	20	1400	15	81
305-17	0.0566	0.0009	0.0622	0.0008	0.486	0.008	132	17860	0.0073	476	36	389	5	82
305-21	0.0528	0.0008	0.0415	0.0005	0.302	0.004	137	30911	0.0044	318	32	262	3	82
305-74	0.0594	0.0008	0.0775	0.0010	0.635	0.010	135	51068	0.0026	583	30	481	6	82
305-58	0.0654	0.0008	0.1071	0.0013	0.966	0.013	125	64596	0.0019	788	27	656	7	83
305-27	0.0744	0.0010	0.1503	0.0018	1.541	0.022	134	29870	0.0045	1051	28	903	10	86
305-25	0.0639	0.0010	0.1065	0.0013	0.939	0.015	129	29244	0.0044	740	32	653	8	88
305-57	0.0625	0.0012	0.0996	0.0013	0.857	0.017	133	15469	0.0085	690	40	612	8	89
305-22	0.0526	0.0015	0.0443	0.0006	0.321	0.009	136	8168	0.0164	313	61	279	4	89
305-52	0.0617	0.0010	0.0985	0.0012	0.838	0.014	132	15816	0.0083	664	35	606	7	91
305-06	0.0562	0.0010	0.0676	0.0009	0.524	0.010	114	31206	0.0036	458	39	422	5	92
305-14	0.0631	0.0007	0.1100	0.0013	0.957	0.012	145	118971	0.0012	713	24	673	7	94
305-16	0.0593	0.0008	0.0890	0.0011	0.728	0.010	138	44303	0.0031	577	28	550	6	95
305-34	0.0530	0.0011	0.0497	0.0007	0.363	0.008	128	12569	0.0101	327	47	313	4	96
305-05	0.0576	0.0008	0.0800	0.0010	0.636	0.010	155	74859	0.0021	514	31	496	6	97
305-39	0.0559	0.0009	0.0696	0.0008	0.537	0.009	146	20601	0.0070	448	35	434	5	97
305-59	0.3074	0.0036	0.6957	0.0082	29.480	0.375	118	105456	0.0011	3508	18	3404	31	97
305-49	0.1564	0.0018	0.4403	0.0051	9.495	0.119	136	291524	0.0005	2417	19	2352	23	97
305-65	0.1221	0.0014	0.3511	0.0041	5.911	0.073	142	209567	0.0007	1987	20	1940	19	98
305-43	0.0577	0.0009	0.0820	0.0010	0.652	0.010	114	23215	0.0049	519	33	508	6	98
305-36	0.0985	0.0012	0.2757	0.0030	3.744	0.046	150	199464	0.0008	1595	22	1570	15	98
305-15	0.0584	0.0009	0.0867	0.0011	0.698	0.012	145	35182	0.0041	544	35	536	6	99

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
305-45	0.0549	0.0009	0.0648	0.0009	0.491	0.009	115	45021	0.0025	410	37	405	5	99
305-13	0.0595	0.0008	0.0938	0.0012	0.769	0.011	125	55279	0.0023	584	28	578	7	99
305-78	0.0581	0.0008	0.0854	0.0010	0.684	0.010	132	32173	0.0041	533	31	528	6	99
305-44	0.0810	0.0010	0.2063	0.0024	2.303	0.031	119	38788	0.0031	1221	25	1209	13	99
305-69	0.0753	0.0011	0.1805	0.0022	1.873	0.028	136	24700	0.0055	1076	29	1069	12	99
305-38	0.1071	0.0013	0.3109	0.0036	4.590	0.057	134	142042	0.0009	1750	21	1745	18	100
305-56	0.1657	0.0021	0.4776	0.0062	10.910	0.157	130	112891	0.0012	2515	21	2517	27	100
305-77	0.0525	0.0008	0.0490	0.0006	0.355	0.005	115	28717	0.0040	308	33	309	4	100
305-51	0.0954	0.0013	0.2696	0.0035	3.547	0.053	114	33722	0.0034	1537	25	1539	18	100
305-30	0.1066	0.0014	0.3130	0.0038	4.601	0.063	140	113275	0.0012	1743	23	1755	18	101
305-40	0.0546	0.0011	0.0639	0.0008	0.481	0.009	137	24390	0.0056	396	43	399	5	101
305-73	0.0570	0.0007	0.0802	0.0009	0.631	0.008	123	68446	0.0018	492	27	498	6	101
305-64	0.0591	0.0009	0.0940	0.0011	0.765	0.012	132	20327	0.0065	569	34	579	7	102
305-71	0.1078	0.0013	0.3221	0.0038	4.787	0.061	140	59132	0.0024	1763	21	1800	18	102
305-37	0.0596	0.0009	0.0992	0.0012	0.815	0.012	142	28467	0.0050	589	31	610	7	103
305-47	0.0600	0.0008	0.1030	0.0012	0.851	0.012	132	47200	0.0028	602	28	632	7	105
305-20	0.0584	0.0007	0.0935	0.0011	0.752	0.010	92	82010	0.0011	544	27	576	6	106
305-26	0.0548	0.0009	0.0684	0.0009	0.517	0.009	142	46619	0.0030	402	34	427	5	106
305-31	0.0805	0.0011	0.2225	0.0028	2.470	0.037	134	38695	0.0035	1210	28	1295	15	107
305-48	0.0687	0.0009	0.1610	0.0019	1.525	0.021	123	45326	0.0027	890	26	963	11	108
305-10	0.0580	0.0012	0.0937	0.0013	0.750	0.016	100	18957	0.0052	529	47	578	8	109
305-53	0.0527	0.0009	0.0564	0.0007	0.410	0.007	126	17012	0.0074	316	38	354	4	112
305-80	0.0587	0.0008	0.1015	0.0012	0.820	0.012	129	55077	0.0023	554	29	623	7	112
305-54	0.0482	0.0020	0.0246	0.0005	0.163	0.007	128	9708	0.0130	109	94	157	3	144
Sample 2017306														
306-41	0.3698	0.0111	0.0032	0.0001	0.164	0.004	130	799	0.1399	3791	45	21	0	1
306-59	0.1456	0.0038	0.0308	0.0005	0.617	0.015	161	5474	0.0286	2294	44	195	3	9
306-24	0.2245	0.0025	0.0676	0.0008	2.093	0.025	1542	176658	0.0087	3013	18	422	5	14

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
306-79	0.0873	0.0012	0.0529	0.0007	0.637	0.009	214	67013	0.0032	1367	26	332	4	24
306-39	0.2449	0.0045	0.1918	0.0030	6.472	0.125	458	29971	0.0151	3152	29	1131	16	36
306-02	0.0599	0.0017	0.0355	0.0006	0.294	0.008	89	10690	0.0083	601	59	225	3	37
306-50	0.0672	0.0017	0.0637	0.0009	0.590	0.015	119	6925	0.0169	843	53	398	6	47
306-05	0.1648	0.0020	0.2034	0.0023	4.621	0.059	596	100727	0.0059	2506	20	1193	12	48
306-83	0.0697	0.0010	0.0712	0.0009	0.683	0.010	164	81949	0.0020	918	28	443	5	48
306-26	0.0550	0.0012	0.0319	0.0004	0.241	0.005	124	13674	0.0090	411	46	202	3	49
306-78	0.0712	0.0009	0.0831	0.0010	0.815	0.011	154	49531	0.0031	962	26	515	6	53
306-96	0.0827	0.0012	0.1129	0.0014	1.288	0.020	238	174028	0.0014	1262	27	690	8	55
306-11	0.0647	0.0009	0.0674	0.0009	0.601	0.009	142	41924	0.0034	764	30	420	5	55
306-29	0.0629	0.0011	0.0645	0.0009	0.560	0.010	127	33117	0.0038	705	36	403	5	57
306-44	0.0699	0.0009	0.0903	0.0010	0.870	0.012	133	48127	0.0028	926	26	557	6	60
306-84	0.0611	0.0009	0.0629	0.0007	0.530	0.008	124	22780	0.0054	644	32	393	4	61
306-25	0.0610	0.0009	0.0626	0.0008	0.526	0.008	90	26366	0.0034	638	32	392	5	61
306-71	0.0622	0.0008	0.0730	0.0009	0.626	0.009	154	65357	0.0024	682	29	454	6	67
306-57	0.0793	0.0012	0.1322	0.0015	1.446	0.021	127	41368	0.0031	1180	29	801	8	68
306-01	0.0574	0.0013	0.0567	0.0008	0.448	0.010	117	14122	0.0082	505	49	356	5	70
306-77	0.1434	0.0019	0.2816	0.0036	5.566	0.081	197	331525	0.0006	2268	22	1600	18	71
306-94	0.0661	0.0008	0.0947	0.0010	0.862	0.011	138	115655	0.0012	808	26	583	6	72
306-54	0.0748	0.0009	0.1303	0.0016	1.342	0.019	170	171050	0.0010	1062	25	789	9	74
306-68	0.0639	0.0009	0.0895	0.0010	0.789	0.012	128	31995	0.0040	740	31	553	6	75
306-92	0.0571	0.0008	0.0596	0.0007	0.469	0.007	119	67922	0.0017	496	29	373	4	75
306-17	0.0619	0.0011	0.0849	0.0010	0.725	0.013	116	11997	0.0096	672	38	525	6	78
306-98	0.0583	0.0010	0.0676	0.0008	0.543	0.010	99	13738	0.0072	539	39	421	5	78
306-23	0.0863	0.0012	0.1815	0.0022	2.159	0.030	173	114799	0.0015	1345	25	1075	12	80
306-63	0.0571	0.0008	0.0634	0.0008	0.499	0.007	111	38274	0.0029	495	31	396	5	80
306-03	0.0724	0.0009	0.1324	0.0016	1.321	0.018	141	155130	0.0009	997	26	801	9	80
306-51	0.0573	0.0012	0.0662	0.0009	0.523	0.011	133	29993	0.0044	504	44	413	6	82
306-16	0.0535	0.0022	0.0455	0.0009	0.336	0.014	101	7763	0.0128	349	91	287	5	82

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
306-67	0.1326	0.0017	0.3181	0.0039	5.816	0.080	120	164181	0.0007	2133	22	1780	19	83
306-14	0.0520	0.0010	0.0380	0.0005	0.273	0.005	112	21117	0.0053	286	44	241	3	84
306-07	0.0686	0.0010	0.1253	0.0014	1.184	0.017	113	42615	0.0026	886	29	761	8	86
306-21	0.0567	0.0010	0.0660	0.0008	0.516	0.009	109	28625	0.0038	479	37	412	5	86
306-15	0.0567	0.0011	0.0661	0.0009	0.516	0.010	99	29375	0.0034	478	42	413	6	86
306-82	0.0747	0.0011	0.1561	0.0018	1.607	0.023	113	24525	0.0046	1060	28	935	10	88
306-42	0.0552	0.0012	0.0601	0.0009	0.457	0.010	109	15005	0.0072	420	46	376	5	90
306-80	0.0593	0.0012	0.0843	0.0012	0.689	0.015	106	21934	0.0048	579	45	522	7	90
306-12	0.1534	0.0019	0.4010	0.0051	8.481	0.120	100	236384	0.0004	2385	21	2173	23	91
306-89	0.0610	0.0009	0.0948	0.0011	0.797	0.012	97	54597	0.0018	639	31	584	6	91
306-76	0.0743	0.0011	0.1617	0.0020	1.655	0.025	127	48609	0.0026	1049	28	966	11	92
306-45	0.0603	0.0018	0.0928	0.0015	0.771	0.023	101	7444	0.0134	613	64	572	9	93
306-09	0.0596	0.0010	0.0892	0.0011	0.733	0.012	117	36595	0.0032	589	34	551	6	93
306-100	0.0555	0.0008	0.0652	0.0008	0.499	0.007	108	43028	0.0025	433	31	407	5	94
306-72	0.0610	0.0013	0.0980	0.0013	0.825	0.018	112	7950	0.0139	641	46	603	8	94
306-10	0.0779	0.0012	0.1818	0.0021	1.952	0.029	108	40648	0.0026	1144	29	1077	11	94
306-04	0.0580	0.0008	0.0806	0.0009	0.644	0.009	136	40296	0.0034	528	31	500	5	95
306-38	0.0563	0.0010	0.0702	0.0009	0.545	0.010	116	45617	0.0025	462	38	438	5	95
306-60	0.0705	0.0010	0.1490	0.0018	1.448	0.021	117	87935	0.0013	943	28	895	10	95
306-91	0.0580	0.0010	0.0812	0.0010	0.649	0.011	130	24392	0.0053	528	36	503	6	95
306-66	0.0890	0.0018	0.2314	0.0036	2.839	0.061	93	53018	0.0018	1403	39	1342	19	96
306-18	0.0602	0.0011	0.0949	0.0012	0.787	0.015	106	11122	0.0094	611	40	584	7	96
306-53	0.0807	0.0011	0.1975	0.0025	2.195	0.033	107	42180	0.0025	1213	27	1162	13	96
306-19	0.0607	0.0010	0.0980	0.0012	0.819	0.013	109	21229	0.0051	627	34	602	7	96
306-06	0.0793	0.0010	0.1923	0.0021	2.101	0.028	116	82297	0.0014	1179	26	1134	12	96
306-13	0.1089	0.0017	0.3049	0.0043	4.575	0.078	100	33770	0.0030	1781	29	1715	21	96
306-52	0.0766	0.0011	0.1807	0.0023	1.909	0.029	147	70508	0.0021	1111	27	1071	13	96
306-74	0.0785	0.0014	0.1894	0.0024	2.050	0.036	117	12364	0.0094	1160	34	1118	13	96
306-32	0.0782	0.0010	0.1885	0.0024	2.032	0.029	127	198289	0.0006	1151	25	1113	13	97

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
306-85	0.0786	0.0012	0.1915	0.0022	2.073	0.031	126	21824	0.0057	1161	29	1129	12	97
306-90	0.0787	0.0015	0.1924	0.0027	2.089	0.041	119	33041	0.0036	1166	37	1134	14	97
306-56	0.0543	0.0016	0.0598	0.0010	0.447	0.013	129	13904	0.0092	384	65	374	6	98
306-65	0.0610	0.0009	0.1017	0.0012	0.855	0.013	114	25015	0.0045	638	31	625	7	98
306-37	0.0544	0.0010	0.0608	0.0008	0.456	0.009	113	22195	0.0051	389	41	380	5	98
306-55	0.0557	0.0011	0.0689	0.0010	0.529	0.010	118	38430	0.0031	439	41	429	6	98
306-34	0.0782	0.0012	0.1918	0.0023	2.066	0.033	104	16672	0.0062	1151	31	1131	12	98
306-64	0.0578	0.0009	0.0827	0.0010	0.658	0.010	116	20817	0.0055	520	34	512	6	98
306-86	0.1781	0.0022	0.4973	0.0057	12.204	0.156	134	66227	0.0020	2635	20	2602	25	99
306-97	0.0580	0.0017	0.0848	0.0012	0.678	0.020	109	3519	0.0300	531	64	524	7	99
306-08	0.0593	0.0011	0.0930	0.0011	0.761	0.014	106	13497	0.0078	580	39	573	7	99
306-75	0.0654	0.0009	0.1282	0.0016	1.155	0.017	125	115548	0.0011	786	29	778	9	99
306-99	0.0726	0.0009	0.1668	0.0019	1.669	0.022	117	166299	0.0007	1003	25	994	10	99
306-46	0.0575	0.0013	0.0817	0.0011	0.647	0.014	116	7547	0.0151	509	48	506	6	99
306-27	0.1854	0.0022	0.5169	0.0060	13.209	0.169	103	81064	0.0013	2702	20	2686	25	99
306-31	0.0578	0.0008	0.0839	0.0010	0.669	0.010	117	46231	0.0025	522	30	519	6	99
306-49	0.1988	0.0030	0.5487	0.0068	15.040	0.234	85	72548	0.0012	2816	24	2820	28	100
306-81	0.0577	0.0007	0.0844	0.0009	0.671	0.009	108	80302	0.0013	518	27	522	6	101
306-73	0.0708	0.0010	0.1614	0.0019	1.576	0.023	121	41412	0.0029	952	28	965	11	101
306-61	0.0554	0.0007	0.0695	0.0008	0.531	0.007	123	47127	0.0026	427	29	433	5	102
306-87	0.0760	0.0012	0.1883	0.0023	1.971	0.032	104	20671	0.0050	1094	32	1112	13	102
306-88	0.2195	0.0027	0.5998	0.0069	18.144	0.237	113	81166	0.0014	2977	20	3029	28	102
306-28	0.1322	0.0019	0.3999	0.0048	7.290	0.105	100	20070	0.0050	2128	25	2169	22	102
306-20	0.1200	0.0020	0.3623	0.0046	5.992	0.100	103	49457	0.0021	1956	29	1993	22	102
306-70	0.0932	0.0012	0.2662	0.0030	3.419	0.046	111	84246	0.0013	1491	24	1521	15	102
306-93	0.0741	0.0009	0.1802	0.0021	1.841	0.024	106	84341	0.0013	1044	24	1068	11	102
306-36	0.0618	0.0009	0.1118	0.0013	0.952	0.014	125	34354	0.0036	667	30	683	8	102
306-35	0.0577	0.0008	0.0860	0.0010	0.684	0.010	108	36548	0.0029	518	31	532	6	103
306-40	0.0739	0.0012	0.1798	0.0024	1.831	0.031	113	115994	0.0010	1038	32	1066	13	103

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
306-33	0.0819	0.0010	0.2192	0.0026	2.473	0.033	116	74487	0.0016	1242	25	1278	14	103
306-43	0.0552	0.0010	0.0696	0.0009	0.530	0.010	132	31618	0.0042	421	41	434	6	103
306-69	0.0537	0.0013	0.0598	0.0008	0.443	0.011	108	11874	0.0090	360	54	375	5	104
306-95	0.0552	0.0008	0.0715	0.0009	0.544	0.008	104	44769	0.0023	422	32	445	5	105
306-58	0.0587	0.0009	0.0960	0.0012	0.777	0.012	119	78477	0.0015	556	31	591	7	106
306-22	0.0583	0.0008	0.0939	0.0012	0.754	0.011	104	58603	0.0018	539	31	578	7	107
306-48	0.0575	0.0008	0.0900	0.0010	0.714	0.010	117	55004	0.0021	511	29	556	6	109
306-47	0.0584	0.0011	0.1013	0.0012	0.816	0.015	118	12510	0.0093	546	40	622	7	114
306-62	0.0509	0.0010	0.0438	0.0005	0.307	0.006	90	27436	0.0033	235	43	276	3	117
306-30	0.0551	0.0009	0.0829	0.0010	0.629	0.010	90	20065	0.0045	415	36	513	6	124
Sample 2017307														
307-100	0.96872	0.99178	0.02514	0.01798	3.35917	2.5117	53	0	1	5192.7	974.58	160.1	113.03	3
307-108	0.07686	0.00514	0.02477	0.00067	0.26253	0.01645	58	889	0.061246	1117.7	127.88	157.7	4.21	14
307-057	0.0882	0.00217	0.04612	0.00066	0.56077	0.01348	69	8585	0.007973	1386.9	46.32	290.7	4.07	21
307-065	0.12575	0.00302	0.07012	0.00103	1.21555	0.02826	88	6587	0.013184	2039.4	41.82	436.9	6.23	21
307-111	0.07859	0.00397	0.04208	0.00093	0.45594	0.02165	45	1559	0.028055	1161.9	96.99	265.7	5.74	23
307-101	0.09674	0.00229	0.05907	0.00084	0.78776	0.01811	86	11014	0.007748	1562.2	43.67	369.9	5.11	24
307-040	0.09132	0.00163	0.05508	0.00072	0.69356	0.01242	53	14209	0.003716	1453.3	33.52	345.7	4.38	24
307-013	0.09663	0.00195	0.09073	0.00118	1.20857	0.02408	54	14881	0.003616	1560.1	37.47	559.9	6.99	36
307-092	0.06581	0.00118	0.04812	0.00061	0.43634	0.00793	66	30073	0.00219	800.5	37.2	303	3.78	38
307-014	0.07476	0.00209	0.0678	0.00099	0.69874	0.01881	46	6286	0.007265	1061.9	55.24	422.9	5.97	40
307-106	0.06834	0.00203	0.05716	0.00087	0.53863	0.01548	53	3840	0.013614	878.9	60.33	358.3	5.3	41
307-102	0.07215	0.00142	0.06475	0.00084	0.6442	0.01267	68	16759	0.004041	990.1	39.61	404.5	5.11	41
307-046	0.0705	0.00173	0.06164	0.00088	0.5989	0.01443	63	8860	0.00706	942.9	49.52	385.6	5.33	41
307-019	0.06564	0.00176	0.05279	0.00075	0.47753	0.01236	59	7573	0.007731	795	55.24	331.6	4.57	42
307-119	0.09803	0.00335	0.11067	0.00193	1.49576	0.04875	74	4563	0.015959	1587	62.59	676.6	11.22	43
307-098	0.08048	0.0018	0.08761	0.00121	0.97204	0.02145	64	12658	0.005031	1208.8	43.44	541.4	7.15	45
307-083	0.06232	0.00195	0.05082	0.00079	0.43648	0.01319	47	5415	0.008605	685	65.36	319.6	4.83	47

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
307-076	0.06701	0.00286	0.06523	0.00122	0.60272	0.02463	59	2074	0.027661	837.9	86.59	407.4	7.4	49
307-016	0.06073	0.00215	0.05016	0.00084	0.42	0.01427	58	16942	0.003412	629.8	74.41	315.5	5.17	50
307-120	0.0637	0.00167	0.0636	0.00091	0.55848	0.01433	54	7320	0.007323	731.7	54.72	397.5	5.52	54
307-093	0.07044	0.00219	0.08375	0.00133	0.81283	0.02439	55	4688	0.011596	941.2	62.49	518.4	7.93	55
307-002	0.59975	0.02466	0.48327	0.01559	39.95591	1.45145	91	1510	0.056839	4507.4	58.47	2541.5	67.77	56
307-085	0.15874	0.00354	0.25031	0.00351	5.47367	0.11998	75	32879	0.002276	2442.3	37.24	1440.1	18.1	59
307-022	0.06508	0.00169	0.07449	0.00106	0.66815	0.01692	48	4281	0.011088	776.9	53.82	463.2	6.38	60
307-051	0.06273	0.00207	0.06844	0.0011	0.59154	0.0189	51	2948	0.017006	699	68.9	426.7	6.61	61
307-029	0.10561	0.00151	0.18111	0.00221	2.63663	0.03881	52	24132	0.00215	1725	25.96	1073.1	12.08	62
307-075	0.06643	0.00163	0.08303	0.00117	0.76048	0.01839	58	9285	0.006208	820	50.53	514.2	6.96	63
307-062	0.08954	0.00258	0.1526	0.0024	1.88355	0.05256	55	9601	0.005696	1415.7	54.11	915.5	13.42	65
307-090	0.07765	0.00253	0.12241	0.00203	1.30786	0.04091	60	3664	0.016112	1137.8	63.5	744.4	11.64	65
307-017	0.1031	0.00275	0.18685	0.00274	2.65509	0.06802	47	8775	0.005328	1680.7	48.4	1104.3	14.88	66
307-069	0.06035	0.00201	0.06617	0.00106	0.55038	0.01777	51	3405	0.014757	616.3	70.41	413	6.39	67
307-070	0.06733	0.0022	0.09309	0.0015	0.86385	0.02734	49	4695	0.010329	847.9	66.59	573.8	8.82	68
307-043	0.13816	0.00302	0.27138	0.00409	5.16637	0.11091	52	9436	0.005481	2204.2	37.51	1547.8	20.74	70
307-104	0.09544	0.0017	0.19033	0.00242	2.50477	0.04497	61	41215	0.001478	1536.8	33.09	1123.2	13.11	73
307-117	0.07583	0.0016	0.13529	0.00181	1.41444	0.02973	60	22302	0.002683	1090.7	41.82	818	10.3	75
307-007	0.0619	0.0029	0.0814	0.0016	0.6948	0.03116	50	1223	0.039277	670.8	97.3	504.5	9.53	75
307-034	0.06708	0.00153	0.10335	0.00144	0.95581	0.0216	54	8113	0.006612	840.2	46.92	634	8.41	75
307-084	0.05889	0.00168	0.06847	0.00101	0.55536	0.01544	63	4709	0.013202	563	61.06	426.9	6.11	76
307-094	0.05667	0.0018	0.058	0.0009	0.45294	0.01398	47	3690	0.012577	478	69.58	363.5	5.46	76
307-071	0.11609	0.00255	0.25102	0.00351	4.01623	0.0873	54	24800	0.002173	1896.9	38.95	1443.7	18.07	76
307-099	0.07951	0.00165	0.15089	0.00201	1.65403	0.03409	58	23837	0.002427	1184.7	40.37	905.9	11.27	76
307-068	0.05808	0.0017	0.06563	0.00098	0.52532	0.01503	55	6038	0.009027	532.2	62.9	409.8	5.94	77
307-041	0.14364	0.00251	0.32214	0.00432	6.37765	0.11291	48	20145	0.002377	2271.5	29.79	1800.2	21.07	79
307-056	0.10371	0.00216	0.23361	0.00316	3.34013	0.06929	63	24630	0.002551	1691.6	37.89	1353.4	16.54	80
307-020	0.07266	0.00223	0.13524	0.00206	1.35453	0.0398	51	4856	0.010393	1004.4	61.02	817.7	11.68	81
307-113	0.05937	0.00242	0.07611	0.00135	0.62299	0.02436	51	2706	0.018498	580.6	86.05	472.9	8.1	81

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
307-025	0.09294	0.00156	0.20689	0.00261	2.65186	0.04495	58	22248	0.0026	1486.6	31.7	1212.2	13.96	82
307-079	0.06233	0.00216	0.09061	0.00149	0.77883	0.02605	55	3135	0.017241	685.6	72.25	559.2	8.81	82
307-030	0.07871	0.0024	0.15949	0.00257	1.73016	0.05061	54	2485	0.021268	1164.9	59.18	953.9	14.31	82
307-072	0.06236	0.00137	0.09143	0.00124	0.78598	0.01718	61	12308	0.004932	686.5	46.26	564	7.3	82
307-118	0.05709	0.0018	0.0651	0.001	0.51236	0.01571	52	3957	0.012971	494.4	68.78	406.6	6.05	82
307-015	0.0723	0.00188	0.13549	0.00192	1.3503	0.03398	50	6703	0.007404	994.4	51.87	819.1	10.89	82
307-038	0.05707	0.00114	0.06516	0.00085	0.51272	0.01031	53	9816	0.00537	493.7	43.56	406.9	5.17	82
307-087	0.07664	0.0016	0.15584	0.00209	1.64437	0.03406	58	17057	0.003389	1111.9	41.16	933.6	11.67	84
307-112	0.06046	0.00333	0.08482	0.00186	0.70667	0.03715	52	1644	0.03066	620.2	114.6	524.8	11.05	85
307-039	0.05627	0.00117	0.06291	0.00083	0.48806	0.01014	52	9077	0.005696	462.3	45.77	393.3	5.04	85
307-114	0.06132	0.0018	0.08974	0.00135	0.75866	0.02167	52	4183	0.012279	650.6	61.91	554	7.96	85
307-005	0.0733	0.0016	0.14475	0.00198	1.46298	0.03152	54	9724	0.005523	1022.3	43.52	871.4	11.16	85
307-050	0.06365	0.00255	0.10328	0.00186	0.90607	0.03488	48	1658	0.028136	730.2	82.6	633.6	10.87	87
307-088	0.0502	0.00141	0.02801	0.0004	0.19357	0.00531	57	6695	0.008442	204.3	63.94	178.1	2.53	87
307-044	0.05784	0.00127	0.07387	0.001	0.58887	0.01295	52	7886	0.006551	523.4	47.86	459.4	5.99	88
307-026	0.08161	0.00252	0.1836	0.00302	2.06547	0.06115	55	2352	0.02285	1236.3	59.24	1086.6	16.47	88
307-064	0.0723	0.0014	0.14537	0.00192	1.44886	0.02814	53	14455	0.003653	994.3	38.83	875	10.82	88
307-009	0.05602	0.00156	0.06379	0.00093	0.49271	0.01335	66	6776	0.009646	452.9	60.63	398.6	5.62	88
307-105	0.17412	0.00327	0.42577	0.0057	10.22185	0.19179	51	15179	0.003349	2597.6	30.94	2286.6	25.76	88
307-089	0.07864	0.00221	0.17307	0.00266	1.87303	0.05091	55	4629	0.011742	1163	54.67	1029	14.61	88
307-061	0.06135	0.00172	0.0938	0.0014	0.79325	0.02169	54	4381	0.012176	651.4	58.95	578	8.23	89
307-047	0.08683	0.00154	0.20589	0.00271	2.46376	0.04436	53	11972	0.004407	1356.6	33.75	1206.9	14.48	89
307-058	0.08161	0.00213	0.186	0.00274	2.09206	0.05348	55	8801	0.00621	1236.1	50.19	1099.7	14.89	89
307-097	0.08322	0.00353	0.19272	0.00392	2.2109	0.08929	44	1715	0.025014	1274.1	80.84	1136.1	21.21	89
307-012	0.07843	0.00185	0.17459	0.00243	1.88736	0.04342	42	6583	0.00634	1157.8	46	1037.4	13.31	90
307-024	0.06894	0.00135	0.13294	0.00173	1.26332	0.02456	49	9014	0.005407	897.1	39.81	804.6	9.85	90
307-035	0.13715	0.00211	0.35795	0.00468	6.76901	0.10721	53	11808	0.004468	2191.5	26.49	1972.5	22.21	90
307-082	0.07536	0.00148	0.1634	0.00216	1.69649	0.03324	52	14705	0.003524	1078.1	38.84	975.7	11.96	91
307-109	0.20361	0.00437	0.49434	0.00683	13.87746	0.29415	56	19487	0.002865	2855.3	34.52	2589.4	29.48	91

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
307-048	0.05612	0.00143	0.06651	0.00094	0.51445	0.0129	52	4871	0.010563	456.7	55.46	415.1	5.68	91
307-110	0.05627	0.00152	0.06742	0.00096	0.5231	0.01377	56	8083	0.00688	462.4	59.18	420.6	5.81	91
307-103	0.06062	0.00157	0.09347	0.00133	0.78131	0.01981	46	5862	0.007786	625.9	54.9	576	7.83	92
307-045	0.08268	0.00433	0.19766	0.00475	2.25245	0.11188	57	759	0.069853	1261.6	99.06	1162.7	25.54	92
307-018	0.10874	0.0025	0.28993	0.0039	4.34504	0.09717	27	25952	0.001039	1778.4	41.38	1641.2	19.49	92
307-059	0.08165	0.00198	0.19512	0.00276	2.19602	0.05247	52	16644	0.003115	1237.1	46.6	1149.1	14.91	93
307-067	0.07697	0.00163	0.17553	0.00238	1.86208	0.03939	52	16908	0.003066	1120.4	41.73	1042.5	13.06	93
307-055	0.07276	0.00197	0.15716	0.00235	1.57594	0.04175	52	5722	0.009006	1007.3	54.08	941	13.08	93
307-066	0.05928	0.00157	0.08749	0.00126	0.71486	0.01857	52	6427	0.008026	577.4	56.48	540.7	7.49	94
307-080	0.08043	0.00198	0.19267	0.00275	2.13694	0.0516	50	13980	0.003564	1207.7	47.62	1135.8	14.85	94
307-096	0.05588	0.00179	0.06841	0.00106	0.52688	0.01637	57	3821	0.014698	447.3	69.65	426.6	6.39	95
307-095	0.07416	0.00193	0.16772	0.00248	1.71398	0.04357	53	5781	0.009085	1045.9	51.62	999.5	13.67	96
307-008	0.11922	0.00293	0.33506	0.00507	5.50785	0.13176	56	5566	0.009961	1944.6	43.33	1862.9	24.5	96
307-033	0.18345	0.00236	0.49893	0.00612	12.62005	0.17396	50	49618	0.001007	2684.3	21.07	2609.2	26.34	97
307-073	0.07947	0.00205	0.19559	0.0029	2.14286	0.05394	52	5327	0.009667	1183.9	50.05	1151.6	15.63	97
307-028	0.10071	0.0017	0.28186	0.00364	3.91248	0.0664	43	10802	0.003965	1637.2	30.98	1600.7	18.33	98
307-031	0.08126	0.00198	0.20484	0.00301	2.29496	0.05477	43	8033	0.005324	1227.8	46.91	1201.3	16.09	98
307-077	0.07791	0.00278	0.19065	0.00337	2.04788	0.07018	49	2155	0.022232	1144.7	69.29	1124.9	18.26	98
307-086	0.18188	0.00388	0.50325	0.00747	12.60295	0.26451	58	6304	0.009117	2670.1	34.92	2627.8	32.05	98
307-027	0.17937	0.00283	0.50034	0.00643	12.38534	0.19802	49	32123	0.001523	2647	25.92	2615.2	27.64	99
307-036	0.05755	0.0012	0.08172	0.00108	0.64838	0.01353	46	8872	0.005158	512.2	45.62	506.4	6.46	99
307-074	0.05537	0.00163	0.06774	0.00101	0.5171	0.01483	51	5134	0.009836	426.7	63.84	422.5	6.08	99
307-063	0.10865	0.00234	0.31542	0.00443	4.72331	0.10138	60	20586	0.002906	1776.9	38.92	1767.3	21.69	99
307-011	0.0588	0.00126	0.09038	0.00118	0.73235	0.01553	44	13285	0.003301	559.5	46.08	557.8	6.95	100
307-037	0.06178	0.00152	0.10892	0.00154	0.92783	0.02244	52	5177	0.009945	666.5	51.79	666.5	8.96	100
307-004	0.0993	0.00217	0.28489	0.00398	3.90129	0.08388	51	11463	0.004429	1611.1	40.09	1615.9	19.99	100
307-042	0.05434	0.00352	0.06212	0.00148	0.46527	0.02885	51	659	0.071831	385.2	139.13	388.5	8.99	101
307-021	0.05925	0.00136	0.09485	0.00128	0.77452	0.01751	47	6476	0.007205	576.2	49.13	584.1	7.53	101
307-023	0.091	0.00187	0.25572	0.00352	3.20429	0.06516	49	12941	0.003772	1446.5	38.67	1467.9	18.05	101

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
307-052	0.0568	0.00172	0.07978	0.00121	0.62448	0.0184	54	4367	0.012214	483.1	66.12	494.8	7.21	102
307-006	0.07523	0.00279	0.18803	0.00341	1.95056	0.06933	54	1878	0.02795	1074.7	72.74	1110.7	18.49	103
307-032	0.08516	0.00146	0.23635	0.00308	2.77512	0.04829	52	12419	0.00417	1319	32.85	1367.7	16.04	104
307-060	0.05696	0.00199	0.08229	0.00134	0.64617	0.02188	51	3772	0.01334	489.4	75.88	509.8	7.99	104
307-078	0.07201	0.00189	0.1744	0.00256	1.73155	0.0445	56	7321	0.007591	986.3	52.53	1036.3	14.05	105
307-091	0.07539	0.00206	0.19366	0.00296	2.01101	0.05353	49	4800	0.010105	1078.8	53.96	1141.2	15.99	106
307-001	0.05468	0.00142	0.06816	0.00097	0.5139	0.0131	61	6210	0.009727	400.1	55.94	425.1	5.84	106
307-081	0.05463	0.00136	0.06912	0.00096	0.52035	0.01274	37	7078	0.0052	397.3	54.48	430.9	5.79	108
307-010	0.05765	0.00296	0.09363	0.00193	0.74429	0.03652	60	1165	0.04898	516.2	109.08	577	11.36	112
307-003	0.055	0.00124	0.07605	0.00103	0.57671	0.01288	68	10952	0.006171	412.1	48.84	472.5	6.17	115
307-107	0.05734	0.00158	0.09395	0.00136	0.74286	0.01999	63	6629	0.009414	504.2	59.94	578.9	8	115
307-116	0.05274	0.00135	0.06464	0.0009	0.46997	0.01177	65	8175	0.007888	317.7	56.84	403.8	5.44	127
307-115	0.05054	0.00147	0.04517	0.00066	0.31471	0.00896	61	5178	0.011643	220	66.12	284.8	4.04	129
307-054	0.0518	0.00402	0.06702	0.0018	0.47837	0.03563	57	531	0.096939	276.8	168.46	418.2	10.88	151
307-053	0.0452	0.0029	0.00192	0.00004	0.01197	0.00074	49	796	0.057988	0.1	103.98	12.4	0.27	12400
Sample 2017308														
308-081	0.09935	0.00539	0.02708	0.00067	0.37088	0.01859	59	647	0.083569	1612	97.74	172.2	4.2	11
308-109	0.09905	0.00342	0.02905	0.0005	0.39613	0.01317	75	13245	0.005631	1606.2	62.95	184.6	3.15	11
308-075	0.22966	0.00669	0.05996	0.0011	1.89741	0.04995	77	1458	0.050163	3049.7	45.9	375.4	6.67	12
308-111	0.14329	0.05233	0.05021	0.0083	0.99179	0.32654	52	27	0.658228	2267.4	522.66	315.8	50.93	14
308-073	0.10248	0.0029	0.03847	0.00058	0.54346	0.01478	72	9478	0.007539	1669.5	51.48	243.3	3.61	15
308-084	0.08406	0.00171	0.03805	0.0005	0.44071	0.00895	71	12201	0.005786	1293.9	39.13	240.7	3.12	19
308-041	0.10193	0.00375	0.04986	0.00095	0.69872	0.02407	66	1243	0.05042	1659.5	66.57	313.7	5.86	19
308-051	0.08591	0.00189	0.04346	0.00061	0.51284	0.01113	65	6110	0.010526	1336.2	42.09	274.2	3.77	21
308-038	0.07904	0.00453	0.04524	0.00111	0.49125	0.02645	49	930	0.050051	1173.1	109.29	285.2	6.82	24
308-048	0.19292	0.00749	0.11233	0.00258	2.9742	0.10385	68	987	0.064455	2767.2	62.31	686.3	14.95	25
308-119	0.10294	0.0035	0.06992	0.00123	0.99226	0.032	45	2928	0.015136	1677.8	61.55	435.6	7.43	26
308-096	0.07056	0.00209	0.04194	0.00064	0.40815	0.01161	66	6245	0.010458	944.6	59.43	264.8	3.98	28

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
308-027	0.06987	0.00273	0.05536	0.00103	0.53203	0.02007	62	1759	0.034047	924.6	78.33	347.4	6.31	38
308-034	0.07159	0.00172	0.05921	0.00087	0.58287	0.01387	73	7438	0.009719	974.2	48.23	370.8	5.27	38
308-108	0.07215	0.00166	0.06376	0.00089	0.63418	0.01449	63	10495	0.005967	990.1	46.11	398.4	5.4	40
308-088	0.07145	0.00249	0.06445	0.00108	0.63456	0.0213	63	2264	0.027073	970.2	69.44	402.6	6.53	41
308-016	0.07114	0.0035	0.06621	0.00144	0.64755	0.03042	58	1456	0.038309	961.3	96.95	413.3	8.7	43
308-114	0.09386	0.00189	0.10712	0.00144	1.38602	0.02793	91	23593	0.003842	1505.2	37.57	656	8.4	44
308-012	0.05414	0.00312	0.02748	0.00061	0.20479	0.01136	68	822	0.076404	376.8	124.31	174.7	3.85	46
308-050	0.065	0.00395	0.05832	0.00146	0.5181	0.02957	50	3316	0.014854	774.2	122.88	365.4	8.87	47
308-069	0.08782	0.00203	0.1105	0.0015	1.33906	0.03039	75	15863	0.004706	1378.5	43.67	675.7	8.71	49
308-003	0.06303	0.00159	0.05543	0.00085	0.4814	0.01231	71	9028	0.007803	709.1	52.79	347.8	5.22	49
308-100	0.06905	0.00281	0.07136	0.00131	0.6794	0.02639	54	2540	0.020817	900.1	81.85	444.3	7.9	49
308-080	0.10678	0.00386	0.1461	0.0027	2.15034	0.07351	57	1862	0.029703	1745.2	64.81	879.1	15.18	50
308-023	0.06971	0.00192	0.08042	0.00126	0.77101	0.0211	68	4808	0.013946	920	55.74	498.6	7.54	54
308-079	0.06007	0.00194	0.05372	0.00082	0.44486	0.01388	55	4640	0.011715	606.1	68.28	337.3	5.03	56
308-103	0.06604	0.00141	0.07255	0.00098	0.66051	0.01406	70	11678	0.005958	807.6	44.1	451.5	5.88	56
308-106	0.06592	0.00191	0.07228	0.0011	0.65686	0.01851	57	4356	0.012916	803.9	59.45	449.9	6.61	56
308-064	0.06266	0.00185	0.06281	0.00093	0.54231	0.01561	63	5943	0.01049	696.6	61.78	392.7	5.67	56
308-002	0.08529	0.00225	0.12344	0.00198	1.45039	0.0383	61	7951	0.007614	1322	50.42	750.3	11.34	57
308-097	0.06222	0.00171	0.06277	0.00091	0.53856	0.01438	54	5955	0.008987	681.8	57.58	392.4	5.51	58
308-062	0.07714	0.0017	0.10871	0.00147	1.15542	0.02516	59	10057	0.005832	1124.8	43.2	665.3	8.57	59
308-098	0.06243	0.00283	0.06785	0.00131	0.58383	0.02532	61	8120	0.007456	688.7	94.02	423.2	7.92	61
308-091	0.06033	0.00208	0.06132	0.00098	0.51018	0.017	55	2676	0.020139	615.6	72.92	383.6	5.97	62
308-083	0.06476	0.00145	0.0791	0.00106	0.70625	0.0157	68	10778	0.00627	766.5	46.51	490.7	6.34	64
308-001	0.05874	0.00221	0.05806	0.00104	0.46984	0.01729	63	3380	0.018298	557.3	80.08	363.8	6.33	65
308-101	0.06387	0.00166	0.08143	0.00117	0.71702	0.01828	48	5669	0.008396	737.4	54.22	504.6	7	68
308-066	0.05946	0.00167	0.06433	0.00093	0.52775	0.01445	53	5865	0.008956	584.1	59.78	401.9	5.63	69
308-021	0.05968	0.00215	0.06596	0.00118	0.53989	0.01902	56	9204	0.006048	591.9	76.19	411.8	7.11	70
308-008	0.09064	0.00365	0.17052	0.00345	2.12946	0.08286	63	2577	0.023864	1439	74.9	1015	19	71
308-059	0.07655	0.0019	0.12907	0.00182	1.35778	0.03318	58	17242	0.003353	1109.4	48.81	782.6	10.4	71

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
308-018	0.06243	0.0023	0.07858	0.00139	0.67438	0.02412	61	2621	0.022744	689	76.7	487.6	8.29	71
308-043	0.10893	0.00199	0.21699	0.00287	3.2503	0.0602	69	25875	0.00266	1781.6	32.91	1265.9	15.22	71
308-015	0.12991	0.00259	0.26233	0.00382	4.68863	0.09666	59	18696	0.003146	2096.7	34.66	1501.8	19.52	72
308-061	0.05548	0.00171	0.04998	0.00075	0.38192	0.01144	53	3993	0.013099	431.3	66.83	314.4	4.59	73
308-076	0.05817	0.0016	0.06339	0.0009	0.50846	0.01362	62	6390	0.009609	535.6	59.13	396.2	5.46	74
308-056	0.06352	0.00227	0.08878	0.00149	0.77523	0.0268	60	2621	0.02238	725.6	74.18	548.3	8.81	76
308-090	0.05675	0.00187	0.05861	0.00092	0.45843	0.01478	59	4076	0.014268	481.1	71.99	367.2	5.6	76
308-014	0.05741	0.00224	0.06185	0.00112	0.48865	0.01857	71	2179	0.031556	506.7	84.02	386.9	6.78	76
308-031	0.08607	0.0041	0.17207	0.00394	2.03953	0.09208	56	1144	0.046667	1339.8	89.25	1023.5	21.68	76
308-120	0.05641	0.00229	0.05938	0.00105	0.46181	0.01806	48	2373	0.019827	467.6	88.14	371.8	6.42	80
308-068	0.12092	0.0025	0.27796	0.00369	4.63298	0.09515	56	21214	0.002633	1969.9	36.44	1581.1	18.6	80
308-070	0.05891	0.0016	0.07277	0.00103	0.59193	0.01571	67	9198	0.007232	563.7	58.18	452.8	6.2	80
308-025	0.10663	0.00296	0.24394	0.00411	3.57854	0.09781	61	3422	0.017514	1742.5	50.05	1407.2	21.3	81
308-044	0.26116	0.00468	0.50535	0.00673	18.13983	0.33108	60	31746	0.001886	3253.7	27.96	2636.7	28.8	81
308-005	0.08075	0.00286	0.16514	0.00309	1.83783	0.06345	66	1941	0.032885	1215.5	67.93	985.3	17.12	81
308-053	0.05645	0.00152	0.06254	0.0009	0.48538	0.01287	63	5987	0.010413	469.3	59.03	391	5.48	83
308-065	0.07702	0.00183	0.15619	0.00218	1.65683	0.03869	57	11766	0.004821	1121.7	46.58	935.6	12.14	83
308-057	0.08178	0.0026	0.17683	0.00294	1.98662	0.06082	55	2557	0.021057	1240.3	60.93	1049.7	16.1	85
308-052	0.07669	0.00182	0.15758	0.00225	1.65986	0.03886	59	10374	0.005655	1113.1	46.58	943.3	12.51	85
308-067	0.08278	0.00275	0.18244	0.00306	2.08401	0.06648	60	2687	0.021842	1264	63.39	1080.3	16.67	85
308-022	0.05578	0.00152	0.06054	0.00093	0.46439	0.01268	60	5843	0.010164	443.3	59.5	378.9	5.62	85
308-112	0.05755	0.00158	0.07046	0.00103	0.55895	0.01503	57	5299	0.010642	512.3	59.57	438.9	6.21	86
308-054	0.19638	0.00364	0.45012	0.00592	12.15311	0.22854	60	51090	0.001173	2796.4	29.99	2395.8	26.34	86
308-017	0.05631	0.0015	0.06386	0.00097	0.49431	0.01311	64	8392	0.007569	463.8	58.52	399	5.9	86
308-020	0.0771	0.00273	0.16187	0.00291	1.71473	0.05873	51	2561	0.019525	1123.8	69.11	967.2	16.15	86
308-102	0.05681	0.00199	0.06675	0.00109	0.52276	0.01776	58	3760	0.015191	483.6	76.31	416.5	6.57	86
308-042	0.11785	0.00204	0.29362	0.00384	4.75771	0.0845	55	37911	0.001449	1923.9	30.7	1659.6	19.12	86
308-117	0.11238	0.00326	0.28117	0.00474	4.35623	0.12172	52	3193	0.016025	1838.3	51.63	1597.3	23.84	87
308-046	0.07995	0.00284	0.1805	0.00324	1.9828	0.06756	67	2021	0.032088	1195.8	68.53	1069.7	17.7	89

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
308-055	0.07029	0.00169	0.14016	0.00198	1.35467	0.03215	61	8682	0.006977	937	48.52	845.6	11.19	90
308-006	0.05864	0.00169	0.08106	0.00131	0.65504	0.01893	72	5807	0.012247	553.7	61.73	502.4	7.81	91
308-019	0.10029	0.00259	0.25834	0.00408	3.56149	0.09095	63	6487	0.009618	1629.4	47.29	1481.4	20.93	91
308-010	0.06842	0.00181	0.13264	0.0021	1.25074	0.03361	72	14589	0.004911	881.4	53.87	802.9	11.95	91
308-082	0.07885	0.00289	0.18	0.00323	1.95713	0.06879	54	1827	0.028708	1168.4	70.95	1067	17.67	91
308-078	0.1836	0.00386	0.46355	0.00624	11.73463	0.24478	63	19545	0.003213	2685.6	34.37	2455.2	27.47	91
308-028	0.12423	0.00279	0.33131	0.00493	5.66293	0.12937	68	20884	0.003246	2017.8	39.34	1844.7	23.86	91
308-086	0.10855	0.00236	0.28763	0.00398	4.30424	0.09329	57	11683	0.004855	1775.1	39.21	1629.7	19.91	92
308-074	0.0769	0.00289	0.17298	0.00311	1.83436	0.06589	61	1841	0.032072	1118.6	73.09	1028.5	17.12	92
308-029	0.1139	0.00264	0.30468	0.00459	4.77695	0.11184	54	12845	0.004186	1862.5	41.2	1714.5	22.68	92
308-030	0.08001	0.00228	0.18664	0.00302	2.05588	0.05796	62	5586	0.010977	1197.2	55.2	1103.2	16.4	92
308-032	0.0597	0.00253	0.08873	0.00167	0.72896	0.02984	65	1699	0.036848	593.2	89.03	548	9.88	92
308-113	0.07942	0.00218	0.18487	0.00286	2.02392	0.05411	54	4544	0.011744	1182.6	53.31	1093.5	15.54	92
308-040	0.07795	0.00225	0.1802	0.00285	1.92894	0.0539	55	4973	0.010939	1145.5	56.38	1068.1	15.57	93
308-009	0.07455	0.00183	0.16531	0.00256	1.69846	0.04268	69	20866	0.003296	1056.2	48.97	986.2	14.15	93
308-049	0.07149	0.00237	0.15167	0.00252	1.49055	0.04761	70	3228	0.021225	971.5	66.13	910.3	14.08	94
308-004	0.19421	0.00404	0.50301	0.0078	13.46276	0.2913	64	10469	0.006076	2778.1	33.72	2626.7	33.45	95
308-024	0.05365	0.00284	0.0537	0.00113	0.39624	0.02026	66	1116	0.055838	356.3	114.83	337.2	6.93	95
308-011	0.08182	0.00168	0.20016	0.00296	2.25596	0.04823	60	13061	0.004573	1241.2	39.62	1176.2	15.88	95
308-115	0.10524	0.00198	0.28822	0.00381	4.18143	0.07933	48	29824	0.001607	1718.5	34.1	1632.7	19.07	95
308-045	0.10538	0.00208	0.28886	0.00391	4.18381	0.08298	68	20744	0.003267	1720.9	35.84	1635.9	19.55	95
308-095	0.05414	0.00163	0.05713	0.00084	0.42657	0.01246	52	4629	0.011109	376.8	66.04	358.2	5.15	95
308-072	0.13793	0.00248	0.3842	0.0049	7.30768	0.1325	61	25153	0.002419	2201.4	30.93	2095.9	22.83	95
308-013	0.09237	0.00272	0.24413	0.00424	3.1047	0.09004	60	2937	0.02002	1474.9	55.01	1408.1	21.95	95
308-039	0.10533	0.00244	0.29113	0.00425	4.21186	0.09583	61	11147	0.005443	1720.1	41.93	1647.2	21.22	96
308-099	0.07514	0.00213	0.17272	0.00262	1.78974	0.04915	61	4998	0.012058	1072.3	55.9	1027.1	14.41	96
308-026	0.05942	0.00289	0.0906	0.00186	0.74073	0.03473	60	1279	0.04481	582.6	102.18	559.1	11.02	96
308-077	0.07816	0.00195	0.18721	0.00265	2.01774	0.04934	52	7708	0.006701	1151	48.84	1106.3	14.37	96
308-036	0.09996	0.00238	0.27399	0.00412	3.7655	0.08855	63	7235	0.008633	1623.4	43.74	1561	20.86	96

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
308-105	0.07657	0.00191	0.18399	0.00268	1.94209	0.04762	63	6761	0.009232	1110.1	49.04	1088.7	14.6	98
308-033	0.07438	0.00158	0.17376	0.00246	1.77771	0.03804	57	12329	0.004602	1051.9	42.17	1032.8	13.51	98
308-107	0.17037	0.00408	0.47716	0.00765	11.20634	0.26268	66	4324	0.015034	2561.2	39.51	2514.9	33.38	98
308-094	0.06046	0.00138	0.09908	0.00134	0.82614	0.01858	51	10728	0.004731	620.2	48.48	609	7.84	98
308-047	0.06851	0.00154	0.14537	0.00201	1.36873	0.03045	59	15592	0.00377	884	45.7	875	11.3	99
308-037	0.05356	0.00238	0.05592	0.00106	0.41203	0.01765	71	3689	0.018883	352.5	97.32	350.8	6.45	100
308-118	0.09685	0.00239	0.27354	0.00408	3.65216	0.08846	52	6590	0.007829	1564.3	45.58	1558.8	20.64	100
308-058	0.07137	0.00252	0.16172	0.00277	1.58691	0.05405	67	2563	0.025475	968.1	70.44	966.3	15.35	100
308-110	0.06906	0.00205	0.15073	0.00236	1.43499	0.04167	51	4152	0.012134	900.4	60.12	905.1	13.25	101
308-116	0.05389	0.00169	0.05978	0.00092	0.44418	0.01362	60	4250	0.013921	366.4	69.21	374.3	5.61	102
308-092	0.07579	0.00136	0.18965	0.0024	1.98234	0.03578	57	32054	0.001775	1089.6	35.46	1119.5	13.02	103
308-060	0.05603	0.00181	0.07563	0.00117	0.58249	0.01829	62	4455	0.013726	453.3	70.27	470	7.02	104
308-087	0.07447	0.00338	0.18628	0.00384	1.91161	0.08299	47	1219	0.037125	1053.9	89.07	1101.2	20.88	104
308-007	0.05431	0.00228	0.06453	0.00121	0.48296	0.01976	65	2096	0.030079	383.9	90.86	403.1	7.36	105
308-085	0.05099	0.003	0.0401	0.00087	0.28192	0.01595	60	1197	0.047733	240.5	130.24	253.4	5.36	105
308-089	0.05313	0.0025	0.05724	0.00108	0.4192	0.01905	57	1577	0.034884	334.3	103.07	358.8	6.57	107
308-104	0.05433	0.00186	0.0674	0.00107	0.50482	0.01675	51	3788	0.013285	384.7	74.4	420.5	6.48	109
308-093	0.0538	0.00161	0.06409	0.00094	0.47546	0.01381	54	6167	0.00868	362.6	65.88	400.4	5.71	110
308-035	0.05138	0.00228	0.06319	0.00117	0.44627	0.0191	59	1731	0.032961	257.7	98.64	395	7.1	153
308-063	0.04825	0.00423	0.05763	0.00167	0.3829	0.03224	60	886	0.063425	111.3	194.9	361.2	10.19	325
308-071	0.04644	0.00293	0.04473	0.00098	0.28649	0.0174	58	859	0.06325	20.6	145.01	282.1	6.05	1369
Sample 2017309														
309-11	0.1186	0.0016	0.0677	0.0008	1.106	0.015	236	21418	0.011	1934	24	422	5	22
309-49	0.0619	0.0018	0.0236	0.0003	0.202	0.006	157	5957	0.026	672	60	151	2	22
309-98	0.0617	0.0021	0.0251	0.0004	0.213	0.007	132	2741	0.046	663	72	160	2	24
309-51	0.1577	0.0022	0.0977	0.0012	2.124	0.031	259	13204	0.019	2431	24	601	7	25
309-08	0.0771	0.0010	0.0574	0.0007	0.610	0.008	216	49283	0.004	1123	26	360	4	32
309-97	0.0537	0.0011	0.0184	0.0002	0.137	0.003	133	13865	0.010	360	45	118	1	33

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
309-54	0.0752	0.0018	0.0586	0.0008	0.607	0.014	165	9196	0.018	1073	47	367	5	34
309-62	0.0541	0.0019	0.0205	0.0003	0.153	0.005	152	3565	0.041	376	76	131	2	35
309-70	0.0544	0.0021	0.0213	0.0003	0.159	0.006	127	2774	0.044	385	85	136	2	35
309-16	0.0981	0.0013	0.0986	0.0012	1.333	0.019	244	49086	0.005	1588	25	606	7	38
309-41	0.0591	0.0014	0.0384	0.0005	0.313	0.007	148	7192	0.020	572	49	243	3	42
309-87	0.0645	0.0009	0.0597	0.0007	0.531	0.007	127	37035	0.003	759	28	374	4	49
309-53	0.1246	0.0015	0.1976	0.0023	3.392	0.043	143	66064	0.002	2023	21	1162	12	57
309-68	0.0579	0.0020	0.0491	0.0007	0.391	0.013	144	3147	0.044	524	76	309	5	59
309-63	0.0590	0.0007	0.0541	0.0006	0.441	0.006	156	73065	0.002	568	26	340	4	60
309-91	0.0590	0.0007	0.0564	0.0006	0.459	0.006	173	83737	0.002	567	27	354	4	62
309-58	0.0639	0.0009	0.0763	0.0009	0.672	0.010	162	38221	0.004	738	29	474	5	64
309-85	0.0612	0.0008	0.0671	0.0008	0.566	0.008	132	54787	0.002	644	28	419	5	65
309-69	0.0606	0.0009	0.0651	0.0008	0.543	0.008	148	36464	0.004	624	30	406	5	65
309-38	0.0579	0.0010	0.0601	0.0008	0.479	0.008	159	21494	0.007	525	36	376	5	72
309-33	0.0567	0.0008	0.0558	0.0007	0.436	0.006	149	33138	0.004	478	31	350	4	73
309-59	0.0532	0.0009	0.0407	0.0005	0.299	0.005	142	17516	0.008	337	38	257	3	76
309-92	0.0575	0.0009	0.0627	0.0007	0.497	0.008	124	22224	0.006	510	34	392	4	77
309-94	0.0586	0.0013	0.0684	0.0008	0.553	0.011	144	14371	0.010	553	46	427	5	77
309-36	0.0557	0.0010	0.0544	0.0007	0.418	0.008	128	15064	0.008	439	41	342	4	78
309-71	0.1150	0.0013	0.2624	0.0029	4.160	0.049	173	147823	0.001	1880	20	1502	15	80
309-83	0.0572	0.0009	0.0647	0.0007	0.510	0.008	148	21071	0.007	498	35	404	4	81
309-10	0.0631	0.0009	0.0941	0.0011	0.819	0.012	142	42471	0.003	711	28	580	7	82
309-56	0.0562	0.0010	0.0617	0.0007	0.478	0.009	171	16686	0.010	460	40	386	5	84
309-90	0.0552	0.0010	0.0566	0.0007	0.431	0.008	153	15661	0.010	422	39	355	4	84
309-07	0.0516	0.0010	0.0362	0.0005	0.258	0.005	130	21820	0.006	268	44	229	3	86
309-86	0.0537	0.0010	0.0488	0.0006	0.362	0.007	116	11676	0.010	359	43	307	4	86
309-100	0.0559	0.0008	0.0616	0.0007	0.475	0.007	141	45380	0.003	449	30	386	4	86
309-65	0.0616	0.0008	0.0920	0.0010	0.781	0.010	146	85087	0.002	660	27	567	6	86
309-19	0.1383	0.0016	0.3423	0.0039	6.526	0.080	137	178598	0.001	2206	19	1898	19	86

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
309-40	0.0575	0.0010	0.0710	0.0009	0.562	0.010	157	21268	0.007	509	36	442	5	87
309-60	0.0614	0.0015	0.0927	0.0013	0.784	0.018	159	5969	0.026	652	50	571	7	88
309-93	0.0585	0.0008	0.0773	0.0009	0.623	0.008	139	48543	0.003	548	28	480	5	88
309-72	0.0567	0.0007	0.0682	0.0008	0.533	0.007	127	53334	0.002	480	28	425	5	89
309-73	0.0731	0.0009	0.1532	0.0017	1.544	0.020	131	43741	0.003	1017	26	919	10	90
309-47	0.0565	0.0008	0.0685	0.0008	0.533	0.008	161	52136	0.003	470	30	427	5	91
309-57	0.0553	0.0011	0.0623	0.0008	0.475	0.009	132	15836	0.008	424	43	390	5	92
309-88	0.0547	0.0009	0.0587	0.0007	0.442	0.007	154	20831	0.007	399	36	368	4	92
309-81	0.0554	0.0009	0.0632	0.0007	0.482	0.008	143	20818	0.007	426	34	395	4	93
309-82	0.0557	0.0008	0.0652	0.0007	0.500	0.007	154	35469	0.004	439	30	407	4	93
309-78	0.0699	0.0009	0.1422	0.0017	1.370	0.019	122	97404	0.001	924	26	857	10	93
309-04	0.0620	0.0009	0.1021	0.0012	0.873	0.013	159	28227	0.006	674	29	627	7	93
309-02	0.0566	0.0009	0.0711	0.0008	0.554	0.009	166	25593	0.006	475	34	443	5	93
309-96	0.0501	0.0013	0.0292	0.0004	0.201	0.005	139	10001	0.014	198	60	185	3	93
309-61	0.0800	0.0011	0.1896	0.0023	2.090	0.030	155	21926	0.007	1196	27	1119	12	94
309-67	0.0579	0.0007	0.0793	0.0009	0.633	0.008	142	91228	0.002	525	27	492	5	94
309-18	0.0765	0.0010	0.1760	0.0020	1.856	0.024	134	53005	0.003	1108	25	1045	11	94
309-84	0.0988	0.0013	0.2639	0.0031	3.592	0.050	109	25240	0.004	1601	25	1510	16	94
309-79	0.0554	0.0008	0.0649	0.0007	0.495	0.007	172	35814	0.005	429	31	405	5	95
309-05	0.0592	0.0008	0.0887	0.0011	0.724	0.011	139	35778	0.004	576	30	548	6	95
309-22	0.0581	0.0008	0.0821	0.0010	0.658	0.009	162	44466	0.004	534	29	508	6	95
309-43	0.0555	0.0009	0.0660	0.0008	0.505	0.009	149	16012	0.009	432	37	412	5	95
309-24	0.0548	0.0008	0.0620	0.0007	0.469	0.007	156	27560	0.006	405	31	388	5	96
309-46	0.0569	0.0009	0.0757	0.0009	0.594	0.010	150	40068	0.004	488	36	471	5	96
309-66	0.0789	0.0009	0.1914	0.0022	2.082	0.026	124	140339	0.001	1170	23	1129	12	97
309-32	0.0588	0.0009	0.0876	0.0011	0.710	0.011	124	26147	0.005	559	31	542	6	97
309-20	0.0612	0.0009	0.1020	0.0012	0.861	0.012	143	34626	0.004	646	30	626	7	97
309-74	0.0717	0.0008	0.1584	0.0018	1.565	0.019	156	110547	0.001	977	24	948	10	97
309-64	0.1049	0.0012	0.2944	0.0034	4.258	0.051	163	215548	0.001	1712	20	1664	17	97

	Isotopic ratio						Counts per second			Age				
Analysis	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
309-99	0.1077	0.0014	0.3044	0.0035	4.518	0.061	136	41766	0.003	1760	24	1713	17	97
309-37	0.0739	0.0010	0.1700	0.0021	1.731	0.025	116	79104	0.001	1037	27	1012	11	98
309-17	0.0559	0.0010	0.0700	0.0009	0.539	0.010	112	31990	0.003	446	40	436	5	98
309-09	0.0520	0.0009	0.0442	0.0005	0.317	0.006	159	17869	0.009	285	39	279	3	98
309-27	0.0723	0.0009	0.1639	0.0020	1.634	0.023	114	53436	0.002	995	26	978	11	98
309-45	0.0589	0.0007	0.0900	0.0011	0.731	0.010	152	71269	0.002	563	27	556	6	99
309-48	0.2545	0.0030	0.6401	0.0074	22.460	0.281	145	574517	0.000	3213	18	3190	29	99
309-80	0.0568	0.0008	0.0775	0.0009	0.607	0.009	148	31361	0.005	483	33	481	5	100
309-15	0.2573	0.0029	0.6476	0.0074	22.970	0.279	134	67278	0.002	3230	18	3219	29	100
309-76	0.0640	0.0008	0.1214	0.0014	1.071	0.014	144	91265	0.002	741	25	739	8	100
309-95	0.0493	0.0011	0.0254	0.0003	0.173	0.004	135	8754	0.015	162	51	162	2	100
309-52	0.0971	0.0011	0.2757	0.0032	3.691	0.046	160	137515	0.001	1570	21	1570	16	100
309-14	0.0594	0.0008	0.0944	0.0011	0.773	0.011	143	41473	0.003	581	29	582	6	100
309-39	0.1856	0.0022	0.5220	0.0062	13.358	0.175	144	75151	0.002	2704	20	2708	26	100
309-89	0.0759	0.0012	0.1848	0.0021	1.932	0.030	123	31509	0.004	1091	31	1093	11	100
309-35	0.0557	0.0008	0.0705	0.0009	0.541	0.008	158	67829	0.002	438	30	439	5	100
309-13	0.0582	0.0009	0.0870	0.0010	0.697	0.011	142	18597	0.008	536	35	537	6	100
309-75	0.0557	0.0008	0.0707	0.0008	0.543	0.008	156	41897	0.004	439	29	441	5	100
309-06	0.0962	0.0012	0.2738	0.0033	3.630	0.048	141	34683	0.004	1551	23	1560	16	101
309-42	0.0588	0.0011	0.0912	0.0012	0.739	0.014	100	26143	0.004	558	40	563	7	101
309-55	0.0609	0.0009	0.1063	0.0012	0.893	0.014	145	29600	0.005	636	32	651	7	102
309-29	0.0847	0.0013	0.2311	0.0030	2.699	0.043	162	24452	0.007	1309	29	1340	16	102
309-01	0.0594	0.0011	0.0968	0.0012	0.793	0.015	153	12385	0.012	581	40	596	7	102
309-44	0.0798	0.0009	0.2117	0.0024	2.330	0.029	149	290461	0.001	1193	22	1238	13	104
309-28	0.0594	0.0011	0.0985	0.0014	0.807	0.016	139	24986	0.006	583	41	606	8	104
309-25	0.0582	0.0009	0.0908	0.0011	0.728	0.011	159	25634	0.006	535	32	560	6	105
309-34	0.0560	0.0008	0.0769	0.0009	0.593	0.009	153	34756	0.004	450	31	478	6	106
309-03	0.0603	0.0008	0.1065	0.0012	0.886	0.012	155	39845	0.004	614	29	653	7	106
309-77	0.0548	0.0007	0.0693	0.0008	0.524	0.007	138	51106	0.003	403	29	432	5	107

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
309-21	0.0576	0.0009	0.0903	0.0012	0.717	0.012	151	34222	0.004	512	34	557	7	109
309-31	0.0566	0.0009	0.0844	0.0010	0.659	0.011	125	16949	0.007	477	36	522	6	110
309-50	0.0576	0.0010	0.0978	0.0012	0.776	0.013	154	19316	0.008	513	36	602	7	117
309-12	0.0577	0.0012	0.0997	0.0014	0.793	0.016	143	14958	0.009	519	45	612	8	118
309-26	0.0581	0.0007	0.1025	0.0012	0.820	0.010	147	105204	0.001	532	26	629	7	118
309-30	0.0556	0.0007	0.0891	0.0011	0.683	0.009	121	65510	0.002	437	27	550	6	126
309-23	0.0529	0.0008	0.0661	0.0008	0.482	0.007	135	35141	0.004	324	32	412	5	127
Sample 2017310														
310-34	0.1407	0.0033	0.0448	0.0006	0.869	0.019	676	75224	0.009	2236	40	283	4	13
310-93	0.1358	0.0016	0.0563	0.0007	1.053	0.014	499	70279	0.007	2174	21	353	4	16
310-76	0.1014	0.0013	0.0467	0.0006	0.653	0.009	529	96490	0.005	1650	23	295	4	18
310-74	0.0959	0.0012	0.0530	0.0007	0.701	0.010	295	51147	0.006	1546	23	333	4	22
310-18	0.0743	0.0020	0.0363	0.0005	0.372	0.009	193	9616	0.020	1050	52	230	3	22
310-66	0.5652	0.0067	0.1860	0.0023	14.498	0.185	1207	29113	0.040	4421	17	1100	12	25
310-04	0.0582	0.0012	0.0226	0.0003	0.181	0.004	219	13887	0.016	536	47	144	2	27
310-94	0.0980	0.0021	0.0686	0.0010	0.927	0.019	181	13603	0.013	1586	39	428	6	27
310-29	0.1431	0.0037	0.1012	0.0017	1.996	0.051	220	16711	0.013	2265	44	621	10	27
310-11	0.0637	0.0008	0.0350	0.0004	0.307	0.004	218	101014	0.002	732	25	222	2	30
310-75	0.0771	0.0010	0.0674	0.0008	0.716	0.009	281	77893	0.004	1122	24	420	5	37
310-13	0.0956	0.0014	0.0968	0.0012	1.276	0.019	289	43485	0.007	1540	27	596	7	39
310-25	0.0818	0.0010	0.0780	0.0009	0.880	0.011	312	81174	0.004	1241	24	484	5	39
310-83	0.0796	0.0010	0.0772	0.0009	0.848	0.011	232	53928	0.004	1188	25	480	5	40
310-17	0.0608	0.0017	0.0433	0.0006	0.363	0.010	186	9821	0.019	633	58	274	4	43
310-80	0.0655	0.0010	0.0590	0.0007	0.533	0.008	165	28855	0.006	789	31	370	4	47
310-79	0.0510	0.0016	0.0179	0.0003	0.126	0.004	140	6074	0.023	241	69	115	2	48
310-82	0.0773	0.0015	0.0908	0.0012	0.967	0.019	147	12056	0.012	1129	38	560	7	50
310-09	0.0652	0.0009	0.0629	0.0007	0.566	0.008	264	71407	0.004	781	28	393	4	50
310-81	0.2152	0.0099	0.2654	0.0074	7.871	0.328	138	525	0.208	2945	73	1517	38	52

Analysis	Isotopic ratio						Counts per second			Age				
	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	^{204}Pb	^{206}Pb	Net ^{204}Pb	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
310-22	0.1014	0.0012	0.1431	0.0016	2.001	0.025	220	94519	0.002	1650	22	862	9	52
310-53	0.0629	0.0007	0.0592	0.0007	0.514	0.007	232	86631	0.003	705	25	371	4	53
310-72	0.0560	0.0009	0.0381	0.0005	0.294	0.005	168	19953	0.008	452	34	241	3	53
310-23	0.0649	0.0010	0.0676	0.0008	0.605	0.010	170	16975	0.010	771	33	421	5	55
310-69	0.1505	0.0023	0.2270	0.0030	4.710	0.077	541	66614	0.008	2352	26	1319	16	56
310-02	0.0739	0.0009	0.0968	0.0010	0.986	0.012	289	99668	0.003	1037	24	596	6	57
310-33	0.0709	0.0017	0.0892	0.0012	0.871	0.020	173	5213	0.032	954	48	551	7	58
310-97	0.0604	0.0009	0.0590	0.0008	0.492	0.008	164	63579	0.003	619	31	369	5	60
310-50	0.0745	0.0009	0.1027	0.0012	1.054	0.014	233	115682	0.002	1055	24	630	7	60
310-38	0.0623	0.0009	0.0722	0.0008	0.619	0.009	185	51596	0.004	683	29	449	5	66
310-21	0.0775	0.0009	0.1255	0.0014	1.341	0.016	303	161060	0.002	1135	23	762	8	67
310-35	0.0655	0.0010	0.0883	0.0011	0.797	0.013	184	26591	0.007	791	33	546	7	69
310-12	0.0850	0.0014	0.1562	0.0021	1.830	0.032	214	122407	0.002	1315	31	936	12	71
310-43	0.0589	0.0008	0.0647	0.0007	0.525	0.007	213	58907	0.004	564	29	404	4	72
310-31	0.1143	0.0013	0.2394	0.0027	3.768	0.045	185	203720	0.001	1869	20	1383	14	74
310-95	0.0574	0.0010	0.0610	0.0009	0.483	0.009	166	58311	0.003	506	39	381	5	75
310-40	0.0622	0.0008	0.0829	0.0009	0.711	0.009	173	106153	0.002	680	27	514	6	76
310-28	0.1814	0.0024	0.3751	0.0046	9.379	0.136	188	133475	0.001	2665	22	2053	21	77
310-85	0.0628	0.0009	0.0880	0.0011	0.761	0.011	157	32038	0.005	701	30	544	6	78
310-54	0.0595	0.0008	0.0732	0.0009	0.600	0.008	177	42563	0.004	585	28	455	5	78
310-91	0.0625	0.0016	0.0870	0.0013	0.749	0.019	149	8559	0.017	690	53	538	8	78
310-39	0.0799	0.0010	0.1564	0.0018	1.723	0.022	204	110123	0.002	1195	24	937	10	78
310-30	0.0642	0.0014	0.0973	0.0014	0.861	0.019	211	33750	0.006	749	45	599	8	80
310-10	0.0569	0.0008	0.0632	0.0007	0.496	0.007	188	37656	0.005	489	32	395	4	81
310-07	0.0821	0.0013	0.1700	0.0020	1.923	0.030	216	17296	0.012	1247	30	1012	11	81
310-56	0.0578	0.0007	0.0692	0.0008	0.551	0.007	176	103780	0.002	520	26	432	5	83
310-92	0.0616	0.0008	0.0902	0.0011	0.766	0.011	161	78071	0.002	661	27	557	7	84
310-36	0.0710	0.0012	0.1346	0.0017	1.316	0.023	160	19296	0.008	957	35	814	10	85
310-61	0.1159	0.0018	0.2924	0.0038	4.671	0.072	180	9860	0.018	1894	27	1653	19	87

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
310-71	0.0596	0.0009	0.0839	0.0010	0.690	0.010	158	29439	0.005	589	31	520	6	88
310-08	0.0917	0.0012	0.2211	0.0025	2.794	0.038	222	38585	0.006	1460	25	1288	13	88
310-65	0.0617	0.0007	0.0960	0.0011	0.816	0.011	165	78390	0.002	662	25	591	7	89
310-48	0.0602	0.0009	0.0882	0.0010	0.731	0.011	197	33574	0.006	610	30	545	6	89
310-24	0.0756	0.0011	0.1629	0.0020	1.697	0.026	193	43307	0.004	1084	29	973	11	90
310-98	0.0842	0.0012	0.1990	0.0023	2.310	0.032	178	38496	0.005	1297	27	1170	12	90
310-32	0.1619	0.0018	0.4151	0.0046	9.260	0.109	188	424541	0.000	2476	18	2238	21	90
310-15	0.0772	0.0011	0.1716	0.0020	1.827	0.026	142	26324	0.005	1127	27	1021	11	91
310-47	0.1735	0.0020	0.4451	0.0050	10.641	0.129	294	328818	0.001	2592	19	2373	22	92
310-55	0.0568	0.0007	0.0717	0.0008	0.562	0.007	149	62998	0.002	485	28	447	5	92
310-19	0.0681	0.0009	0.1333	0.0015	1.251	0.016	195	124980	0.002	872	26	806	8	93
310-03	0.1490	0.0017	0.4009	0.0043	8.235	0.094	206	226704	0.001	2334	19	2173	20	93
310-58	0.0718	0.0009	0.1530	0.0018	1.515	0.020	170	80903	0.002	980	26	918	10	94
310-20	0.1324	0.0016	0.3635	0.0041	6.633	0.083	177	421090	0.000	2129	21	1999	19	94
310-49	0.0751	0.0010	0.1696	0.0020	1.755	0.024	146	36404	0.004	1071	26	1010	11	94
310-46	0.1442	0.0023	0.3989	0.0053	7.929	0.134	126	154242	0.001	2279	27	2164	25	95
310-51	0.2966	0.0032	0.6693	0.0074	27.373	0.314	175	341607	0.001	3453	17	3303	29	96
310-06	0.1746	0.0020	0.4738	0.0051	11.404	0.134	212	294814	0.001	2602	19	2500	22	96
310-16	0.0759	0.0009	0.1785	0.0020	1.867	0.024	153	101241	0.002	1092	24	1059	11	97
310-14	0.0584	0.0010	0.0852	0.0011	0.685	0.012	161	33252	0.005	543	36	527	6	97
310-87	0.0743	0.0011	0.1718	0.0021	1.760	0.026	141	27787	0.005	1051	28	1022	12	97
310-05	0.0799	0.0010	0.1984	0.0022	2.186	0.029	191	41336	0.005	1195	26	1167	12	98
310-01	0.0765	0.0009	0.1834	0.0020	1.935	0.023	227	109853	0.002	1109	23	1085	11	98
310-27	0.0750	0.0011	0.1762	0.0022	1.822	0.028	169	61019	0.003	1069	29	1046	12	98
310-41	0.0593	0.0007	0.0921	0.0012	0.752	0.010	196	123766	0.002	578	27	568	7	98
310-67	0.0592	0.0013	0.0931	0.0013	0.760	0.016	137	10280	0.013	576	46	574	8	100
310-90	0.1824	0.0023	0.5143	0.0061	12.933	0.172	165	112106	0.001	2675	20	2675	26	100
310-99	0.0738	0.0010	0.1773	0.0021	1.804	0.025	152	47497	0.003	1037	26	1052	11	101
310-77	0.0551	0.0014	0.0682	0.0010	0.518	0.013	142	13339	0.011	417	56	425	6	102

Analysis	Isotopic ratio $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{235}U$	1σ	Counts per second ^{204}Pb	^{206}Pb	Net ^{204}Pb	Age $^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	% Conc.
310-96	0.0556	0.0008	0.0717	0.0008	0.550	0.008	157	33347	0.005	437	31	447	5	102
310-78	0.0660	0.0009	0.1372	0.0016	1.249	0.017	162	62565	0.003	807	27	829	9	103
310-26	0.0956	0.0012	0.2795	0.0031	3.684	0.047	178	121998	0.001	1540	23	1589	16	103
310-84	0.3035	0.0037	0.7496	0.0095	31.362	0.430	194	506355	0.000	3488	19	3606	35	103
310-100	0.0603	0.0009	0.1036	0.0012	0.862	0.013	148	25675	0.006	615	32	636	7	103
310-42	0.0606	0.0008	0.1062	0.0011	0.886	0.011	185	105060	0.002	625	27	650	7	104
310-68	0.0966	0.0012	0.2866	0.0034	3.816	0.051	177	291016	0.001	1559	23	1624	17	104
310-70	0.0553	0.0008	0.0713	0.0009	0.543	0.008	131	34020	0.004	423	33	444	5	105
310-37	0.0483	0.0012	0.0185	0.0003	0.123	0.003	162	10635	0.015	112	57	118	2	106
310-57	0.0576	0.0007	0.0884	0.0010	0.703	0.009	162	79737	0.002	515	27	546	6	106
310-86	0.0788	0.0011	0.2119	0.0026	2.301	0.034	151	28419	0.005	1167	27	1239	14	106
310-89	0.0563	0.0008	0.0794	0.0010	0.616	0.009	155	42785	0.004	462	31	493	6	107
310-64	0.0703	0.0011	0.1700	0.0023	1.649	0.027	126	63653	0.002	938	31	1012	13	108
310-62	0.0549	0.0008	0.0719	0.0009	0.544	0.008	153	24706	0.006	409	32	447	5	110
310-44	0.0585	0.0008	0.0987	0.0012	0.796	0.012	164	28214	0.006	550	31	607	7	110
310-60	0.0534	0.0010	0.0609	0.0008	0.448	0.008	161	14999	0.011	344	40	381	5	111
310-63	0.0737	0.0009	0.1999	0.0023	2.031	0.025	149	114657	0.001	1033	23	1175	13	114
310-59	0.0576	0.0008	0.0947	0.0011	0.751	0.010	192	106974	0.002	512	29	583	6	114
310-45	0.0544	0.0009	0.0725	0.0009	0.543	0.009	175	20880	0.008	387	35	451	5	117
310-52	0.0583	0.0008	0.1052	0.0013	0.846	0.013	171	139559	0.001	541	30	645	8	119
310-73	0.0576	0.0007	0.1031	0.0012	0.819	0.011	154	94703	0.002	513	26	633	7	123
310-88	0.0486	0.0009	0.0279	0.0004	0.187	0.004	152	24948	0.006	129	43	177	2	138