Tasmanian Geological Survey Record UR2016/04

# Age constraints and provenance of the Mount Bischoff inlier and the Luina Group: evidence from LA-ICPMS U-Pb dating of detrital zircon

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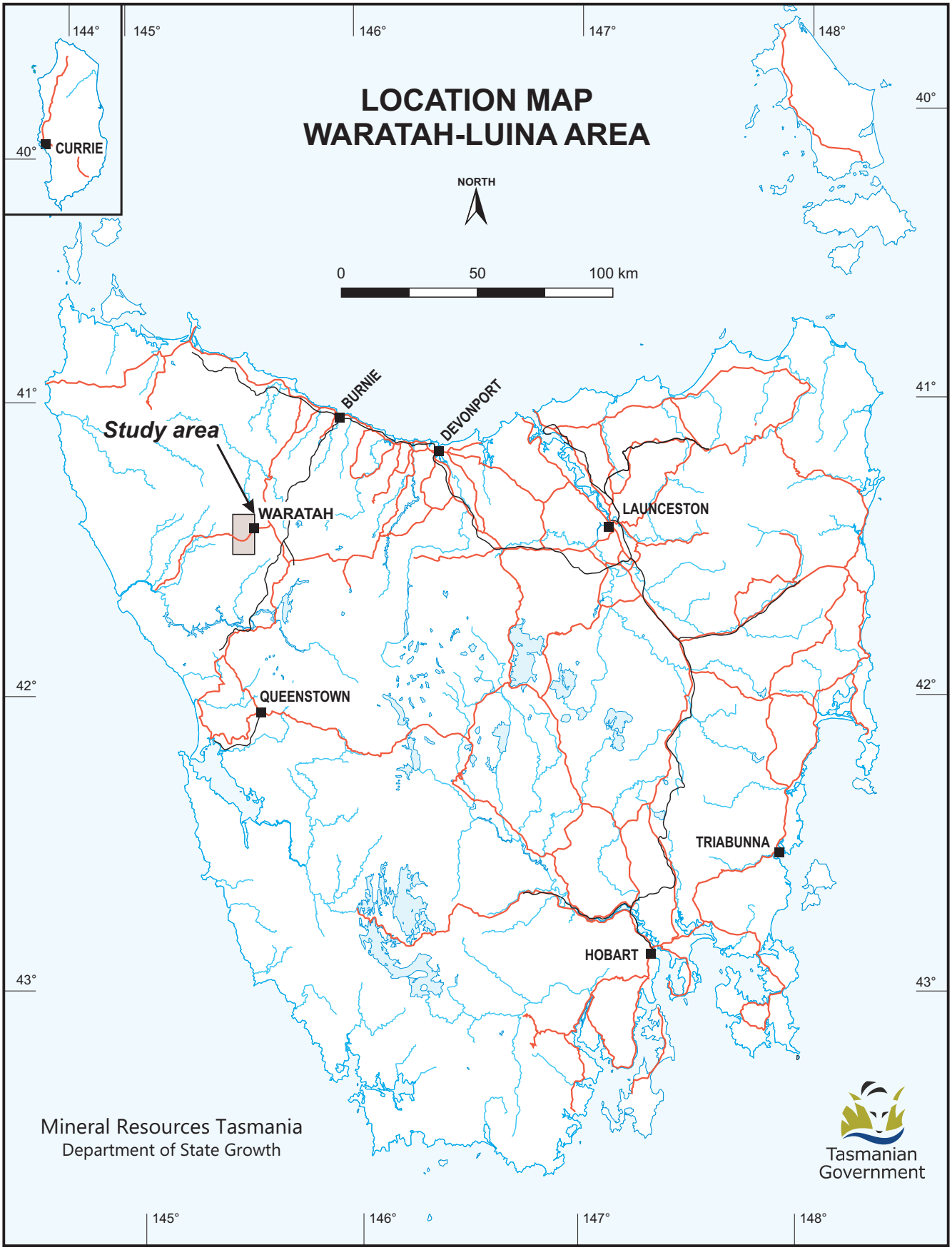
LOCATION MAP
WARATAH-LUINA AREA
NORTH
0
50
100 km
144°
145°
146°
147°
148°
40°
41°
42°
43°
CURRIE
BURNIE
DEVONPORT
Study area
WARATAH
LAUNCESTON
QUEENSTOWN
TRIABUNNA
HOBART
Mineral Resources Tasmania
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# Abstract

Recent geological mapping has shown that the Waratah area, northwest Tasmania, is structurally complex, with numerous probable thrust-emplaced sedimentary and igneous units of inferred Proterozoic or Early Cambrian age. In order to better constrain the age of two poorly dated units, detrital zircon was extracted from two samples from the Mt Bischoff inlier and five samples from the Luina Group, and dated by the U-Pb method using laser ablation inductively coupled mass spectrometry (LA-ICPMS).

Results from the quartz sandstone samples from Mount Bischoff inlier indicate that they were deposited after ~1030 Ma. The detrital zircon age spectra are comparable to those previously obtained from the Oonah Formation, and support a previously suggested correlation with this unit, although they are also broadly similar to many other western Tasmanian Proterozoic successions. However, this age constraint is significantly younger than the 1100–1280 Ma maximum ages obtained from the Oonah Formation and correlatives elsewhere. Our data also suggest a fluid-flow event indicated by lead loss and metamict zircon ages at ~757 Ma, which may be an expression of the Wickham Orogeny.

Our results from the Luina Group indicate that it was deposited after ~536 Ma, and support a pre-Tyennan age (>510 Ma) inferred from field relations, thus tightly constraining its age as Early Cambrian. Two samples from volcaniclastic intervals within the locally lowermost unit, the Deep Creek Volcanics, contain only young (<583 Ma) zircons, which probably record a nearby episode of late Ediacaran felsic-intermediate volcanism. The overlying Halls Formation (one sample) and Crescent Spur Sandstone (two samples) are dominated by much older zircons, consistent with a progressively increasing influx of terrigenous material, probably from a more distal source. The age spectra of two of these samples have prominent peaks at 1700–1800 Ma and are similar to those of many Proterozoic terranes in western Tasmania. The other sample from the Crescent Spur Sandstone has a quite different age profile with a broad peak at 1050–1150 Ma, a feature only previously observed in the Wings Sandstone from southern Tasmania.


# Introduction

In the Waratah-Luina area, northwest Tasmania, two major structurally complex rock units are apparently unfossiliferous and, despite recent detailed geological mapping, their age is poorly constrained by geological relationships. The rocks of the fault-bounded Mount Bischoff inlier consist of lithological correlatives of the Oonah Formation, which elsewhere has been shown to be older than ca. 750 Ma and probably younger than ca. 1100 Ma (Black et al. 2004). An Early Cambrian age has been proposed for the Luina Group (previously known as the Cleveland-Waratah association; Brown 1989), but it has only confidently been shown to be older than ca. 510 Ma, and a correlation with the Neoproterozoic Crimson Creek Formation has also been suggested (e.g. Brown 1986).

In order to obtain better constraints on the depositional age and provenance of each unit, detrital zircons were separated from representative samples of each and dated by the U-Pb method, using laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS).

# Geological Setting

The distribution in northwest Tasmania of the Oonah Formation and correlatives, and the Luina Group, is shown in Figure 1.

Both the Mount Bischoff inlier and the Luina Group are structurally juxtaposed or interleaved with several slices of arc-related boninites, low-titanium tholeiites

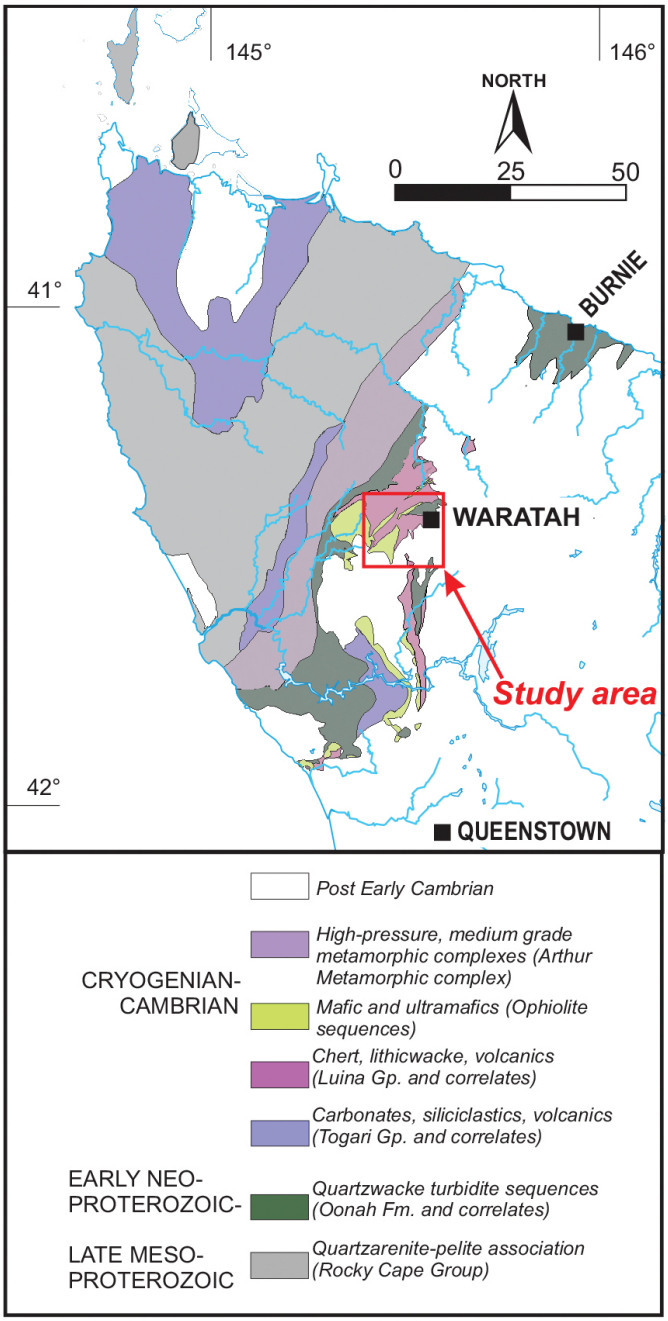



Figure 1. NW Tasmania showing the extent of Neoproterozoic to Cambrian rock units, with the study area shown.

and complementary ultramafics (including the Magnet, Whyte River and Heazlewood River complexes). These are considered to be the dismembered fragments of an ophiolite which was obducted westward over a passive margin, following an arc-continent collision at ca. 510 Ma, during an event known as the Tyennan Orogeny (Berry & Crawford 1988; Crawford & Berry 1992; Berry et al. 2007; Meffre et al. 2000; Chmielowski & Berry 2012; Mulder et al. 2016). The Waratah-Luina region is considered by Berry (2014) to lie in the "External Zone" or foreland of the obduction complex, in which "relatively intact ophiolites sit on top of a relatively unmetamorphosed (very low grade) continental shelf sequence dominated by thin skinned deformation."

The Luina Group is a probably allochthonous package of deep water sedimentary rocks, MORB-like rift tholeiite basalts and continentally-derived micaceous quartzwacke turbidites (e.g. Everard and Calver 2014). The Oonah Formation and correlatives consist mainly of continental turbidites with lesser pelite, dolostone and alkali basalt, and may represent parautochthonous thin-skinned slices of the passive margin, deformed and transported during the Tyennan Orogeny (e.g. Berry 2014).

## *Mount Bischoff inlier*

The Mount Bischoff inlier crops out over about 17 km$^2$ immediately north of Waratah. It is bounded by faults just west of Arthur River, south of Deep Gully Creek and north of Ritchies Creek, and is overlapped by Tertiary basalt to the east. It comprises a 600-m-thick sequence of quartzite, siltstone and shale, overlain by a 60-m-thick unit of dolomite, followed by a 300-m-thick sequence of shale, siltstone and minor quartzite. The rocks of the Mt Bischoff inlier have undergone complex structural deformation and metamorphism (Groves 1969; Williams, in Seymour 1989). Folding of pelite and quartz sandstone beds is tight, especially directly adjacent to the margins of the inlier (Fig. 3). Williams (in Seymour 1989) identified two Proterozoic and two Devonian episodes of folding in the Mt Bischoff inlier. However, subsequent work elsewhere in Tasmania indicates that the earlier events ("Penguin Orogeny") are probably Cambrian in age (Seymour & Calver 1995; Turner et al. 1998) and attributable to the Tyennan Orogeny.

The contact between the Mount Bischoff inlier and the enclosing Luina Group is complex. In drill-core (Fingerpost BH-1), the Oonah Formation near this contact comprises an interval of foliated black to grey, weakly carbonaceous mudstone, siltstone and quartzite. Elsewhere, the contact is marked by an extensive melange zone (up to 200 m across) in which a series of faults implies significant movement. Quartzite-pyrite clast breccias, of probable hydrothermal origin, crosscut the Oonah Formation above these fault zones.

## *Luina Group*

The term Luina Group was formalised by Everard and Calver (2014) to apply to "the succession of sedimentary rocks and intercalated basalt north of the Heemskirk

Granite and east of the Heazlewood River Ultramafic Complex." It comprises a thick sequence of lithicwacke sandstone, maroon volcaniclastic (locally shard-rich) siltstone, mudstone, chert and minor dolostone intercalated with tholeiitic, locally pillowed basalt flows. It is equivalent to the Luina Beds of Rubenach (1973) and Ford (1981), and the Arthur River sequence of Groves and Solomon (1964) and Groves (1968). These and subsequent workers (e.g. Brown 1986; Varne & Foden 1987) correlated these rocks with the Crimson Creek Formation, a lithologically similar sequence in the Pieman River-Renison Bell area (Blissett 1962). However, Brown and Jenner (1988) and Brown (1989), on the basis of basalt geochemistry (including unpublished Nd isotope data) and sedimentological differences, considered that they form a distinct succession with ocean-floor affinities, in contrast to the continentally derived Crimson Creek Formation. Brown (1989) applied the informal term "Cleveland-Waratah association" to these rocks.

Previous and recent mapping suggests the Luina Group extends northwards and generally dips and faces NW at Luina (Collins 1983; Everard 2003), and traces of fold axes generally strike NNE along the flanks of Magnet Range and towards Horizontal Creek, northwest of Waratah. To the northwest, the Luina Group is faulted against the Heazlewood River Ultramafic Complex and the Oonah Formation. The Luina Group extends northward to the Hellyer River near Parrawe and southward along the eastern margin of the Huskisson Syncline to the vicinity of Rosebery. Possible correlates occur near Ulverstone (the Barrington Chert and Motton Spilite), near Trial Harbour, in southwest Tasmania (the Mainwaring Group) and near Adamsfield (the Ragged Basin Complex).

In the vicinity of the Cleveland Mine at Luina, the designated type area of the Luina Group (Everard & Calver 2014), Collins (1983) recognised three formations. The Deep Creek Volcanics (tholeiitic basalt and intercalated mainly volcaniclastic sediment), is overlain by the Halls Formation (dominantly shale, greywacke, chert and dolomite), followed by the Crescent Spur Sandstone (micaceous quartz-rich lithicwacke and interbedded siltstone, mudstone and chert).

Subsequent geological mapping on the Luina and Waratah 1:25,000 sheets (Everard & Cumming 2016) has shown that these lithological groupings can be recognised away from the type area, but are not necessarily in the same stratigraphic order.

# Previous age constraints

## *Oonah Formation*

The type area of the Oonah Formation is northwest of Zeehan (Oonah Quartzite and Slate; Spry 1958; Blissett 1962). Probable correlatives are present on the northwest coast (Burnie Formation (e.g. Spry 1957; Gee 1968, 1977) and the north coast (Badger Head Group; Gee & Legge 1979). There are also several smaller, mainly fault-bounded inliers in western Tasmania, at Dundas (Concert Schist of Blissett 1962), Ramsay River (Brown 1986) and south of Macquarie Harbour (McClenaghan & Findlay 1989, 1993), as well as Mount Bischoff. Everard and Calver (2014), to simplify nomenclature, applied the term Oonah Formation to all these occurrences.

The age of the Oonah Formation is poorly constrained from geological relationships. In the Pieman River, within the type area, Taylor (1954) and Brown (1986) inferred an unconformable relationship between the Oonah Formation and the Success Creek Group, because of the greater structural complexity of the former. However, the actual contact (now beneath Lake Pieman) is faulted. The age of the Success Creek Group is indirectly constrained by a correlation with the Togari Group of the Smithton area, the base of which is ca. 750 Ma, based on carbon and strontium isotope chemostratigraphy (Calver 1998).

At Burnie, the Burnie (i.e. Oonah) Formation is intruded by sills of the Cooee Dolerite. Peperitic textures at the contact suggest that the dolerite was intruded into wet, unconsolidated sediment (Gee 1977; Crook 1979). However, a K-Ar biotite date of 711 ± 16 Ma (recalculated for new decay constants) from the Cooee Dolerite was interpreted as a minimum age due to possible argon loss (McDougall & Leggo 1965). Therefore it provides only a minimum depositional age for the Oonah Formation. Efforts to obtain a more robust radiometric date from the Cooee Dolerite have so far been unsuccessful (e.g. Black et al. 1997; Turner et al. 1998).

The relationship of the dominantly turbiditic Oonah Formation to the shelf succession of the Rocky Cape Group (Mesoproterozoic: Halpin et al. 2014) in far northwest Tasmania has been controversial. The two units are separated by the Arthur Metamorphic Complex, which contains higher grade equivalents of both, but are nowhere in unfaulted contact. Gee (1967) considered that the Burnie (Oonah) Formation is younger than the Rocky Cape Group and was possibly derived from it. Gee (1968) suggested, on general

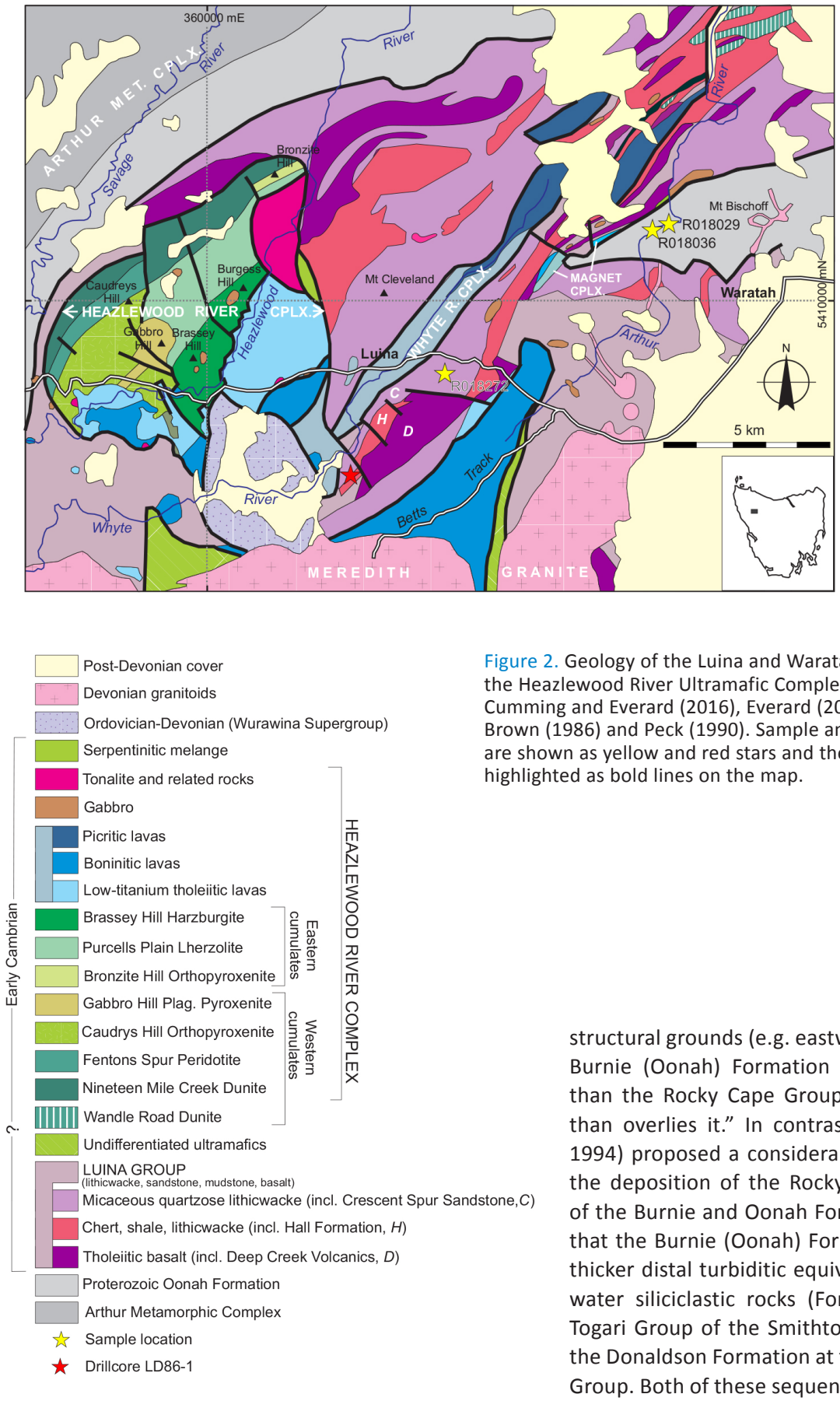



Figure 2. Geology of the Luina and Waratah area, including the Heazlewood River Ultramafic Complex. Adapted from Cumming and Everard (2016), Everard (2016), Collins (1983), Brown (1986) and Peck (1990). Sample and drill-hole location are shown as yellow and red stars and the key faults are highlighted as bold lines on the map.

structural grounds (e.g. eastward younging) that the Burnie (Oonah) Formation was probably younger than the Rocky Cape Group, "but onlaps it rather than overlies it." In contrast, Turner et al. (1992, 1994) proposed a considerable time-span between the deposition of the Rocky Cape Group and that of the Burnie and Oonah Formations. He suggested that the Burnie (Oonah) Formation may be a much thicker distal turbiditic equivalent to basal shallow-water siliciclastic rocks (Forest Formation) in the Togari Group of the Smithton Synclinorium, and to the Donaldson Formation at the base of the Ahrberg Group. Both of these sequences are mid-Cryogenian in age and rest unconformably on the Rocky Cape Group (Seymour and Calver 1995).

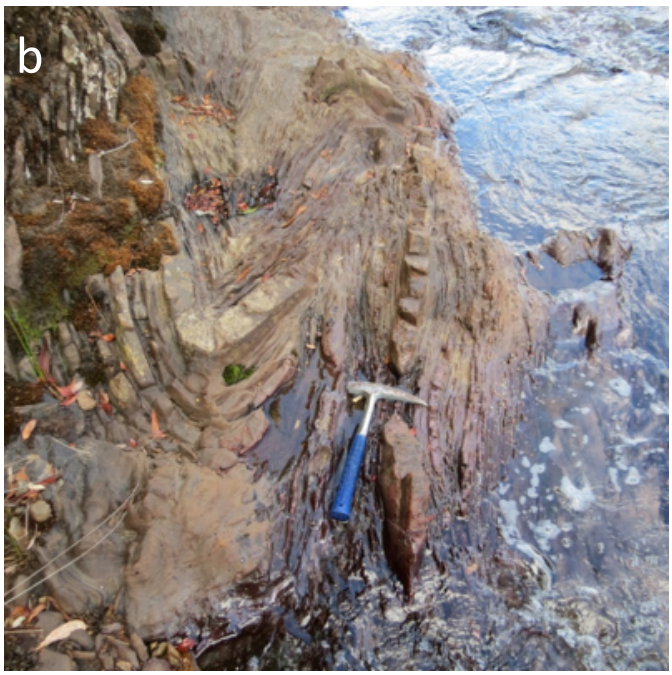




Figure 3. Photographs showing thinly bedded pelites and more resistant ortho-quartz sandstones which were sampled for geochronology. Samples were selected from Arthur River (sample R018036; shown in photograph a) and Magnet Creek (R018029; shown in photograph b).

A previous detrital zircon study, aimed at constraining the deposition age and provenance of predominantly western Tasmanian Proterozoic successions (Black et al. 2004), included three samples of the Oonah Formation and correlatives. A sample from Montana Flats, near the type area, yielded two zircons with an "imprecisely defined" age of ca. 1200 Ma. The two youngest zircons from a sample from the Heazlewood River (near Savage River township and about 20 km WSW of the Mt Bischoff inlier) were ca. 1280 Ma. A sample from the Badger Head inlier on the north coast contained a single zircon of ca. 1100 Ma "which in isolation does not provide a precise temporal constraint for deposition" which was "better achieved by the nine next oldest grains, which yield an age of 1242 ± 29 Ma." All three samples yielded complex but similar age spectra of older zircons, with prominent components at ca. 1435–1470 Ma and 1780–1790 Ma, and many Archean zircons.

### *Luina Group*

A minimum age for the Luina Group can be inferred from the age of the allochthonous arc-related volcanic and ultramafic complexes, tectonically emplaced within it. In particular, igneous zircons from a tonalite, considered to represent the last stage of magmatism in the Heazlewood River Ultramafic Complex, gave a SHRIMP U-Pb age of 513.6 ± 5.0 Ma, using the QCNG standard (Black et al. 1997). These authors prefer this age to a previously obtained 510 ± 6 Ma age from the same sample, based on the SL13 standard (Turner et al. 1998).

## Sample selection

Representative samples from the Mount Bischoff inlier and the Luina Group were collected during geological mapping of the region in the period 2012–2015 (Fig. 1) and logging of drill core. Seven samples of relatively coarse-grained clastic facies were selected for age dating purposes (Fig. 2). Sample details are given in Table 1.

### *Oonah Formation*

A distinctive succession of massive quartzite, passing upwards into quartz sandstone, pelite and abundant shale is exposed along the Arthur River and at Mt Bischoff (Figs 2, 3). Two samples were collected from the western part of the inlier, about 1.6 km apart, from outcrop along the upper Arthur River (R018029) and Magnet Creek (R018036).

These lithic and quartz-rich sandstones (including greywacke and quartzite), and siltstones contain 70–90% clastic quartz grains, minor muscovite (2–10%), titanite and monazite (5%) set in a quartz and sericite matrix (Fig. 4a). Clastic grains measure up to 0.2 mm in diameter, with an average grain size of approximately 0.05 mm.

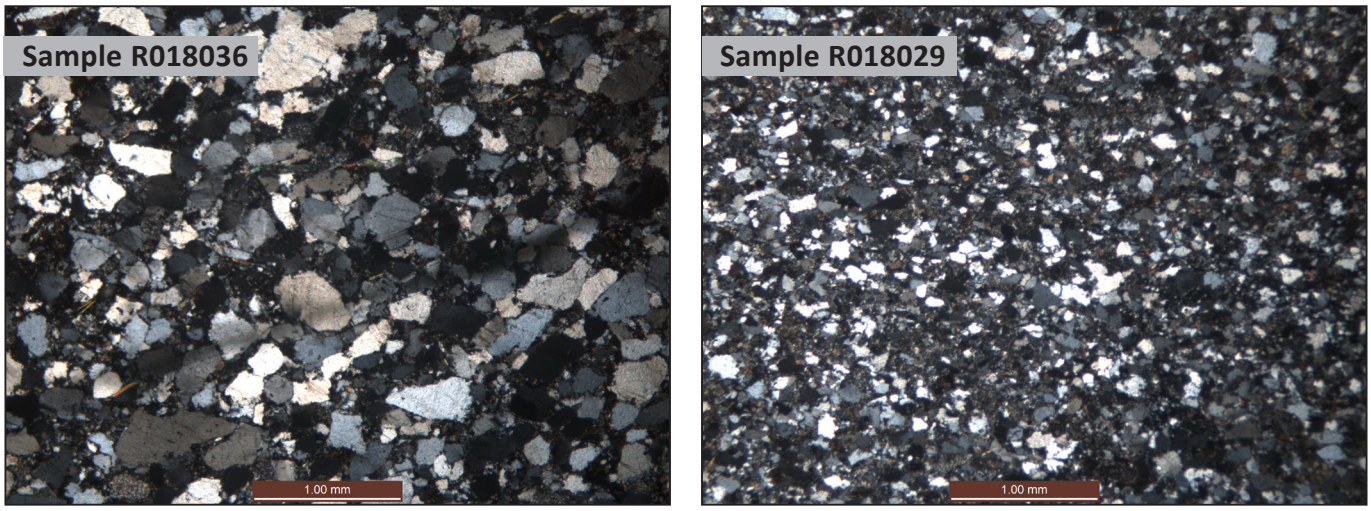



Figure 4a. Photomicrographs of dated samples, showing coarse (R018036) and fine (R018029) grained dominantly quartz sandstone (under cross polarised light).

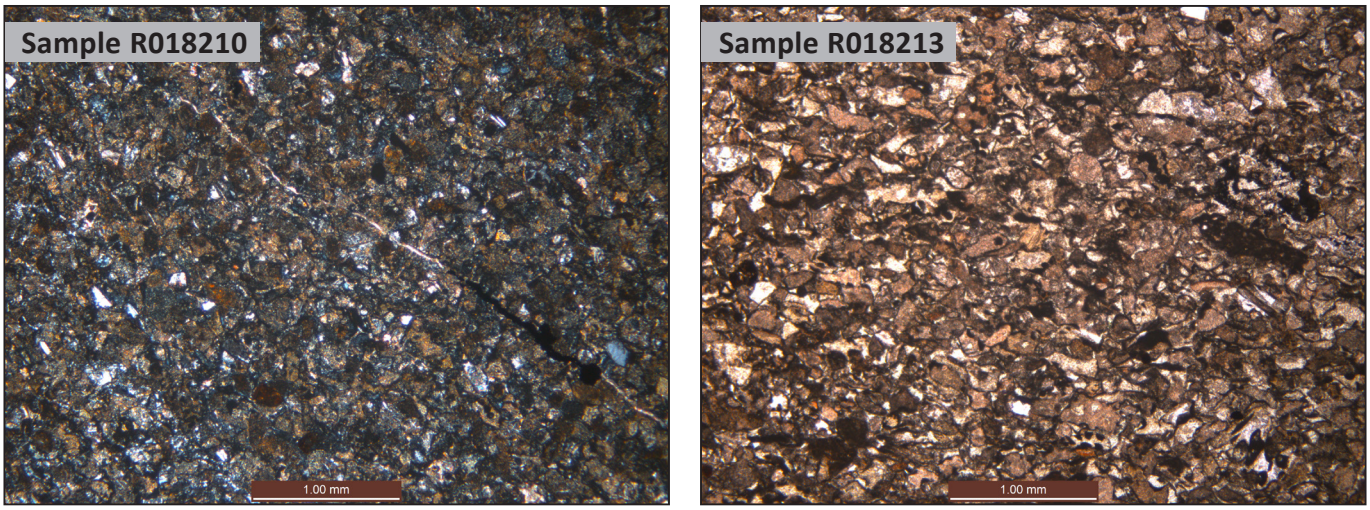



Figure 4b. Photomicrographs of dated samples of volcaniclastic sandstone (R018210 and R018213).

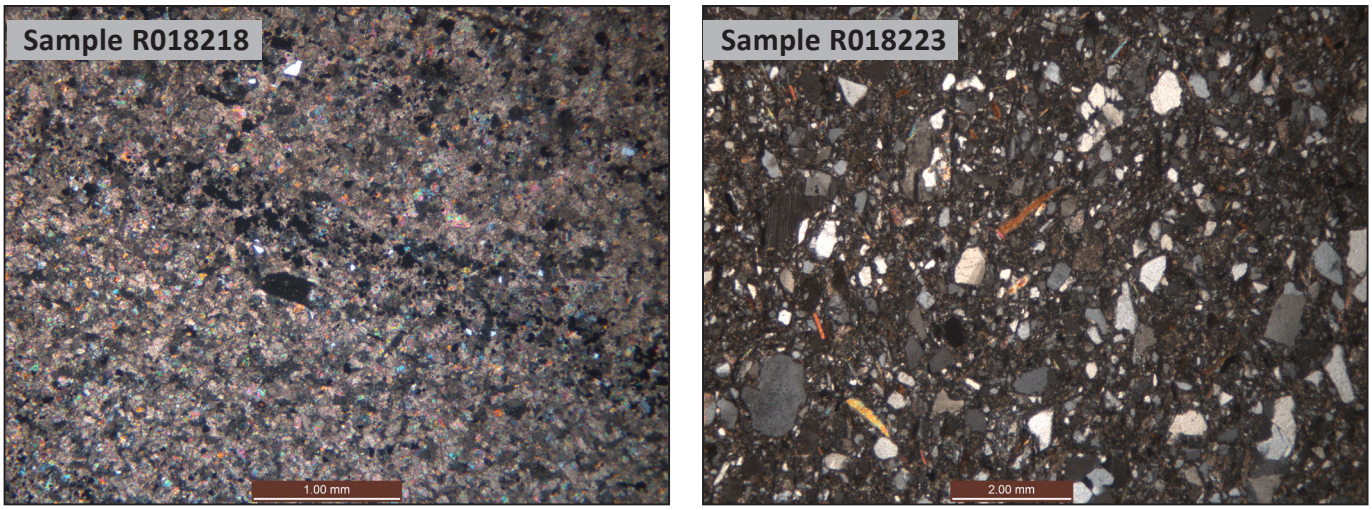



Figure 4c. Photomicrographs of dated samples of massive sandstone (R018218 and R018223).

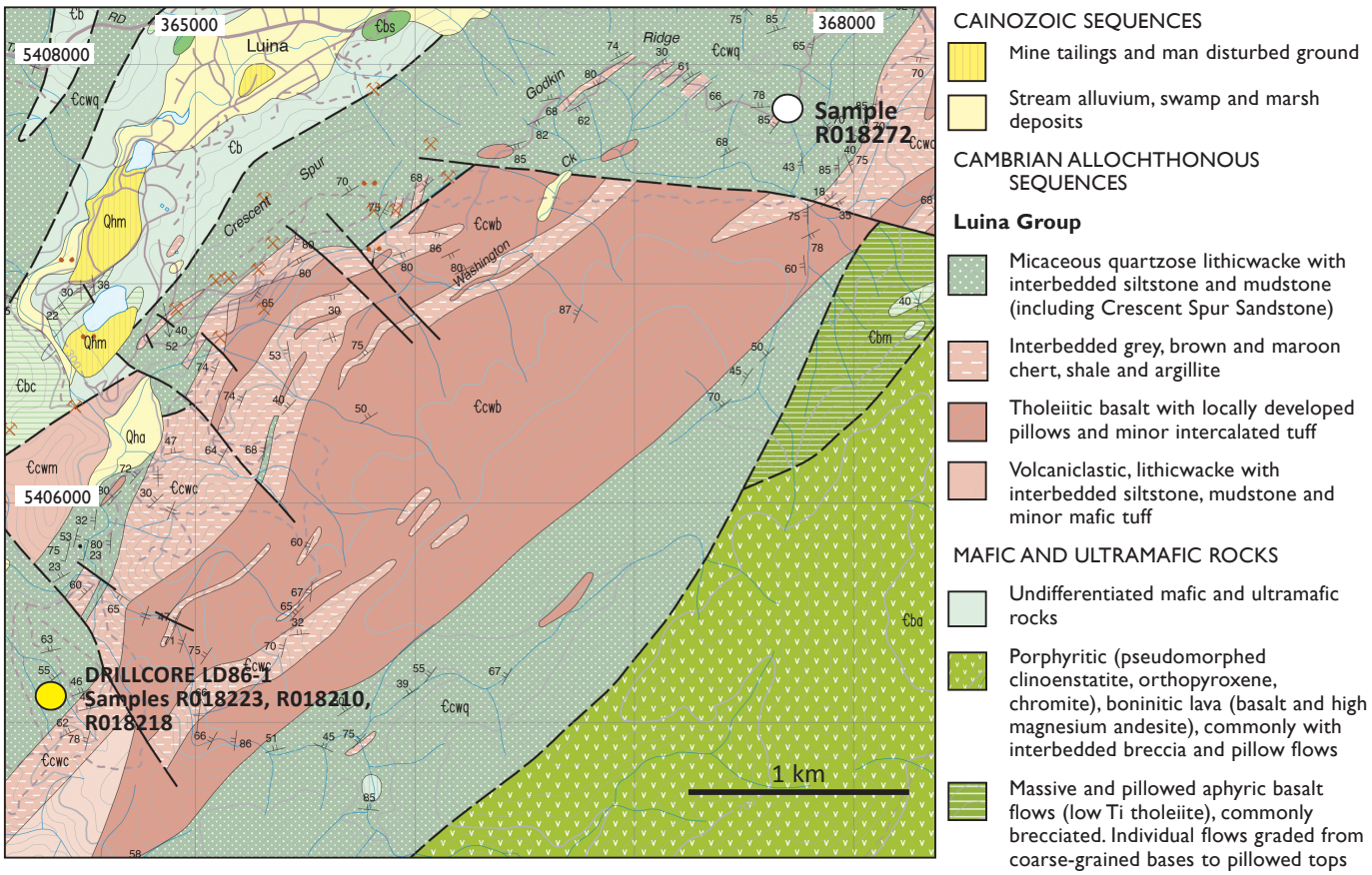



Figure 5. Geological map showing the location of drill-hole LD86-1 south of Luina. Samples R018223, R018210 and R018218 were selected from this core. Sample R018272 was collected from Godkin Ridge and its location is indicated on the map.

**Table 1.** Locations and rock types dated from the Bischoff inlier and the Luina Group

| Sample Number | Locality (GDA94) | Rock Type | Stratigraphic Unit |
|---|---|---|---|
| R018036 | 372365mE/ 5411887mN | Massive sandstone | Oonah Formation |
| R018029 | 373837mE/ 5412538mN | Stratified quartzite | Oonah Formation |
| R018223 | 364312mE/ 5404984mN | Micaceous sandstone | Luina Group; Crescent Spur Sandstone (?) |
| R018218 | 364312mE/ 5404984mN | Massive sandstone | Luina Group; Halls Formation |
| R018210 | 364312mE/ 5404984mN | Massive volcaniclastic sandstone | Luina Group; Deep Creek Volcanics |
| R018213 | 364312mE/ 5404984mN | Volcaniclastic sandstone | Luina Group; Deep Creek Volcanics |
| R018272 | 367796mE/ 5408040mN | Micaceous lithicwacke | Luina Group; Crescent Spur Formation |

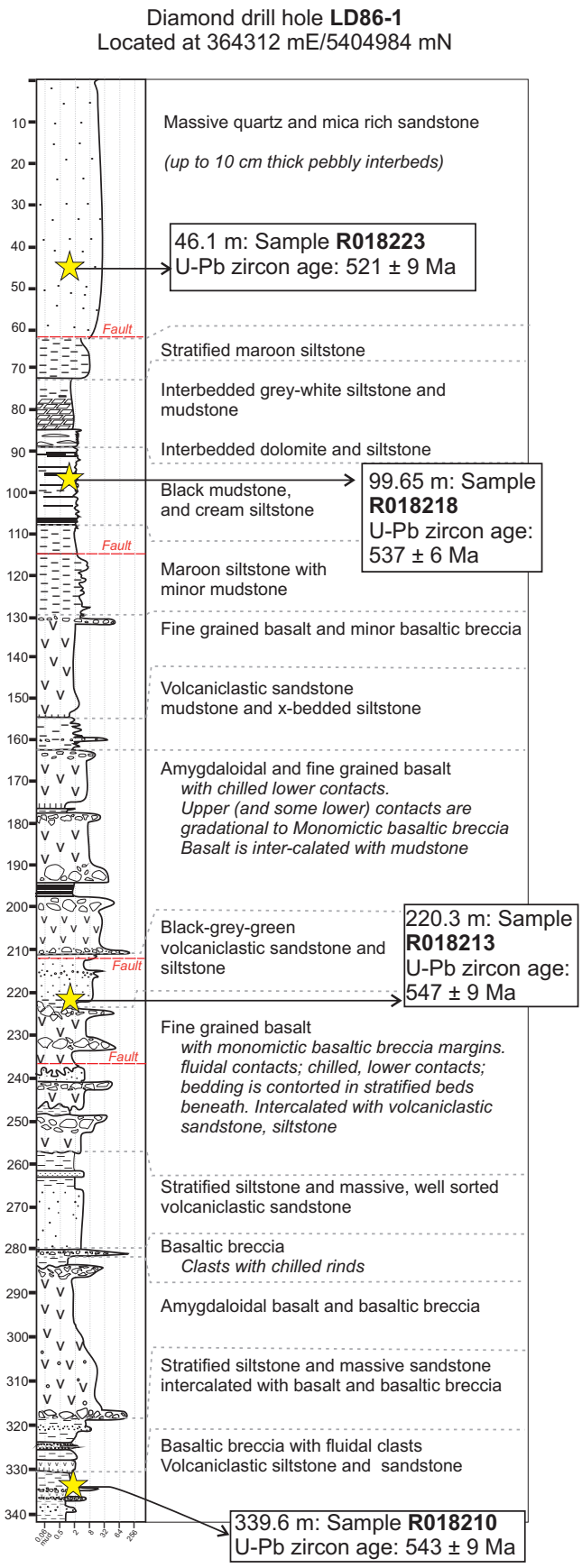



Figure 6. Schematic grainsize log for drillcore LD86-1 showing the key lithologies and sample locations with minimum U-Pb detrital zircon ages for each.

## *Luina Group*

Four samples from the Luina Group were taken from core of hole LD86-1, drilled in 1986 by Billiton Australia about 3.3 km SSW of Luina. The hole was collared in the Crescent Spur Sandstone and plunged at 55° to 132°, approximately normal to local bedding which dips and faces to the northwest. However, stratigraphic relationships are somewhat uncertain due to at least four faults of unknown significance, identified in core (Figs 5, 6).

The hole initially passed through micaceous quartz sandstone, from which a sample (R018223) was taken at 46.1 m. At about 61 m, the hole encountered a faulted contact with a transitional interval of about 60 m of mixed volcanic and non-volcanic units, comprising interbedded maroon, grey-white, cream and black siltstone, mudstone and minor dolomite, referrable to the Halls Formation. A sample (R018218) of a fine-grained non-volcanic, siltstone-dominant interval was taken at 99.65 m. From about 130 m to 342 m (end of hole) the core consists of dominantly basalt and basaltic breccia with intercalated volcaniclastic sandstone, siltstone and mudstone, referrable to the Deep Creek Volcanics. Two samples (R018213, R018210) of glass shard and lithic-rich volcaniclastic sandstone (Fig. 4b) were selected (220.3–220.4 m and 336.2–337 m, respectively).

A second sample of micaceous lithicwacke (R018272) was taken from surface outcrop at Godkin Ridge near Crescent Spur (Fig. 4c). Exposures in this area, along Corinna Road on the northern flank of Godkin Ridge form the type section for the Crescent Spur Formation, where it is over 350 m thick (Collins 1983).

# Geochronology

## *Methods*

U-Pb geochronology was undertaken at the University of Tasmania using the LA-ICPMS technique. The zircons were separated using a gold pan and a hand magnet from 200 g of rock powder crushed to a coarse sand using a ring mill. The zircons were hand-picked from the non-magnetic concentrate, mounted in epoxy resin, polished using a clean lap, washed and analysed using an excimer (193 nm) laser fitted with a Resonetics M50 ablation cell and an Agilent 7500 quadrupole ICPMS. Samples were analysed using a 32 µm spot at 5 Hz and 2J cm$^2$. The 91500 Zircon (Wiedenbeck et al. 1995, 2005)

was used as a primary standard and the Temora, Gj1 and Plesovice zircons (Black et al. 2003; Jackson et al. 2004; Sláma et al. 2008) were used a secondary standard. Pb-Pb mass bias was corrected using the NIST610 standard glass. Age calculations were performed using the techniques described in various University of Tasmania publications (e.g. Sack et al. 2011; Halpin et al. 2014).

## Results

Numerical results for each sample are presented in Table 2 and graphically as plots of $^{238}U/^{206}Pb$ against $^{207}Pb/^{206}Pb$ (Figs 7, 8, 9) and $^{207}Pb/^{235}U$ against $^{206}Pb/^{238}U$ (Figs 7, 8), in each case with concordia curves shown.

For each individual zircon analysis, a "preferred age" was chosen based on the degree of discordance, the amount of common Pb and the age of the zircons. For many analyses, this is the $^{206}Pb/^{238}U$ age, where necessary corrected for common lead, using $^{207}Pb$, to bring to concordia. In most cases, this correction is less than 10 m.y. For those analyses for which lead loss is identifiable, the preferred age has been taken as the $^{207}Pb/^{206}Pb$ age.

The preferred zircon ages from each sample are also presented in the form of an age spectrum (Fig. 10).

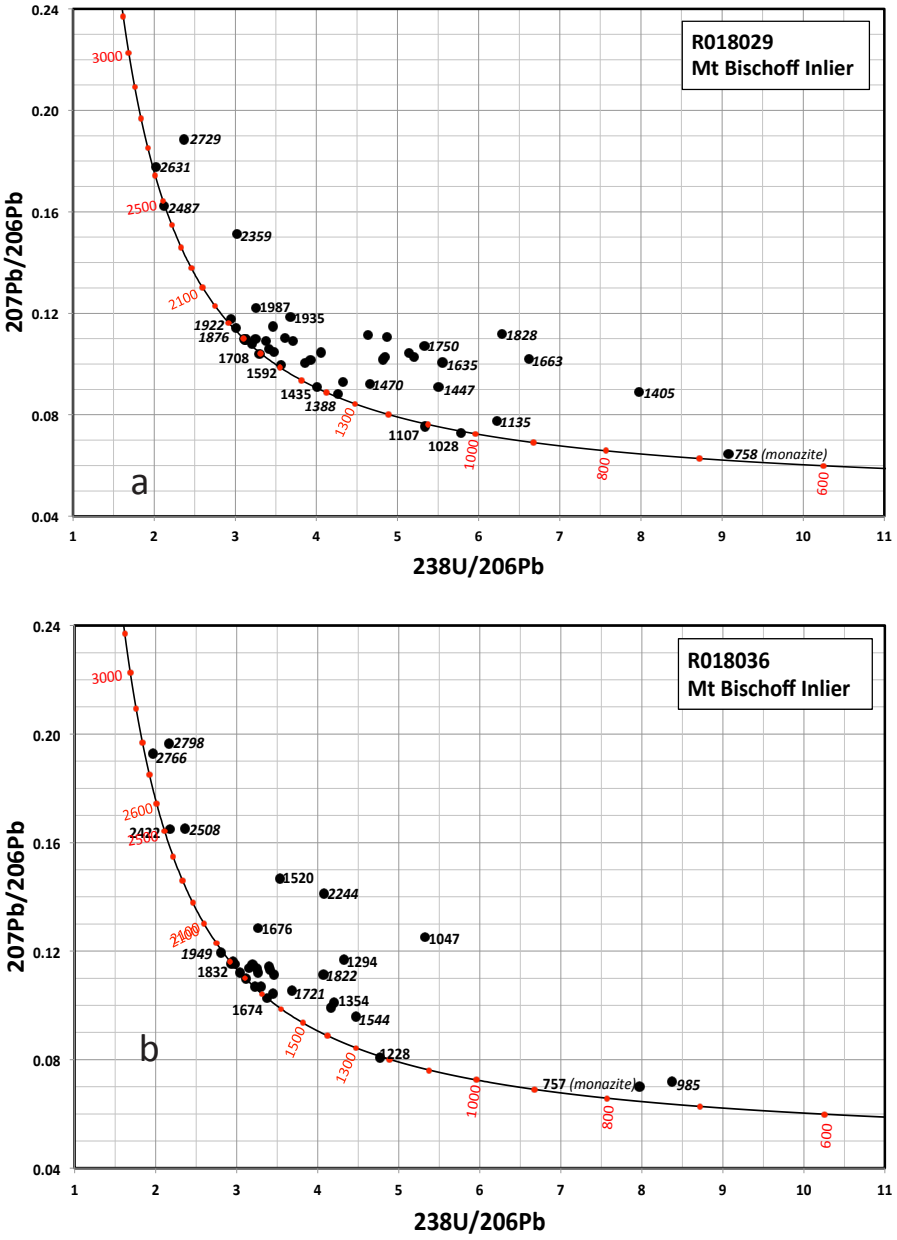
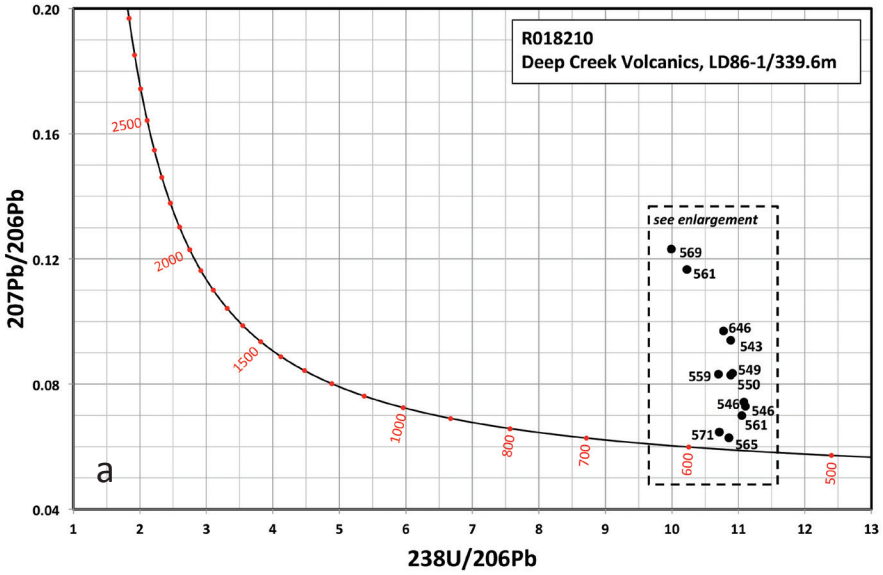



Figure 7. Tera-Wasserburg plots of U-Pb zircon analyses from the Oonah Formation. Individual $^{206}Pb/^{238}U$ ages are labelled in normal type and $^{207}Pb/^{206}Pb$ ages are in italics. A single monazite analysis from R018029 at 758 Ma and from R018036 at 757 Ma may relate to the Wickham Orogeny.


R018210
Deep Creek Volcanics, LD86-1/339.6m
see enlargement
569
561
646
543
559
549
550
546
546
561
571
565
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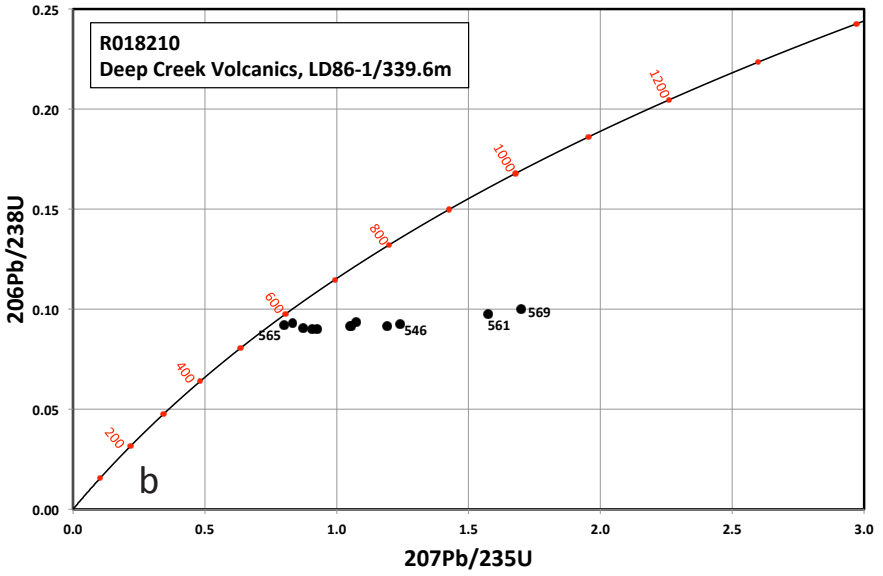
800
700
600
500
a
207Pb/206Pb
238U/206Pb


R018210
Deep Creek Volcanics, LD86-1/339.6m
1200
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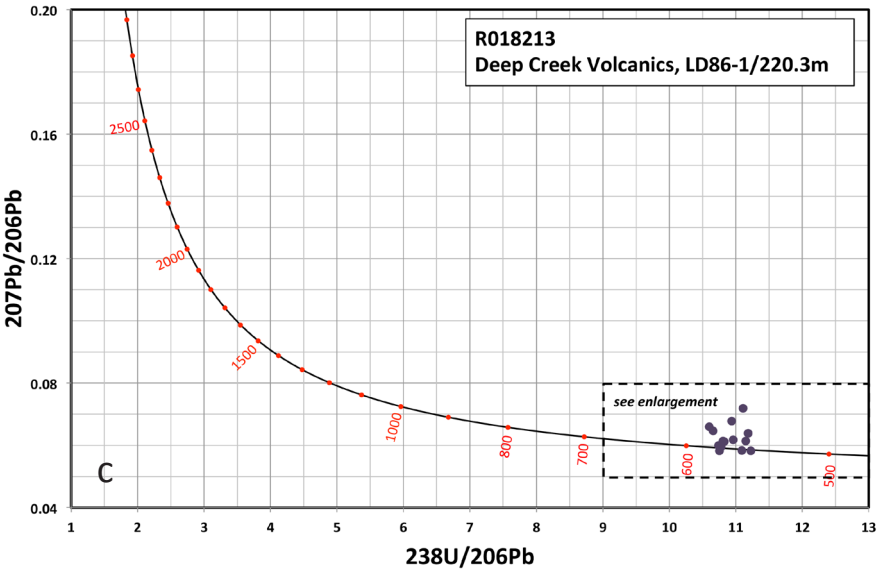
569
b
206Pb/238U
207Pb/235U


R018213
Deep Creek Volcanics, LD86-1/220.3m
see enlargement
2500
2000
1500
1000
800
700
600
500
c
207Pb/206Pb
238U/206Pb

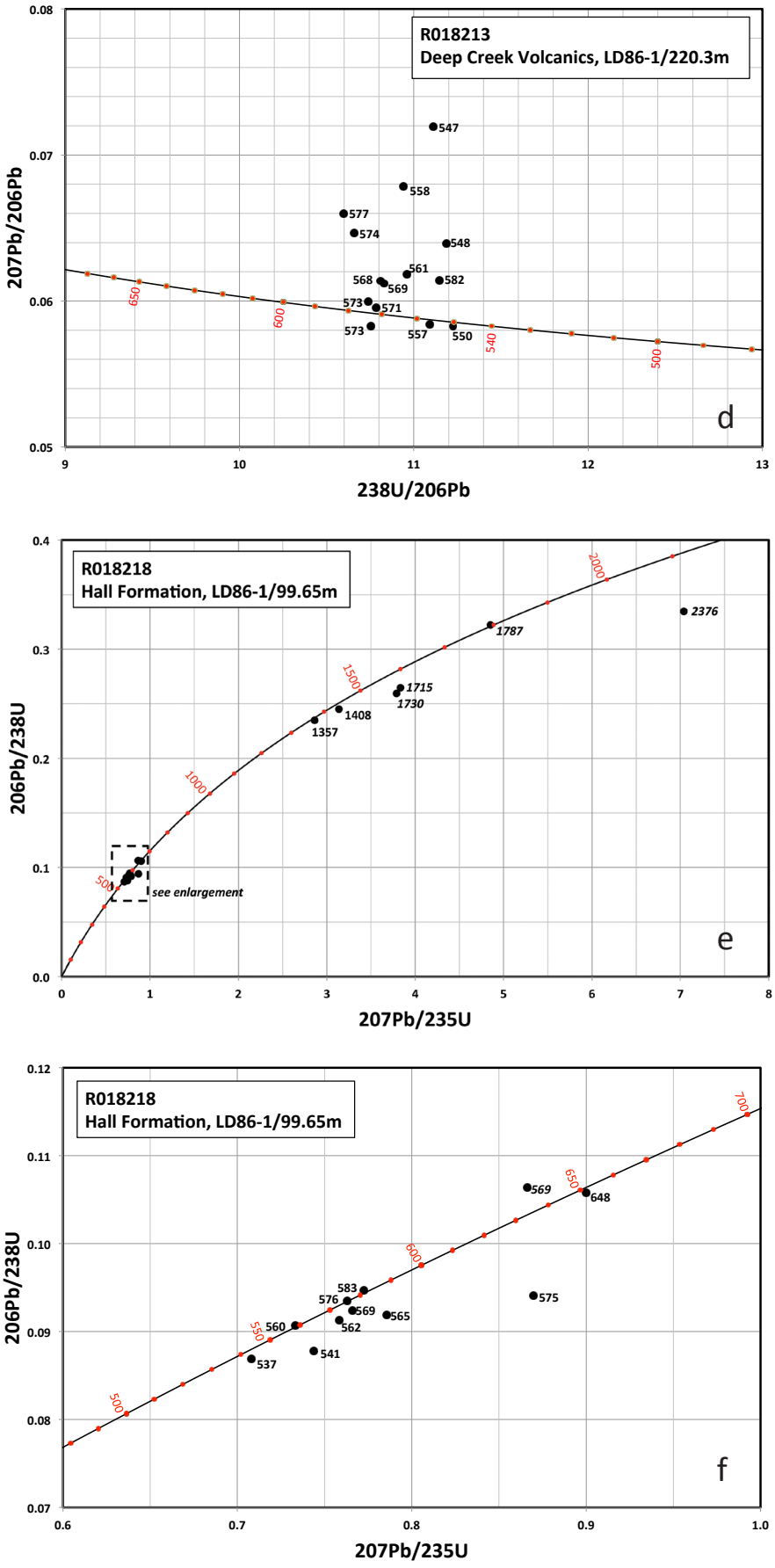
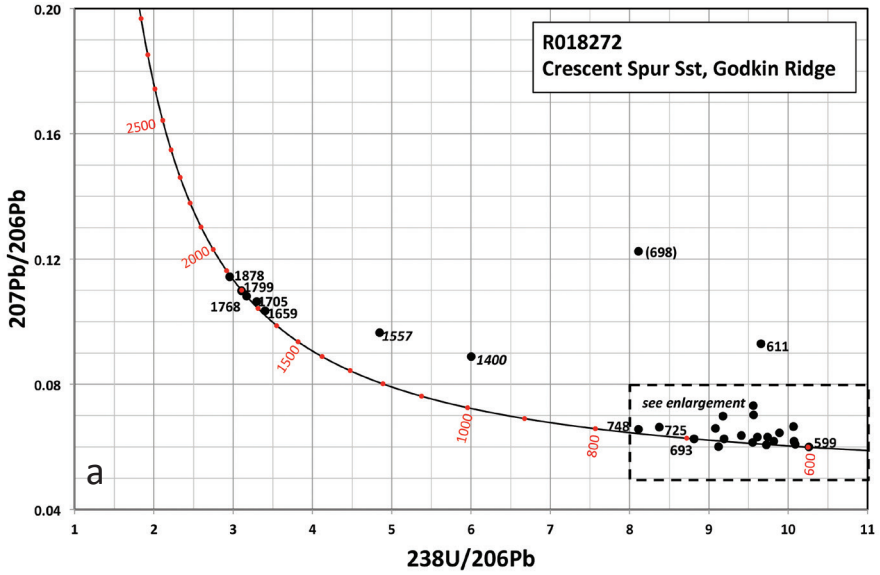
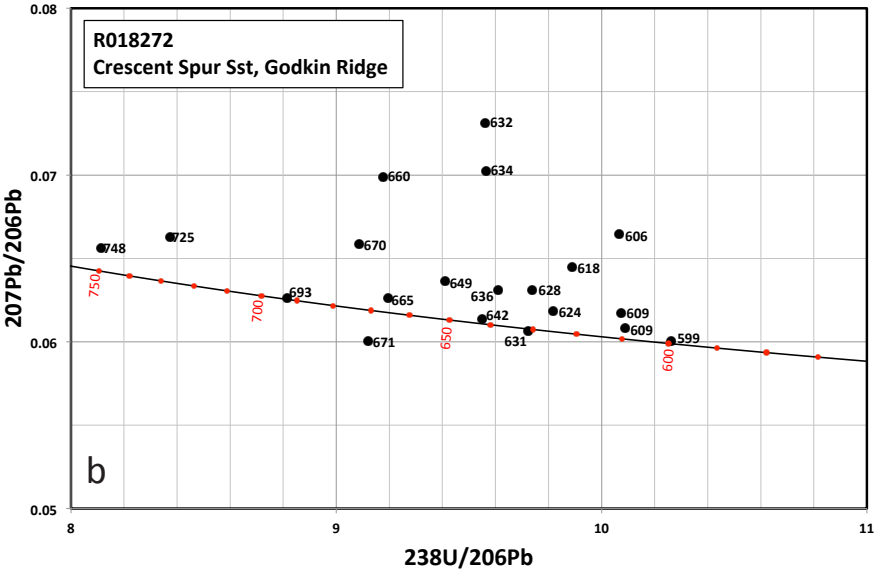
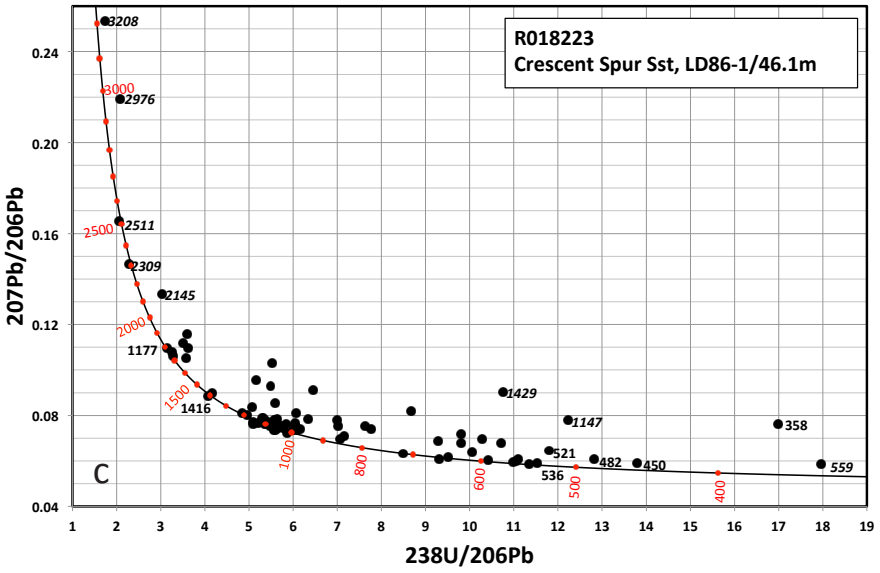



Figure 8 (a–f) Tera-Wasserburg plots of U-Pb zircon analyses for the Luina Group. Individual $^{206}Pb/^{238}U$ ages are labelled in normal type and $^{207}Pb/^{206}Pb$ ages are in italics. Analyses are scaled to show variability and zircons which are non-concordant for R018210, R018213 and R018218.


R018272
Crescent Spur Sst, Godkin Ridge
207Pb/206Pb
238U/206Pb
a
see enlargement
(698)
1878
1799
1768
1705
1659
1557
1400
611
748
725
693
599
2500
2000
1500
1000
800
600


R018272
Crescent Spur Sst, Godkin Ridge
207Pb/206Pb
238U/206Pb
b
632
634
660
606
748
725
670
618
649
636
628
693
665
642
624
609
609
671
631
599
750
700
650
600


R018223
Crescent Spur Sst, LD86-1/46.1m
207Pb/206Pb
238U/206Pb
c
3208
2976
2511
2309
2145
1177
1416
1429
1147
358
521
482
450
559
536
3000
2500
2000
1500
1000
800
600
500
400

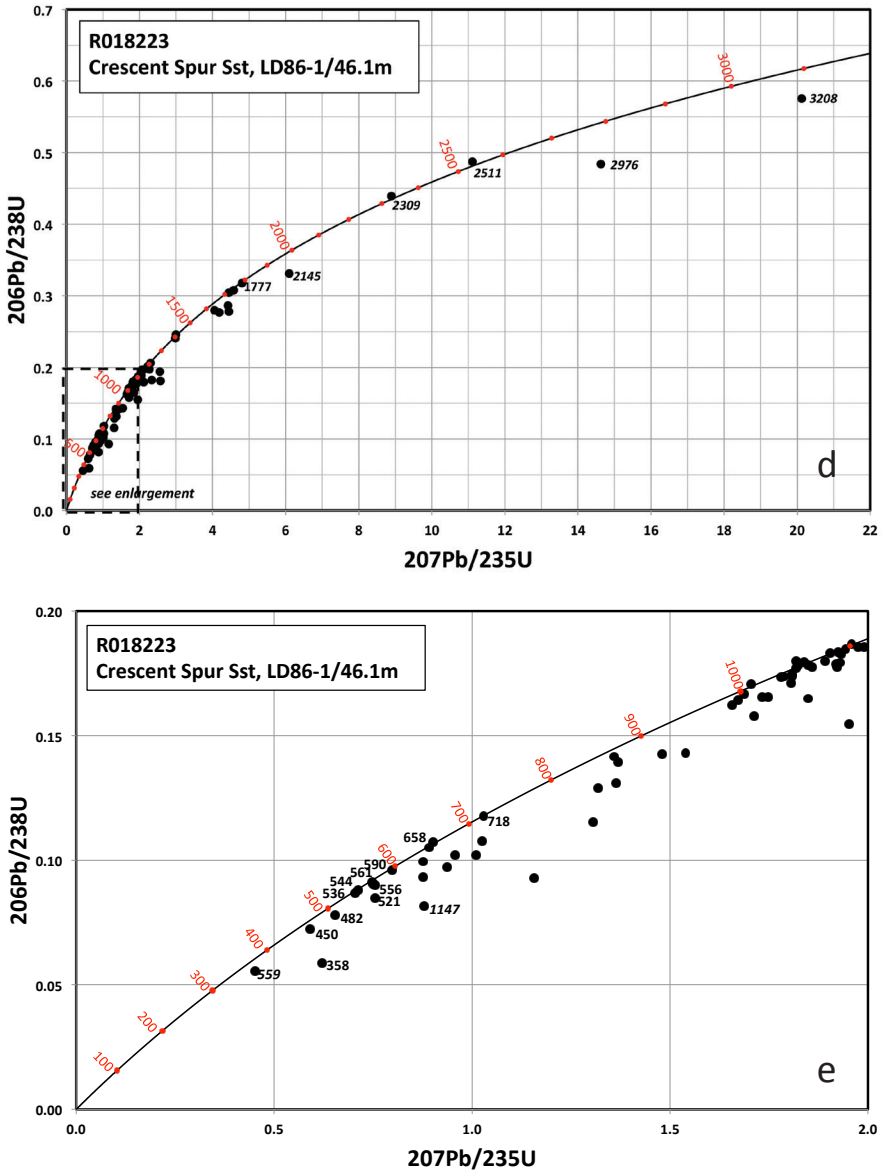



Figure 9 (a–e) Tera-Wasserburg plots of U-Pb zircon analyses for the Crescent Spur sandstone, which forms part of the Luina Group. Individual $^{206}Pb/^{238}U$ ages are labelled in normal type and $^{207}Pb/^{206}Pb$ ages are in italics. Analyses are re-scaled to show various non-concordant zircons in samples R018272 and R018223.

Table 2. Summary of ages for Oonah Formation and the Luina Group. All ages are U-Pb on zircon unless otherwise indicated.

| Sample number | Rock type | Stratigraphic unit | Age | Median age (Ma) | Uncertainty (Ma) |
|---|---|---|---|---|---|
| R018036 | Massive sandstone | Oonah Formation | 757 | 1673.7 | 33 |
| R018029 | Stratified quartzite | Oonah Formation | 758 on monazite | 758 | 21 |
| R018223 | Micaceous sandstone | Luina Group; Crescent Spur Formation | 358 | 450 | 11 |
| R018218 | Massive sandstone | Luina Group; Halls Formation | 537 | 570.6 | 5.4 |
| R018210 | Massive volcaniclastic sandstone | Luina Group; Deep Creek Volcanics | 543 | 556.3 | 6.7 |
| R018213 | Volcaniclastic sandstone | Luina Group; Deep Creek Volcanics | 548 | 562.4 | 6.3 |
| R018272 | Micaceous lithicwacke | Luina Group; Crescent Spur Formation | 599 | 613.5 | 7.3 |

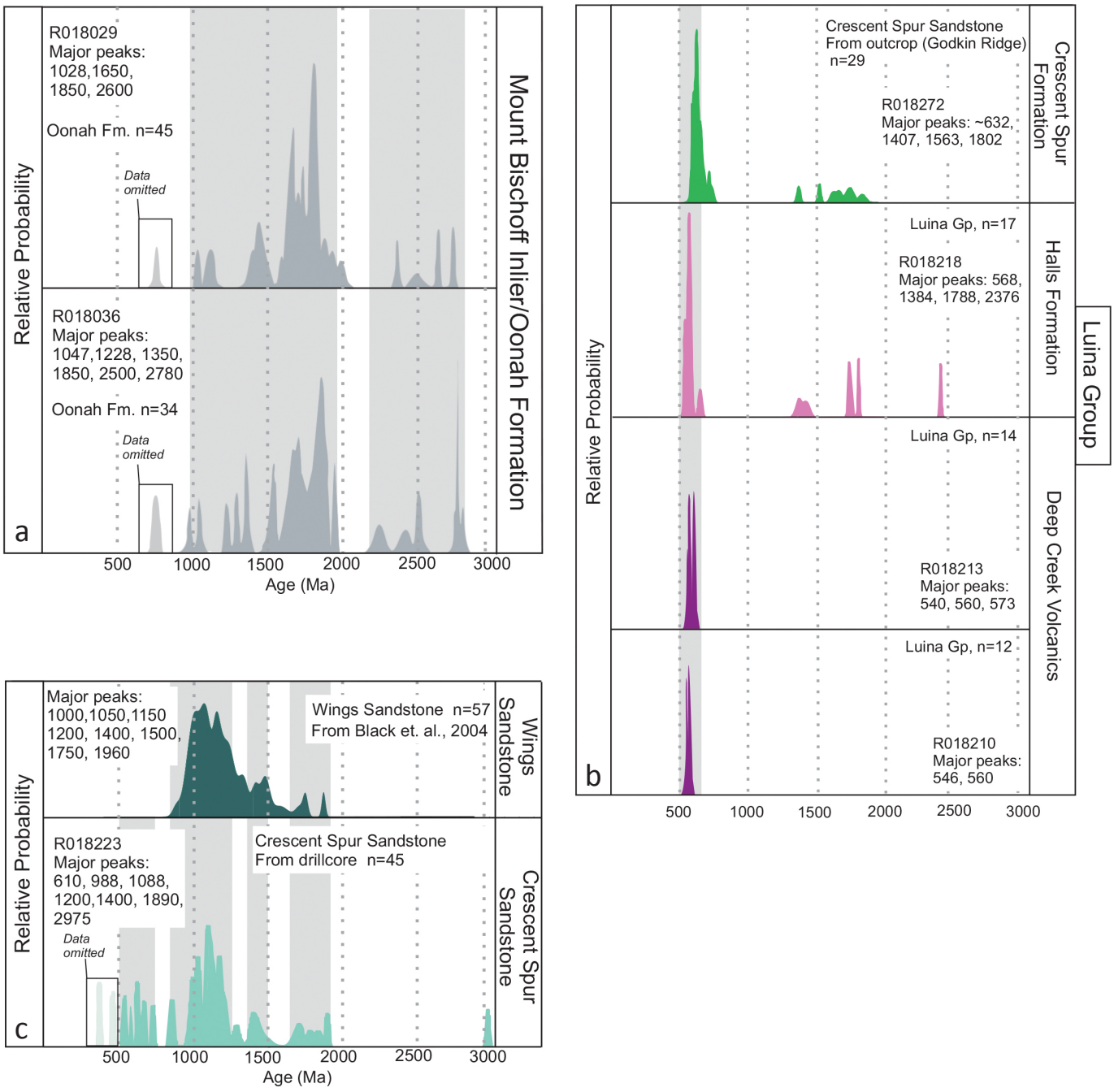



Figure 10. Probability plots of U-Pb ICPMS ages of detrital zircons from the Luina-Waratah region. (a) Probability plots for samples from the Oonah Formation. The 758 and 757 ages (as highlighted in the block on the left hand side) are omitted from the final age calculations. (b) The samples from the Luina Group show peak age ranges between 546 and 632 Ma and the volcanic dominated facies do not reveal any Paleo-Mesoproterozoic aged zircons. Samples from the Halls Formation and Crescent Spur Formation have similar detrital spectra. (c) The Wings Sandstone and sample R018223 from the Luina Group show a similar detrital spectrum between 1000 and 2000 Ma.

## *Mount Bischoff inlier (Oonah Formation correlative)*

**R018029**

Many of the 45 grains analysed (including one monazite) exhibit lead loss, and for most the $^{207}Pb/^{206}Pb$ age is preferred.

The youngest grain is a single concordant monazite. Because of the absence of a monazite standard in the analytical run, the $^{207}Pb/^{206}Pb$ age of 758 ± 21 Ma is preferred as the $^{207}Pb/^{206}Pb$ system is not affected by mineral matrix effects. This is interpreted as an authigenic monazite that grew during the Wickham Orogeny (Berry 2014). Otherwise, the next youngest concordant grain is a zircon with a $^{206}Pb/^{238}U$ age (not requiring correction for common Pb) of 1028 ± 11 Ma. This provides a maximum depositional age for the sample. There is another similar concordant zircon at 1107 ± 13 Ma.

Most grains have ages between ca. 1400 Ma and ca. 2000 Ma. Many of these are discordant indicating Pb loss and thus the $^{207}Pb/^{206}Pb$ ages were mostly used. There are peaks in the age populations at ca. 1710 Ma and ca. 1800 Ma (with some concordant grains). There are four older grains with $^{207}Pb/^{206}Pb$ ages ranging from 2359 to 2729 Ma; the oldest concordant grain is 2487 ± 32 Ma ($^{206}Pb/^{238}U$).

**R018036**

Overall, the 34 grains show a similar age spectra to the other Oonah sample (R018029), although a somewhat higher proportion are concordant or nearly so. Generally $^{206}Pb/^{238}U$ ages are preferred for the relatively younger grains (ca. 1700 Ma) and $^{207}Pb/^{206}Pb$ ages for the older grains due to the presence of a small amount of Pb loss in the older grains.

The youngest apparent age is 757 ± 14 Ma from a metamict zircon exhibiting minor common lead. This age is interpreted to have been reset during the Wickham Orogeny, a feature also observed in some samples analysed by Black et al. (2004). There are also young zircons with ages of 985 ± 18 Ma (with lead loss and minor common lead, as well as very high Th and low Hf) and 1047 ± 15 Ma (markedly discordant with slight common lead). The youngest concordant zircon, however, yielded a $^{206}Pb/^{238}U$ age of 1228 ± 16 Ma.

There is a marked cluster of older ages, many concordant, between 1674 Ma and 1949 Ma with a peak at ca. 1850–1860 Ma. There are five older grains; the oldest with a $^{207}Pb/^{206}Pb$ age of 2798 Ma.

## *Luina Group*

**R018210 (Deep Creek Volcanics)**

Twelve grains yield a narrow range of $^{206}Pb/^{238}U$ ages, from 543 to 571 Ma (late Ediacaran). However, most of the analyses are markedly discordant. On the $^{238}U/^{206}Pb$ against $^{207}Pb/^{206}Pb$ plot, an isochron anchored at the $^{207}Pb/^{206}Pb$ value for common lead in zircon yields an intercept age with the concordia curve of 556.3 ± 6.7 Ma (Fig. 10a).

**R018213 (Deep Creek Volcanics)**

Fourteen grains form a fairly close cluster at or close to concordia (Fig. 10b). The preferred $^{207}Pb/^{206}Pb$ ages, with slight (up to 9 m.y.) common lead corrections, yield an age range from 547 to 577 Ma. Although this sample (R018213) was taken from ~200 m higher in the same drill-hole and, if the intervening fault is unimportant, is thus probably younger than R018210, this range is slightly older.

Both R018210 and R018213 yield simple detrital zircon age spectra (Fig. 10). In particular, neither yielded any Mesoproterozoic or older zircons. This may be due to the small number of analyses, but from the formula $P = (1–f)^N$ it is a simple matter to calculate that another age component (say, >600 Ma) would probably (N <0.5) have been detected from 12 analyses (N = 12) if it comprised more than 5.6% (f= 0.056) of the population. If the data from R018210 and R018213 are considered together as a single population (N= 26), an unobserved component would probably comprise no more than 2.6% of the population.

**R018218 (Halls Formation)**

Seventeen detrital zircons were analysed. Ten span an earliest Cambrian to Ediacaran age range (537 to 583 Ma) closely similar to those from the lower volcaniclastic sandstones. Eight of these are close to concordance, one (at 575 Ma) is slightly discordant, and another is strongly reverse discordant with a preferred $^{207}Pb/^{206}Pb$ age of 569 Ma. Another grain yielded a significantly older (Cryogenian) concordant age of 648 Ma.

Six grains yielded much older Mesoproterozoic to Palaeoproterozoic ages, ranging from near concordant $^{207}Pb/^{206}Pb$ ages of 1357 Ma and 1408 Ma to discordant $^{207}Pb/^{206}Pb$ ages of up to 2376 Ma.

**R018223 (Crescent Spur Sandstone from LD86-1)**

Eighty-nine zircon grains from this sample were analysed in two sessions, because of some ambiguity in the interpretation of the data from the youngest zircons obtained from the first session.

There is a wide range of apparent ages from 358 Ma (latest Devonian) to 3208 Ma (Archean), with a large cluster of concordant ages at ca. 950–1220 Ma. However, the three youngest ages have characteristics which suggest that the U-Pb isotopes in these analyses have been disturbed. The 358 Ma zircon has common lead, is slightly discordant and shows the highest U and Th values of any zircons analysed from the sample (R018223). The 450 Ma zircon also shows slight Pb loss and although concordant, its time-resolved depth profile varies between 350 and 470 Ma and was hence considered unreliable. The 482 Ma zircon is also affected by lead loss. Accordingly, these ages are rejected. The next youngest zircon, at 521 Ma, is slightly discordant due to the presence of common lead, but may provide an Early Cambrian maximum depositional age for this sample. The youngest completely concordant zircons yield $^{206}Pb/^{238}U$ ages of 536 and 544 Ma.

As well as the cluster of mostly concordant ages at ca. 980–1100 Ma, there is another possible smaller cluster at ca. 1700–1800 Ma and five concordant or slightly discordant $^{207}Pb/^{206}Pb$ ages of 2145, 2309, 2511, 2976 and 3208 Ma.

**R018272 (Crescent Spur Sandstone from Godkin Ridge)**
Twenty-seven zircons yielded ages ranging from 599 Ma to 1878 Ma. There is a large cluster of mostly concordant or near-concordant ages of 599 Ma to 693 Ma, and another two near-concordant zircons at 725 Ma and 747 Ma. Two strongly discordant zircons yielded $^{207}Pb/^{206}Pb$ ages of 1400 Ma and 1557 Ma, but the five oldest zircons are nearly concordant, with Palaeoproterozoic ages ranging from 1659 Ma to 1878 Ma (Fig. 10).

# Discussion

## *Mt Bischoff inlier (Oonah Formation correlative)*

The youngest reliable zircon ages from the two samples, particularly the concordant 1028 ± 11 Ma age from R018029, provide a latest Mesoproterozoic maximum depositional age for the Mount Bischoff inlier. This is significantly younger than the maximum ages of ~1100 Ma, ~1200 Ma and ~1280 Ma recorded from the Oonah Formation (and correlates) at Badger Head, Montana Flats and Heazlewood River respectively (Black et al. 2004).

The age spectra, with strong peaks between ~1710 and ~1860 Ma, tend to support the correlation with the Oonah Formation, although many western Tasmanian Proterozoic rocks have a similar zircon age profile (Black et al. 2004). The absence of any clear evidence for ~760 Ma igneous zircon tends to discount the alternative correlation with the Forest Conglomerate and the Donaldson Formation, since Cryogenian granites which might be expected to shed zircon of this age are known in the Bowry Formation (777 ± 7 Ma) and on King Island (748 ± and 760 ± Ma) (Turner et al. 1998; Black et al. 1997). We have preferred to interpret monazite and metamict zircon grains of that age in this sample as crystallisation or resetting during the Wickham Orogeny. It is also noteworthy that the Forest Conglomerate itself failed to yield any zircons younger than ca. 1300 Ma, despite a ~750 Ma depositional age (Berry et al. 2001).

Zircons younger than 1047 Ma are generally absent in the Rocky Cape Group (Black et al. 2004; Halpin et al. 2014) although Black et al. (2004) noted a younger 1010 ± 45 population in the Jacob Quartzite. Sample (R018029) displays a small peak of ~1790 Ma zircon, similar to the Oonah Formation at Montana Flats and has similar 1600, 1700 and 1800 Ma peak ages to the Oonah Formation at Heazlewood (Black et al. 2004).

The samples also share peak 1450–1500 and 1850 Ma zircon ages with the Jacob Quartzite but lack the prominent 1245 Ma age. The age spectra show some similarity with that of the Detention Subgroup of the Rocky Cape Group as they both have peak ages centred around 1450 and 1750 Ma and contain Archean grains. The samples also share affinities with the lower-middle Rocky Cape Group as major age peaks between 1850 and 1830 are also present in the Balfour Subgroup (Halpin et al. 2014). The smaller age peak at 1650 Ma is present in most units within the Rocky Cape Group (except for the Detention Subgroup).

## *Luina Group*

The youngest reliable zircon ages in each of the five samples are 543, 547, 537, 521 and 599 Ma. Given that the base of the Cambrian System has now been fairly accurately determined at 541.0 ± 1.0 Ma (Cohen et al. 2013), this data is consistent with an Early Cambrian age for the Luina Group. The possibility of a correlation with lithologically similar rocks in the Togari Group (Kanunnah Subgroup), and by extension the Crimson Creek Formation, is eliminated.

The absence of any zircon with Mt Read Volcanics ages (ca. 494–510 Ma; Black et al. 1997; Turner et al. 1998; Perkins & Walshe 1993; Mortensen et al. 2015) is consistent with a pre-Tyennan Orogeny (i.e. >513.6 ± 5 Ma) age for the Luina Group.

The narrow age ranges of detrital zircons (543–571 Ma and 547–577 Ma) from the two volcaniclastic samples (R010210, R010213) from the Deep Creek Volcanics suggest that they were derived from a local, restricted, and probably intermediate to felsic volcanic source. However, the range in ages (28–29 m.y. for each sample) is probably too great to be attributable to analytical error (mostly 12–24 m.y. for each analysis; 2σ). This suggests that this phase of late Ediacaran volcanism probably lasted at least several million years, and was not a single short event.

Although the presence of intact and broken glass shards in these samples, together with the intercalated basalt and some relatively euhedral zircons, indicates syn-eruptive resedimentation, the older (up to 577 Ma) round to subhedral zircons suggest a detrital component from a slightly older volcanic terrain. These older zircons are approximately coeval with the onset of rift volcanism of the passive margin at 580–575 Ma, preserved in the Kanunnah Subgroup and on King Island (Everard & Calver 2014, p. 84). Although the bulk of this volcanism was basaltic, minor felsic activity, dated at 582 ± 4 Ma in northwest Tasmania and 575 ± 3 Ma on King Island (Calver et al. 2004), also occurred and may have provided a source of zircon.

The apparently overlying sample from the Halls Formation (R018218) also contains zircons with dominantly similar ages (537–583 Ma), but a scattering of older ages (1357–2376 Ma) appears to mark the influx of a component from an older, probably more distal and non-volcanic provenance. In the two samples (R018223 and R018272) of the Crescent Spur Sandstone, this older component is dominant.

Six of the thirteen older zircons in R018218 and R018272 have ages between 1700 and 1800 Ma. Zircons of this age are very common in western Tasmania Proterozoic successions, such as the Rocky Cape Group and Oonah Formation (Black et al. 2004; Halpin et al., 2014). These are potentially source areas for the Luina Group particularly the Crescent Spur Sandstone, which thus may have received terrigenous material from the passive margin shortly before the obduction event.

However, the other Crescent Spur Sandstone sample (R018223) has a very different zircon age profile, with a preponderance of Grenvillian zircon ages from 967 Ma to 1456 Ma and a broad peak between ca. 1050 and 1150 Ma. Zircons of this age are relatively rare in western Tasmania, but a similar age profile is displayed by the enigmatic Wings Sandstone, an east-dipping thrust slice outcropping near Adamsfield in southwest Tasmania. Before now, the detrital zircon distributions observed in the Wings Sandstone were unlike anything observed from any other unit in Tasmania (Black et al. 2004). However, the Wings Sandstone lacks any zircon younger than 914 ± 44 Ma (Black et al. 2004), whereas R018223 contains numerous zircons between 521 Ma and 898 Ma (Table 2). The data suggest that the Crescent Spur Sandstone south of Luina is probably derived (or derived in part) from a similar source area to the Wings Sandstone or a very similar correlate.

Another feature of this sample (R018223) is the three anomalously young apparent ages, particularly the 450 Ma and 482 Ma $^{207}Pb/^{206}Pb$ ages, which are only slightly discordant. An alternative explanation is that this sample, from the upper part of drill hole LD86-1, is a fault-bound outlier of the Eldon Group and may be related to the Crotty Formation. The Eldon Group contains Silurian fossils, and crops out about 1 km to the west. However, the Crotty correlative in that area (e.g. sample R017916) is a well-sorted quartz sandstone, very different from R018223. A second analytical session on this sample failed to reveal any similar young grains. The most likely explanation for these ages may be that they represent an old lead-loss event, possibly occurring during the Tyennan Orogeny at ca. 500–510 Ma.

# Conclusion

Our new data demonstrate that the rocks of the Mount Bischoff inlier near Waratah are younger than ~1030 Ma. Although their detrital zircon age spectra support a correlation with the Oonah Formation (and are broadly similar to many other western Tasmania Proterozoic successions), this age constraint is significantly younger than the 1100–1280 Ma maximum ages obtained from the Oonah Formation and correlatives elsewhere. Zircons also reveal a fluid-flow event indicated by monazite, Pb loss and metamict zircon ages at ~757 Ma.

Our data also show that the Luina Group is Early Cambrian and no older than ~536 Ma, nor younger than ~510 Ma. Volcaniclastic intervals within the locally lowermost unit at Luina, the Deep Creek Volcanics, are dominated by young (<583 Ma) zircon probably recording a nearby episode of felsic-intermediate volcanism. The Halls Formation and the Crescent Spur Sandstone are dominated by much older zircon, recording an influx of terrigenous material, probably from a more distal source. The age spectra of two samples have prominent peaks at 1700–1800 Ma and are similar to that of many Proterozoic terranes in western Tasmania, but the third sample, from the Crescent Spur Sandstone, has an age profile only previously observed in the Wings Sandstone.

Additional synthesis of age data from the Oonah Formation by Black et al. (2004) and this study may help unravel the source region for the upper Mesoproterozoic stratigraphy in Tasmania.

At this stage further work is required to fully understand the timing and source characteristics of allochthonous units prior to their emplacement in the Early Cambrian. More detrital zircon age data may help to adequately define the nature and arrangement of sedimentary basins prior to the obduction and accretion of Tasmania to Gondwana in the Early Cambrian.

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# APPENDIX – Isotopic and age data from LA-ICPMS analysis of zircons

Table 1. Isotopic and age data from LA-ICPMS analysis of zircons in samples R018036 from the Mount Bischoff inlier.

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age ($^{207}$ corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | $^{204}Pb$ (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | $^{56}Fe$ (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018036 (2013-392) Mt Bischoff inlier** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SE18B292 | 757 | 14 | 757 | 14 | 762 | 15 | 930 | 34 | 0.125 | 1.9% | 0.070 | 3.3% | 1.212 | 7.97 | 0.15 | 0.02 | 29 | 2 | 6 | 177 | 258 | 20 | 0 | 10374 | 0.890 | 764 | 14 | 0.039 | 1.8% | slight common Pb |
| SE18B314 | 985 | 18 | 720 | 8 | 727 | 8 | 985 | 18 | 0.119 | 1.1% | 0.072 | 1.8% | 1.185 | 8.37 | 0.10 | 0.06 | 89 | 6 | 104 | 3120 | 839 | 431 | 1605 | 5895 | 0.887 | 727 | 9 | 0.037 | 1.2% | Pb loss, minor $^{204}Pb$ |
| SE18B317 | 1047 | 15 | 1047 | 15 | 1109 | 16 | 2031 | 16 | 0.188 | 1.5% | 0.125 | 1.8% | 3.239 | 5.33 | 0.08 | 0.04 | 11 | 1 | 5 | 66 | 58 | 20 | 17 | 11565 | 0.918 | 1460 | 26 | 0.075 | 1.8% | slight common Pb, 204 corr brings to concordia |
| SE18B307 | 1228 | 16 | 1228 | 16 | 1228 | 16 | 1214 | 24 | 0.210 | 1.3% | 0.081 | 2.4% | 2.335 | 4.77 | 0.06 | 0.01 | 13 | 1 | 7 | 104 | 62 | 28 | 2 | 8873 | 0.928 | 1248 | 20 | 0.064 | 1.6% | ok |
| SE18B309 | 1294 | 13 | 1294 | 13 | 1341 | 14 | 1911 | 11 | 0.231 | 1.0% | 0.117 | 1.2% | 3.732 | 4.32 | 0.05 | 0.17 | 78 | 9 | 17 | 198 | 334 | 17 | 68 | 11555 | 0.938 | 1655 | 28 | 0.085 | 1.7% | common Pb, 204 corr brings to concordia |
| SE18B315 | 1354 | 16 | 1354 | 16 | 1375 | 17 | 1642 | 13 | 0.238 | 1.2% | 0.101 | 1.4% | 3.311 | 4.21 | 0.05 | 0.06 | 59 | 6 | 17 | 214 | 248 | 18 | 105 | 10297 | 0.941 | 1552 | 27 | 0.080 | 1.7% | common Pb, $^{204}$corr brings to concordia |
| SE18B311 | 1369 | 13 | 1369 | 13 | 1386 | 14 | 1608 | 11 | 0.240 | 1.0% | 0.099 | 1.2% | 3.279 | 4.17 | 0.04 | 0.06 | 55 | 5 | 17 | 231 | 244 | 9 | 14 | 10086 | 0.942 | 1484 | 22 | 0.076 | 1.5% | common Pb, U/Pb age should be good |
| SE18B301 | 1520 | 24 | 1520 | 24 | 1606 | 25 | 2309 | 15 | 0.283 | 1.6% | 0.147 | 1.7% | 5.726 | 3.53 | 0.06 | 0.12 | 38 | 5 | 10 | 88 | 126 | 14 | 49 | 10555 | 0.963 | 2206 | 45 | 0.115 | 2.0% | common Pb |
| SE18B295 | 1544 | 8 | 1283 | 13 | 1300 | 14 | 1544 | 8 | 0.223 | 1.0% | 0.096 | 0.9% | 2.952 | 4.47 | 0.05 | 0.00 | 67 | 6 | 26 | 389 | 305 | 180 | 215 | 9281 | 0.935 | 1293 | 16 | 0.066 | 1.3% | Pb loss |
| SE18B300 | 1618 | 36 | 1618 | 36 | 1638 | 38 | 1821 | 9 | 0.289 | 2.3% | 0.111 | 1.0% | 4.438 | 3.46 | 0.08 | 0.04 | 95 | 10 | 9 | 138 | 373 | 20 | 128 | 12126 | 0.966 | 1529 | 49 | 0.079 | 3.2% | common Pb |
| SE18B305 | 1640 | 21 | 1640 | 21 | 1662 | 22 | 1868 | 12 | 0.294 | 1.3% | 0.114 | 1.3% | 4.634 | 3.40 | 0.05 | 0.06 | 41 | 5 | 14 | 145 | 141 | 21 | 13 | 8131 | 0.968 | 1728 | 27 | 0.089 | 1.5% | slight common Pb |
| AU21E156 | 1674 | 17 | 1674 | 17 | 1674 | 17 | 1674 | 16 | 0.296 | 1.0% | 0.103 | 0.9% | 4.199 | 3.37 | 0.03 | 0.04 | 116 | 12 | 16 | 174 | 388 | 10 | 14 | 11930 | 0.969 | 1757 | 27 | 0.091 | 1.5% | Common Pb @ begin |
| SE18B297 | 1676 | 17 | 1676 | 17 | 1720 | 17 | 2078 | 12 | 0.306 | 1.0% | 0.129 | 1.4% | 5.419 | 3.27 | 0.03 | 0.08 | 86 | 11 | 18 | 182 | 278 | 13 | 1046 | 11294 | 0.974 | 1974 | 34 | 0.103 | 1.7% | common Pb |
| SE18B302 | 1701 | 33 | 1701 | 33 | 1705 | 34 | 1749 | 28 | 0.303 | 2.0% | 0.107 | 3.1% | 4.467 | 3.30 | 0.07 | 0.04 | 10 | 1 | 2 | 14 | 31 | 4 | 2 | 13234 | 0.973 | 2673 | 131 | 0.141 | 4.9% | Common Pb @ begin |
| SE18B313 | 1705 | 11 | 1633 | 17 | 1639 | 17 | 1705 | 11 | 0.290 | 1.1% | 0.104 | 1.2% | 4.172 | 3.45 | 0.04 | 0.00 | 38 | 4 | 8 | 98 | 135 | 22 | 10 | 10851 | 0.966 | 1575 | 23 | 0.081 | 1.5% | slight Pb loss |
| AU21E149 | 1721 | 30 | 1533 | 17 | 1549 | 18 | 1721 | 30 | 0.272 | 1.1% | 0.105 | 1.6% | 3.947 | 3.68 | 0.04 | 0.01 | 60 | 6 | 8 | 77 | 210 | 363 | 21 | 11277 | 0.957 | 1770 | 40 | 0.092 | 2.3% | Pb loss, used lowest $^{204}$ |
| SE18B299 | 1737 | 20 | 1737 | 20 | 1738 | 20 | 1747 | 7 | 0.309 | 1.2% | 0.107 | 0.8% | 4.562 | 3.23 | 0.04 | 0.04 | 96 | 10 | 19 | 217 | 335 | 21 | 37 | 10580 | 0.976 | 1796 | 23 | 0.093 | 1.3% | ok |
| AU21E147 | 1769 | 23 | 1769 | 23 | 1779 | 23 | 1862 | 28 | 0.318 | 1.3% | 0.114 | 1.5% | 4.989 | 3.15 | 0.04 | 0.04 | 103 | 12 | 16 | 187 | 364 | 3 | 39 | 12328 | 0.980 | 1871 | 33 | 0.097 | 1.8% | Slight common Pb, $^{204}$ correction brings to concordia |
| AU21E161 | 1794 | 16 | 1794 | 16 | 1794 | 16 | 1796 | 14 | 0.321 | 0.9% | 0.110 | 0.8% | 4.857 | 3.12 | 0.03 | 0.00 | 55 | 6 | 8 | 90 | 175 | 10 | 19 | 12055 | 0.981 | 1804 | 25 | 0.093 | 1.4% | ok |
| AU21E145 | 1822 | 27 | 1380 | 19 | 1415 | 20 | 1822 | 27 | 0.245 | 1.4% | 0.111 | 1.5% | 3.770 | 4.07 | 0.06 | 0.07 | 43 | 5 | 14 | 181 | 185 | 19 | 411 | 10880 | 0.945 | 1595 | 27 | 0.082 | 1.7% | Pb loss, $^{204}$ Present |
| AU21E157 | 1832 | 19 | 1832 | 19 | 1832 | 19 | 1834 | 13 | 0.329 | 1.0% | 0.112 | 0.7% | 5.083 | 3.04 | 0.03 | 0.03 | 120 | 14 | 24 | 228 | 363 | 10 | 7 | 11682 | 0.985 | 2021 | 27 | 0.105 | 1.4% | Mix along concordia middle to end, common Pb @ begin |
| AU21E167 | 1836 | 19 | 1711 | 16 | 1724 | 17 | 1836 | 19 | 0.307 | 1.0% | 0.112 | 1.0% | 4.746 | 3.26 | 0.03 | 0.00 | 39 | 4 | 9 | 99 | 126 | 9 | 29 | 11052 | 0.974 | 1824 | 26 | 0.094 | 1.4% | slight Pb loss |
| AU21E152 | 1851 | 23 | 1634 | 20 | 1656 | 21 | 1851 | 23 | 0.293 | 1.2% | 0.113 | 1.3% | 4.569 | 3.42 | 0.04 | 0.03 | 100 | 11 | 21 | 266 | 395 | 20 | 36 | 11813 | 0.968 | 1697 | 28 | 0.088 | 1.7% | Pb loss, minor $^{204}$ |
| AU21E160 | 1857 | 17 | 1713 | 17 | 1728 | 18 | 1857 | 17 | 0.307 | 1.0% | 0.114 | 0.9% | 4.813 | 3.25 | 0.03 | 0.02 | 108 | 12 | 23 | 252 | 349 | 14 | 135 | 9359 | 0.975 | 1819 | 26 | 0.094 | 1.4% | Pb loss, used lowest $^{204}$ interval |
| AU21E162 | 1867 | 18 | 1867 | 18 | 1869 | 18 | 1883 | 15 | 0.336 | 0.9% | 0.115 | 0.9% | 5.343 | 2.97 | 0.03 | 0.02 | 82 | 9 | 16 | 153 | 239 | 8 | 15 | 12051 | 0.989 | 1963 | 29 | 0.102 | 1.5% | ok |
| SE18B303 | 1874 | 22 | 1874 | 22 | 1877 | 22 | 1896 | 15 | 0.338 | 1.2% | 0.116 | 1.7% | 5.407 | 2.96 | 0.03 | 0.05 | 75 | 9 | 11 | 99 | 219 | 7 | 10 | 10504 | 0.990 | 2005 | 60 | 0.104 | 3.0% | used concordant part |
| SE18B293 | 1879 | 14 | 1740 | 22 | 1755 | 23 | 1879 | 14 | 0.313 | 1.3% | 0.115 | 1.6% | 4.959 | 3.20 | 0.04 | 0.00 | 44 | 5 | 15 | 175 | 158 | 18 | 24 | 10263 | 0.977 | 1752 | 27 | 0.091 | 1.5% | slight Pb loss |
| AU21E164 | 1888 | 21 | 1888 | 21 | 1888 | 21 | 1887 | 20 | 0.340 | 1.1% | 0.115 | 1.1% | 5.419 | 2.94 | 0.03 | 0.04 | 117 | 13 | 16 | 147 | 328 | 15 | 51 | 11227 | 0.991 | 1893 | 34 | 0.098 | 1.8% | |
| SE18B296 | 1949 | 7 | 1965 | 17 | 1965 | 17 | 1949 | 7 | 0.356 | 0.9% | 0.120 | 0.8% | 5.873 | 2.81 | 0.02 | 0.00 | 122 | 15 | 19 | 199 | 360 | 6 | 15 | 11318 | 0.999 | 1933 | 24 | 0.100 | 1.3% | |
| AU21E146 | 2244 | 29 | 1331 | 25 | 1414 | 27 | 2244 | 29 | 0.245 | 1.9% | 0.141 | 1.7% | 4.779 | 4.08 | 0.08 | 0.09 | 30 | 4 | 9 | 74 | 119 | 16 | 125 | 10720 | 0.945 | 2226 | 52 | 0.116 | 2.3% | |
| AU21E166 | 2422 | 35 | 2422 | 35 | 2440 | 33 | 2507 | 16 | 0.460 | 1.4% | 0.165 | 1.0% | 10.466 | 2.17 | 0.03 | 0.05 | 164 | 27 | 7 | 47 | 420 | 6 | 42 | 13866 | 1.049 | 3136 | 85 | 0.168 | 2.7% | |
| AU21E163 | 2508 | 14 | 2225 | 31 | 2280 | 31 | 2508 | 14 | 0.424 | 1.4% | 0.165 | 0.8% | 9.654 | 2.36 | 0.03 | 0.02 | 227 | 38 | 30 | 290 | 511 | 13 | 320 | 10964 | 1.032 | 1824 | 33 | 0.094 | 1.8% | |
| SE18B289 | 2766 | 4 | 2608 | 25 | 2651 | 23 | 2766 | 4 | 0.509 | 0.9% | 0.193 | 0.5% | 13.525 | 1.97 | 0.02 | 0.01 | 88 | 17 | 11 | 82 | 178 | 10 | 123 | 10163 | 1.072 | 2607 | 37 | 0.138 | 1.4% | |
| AU21E155 | 2798 | 18 | 2338 | 33 | 2446 | 33 | 2798 | 18 | 0.461 | 1.3% | 0.197 | 1.1% | 12.507 | 2.17 | 0.03 | 0.02 | 76 | 15 | 13 | 102 | 176 | 26 | 164 | 10335 | 1.050 | 2530 | 43 | 0.133 | 1.7% | |

Table 2. Isotopic and age data from LA-ICPMS analysis of zircons in samples R018029 from the Mount Bischoff inlier.

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age ($^{207}$ corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | $^{204}Pb$ (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | $^{56}Fe$ (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018029 (2013-391) Mt Bischoff inlier** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AU21E132 | 758 | 11 | 671 | 6 | 673 | 6 | 758 | 11 | 0.110 | 0.9% | 0.064 | 0.5% | 0.979 | 9.08 | 0.09 | | | | | | | | | | 0.883 | 646 | 8 | 0.032 | 1.2% | Monazite, use 7/6 age, Hg inclusion |
| AU21E130 | 1028 | 11 | 1028 | 11 | 1028 | 11 | 1005 | 25 | 0.173 | 1.1% | 0.073 | 1.2% | 1.732 | 5.79 | 0.06 | 0.00 | 29 | 2 | 2 | 49 | 173 | 12 | 9 | 10432 | 0.911 | 1006 | 20 | 0.051 | 2.0% | ok |
| AU21E133 | 1107 | 13 | 1107 | 13 | 1107 | 14 | 1078 | 36 | 0.187 | 1.2% | 0.075 | 1.8% | 1.948 | 5.34 | 0.07 | 0.01 | 12 | 1 | 2 | 34 | 63 | 30 | 2 | 10366 | 0.918 | 1050 | 21 | 0.053 | 2.0% | ok |
| AU21E139 | 1135 | 14 | 954 | 9 | 961 | 9 | 1135 | 14 | 0.161 | 0.9% | 0.078 | 0.7% | 1.718 | 6.22 | 0.06 | 0.02 | 237 | 18 | 1 | 19 | 1587 | 13 | 1766 | 14080 | 0.905 | 1550 | 47 | 0.080 | 3.0% | Pb loss, slight 204 |
| SE18B270 | 1388 | 21 | 1357 | 20 | 1359 | 21 | 1388 | 21 | 0.235 | 1.5% | 0.088 | 2.2% | 2.855 | 4.26 | 0.06 | 0.00 | 14 | 1 | 5 | 83 | 63 | 7 | 39 | 8409 | 0.940 | 1319 | 21 | 0.067 | 1.6% | Pb loss in 2nd half |
| AU21E138 | 1405 | 24 | 740 | 11 | 761 | 11 | 1405 | 24 | 0.125 | 1.5% | 0.089 | 1.3% | 1.539 | 7.98 | 0.12 | 0.00 | 96 | 9 | 5 | 121 | 740 | 27 | 1224 | 14199 | 0.889 | 772 | 23 | 0.039 | 3.0% | Pb loss, used lowest 204 |
| AU21E141 | 1435 | 14 | 1435 | 14 | 1435 | 15 | 1442 | 19 | 0.249 | 1.0% | 0.091 | 1.0% | 3.121 | 4.01 | 0.04 | 0.00 | 53 | 5 | 26 | 342 | 211 | 19 | 12 | 9813 | 0.947 | 1483 | 19 | 0.076 | 1.3% | ok |
| AU21E115 | 1447 | 20 | 1057 | 13 | 1076 | 14 | 1447 | 20 | 0.182 | 1.3% | 0.091 | 1.1% | 2.280 | 5.50 | 0.07 | 0.02 | 39 | 4 | 10 | 139 | 209 | 27 | 65 | 9506 | 0.915 | 1429 | 22 | 0.073 | 1.5% | Pb loss, used lowest 204Pb |
| AU21E119 | 1470 | 27 | 1239 | 17 | 1253 | 18 | 1470 | 27 | 0.215 | 1.4% | 0.092 | 1.4% | 2.726 | 4.66 | 0.07 | 0.03 | 57 | 5 | 8 | 137 | 298 | 31 | 106 | 10998 | 0.930 | 1235 | 26 | 0.063 | 2.1% | Pb loss, used lowest 204 |
| SE18B272 | 1485 | 28 | 1331 | 29 | 1341 | 30 | 1485 | 28 | 0.231 | 2.2% | 0.093 | 3.0% | 2.961 | 4.32 | 0.10 | 0.00 | 13 | 1 | 4 | 60 | 64 | 26 | 0 | 8144 | 0.938 | 1359 | 31 | 0.070 | 2.3% | Pb loss |
| AU21E135 | 1592 | 15 | 1592 | 15 | 1595 | 15 | 1620 | 18 | 0.281 | 1.0% | 0.100 | 1.0% | 3.860 | 3.56 | 0.03 | 0.00 | 71 | 7 | 13 | 152 | 244 | 4 | 98 | 11038 | 0.962 | 1589 | 24 | 0.082 | 1.5% | ok |
| AU21E112 | 1631 | 13 | 1474 | 12 | 1487 | 13 | 1631 | 13 | 0.259 | 0.9% | 0.100 | 0.7% | 3.591 | 3.86 | 0.03 | 0.00 | 82 | 8 | 21 | 275 | 321 | 11 | 235 | 12107 | 0.952 | 1510 | 19 | 0.078 | 1.3% | Minor Pb loss |
| AU21E136 | 1635 | 19 | 1036 | 12 | 1067 | 13 | 1635 | 19 | 0.180 | 1.2% | 0.101 | 1.0% | 2.498 | 5.55 | 0.07 | 0.01 | 118 | 12 | 22 | 469 | 667 | 66 | 995 | 11031 | 0.914 | 949 | 17 | 0.048 | 1.8% | Pb loss, used lowest 204 |
| SE18B278 | 1651 | 11 | 1446 | 15 | 1462 | 16 | 1651 | 11 | 0.255 | 1.1% | 0.101 | 1.2% | 3.563 | 3.93 | 0.04 | 0.02 | 56 | 6 | 23 | 297 | 218 | 13 | 70 | 10754 | 0.949 | 1458 | 20 | 0.075 | 1.3% | Pb loss |
| SE18B276 | 1657 | 18 | 1185 | 33 | 1214 | 35 | 1657 | 18 | 0.207 | 2.9% | 0.102 | 1.9% | 2.910 | 4.82 | 0.14 | 0.00 | 17 | 2 | 4 | 70 | 91 | 25 | 46 | 9885 | 0.927 | 1269 | 28 | 0.065 | 2.2% | Pb loss |
| SE18B271 | 1663 | 6 | 872 | 8 | 907 | 9 | 1663 | 6 | 0.151 | 1.0% | 0.102 | 0.7% | 2.127 | 6.62 | 0.06 | 0.12 | 382 | 39 | 24 | 1099 | 2677 | 549 | 3766 | 12774 | 0.901 | 470 | 7 | 0.024 | 1.4% | Pb loss, minor $^{204}Pb$ |
| AU21E122 | 1671 | 27 | 1101 | 25 | 1134 | 26 | 1671 | 27 | 0.192 | 2.3% | 0.103 | 1.5% | 2.720 | 5.20 | 0.12 | 0.01 | 30 | 3 | 13 | 216 | 172 | 39 | 215 | 9528 | 0.920 | 1260 | 21 | 0.064 | 1.7% | Pb loss, used lowest 204 |
| AU21E109 | 1677 | 15 | 1178 | 14 | 1209 | 15 | 1677 | 15 | 0.206 | 1.2% | 0.103 | 0.8% | 2.927 | 4.85 | 0.06 | 0.02 | 194 | 20 | 20 | 538 | 1041 | 97 | 866 | 12047 | 0.927 | 826 | 13 | 0.042 | 1.5% | Pb loss, off concordia, used lowest 204 |
| AU21E113 | 1703 | 17 | 1111 | 19 | 1146 | 20 | 1703 | 17 | 0.195 | 1.7% | 0.104 | 0.9% | 2.799 | 5.14 | 0.09 | 0.00 | 92 | 10 | 18 | 382 | 458 | 31 | 880 | 12058 | 0.921 | 871 | 16 | 0.044 | 1.8% | Pb loss, used least discordant interval |
| AU21E131 | 1706 | 22 | 1397 | 22 | 1421 | 23 | 1706 | 22 | 0.247 | 1.6% | 0.105 | 1.2% | 3.554 | 4.05 | 0.07 | 0.00 | 112 | 12 | 14 | 241 | 521 | 35 | 247 | 12083 | 0.946 | 1264 | 25 | 0.065 | 1.9% | Pb loss, used lowest 204, small interval |
| AU21E108 | 1708 | 21 | 1708 | 21 | 1708 | 21 | 1698 | 22 | 0.303 | 1.2% | 0.104 | 1.2% | 4.354 | 3.30 | 0.04 | 0.01 | 31 | 3 | 5 | 62 | 110 | 32 | 10 | 10217 | 0.973 | 1674 | 27 | 0.086 | 1.6% | brought to concordia |
| AU21E140 | 1713 | 20 | 1619 | 17 | 1628 | 18 | 1713 | 20 | 0.287 | 1.1% | 0.105 | 1.1% | 4.155 | 3.48 | 0.04 | 0.01 | 66 | 7 | 8 | 107 | 251 | 5 | 49 | 7140 | 0.965 | 1644 | 28 | 0.085 | 1.7% | slight Pb loss |
| SE18B269 | 1733 | 7 | 1648 | 14 | 1656 | 15 | 1733 | 7 | 0.293 | 0.9% | 0.106 | 0.8% | 4.284 | 3.41 | 0.03 | 0.00 | 90 | 10 | 7 | 89 | 320 | 5 | 24 | 12520 | 0.968 | 1581 | 24 | 0.081 | 1.5% | slight Pb loss |
| AU21E121 | 1750 | 19 | 1750 | 19 | 1751 | 19 | 1765 | 27 | 0.312 | 1.1% | 0.108 | 1.5% | 4.646 | 3.20 | 0.04 | 0.01 | 39 | 4 | 7 | 81 | 134 | 3 | 33 | 10010 | 0.977 | 1782 | 29 | 0.092 | 1.6% | Took concordant section |
| SE18B273 | 1750 | 12 | 1069 | 13 | 1108 | 14 | 1750 | 12 | 0.187 | 1.3% | 0.107 | 1.3% | 2.767 | 5.33 | 0.07 | 0.06 | 145 | 16 | 18 | 372 | 761 | 131 | 819 | 11700 | 0.918 | 911 | 19 | 0.046 | 2.0% | Pb loss, chose lowet $^{204}Pb$ |
| SE18B277 | 1781 | 12 | 1660 | 20 | 1672 | 21 | 1781 | 12 | 0.296 | 1.2% | 0.109 | 1.3% | 4.447 | 3.38 | 0.04 | 0.00 | 53 | 6 | 11 | 125 | 178 | 13 | 152 | 9866 | 0.969 | 1645 | 24 | 0.085 | 1.5% | Pb loss |
| AU21E129 | 1782 | 15 | 1513 | 15 | 1536 | 15 | 1782 | 15 | 0.269 | 1.0% | 0.109 | 0.8% | 4.044 | 3.72 | 0.04 | 0.01 | 109 | 12 | 8 | 141 | 434 | 8 | 303 | 11656 | 0.956 | 1177 | 19 | 0.060 | 1.6% | Pb loss |
| AU21E128 | 1790 | 16 | 1790 | 16 | 1790 | 16 | 1793 | 10 | 0.320 | 0.9% | 0.110 | 0.6% | 4.838 | 3.12 | 0.03 | 0.00 | 118 | 13 | 7 | 82 | 376 | 9 | 19 | 12387 | 0.981 | 1795 | 27 | 0.093 | 1.5% | ok |
| SE18B279 | 1791 | 17 | 1791 | 17 | 1791 | 17 | 1788 | 9 | 0.320 | 1.0% | 0.109 | 0.9% | 4.828 | 3.12 | 0.03 | 0.02 | 51 | 6 | 8 | 83 | 164 | 6 | 7 | 10840 | 0.981 | 1790 | 26 | 0.093 | 1.4% | ok |
| SE18B274 | 1796 | 15 | 1722 | 22 | 1730 | 22 | 1796 | 15 | 0.308 | 1.3% | 0.110 | 1.7% | 4.661 | 3.25 | 0.04 | 0.02 | 25 | 3 | 5 | 56 | 80 | 21 | 82 | 10698 | 0.975 | 1758 | 31 | 0.091 | 1.8% | very slight Pb loss |
| SE18B283 | 1798 | 15 | 1798 | 15 | 1799 | 15 | 1801 | 7 | 0.322 | 0.9% | 0.110 | 0.8% | 4.884 | 3.11 | 0.03 | 0.01 | 67 | 7 | 4 | 47 | 216 | 10 | 4 | 12420 | 0.982 | 1805 | 27 | 0.093 | 1.5% | ok |
| SE18B281 | 1801 | 17 | 1783 | 30 | 1785 | 31 | 1801 | 17 | 0.319 | 1.7% | 0.110 | 1.8% | 4.841 | 3.14 | 0.05 | 0.02 | 25 | 3 | 5 | 57 | 79 | 57 | 1750 | 10405 | 0.980 | 1862 | 38 | 0.097 | 2.0% | Slight Pb loss, Fe-Ti phase present |
| SE18B280 | 1803 | 7 | 1552 | 13 | 1575 | 14 | 1803 | 7 | 0.277 | 0.9% | 0.110 | 0.7% | 4.206 | 3.61 | 0.03 | 0.00 | 88 | 10 | 22 | 286 | 334 | 34 | 2976 | 10882 | 0.960 | 1553 | 20 | 0.080 | 1.3% | Pb los, Fe rich phase throughout |
| AU21E120 | 1811 | 21 | 1163 | 14 | 1205 | 15 | 1811 | 21 | 0.206 | 1.2% | 0.111 | 1.1% | 3.137 | 4.87 | 0.06 | 0.06 | 200 | 22 | 13 | 308 | 929 | 79 | 889 | 13669 | 0.926 | 789 | 15 | 0.040 | 1.9% | Pb loss, used lowest 204 |
| SE18B275 | 1825 | 17 | 1217 | 17 | 1259 | 17 | 1825 | 17 | 0.216 | 1.4% | 0.112 | 1.9% | 3.317 | 4.64 | 0.06 | 0.01 | 40 | 4 | 10 | 126 | 196 | 14 | 37 | 8998 | 0.931 | 1618 | 27 | 0.083 | 1.7% | Pb loss |
| SE18B285 | 1828 | 12 | 907 | 14 | 952 | 16 | 1828 | 12 | 0.159 | 1.6% | 0.112 | 1.4% | 2.452 | 6.28 | 0.10 | 0.07 | 46 | 5 | 11 | 243 | 297 | 16 | 13023 | 9311 | 0.905 | 897 | 16 | 0.045 | 1.8% | Pb loss, minor $^{204}Pb$ |
| AU21E116 | 1870 | 19 | 1849 | 20 | 1851 | 20 | 1870 | 19 | 0.333 | 1.1% | 0.114 | 1.1% | 5.245 | 3.01 | 0.03 | 0.00 | 60 | 7 | 13 | 133 | 174 | 20 | 7 | 10221 | 0.987 | 1801 | 27 | 0.093 | 1.5% | Pb loss @ begin |
| AU21E118 | 1876 | 16 | 1609 | 16 | 1635 | 17 | 1876 | 16 | 0.289 | 1.0% | 0.115 | 0.9% | 4.567 | 3.46 | 0.04 | 0.00 | 55 | 6 | 24 | 289 | 189 | 13 | 98 | 12331 | 0.966 | 1541 | 21 | 0.079 | 1.4% | Th zoning, Pb loss |
| AU21E126 | 1922 | 20 | 1880 | 22 | 1885 | 22 | 1922 | 20 | 0.340 | 1.2% | 0.118 | 1.1% | 5.512 | 2.94 | 0.03 | 0.00 | 64 | 7 | 9 | 82 | 179 | 13 | 47 | 10789 | 0.990 | 2033 | 33 | 0.106 | 1.6% | Very slight Pb loss |
| AU21E123 | 1935 | 27 | 1510 | 24 | 1549 | 25 | 1935 | 27 | 0.272 | 1.6% | 0.119 | 1.5% | 4.440 | 3.68 | 0.06 | 0.03 | 102 | 12 | 21 | 295 | 434 | 19 | 294 | 10759 | 0.957 | 1556 | 31 | 0.080 | 2.0% | Pb loss, used lowest 204 |
| AU21E127 | 1987 | 17 | 1693 | 21 | 1725 | 22 | 1987 | 17 | 0.307 | 1.3% | 0.122 | 1.0% | 5.165 | 3.26 | 0.04 | 0.02 | 85 | 10 | 9 | 116 | 274 | 13 | 98 | 11026 | 0.974 | 1589 | 30 | 0.082 | 1.9% | Pb loss, used lowest 204Pb |
| AU21E114 | 2359 | 9 | 1761 | 22 | 1841 | 24 | 2359 | 9 | 0.331 | 1.3% | 0.151 | 0.5% | 6.890 | 3.03 | 0.04 | 0.00 | 155 | 23 | 13 | 176 | 474 | 16 | 317 | 11573 | 0.986 | 1408 | 25 | 0.072 | 1.8% | Pb loss |

Table 2. (cont.)

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age ($^{207}$ corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | $^{204}Pb$ (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | $^{56}Fe$ (ppm) | 178Hf (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018029 (2013-391) Mt Bischoff inlier (cont.)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SE18B266 | 2487 | 32 | 2487 | 32 | 2487 | 29 | 2479 | 11 | 0.471 | 1.2% | 0.162 | 1.3% | 10.529 | 2.12 | 0.03 | 0.02 | 94 | 15 | 11 | 80 | 196 | 8 | 15 | 12035 | 1.054 | 2533 | 43 | 0.133 | 1.7% | ok |
| SE18B284 | 2631 | 7 | 2580 | 30 | 2593 | 27 | 2631 | 7 | 0.495 | 1.0% | 0.178 | 0.8% | 12.125 | 2.02 | 0.02 | 0.01 | 110 | 20 | 9 | 72 | 221 | 5 | 143 | 10514 | 1.066 | 2434 | 39 | 0.128 | 1.6% | Slight Pb loss |
| SE18B282 | 2729 | 7 | 2153 | 24 | 2270 | 24 | 2729 | 7 | 0.422 | 1.1% | 0.189 | 0.8% | 10.971 | 2.37 | 0.03 | 0.03 | 130 | 25 | 26 | 224 | 305 | 9 | 412 | 9740 | 1.031 | 2119 | 37 | 0.111 | 1.8% | Pb loss |
| SE18B325 | 358 | 5 | 358 | 5 | 369 | 5 | 1106 | 16 | 0.059 | 1.4% | 0.076 | 1.6% | 0.620 | 16.99 | 0.23 | 0.12 | 61 | 5 | 13 | 971 | 1096 | 32 | 1439 | 11895 | 0.860 | 287 | 6 | 0.014 | 2.0% | common Pb |
| AU21E184 | 450 | 6 | 450 | 6 | 451 | 6 | 572 | 37 | 0.073 | 1.3% | 0.059 | 1.7% | 0.591 | 13.79 | 0.18 | 0.01 | 34 | 2 | 3 | 108 | 484 | 3 | 316 | 12141 | 0.866 | 548 | 11 | 0.016 | 2.9% | took most concordant interval |
| MY04C326 | 482 | 7 | 482 | 7 | 484 | 8 | 633 | 22 | 0.078 | 1.6% | 0.061 | 1.0% | 0.654 | 12.81 | 0.20 | 0.01 | 98 | 6 | 6 | 689 | 1442 | 25 | 692 | 12412 | 0.869 | 183 | 4 | 0.023 | 2.4% | Pb loss in 2nd half |
| AU21E179 | 521 | 9 | 521 | 9 | 525 | 10 | 762 | 35 | 0.085 | 1.8% | 0.065 | 1.6% | 0.756 | 11.79 | 0.22 | 0.00 | 58 | 4 | 2 | 322 | 666 | 14 | 423 | 14371 | 0.872 | 123 | 4 | 0.024 | 2.3% | Off concordia, common Pb |
| SE18B322 | 536 | 8 | 536 | 8 | 536 | 8 | 565 | 30 | 0.087 | 1.4% | 0.059 | 2.8% | 0.705 | 11.53 | 0.17 | 0.00 | 23 | 1 | 5 | 180 | 265 | 7 | 892 | 10987 | 0.872 | 523 | 12 | 0.008 | 2.8% | ok |
| MY04C277 | 544 | 5 | 544 | 5 | 544 | 5 | 555 | 27 | 0.088 | 0.9% | 0.059 | 1.3% | 0.713 | 11.35 | 0.10 | 0.00 | 21 | 1 | 3 | 120 | 236 | 11 | 23 | 10414 | 0.873 | 546 | 9 | 0.047 | 2.7% | ok |
| MY04C293 | 556 | 5 | 556 | 5 | 557 | 5 | 628 | 33 | 0.090 | 1.0% | 0.061 | 1.6% | 0.755 | 11.08 | 0.11 | 0.01 | 23 | 1 | 2 | 74 | 246 | 4 | 9 | 13003 | 0.874 | 521 | 12 | 0.052 | 2.3% | Pb/U age |
| MY04C306 | 557 | 4 | 557 | 4 | 558 | 4 | 609 | 32 | 0.090 | 0.8% | 0.060 | 1.5% | 0.750 | 11.06 | 0.09 | 0.02 | 40 | 2 | 7 | 239 | 420 | 8 | 531 | 10445 | 0.874 | 535 | 9 | 0.037 | 3.5% | ok |
| MY04C278 | 559 | 29 | 347 | 10 | 349 | 10 | 559 | 29 | 0.056 | 2.8% | 0.059 | 1.3% | 0.451 | 17.96 | 0.50 | 0.02 | 131 | 8 | 4 | 488 | 2208 | 14 | 2626 | 8853 | 0.859 | 169 | 5 | 0.025 | 2.9% | Pb loss, slight commoN Pb |
| MY04C274 | 561 | 5 | 561 | 5 | 562 | 5 | 584 | 21 | 0.091 | 0.8% | 0.059 | 0.9% | 0.747 | 10.98 | 0.09 | 0.00 | 112 | 7 | 1 | 175 | 1170 | 11 | 230 | 15451 | 0.874 | 83 | 5 | 0.028 | 2.2% | common Pb in 1st hal |
| AU21E175 | 570 | 8 | 570 | 8 | 576 | 8 | 870 | 54 | 0.093 | 1.3% | 0.068 | 2.6% | 0.876 | 10.71 | 0.14 | 0.03 | 31 | 2 | 6 | 229 | 362 | 15 | 567 | 12147 | 0.875 | 566 | 13 | 0.006 | 3.3% | Variable U/Pb |
| MY04C330 | 590 | 7 | 590 | 7 | 591 | 7 | 612 | 47 | 0.096 | 1.3% | 0.060 | 2.2% | 0.797 | 10.42 | 0.13 | 0.02 | 44 | 3 | 5 | 167 | 434 | 7 | 37 | 14101 | 0.876 | 568 | 15 | 0.073 | 6.2% | Pb loss in middle |
| MY04C303 | 591 | 7 | 591 | 7 | 598 | 8 | 923 | 43 | 0.097 | 1.3% | 0.070 | 2.1% | 0.936 | 10.28 | 0.13 | 0.03 | 39 | 3 | 9 | 332 | 383 | 5 | 103 | 12667 | 0.877 | 497 | 14 | 0.058 | 1.9% | common Pb, 204 corr brings to concordia |
| AU21E203 | 609 | 6 | 609 | 6 | 611 | 6 | 735 | 35 | 0.100 | 1.0% | 0.064 | 1.6% | 0.875 | 10.05 | 0.10 | 0.02 | 25 | 2 | 3 | 98 | 254 | 8 | 19 | 12618 | 0.878 | 592 | 11 | 0.024 | 4.4% | Variable U/Pb |
| SE18B344 | 621 | 10 | 621 | 10 | 626 | 10 | 868 | 30 | 0.102 | 1.6% | 0.068 | 2.9% | 0.956 | 9.80 | 0.15 | 0.01 | 13 | 1 | 0 | 5 | 122 | 5 | 9 | 11150 | 0.879 | 1425 | 88 | 0.020 | 2.3% | off concordia, likely due to common Pb |
| MY04C323 | 644 | 4 | 644 | 4 | 644 | 4 | 660 | 21 | 0.105 | 0.7% | 0.062 | 1.0% | 0.892 | 9.52 | 0.06 | 0.00 | 22 | 1 | 5 | 151 | 211 | 15 | 0 | 12816 | 0.880 | 637 | 9 | 0.060 | 1.5% | ok |
| SE18B345 | 658 | 7 | 658 | 7 | 658 | 7 | 635 | 17 | 0.107 | 1.0% | 0.061 | 1.6% | 0.902 | 9.31 | 0.10 | 0.00 | 33 | 2 | 4 | 124 | 316 | 15 | 9 | 12483 | 0.882 | 639 | 12 | 0.035 | 2.8% | ok |
| AU21E197 | 718 | 7 | 718 | 7 | 718 | 8 | 718 | 28 | 0.118 | 1.0% | 0.063 | 1.3% | 1.029 | 8.48 | 0.09 | 0.01 | 37 | 2 | 2 | 54 | 319 | 2 | 20 | 13408 | 0.886 | 699 | 14 | 0.032 | 2.0% | ok |
| SE18B326 | 839 | 11 | 839 | 11 | 843 | 12 | 959 | 22 | 0.140 | 1.4% | 0.071 | 2.1% | 1.368 | 7.16 | 0.10 | 0.00 | 36 | 3 | 6 | 135 | 256 | 46 | 561 | 11000 | 0.896 | 849 | 20 | 0.009 | 2.0% | mix along concordia @ beginning |
| SE18B321 | 852 | 10 | 852 | 10 | 854 | 11 | 916 | 20 | 0.142 | 1.3% | 0.070 | 1.9% | 1.358 | 7.06 | 0.09 | 0.01 | 26 | 2 | 2 | 54 | 198 | 7 | 17 | 10971 | 0.897 | 862 | 23 | 0.028 | 2.1% | slightly off concordia -common Pb? |
| MY04C273 | 898 | 19 | 654 | 6 | 659 | 7 | 898 | 19 | 0.108 | 1.0% | 0.069 | 0.9% | 1.024 | 9.29 | 0.09 | 0.01 | 61 | 4 | 4 | 161 | 584 | 7 | 301 | 13743 | 0.882 | 480 | 21 | 0.016 | 2.3% | Pb loss, some common Pb |
| AU21E177 | 967 | 12 | 967 | 12 | 970 | 13 | 1041 | 42 | 0.162 | 1.3% | 0.074 | 2.1% | 1.656 | 6.16 | 0.08 | 0.02 | 31 | 2 | 3 | 61 | 214 | 2 | 51 | 13236 | 0.906 | 962 | 26 | 0.040 | 1.9% | slight common Pb |
| MY04C279 | 977 | 39 | 619 | 10 | 627 | 11 | 977 | 39 | 0.102 | 1.7% | 0.072 | 1.9% | 1.009 | 9.79 | 0.17 | 0.01 | 15 | 1 | 1 | 33 | 145 | 6 | 4 | 12634 | 0.879 | 731 | 25 | 0.056 | 2.4% | Pb loss, slight common Pb |
| MY04C310 | 979 | 7 | 979 | 7 | 981 | 7 | 1034 | 18 | 0.164 | 0.7% | 0.074 | 0.9% | 1.671 | 6.08 | 0.04 | 0.00 | 38 | 3 | 7 | 161 | 229 | 8 | 13 | 10283 | 0.907 | 826 | 12 | 0.030 | 1.8% | ok |
| AU21E178 | 982 | 9 | 982 | 9 | 987 | 10 | 1093 | 21 | 0.165 | 1.0% | 0.076 | 1.1% | 1.732 | 6.05 | 0.06 | 0.02 | 56 | 4 | 5 | 109 | 347 | 1 | 40 | 11493 | 0.908 | 956 | 18 | 0.030 | 1.9% | Slight common Pb |
| AU21E191 | 992 | 9 | 992 | 9 | 993 | 9 | 1027 | 14 | 0.167 | 0.9% | 0.073 | 0.7% | 1.687 | 6.00 | 0.05 | 0.01 | 101 | 7 | 25 | 513 | 621 | 17 | 29 | 10851 | 0.908 | 965 | 13 | 0.044 | 2.5% | ok |
| AU21E200 | 1015 | 11 | 1015 | 11 | 1015 | 11 | 1000 | 33 | 0.171 | 1.1% | 0.073 | 1.6% | 1.706 | 5.86 | 0.06 | 0.00 | 17 | 1 | 3 | 68 | 100 | 8 | 5 | 8393 | 0.910 | 1006 | 16 | 0.134 | 1.5% | ok |
| SE18B340 | 1015 | 11 | 1015 | 11 | 1019 | 11 | 1106 | 17 | 0.171 | 1.1% | 0.076 | 1.7% | 1.805 | 5.84 | 0.07 | 0.03 | 28 | 2 | 6 | 128 | 171 | 18 | 332 | 9595 | 0.910 | 988 | 16 | 0.092 | 1.3% | common Pb, use U/Pb age |
| AU21E202 | 1031 | 13 | 1031 | 13 | 1032 | 13 | 1051 | 35 | 0.174 | 1.3% | 0.074 | 1.8% | 1.779 | 5.76 | 0.07 | 0.00 | 38 | 3 | 6 | 116 | 210 | 4 | 5 | 9484 | 0.911 | 1012 | 18 | 0.060 | 1.8% | ok |
| AU21E194 | 1031 | 12 | 1031 | 12 | 1033 | 13 | 1081 | 37 | 0.174 | 1.2% | 0.075 | 1.8% | 1.809 | 5.75 | 0.07 | 0.00 | 38 | 3 | 6 | 133 | 238 | 12 | 77 | 11724 | 0.911 | 1041 | 17 | 0.043 | 2.4% | Pb loss in 2nd half |
| MY04C320 | 1037 | 7 | 1037 | 7 | 1038 | 7 | 1069 | 13 | 0.175 | 0.7% | 0.075 | 0.6% | 1.808 | 5.72 | 0.04 | 0.01 | 138 | 10 | 16 | 339 | 773 | 8 | 168 | 10796 | 0.912 | 903 | 12 | 0.078 | 2.2% | ok |
| SE18B342 | 1044 | 39 | 774 | 14 | 782 | 14 | 1044 | 39 | 0.129 | 1.8% | 0.074 | 3.9% | 1.317 | 7.76 | 0.14 | 0.00 | 4 | 0 | 1 | 24 | 34 | 22 | 133 | 7814 | 0.891 | 689 | 20 | 0.026 | 2.2% | off concordia - common Pb? Pb loss? |
| MY04C297 | 1050 | 10 | 1050 | 10 | 1063 | 10 | 1326 | 17 | 0.179 | 0.9% | 0.085 | 0.9% | 2.113 | 5.58 | 0.05 | 0.06 | 113 | 10 | 27 | 702 | 663 | 14 | 710 | 10921 | 0.914 | 792 | 15 | 0.045 | 1.4% | common Pb |
| MY04C319 | 1051 | 8 | 1051 | 8 | 1051 | 8 | 1054 | 17 | 0.177 | 0.8% | 0.074 | 0.8% | 1.819 | 5.65 | 0.05 | 0.00 | 106 | 8 | 19 | 361 | 573 | 8 | 164 | 10996 | 0.913 | 1015 | 14 | 0.048 | 1.8% | ok |
| MY04C314 | 1052 | 8 | 1052 | 8 | 1054 | 8 | 1091 | 18 | 0.178 | 0.7% | 0.076 | 0.9% | 1.858 | 5.63 | 0.04 | 0.00 | 57 | 4 | 6 | 110 | 338 | 56 | 3170 | 10910 | 0.913 | 1078 | 18 | 0.048 | 1.6% | ok |
| MY04C302 | 1057 | 7 | 1057 | 7 | 1058 | 8 | 1075 | 13 | 0.178 | 0.7% | 0.075 | 0.6% | 1.850 | 5.61 | 0.04 | 0.00 | 51 | 4 | 10 | 183 | 291 | 6 | 20 | 9212 | 0.914 | 1065 | 14 | 0.053 | 1.3% | ok |
| MY04C325 | 1058 | 6 | 1058 | 6 | 1058 | 6 | 1047 | 12 | 0.178 | 0.6% | 0.074 | 0.6% | 1.825 | 5.61 | 0.03 | 0.00 | 73 | 5 | 8 | 152 | 421 | 9 | 38 | 11721 | 0.914 | 1032 | 13 | 0.122 | 2.0% | ok |
| MY04C285 | 1060 | 23 | 1031 | 12 | 1033 | 13 | 1060 | 23 | 0.174 | 1.2% | 0.075 | 1.1% | 1.789 | 5.76 | 0.07 | 0.01 | 53 | 4 | 2 | 47 | 344 | 10 | 34 | 13182 | 0.911 | 1035 | 27 | 0.027 | 1.7% | Use 7/6 age |
| MY04C329 | 1062 | 7 | 1062 | 7 | 1062 | 7 | 1037 | 13 | 0.179 | 0.7% | 0.074 | 0.6% | 1.823 | 5.58 | 0.04 | 0.01 | 88 | 7 | 21 | 409 | 522 | 6 | 149 | 8237 | 0.914 | 1046 | 14 | 0.050 | 1.7% | ok |

Table 2. (cont.)

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age ($^{207}$ corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | 204Pb (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | $^{56}Fe$ (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018223 (2013-388)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MY04C316 | 1065 | 6 | 1065 | 6 | 1065 | 7 | 1047 | 11 | 0.180 | 0.6% | 0.074 | 0.6% | 1.839 | 5.56 | 0.03 | 0.00 | 106 | 8 | 10 | 192 | 619 | 5 | 29 | 12654 | 0.914 | 1064 | 14 | 0.079 | 1.4% | ok |
| MY04C305 | 1066 | 8 | 1066 | 8 | 1066 | 8 | 1023 | 17 | 0.180 | 0.8% | 0.073 | 0.8% | 1.818 | 5.56 | 0.04 | 0.00 | 32 | 2 | 5 | 87 | 183 | 12 | 9 | 11969 | 0.914 | 1092 | 16 | 0.051 | 1.6% | ok |
| MY04C298 | 1077 | 16 | 852 | 10 | 859 | 11 | 1077 | 16 | 0.143 | 1.2% | 0.075 | 0.8% | 1.481 | 7.01 | 0.09 | 0.03 | 140 | 10 | 6 | 400 | 991 | 20 | 443 | 14601 | 0.897 | 320 | 7 | 0.053 | 1.7% | common Pb, slightPb loss |
| SE18B330 | 1081 | 12 | 1081 | 12 | 1082 | 13 | 1113 | 20 | 0.183 | 1.2% | 0.077 | 2.0% | 1.933 | 5.47 | 0.06 | 0.00 | 22 | 2 | 3 | 65 | 127 | 5 | 3 | 10680 | 0.916 | 1095 | 22 | 0.049 | 2.7% | ok |
| MY04C301 | 1081 | 26 | 785 | 8 | 794 | 8 | 1081 | 26 | 0.131 | 1.0% | 0.075 | 1.3% | 1.364 | 7.63 | 0.08 | 0.00 | 78 | 6 | 12 | 628 | 667 | 25 | 568 | 12037 | 0.892 | 397 | 9 | 0.044 | 2.7% | Pb loss |
| SE18B339 | 1084 | 11 | 1084 | 11 | 1084 | 11 | 1082 | 13 | 0.183 | 1.0% | 0.075 | 1.3% | 1.905 | 5.46 | 0.06 | 0.00 | 43 | 3 | 7 | 127 | 239 | 11 | 15 | 11531 | 0.916 | 1054 | 15 | 0.059 | 2.8% | ok |
| AU21E193 | 1086 | 10 | 1086 | 10 | 1086 | 10 | 1097 | 21 | 0.183 | 0.9% | 0.076 | 1.0% | 1.925 | 5.45 | 0.05 | 0.01 | 33 | 2 | 7 | 128 | 185 | 6 | 22 | 11740 | 0.916 | 1098 | 15 | 0.042 | 1.4% | ok |
| MY04C281 | 1093 | 7 | 1093 | 7 | 1094 | 7 | 1101 | 13 | 0.185 | 0.6% | 0.076 | 0.6% | 1.943 | 5.41 | 0.04 | 0.00 | 58 | 4 | 11 | 205 | 321 | 15 | 488 | 9524 | 0.917 | 1086 | 14 | 0.026 | 2.3% | ok |
| MY04C291 | 1096 | 11 | 1096 | 11 | 1098 | 11 | 1139 | 35 | 0.186 | 1.0% | 0.078 | 1.7% | 1.990 | 5.38 | 0.05 | 0.00 | 39 | 3 | 11 | 186 | 199 | 10 | 87 | 10673 | 0.917 | 1073 | 19 | 0.053 | 1.8% | ok |
| MY04C292 | 1097 | 7 | 1097 | 7 | 1098 | 7 | 1125 | 14 | 0.186 | 0.6% | 0.077 | 0.7% | 1.975 | 5.39 | 0.03 | 0.00 | 49 | 4 | 4 | 76 | 269 | 9 | 290 | 7485 | 0.917 | 1129 | 16 | 0.053 | 1.6% | ok |
| AU21E183 | 1101 | 16 | 1065 | 9 | 1067 | 10 | 1101 | 16 | 0.180 | 0.9% | 0.076 | 0.8% | 1.892 | 5.56 | 0.05 | 0.00 | 64 | 5 | 16 | 290 | 355 | 8 | 46 | 11215 | 0.914 | 1055 | 14 | 0.053 | 1.6% | very slight pb loss |
| MY04C315 | 1104 | 15 | 1156 | 8 | 1156 | 8 | 1104 | 15 | 0.196 | 0.7% | 0.076 | 0.8% | 2.066 | 5.09 | 0.04 | 0.00 | 47 | 4 | 8 | 149 | 251 | 17 | 3 | 12380 | 0.922 | 1104 | 15 | 0.004 | 6.4% | reverse discordant throughout |
| MY04C327 | 1105 | 8 | 1105 | 8 | 1105 | 8 | 1095 | 18 | 0.187 | 0.7% | 0.076 | 0.9% | 1.959 | 5.35 | 0.04 | 0.00 | 23 | 2 | 5 | 90 | 120 | 15 | 60 | 10194 | 0.918 | 1061 | 19 | 0.055 | 1.8% | ok |
| AU21E180 | 1106 | 15 | 1106 | 15 | 1108 | 16 | 1144 | 40 | 0.187 | 1.4% | 0.078 | 2.0% | 2.013 | 5.33 | 0.07 | 0.02 | 44 | 3 | 5 | 80 | 224 | 23 | 769 | 11152 | 0.918 | 1166 | 26 | 0.028 | 2.6% | took concordant interval |
| SE18B328 | 1106 | 17 | 1106 | 17 | 1109 | 17 | 1171 | 26 | 0.188 | 1.5% | 0.079 | 2.7% | 2.044 | 5.33 | 0.08 | 0.00 | 14 | 1 | 2 | 37 | 73 | 11 | 3 | 9390 | 0.918 | 1157 | 32 | 0.055 | 1.6% | common Pb @ begin |
| SE18B329 | 1108 | 11 | 1108 | 11 | 1110 | 11 | 1154 | 12 | 0.188 | 1.0% | 0.078 | 1.2% | 2.029 | 5.32 | 0.05 | 0.03 | 99 | 8 | 12 | 253 | 579 | 5 | 22 | 11732 | 0.918 | 1048 | 17 | 0.049 | 1.3% | slight common Pb |
| MY04C321 | 1110 | 16 | 983 | 8 | 988 | 9 | 1110 | 16 | 0.166 | 0.9% | 0.077 | 0.8% | 1.749 | 6.04 | 0.05 | 0.01 | 74 | 6 | 13 | 309 | 487 | 15 | 381 | 12009 | 0.908 | 884 | 13 | 0.059 | 2.2% | Pb loss |
| SE18B332 | 1132 | 11 | 1132 | 11 | 1132 | 11 | 1114 | 9 | 0.192 | 1.0% | 0.077 | 0.9% | 2.031 | 5.21 | 0.05 | 0.00 | 76 | 6 | 2 | 57 | 417 | 10 | 53 | 12674 | 0.920 | 840 | 20 | 0.054 | 1.3% | mix with older Pb in 2nd half |
| MY04C296 | 1142 | 29 | 1057 | 10 | 1061 | 11 | 1142 | 29 | 0.179 | 1.0% | 0.078 | 1.5% | 1.919 | 5.59 | 0.06 | 0.01 | 23 | 2 | 5 | 103 | 138 | 7 | 11 | 9476 | 0.914 | 1037 | 18 | 0.046 | 1.4% | Slight Pb loss? |
| AU21E186 | 1147 | 25 | 852 | 9 | 862 | 9 | 1147 | 25 | 0.143 | 1.0% | 0.078 | 1.3% | 1.539 | 6.99 | 0.07 | 0.00 | 43 | 3 | 8 | 250 | 298 | 19 | 1025 | 11507 | 0.897 | 633 | 13 | 0.056 | 2.0% | off concordia - Pb loss? |
| SE18B324 | 1147 | 33 | 494 | 8 | 506 | 8 | 1147 | 33 | 0.082 | 1.6% | 0.078 | 3.3% | 0.879 | 12.24 | 0.19 | 0.04 | 63 | 5 | 16 | 671 | 760 | 56 | 2739 | 10666 | 0.870 | 452 | 11 | 0.053 | 2.7% | Pb loss, used lowest 204Pb |
| MY04C324 | 1148 | 20 | 1059 | 8 | 1063 | 9 | 1148 | 20 | 0.179 | 0.8% | 0.078 | 1.0% | 1.930 | 5.58 | 0.05 | 0.01 | 56 | 4 | 7 | 151 | 346 | 5 | 67 | 12469 | 0.914 | 1007 | 17 | 0.032 | 1.4% | slight Pb loss |
| MY04C322 | 1157 | 8 | 1157 | 8 | 1157 | 8 | 1129 | 15 | 0.197 | 0.7% | 0.077 | 0.7% | 2.095 | 5.09 | 0.04 | 0.01 | 41 | 3 | 5 | 100 | 216 | 5 | 31 | 11008 | 0.922 | 978 | 22 | 0.057 | 1.4% | ok |
| AU21E188 | 1160 | 21 | 1048 | 10 | 1053 | 10 | 1160 | 21 | 0.177 | 0.9% | 0.079 | 1.1% | 1.921 | 5.64 | 0.05 | 0.01 | 47 | 4 | 14 | 267 | 271 | 7 | 21 | 10301 | 0.913 | 1043 | 14 | 0.071 | 1.7% | Slight Pb loss |
| SE18B334 | 1165 | 9 | 935 | 8 | 944 | 8 | 1165 | 9 | 0.158 | 0.9% | 0.079 | 0.9% | 1.712 | 6.34 | 0.06 | 0.02 | 83 | 7 | 10 | 324 | 527 | 28 | 190 | 10840 | 0.904 | 597 | 11 | 0.089 | 1.2% | Pb loss |
| AU21E182 | 1170 | 19 | 1111 | 12 | 1113 | 12 | 1170 | 19 | 0.189 | 1.1% | 0.079 | 1.0% | 2.052 | 5.30 | 0.06 | 0.00 | 107 | 8 | 11 | 232 | 618 | 6 | 114 | 13649 | 0.918 | 1043 | 18 | 0.027 | 1.7% | very slight Pb loss |
| AU21E185 | 1184 | 13 | 1184 | 13 | 1184 | 14 | 1201 | 30 | 0.202 | 1.1% | 0.080 | 1.5% | 2.229 | 4.96 | 0.06 | 0.00 | 66 | 5 | 3 | 58 | 366 | 4 | 22 | 13570 | 0.924 | 1144 | 27 | 0.051 | 1.8% | took concordant interval |
| AU21E199 | 1208 | 11 | 1208 | 11 | 1209 | 12 | 1224 | 32 | 0.206 | 1.0% | 0.081 | 1.6% | 2.307 | 4.85 | 0.05 | 0.00 | 123 | 10 | 19 | 283 | 573 | 3 | 119 | 13165 | 0.926 | 1190 | 20 | 0.054 | 1.3% | Pb loss @ begin & middle |
| AU21E198 | 1228 | 58 | 974 | 17 | 984 | 18 | 1228 | 58 | 0.165 | 1.8% | 0.081 | 3.0% | 1.848 | 6.06 | 0.11 | 0.02 | 14 | 1 | 3 | 46 | 80 | 3 | 2 | 8799 | 0.907 | 1105 | 27 | 0.058 | 2.4% | Ancient Pb loss? Use 7/6 age |
| MY04C287 | 1247 | 31 | 689 | 8 | 705 | 9 | 1247 | 31 | 0.116 | 1.2% | 0.082 | 1.6% | 1.307 | 8.66 | 0.11 | 0.00 | 61 | 5 | 15 | 616 | 500 | 15 | 599 | 12208 | 0.885 | 476 | 11 | 0.061 | 1.7% | Pb loss |
| AU21E187 | 1283 | 17 | 1154 | 10 | 1161 | 11 | 1283 | 17 | 0.197 | 0.9% | 0.084 | 0.9% | 2.274 | 5.07 | 0.05 | 0.01 | 82 | 7 | 8 | 180 | 424 | 5 | 189 | 12533 | 0.922 | 953 | 15 | 0.055 | 1.7% | Slight Pb loss |
| AU21E195 | 1388 | 15 | 1388 | 15 | 1390 | 16 | 1424 | 28 | 0.241 | 1.1% | 0.090 | 1.5% | 2.984 | 4.16 | 0.05 | 0.00 | 26 | 2 | 5 | 70 | 104 | 14 | 101 | 10651 | 0.943 | 1383 | 23 | 0.056 | 1.4% | ok |
| AU21E181 | 1416 | 19 | 1416 | 19 | 1416 | 20 | 1396 | 24 | 0.246 | 1.4% | 0.089 | 1.3% | 3.002 | 4.07 | 0.06 | 0.00 | 36 | 3 | 6 | 73 | 142 | 23 | 228 | 12240 | 0.945 | 1442 | 27 | 0.084 | 2.4% | Pb mobility, brought to concordia |
| AU21E196 | 1429 | 52 | 552 | 9 | 573 | 9 | 1429 | 52 | 0.093 | 1.7% | 0.090 | 2.7% | 1.156 | 10.75 | 0.18 | 0.06 | 48 | 4 | 8 | 506 | 544 | 28 | 1359 | 12267 | 0.875 | 325 | 9 | 0.055 | 1.3% | Common Pb, Pb loss? |
| AU21E192 | 1456 | 48 | 905 | 16 | 928 | 16 | 1456 | 48 | 0.155 | 1.8% | 0.091 | 2.5% | 1.951 | 6.46 | 0.11 | 0.01 | 8 | 1 | 2 | 39 | 52 | 57 | 6947 | 9626 | 0.903 | 1032 | 24 | 0.052 | 1.4% | off concordia, Pb loss? |
| MY04C304 | 1488 | 35 | 1058 | 13 | 1080 | 14 | 1488 | 35 | 0.182 | 1.3% | 0.093 | 1.8% | 2.339 | 5.48 | 0.07 | 0.00 | 21 | 2 | 5 | 99 | 123 | 17 | 152 | 8457 | 0.915 | 1146 | 22 | 0.035 | 2.0% | Pb loss |
| MY04C282 | 1543 | 16 | 1119 | 11 | 1142 | 12 | 1543 | 16 | 0.194 | 1.1% | 0.096 | 0.9% | 2.559 | 5.16 | 0.05 | 0.00 | 68 | 7 | 15 | 264 | 382 | 6 | 54 | 10702 | 0.921 | 1173 | 18 | 0.054 | 1.4% | Pb loss |
| AU21E176 | 1682 | 28 | 1038 | 19 | 1072 | 20 | 1682 | 28 | 0.181 | 1.9% | 0.103 | 1.5% | 2.574 | 5.53 | 0.10 | 0.01 | 73 | 7 | 9 | 201 | 425 | 27 | 478 | 11793 | 0.915 | 933 | 25 | 0.054 | 1.7% | Pb loss, through grain in middle |
| SE18B323 | 1710 | 20 | 1710 | 20 | 1712 | 20 | 1730 | 10 | 0.304 | 1.2% | 0.106 | 1.1% | 4.443 | 3.29 | 0.04 | 0.02 | 150 | 16 | 15 | 266 | 484 | 11 | 525 | 10153 | 0.973 | 1087 | 19 | 0.052 | 1.3% | used concordant section |
| MY04C272 | 1717 | 16 | 1578 | 12 | 1590 | 12 | 1717 | 16 | 0.280 | 0.8% | 0.105 | 0.9% | 4.057 | 3.57 | 0.03 | 0.00 | 48 | 5 | 10 | 136 | 178 | 17 | 154 | 11131 | 0.961 | 1532 | 21 | 0.074 | 1.8% | Pb loss |
| MY04C328 | 1764 | 12 | 1725 | 13 | 1729 | 13 | 1764 | 12 | 0.308 | 0.8% | 0.108 | 0.6% | 4.576 | 3.25 | 0.03 | 0.01 | 148 | 16 | 41 | 447 | 459 | 11 | 8 | 9699 | 0.975 | 1714 | 21 | 0.051 | 1.6% | ok |
| AU21E201 | 1777 | 20 | 1777 | 20 | 1779 | 20 | 1795 | 26 | 0.318 | 1.1% | 0.110 | 1.4% | 4.807 | 3.15 | 0.03 | 0.00 | 49 | 5 | 3 | 38 | 168 | 10 | 3 | 12902 | 0.980 | 1640 | 39 | 0.042 | 2.4% | took concordant section |

Table 2. (cont.)

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age ($^{207}$ corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | 204Pb (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | $^{56}Fe$ (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018223 (2013-388) continued** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MY04C283 | 1794 | 14 | 1553 | 13 | 1575 | 13 | 1794 | 14 | 0.277 | 0.9% | 0.110 | 0.8% | 4.186 | 3.61 | 0.03 | 0.00 | 194 | 21 | 25 | 393 | 666 | 74 | 764 | 12213 | 0.960 | 1180 | 21 | 0.122 | 1.4% | Pb loss |
| SE18B343 | 1833 | 20 | 1602 | 39 | 1624 | 40 | 1833 | 20 | 0.286 | 2.5% | 0.112 | 2.2% | 4.424 | 3.49 | 0.09 | 0.00 | 26 | 3 | 8 | 117 | 105 | 18 | 19 | 8791 | 0.965 | 1524 | 34 | 0.054 | 1.3% | Pb loss |
| SE18B333 | 1894 | 9 | 1549 | 14 | 1581 | 15 | 1894 | 9 | 0.278 | 1.0% | 0.116 | 0.7% | 4.443 | 3.60 | 0.03 | 0.03 | 214 | 25 | 8 | 169 | 756 | 13 | 147 | 18009 | 0.961 | 880 | 22 | 0.134 | 1.2% | Pb loss, chose lowest 204Pb |
| MY04C295 | 2145 | 10 | 1800 | 13 | 1843 | 14 | 2145 | 10 | 0.331 | 0.8% | 0.134 | 0.6% | 6.095 | 3.02 | 0.02 | 0.00 | 47 | 6 | 9 | 102 | 145 | 18 | 211 | 12240 | 0.986 | 1786 | 23 | 0.053 | 1.3% | Pb loss |
| MY04C284 | 2309 | 12 | 2348 | 18 | 2348 | 17 | 2309 | 12 | 0.439 | 0.7% | 0.147 | 0.7% | 8.895 | 2.28 | 0.02 | 0.00 | 48 | 7 | 10 | 87 | 115 | 8 | 18 | 11987 | 1.039 | 2328 | 32 | 0.050 | 2.2% | ok |
| MY04C300 | 2511 | 5 | 2559 | 18 | 2559 | 17 | 2511 | 5 | 0.487 | 0.7% | 0.165 | 0.3% | 11.110 | 2.05 | 0.01 | 0.00 | 213 | 35 | 22 | 162 | 445 | 2 | 56 | 12210 | 1.062 | 2550 | 32 | 0.032 | 1.8% | ok |
| SE18B341 | 2976 | 8 | 2391 | 28 | 2544 | 28 | 2976 | 8 | 0.484 | 1.1% | 0.219 | 0.6% | 14.631 | 2.07 | 0.02 | 0.01 | 105 | 23 | 25 | 188 | 217 | 102 | 3504 | 10286 | 1.060 | 2549 | 38 | 0.056 | 1.5% | Pb loss |
| MY04C309 | 3208 | 6 | 2772 | 34 | 2930 | 31 | 3208 | 6 | 0.575 | 1.1% | 0.254 | 0.4% | 20.122 | 1.74 | 0.02 | 0.01 | 135 | 34 | 12 | 109 | 256 | 8 | 214 | 10923 | 1.102 | 2334 | 47 | 0.056 | 1.3% | Pb loss |
| **R018272 (2014-001) Crescent Spur Sst** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| JA31A017 | 599 | 8 | 599 | 8 | 599 | 8 | 605 | 23 | 0.097 | 1.3% | 0.060 | 2.1% | 0.807 | 10.26 | 0.14 | 0.00 | 27 | 2 | 8 | 253 | 271 | 9 | 34 | 9605 | 0.877 | 581 | 10 | 0.029 | 1.8% | ok |
| FE05B007 | 606 | 7 | 606 | 7 | 611 | 8 | 822 | 22 | 0.099 | 1.3% | 0.066 | 2.1% | 0.911 | 10.07 | 0.13 | 0.00 | 48 | 3 | 3 | 96 | 467 | 4 | 596 | 11914 | 0.878 | 588 | 15 | 0.030 | 2.6% | Discordant- common Pb? Pb loss? |
| JA31A012 | 609 | 8 | 609 | 8 | 609 | 9 | 632 | 31 | 0.099 | 1.4% | 0.061 | 2.9% | 0.831 | 10.09 | 0.14 | 0.00 | 23 | 1 | 6 | 193 | 220 | 6 | 0 | 9591 | 0.878 | 603 | 11 | 0.030 | 1.9% | ok |
| JA31A011 | 609 | 12 | 609 | 12 | 610 | 13 | 666 | 45 | 0.099 | 2.1% | 0.062 | 4.2% | 0.845 | 10.07 | 0.21 | 0.00 | 20 | 1 | 5 | 168 | 215 | 18 | 639 | 9130 | 0.878 | 574 | 19 | 0.029 | 3.2% | used concordant part |
| FE05B016 | 611 | 27 | 611 | 27 | 635 | 29 | 1487 | 62 | 0.104 | 4.5% | 0.093 | 6.6% | 1.327 | 9.66 | 0.43 | 0.01 | 8 | 1 | 4 | 47 | 70 | 589 | 4416 | 9582 | 0.880 | 1659 | 71 | 0.086 | 4.3% | small interval w/ lowest common Pb |
| FE05B019 | 618 | 10 | 618 | 10 | 621 | 10 | 757 | 30 | 0.101 | 1.6% | 0.064 | 2.9% | 0.899 | 9.89 | 0.16 | 0.01 | 15 | 1 | 3 | 117 | 165 | 8 | 1088 | 9143 | 0.879 | 600 | 14 | 0.030 | 2.4% | younger in 2nd half |
| JA31A016 | 624 | 9 | 624 | 9 | 625 | 9 | 668 | 31 | 0.102 | 1.4% | 0.062 | 2.9% | 0.868 | 9.82 | 0.14 | 0.00 | 13 | 1 | 3 | 79 | 129 | 5 | 14 | 9682 | 0.879 | 617 | 16 | 0.031 | 2.5% | ok |
| FE05B017 | 628 | 7 | 628 | 7 | 630 | 8 | 712 | 17 | 0.103 | 1.2% | 0.063 | 1.6% | 0.894 | 9.74 | 0.12 | 0.00 | 29 | 2 | 4 | 113 | 295 | 16 | 121 | 10470 | 0.879 | 646 | 11 | 0.032 | 1.7% | slight common Pb |
| JA31A007 | 631 | 9 | 631 | 9 | 631 | 9 | 627 | 31 | 0.103 | 1.5% | 0.061 | 2.9% | 0.860 | 9.72 | 0.15 | 0.02 | 16 | 1 | 4 | 107 | 150 | 7 | 619 | 9546 | 0.879 | 656 | 14 | 0.033 | 2.2% | ok |
| FE05B013 | 632 | 8 | 632 | 8 | 641 | 8 | 1018 | 20 | 0.105 | 1.3% | 0.073 | 1.9% | 1.055 | 9.56 | 0.12 | 0.03 | 24 | 2 | 4 | 119 | 239 | 57 | 12574 | 8447 | 0.880 | 763 | 16 | 0.038 | 2.1% | common Pb, Fe incl. |
| FE05B014 | 634 | 9 | 634 | 9 | 641 | 9 | 936 | 26 | 0.105 | 1.5% | 0.070 | 2.6% | 1.013 | 9.56 | 0.14 | 0.02 | 11 | 1 | 2 | 67 | 110 | 21 | 237 | 8509 | 0.880 | 619 | 16 | 0.031 | 2.5% | common Pb |
| FE05B015 | 636 | 7 | 636 | 7 | 638 | 7 | 712 | 13 | 0.104 | 1.1% | 0.063 | 1.2% | 0.905 | 9.61 | 0.11 | 0.02 | 38 | 2 | 11 | 363 | 374 | 14 | 501 | 10881 | 0.880 | 614 | 9 | 0.031 | 1.4% | ok |
| FE05B011 | 642 | 8 | 642 | 8 | 642 | 8 | 652 | 18 | 0.105 | 1.3% | 0.061 | 1.7% | 0.886 | 9.55 | 0.12 | 0.01 | 18 | 1 | 3 | 88 | 179 | 5 | 256 | 10036 | 0.880 | 630 | 11 | 0.032 | 1.8% | ok |
| FE05B009 | 649 | 9 | 649 | 9 | 651 | 10 | 730 | 16 | 0.106 | 1.5% | 0.064 | 1.5% | 0.933 | 9.41 | 0.14 | 0.00 | 57 | 4 | 16 | 528 | 595 | 16 | 247 | 8673 | 0.881 | 637 | 11 | 0.032 | 1.7% | slight common Pb |
| FE05B010 | 660 | 8 | 660 | 8 | 667 | 9 | 924 | 22 | 0.109 | 1.3% | 0.070 | 2.2% | 1.050 | 9.18 | 0.12 | 0.02 | 14 | 1 | 3 | 85 | 131 | 15 | 15 | 7745 | 0.882 | 727 | 13 | 0.037 | 1.8% | slight common Pb |
| JA31A006 | 665 | 11 | 665 | 11 | 666 | 11 | 695 | 35 | 0.109 | 1.7% | 0.063 | 3.3% | 0.939 | 9.19 | 0.15 | 0.00 | 18 | 1 | 5 | 143 | 166 | 6 | 0 | 9232 | 0.882 | 690 | 15 | 0.035 | 2.2% | ok |
| JA31A018 | 670 | 14 | 670 | 14 | 673 | 14 | 802 | 41 | 0.110 | 2.1% | 0.066 | 3.9% | 1.000 | 9.08 | 0.19 | 0.02 | 14 | 1 | 2 | 49 | 129 | 9 | 3 | 10604 | 0.883 | 707 | 24 | 0.036 | 3.4% | slight common Pb |
| JA31A014 | 671 | 14 | 671 | 14 | 671 | 15 | 606 | 58 | 0.110 | 2.2% | 0.060 | 5.4% | 0.908 | 9.12 | 0.20 | 0.00 | 5 | 0 | 1 | 18 | 42 | 18 | 0 | 7423 | 0.882 | 650 | 27 | 0.033 | 4.1% | ok |
| JA31A013 | 693 | 11 | 693 | 11 | 693 | 11 | 695 | 29 | 0.113 | 1.6% | 0.063 | 2.8% | 0.979 | 8.81 | 0.14 | 0.00 | 40 | 2 | 9 | 227 | 318 | 11 | 42 | 9259 | 0.884 | 680 | 15 | 0.034 | 2.2% | Reverse discordant in 2nd half |
| FE05B020 | 725 | 8 | 725 | 8 | 727 | 8 | 815 | 10 | 0.119 | 1.1% | 0.066 | 0.9% | 1.091 | 8.37 | 0.09 | 0.01 | 96 | 6 | 10 | 271 | 795 | 18 | 787 | 9581 | 0.887 | 715 | 11 | 0.036 | 1.5% | ok |
| JA31A019 | 748 | 14 | 748 | 14 | 749 | 14 | 795 | 51 | 0.123 | 1.9% | 0.066 | 4.9% | 1.115 | 8.11 | 0.15 | 0.00 | 72 | 5 | 8 | 234 | 666 | 6 | 599 | 11112 | 0.889 | 723 | 18 | 0.036 | 2.5% | small concordant interval, common Pb inc. in middle |
| JA31A015 | 1400 | 13 | 974 | 16 | 993 | 17 | 1400 | 13 | 0.167 | 1.7% | 0.089 | 1.4% | 2.039 | 6.00 | 0.10 | 0.00 | 49 | 4 | 5 | 99 | 290 | 52 | 991 | 9680 | 0.908 | 887 | 20 | 0.045 | 2.3% | Pb loss, use 7/6 age |
| FE05B008 | 1557 | 11 | 1187 | 14 | 1209 | 15 | 1557 | 11 | 0.206 | 1.2% | 0.096 | 1.2% | 2.745 | 4.85 | 0.06 | 0.03 | 56 | 5 | 12 | 231 | 287 | 25 | 2499 | 9517 | 0.927 | 1098 | 19 | 0.056 | 1.7% | common Pb, possibly Pb loss? |
| FE05B012 | 1659 | 21 | 1659 | 21 | 1661 | 21 | 1687 | 13 | 0.294 | 1.3% | 0.103 | 1.4% | 4.192 | 3.40 | 0.04 | 0.00 | 64 | 7 | 32 | 350 | 208 | 35 | 2164 | 8042 | 0.968 | 1634 | 23 | 0.084 | 1.4% | took concordant part, Hg incl. @ begin |
| JA31A009 | 1705 | 20 | 1705 | 20 | 1708 | 20 | 1738 | 9 | 0.303 | 1.2% | 0.106 | 1.0% | 4.451 | 3.30 | 0.04 | 0.01 | 88 | 9 | 17 | 173 | 281 | 6 | 14 | 9464 | 0.973 | 1744 | 28 | 0.090 | 1.6% | just off concordia, slight common Pb? |
| JA31A010 | 1768 | 23 | 1768 | 23 | 1768 | 24 | 1769 | 7 | 0.315 | 1.3% | 0.108 | 0.8% | 4.705 | 3.17 | 0.04 | 0.07 | 144 | 16 | 14 | 154 | 471 | 3 | 57 | 7500 | 0.979 | 1756 | 33 | 0.091 | 1.9% | Pb loss in 2nd half |
| JA31A020 | 1799 | 22 | 1799 | 22 | 1799 | 22 | 1797 | 9 | 0.322 | 1.2% | 0.110 | 0.9% | 4.875 | 3.11 | 0.04 | 0.04 | 84 | 9 | 8 | 101 | 262 | 15 | 313 | 11648 | 0.982 | 1594 | 38 | 0.082 | 2.4% | ok |
| JA31A008 | 1878 | 26 | 1878 | 26 | 1878 | 26 | 1870 | 9 | 0.338 | 1.4% | 0.114 | 1.0% | 5.334 | 2.96 | 0.04 | 0.00 | 107 | 12 | 15 | 164 | 335 | 28 | 0 | 9756 | 0.990 | 1826 | 32 | 0.095 | 1.7% | Pb loss in 2nd half |
| FE05B018 | | | 698 | 8 | 749 | 9 | 1993 | 16 | 0.123 | 1.2% | 0.122 | 1.8% | 2.082 | 8.11 | 0.10 | 0.87 | 234 | 29 | 43 | 257 | 1823 | 22 | 1472 | 12857 | 0.889 | 2900 | 101 | 0.154 | 3.5% | Use w/ caution - full of common Pb |

Table 3. Isotopic and age data from LA-ICPMS analysis of zircons in samples R018210, R018213 and R018218 from the Luina Group.

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age ($^{207}$ corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | $^{204}Pb$ (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | $^{56}Fe$ (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018210 (2013-389) Deep Creek Volcs** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AU21E214 | 543 | 9 | 543 | 9 | 567 | 10 | 1508 | 67 | 0.092 | 1.7% | 0.094 | 3.6% | 1.191 | 10.88 | 0.19 | 0.05 | 12 | 1 | 4 | 103 | 142 | 51 | 2812 | 10731 | 0.875 | 798 | 17 | 0.040 | 2.1% | out of grain middle to end |
| AU21E213 | 546 | 9 | 546 | 9 | 572 | 10 | 1567 | 67 | 0.093 | 1.7% | 0.097 | 3.6% | 1.241 | 10.78 | 0.18 | 0.03 | 8 | 1 | 3 | 80 | 94 | 27 | 1324 | 11208 | 0.875 | 798 | 20 | 0.040 | 2.5% | ok |
| AU21E210 | 546 | 6 | 546 | 6 | 556 | 7 | 1013 | 36 | 0.090 | 1.2% | 0.073 | 1.8% | 0.906 | 11.11 | 0.13 | 0.01 | 21 | 2 | 6 | 210 | 248 | 22 | 4047 | 9755 | 0.874 | 627 | 9 | 0.032 | 1.4% | Pb loss & common Pb middle to end |
| AU21E216 | 546 | 8 | 546 | 8 | 557 | 8 | 1049 | 50 | 0.090 | 1.4% | 0.074 | 2.5% | 0.924 | 11.08 | 0.15 | 0.00 | 10 | 1 | 3 | 103 | 115 | 81 | 14048 | 8972 | 0.874 | 624 | 12 | 0.031 | 1.9% | ok |
| AU21E217 | 549 | 11 | 549 | 11 | 565 | 11 | 1282 | 63 | 0.092 | 1.9% | 0.084 | 3.2% | 1.055 | 10.91 | 0.21 | 0.02 | 17 | 1 | 6 | 192 | 197 | 56 | 7640 | 9553 | 0.875 | 653 | 15 | 0.033 | 2.3% | younger & common Pb in 2nd half |
| AU21E207 | 550 | 7 | 550 | 7 | 567 | 7 | 1267 | 45 | 0.092 | 1.2% | 0.083 | 2.3% | 1.050 | 10.88 | 0.14 | 0.01 | 11 | 1 | 3 | 88 | 120 | 160 | 712 | 9891 | 0.875 | 717 | 15 | 0.036 | 2.1% | Off concordia |
| AU21E208 | 551 | 12 | 551 | 12 | 558 | 12 | 926 | 105 | 0.090 | 2.2% | 0.070 | 5.1% | 0.873 | 11.05 | 0.24 | 0.00 | 4 | 0 | 1 | 30 | 52 | 16 | 755 | 9028 | 0.874 | 653 | 24 | 0.033 | 3.6% | variable U/Pb |
| AU21E206 | 559 | 9 | 559 | 9 | 576 | 10 | 1275 | 62 | 0.093 | 1.7% | 0.083 | 3.2% | 1.073 | 10.70 | 0.18 | 0.00 | 6 | 0 | 1 | 32 | 64 | 8 | 1238 | 11069 | 0.875 | 782 | 20 | 0.039 | 2.5% | off concordia, common Pb? |
| AU21E211 | 561 | 9 | 561 | 9 | 601 | 10 | 1906 | 43 | 0.098 | 1.6% | 0.117 | 2.4% | 1.573 | 10.23 | 0.17 | 0.05 | 16 | 2 | 5 | 102 | 177 | 472 | 17679 | 9752 | 0.877 | 1027 | 26 | 0.052 | 2.5% | through grain @ end |
| AU21E212 | 565 | 6 | 565 | 6 | 568 | 6 | 704 | 51 | 0.092 | 1.1% | 0.063 | 2.4% | 0.798 | 10.86 | 0.12 | 0.00 | 13 | 1 | 3 | 103 | 151 | 7 | 59 | 10813 | 0.875 | 601 | 10 | 0.030 | 1.7% | slightly older @ end |
| AU21E215 | 569 | 8 | 569 | 8 | 615 | 9 | 2003 | 35 | 0.100 | 1.4% | 0.123 | 2.0% | 1.700 | 9.99 | 0.14 | 0.07 | 15 | 2 | 6 | 108 | 152 | 166 | 6394 | 11096 | 0.878 | 1057 | 22 | 0.054 | 2.1% | common Pb |
| AU21E209 | 571 | 6 | 571 | 6 | 575 | 6 | 764 | 35 | 0.093 | 1.1% | 0.065 | 1.7% | 0.832 | 10.72 | 0.12 | 0.01 | 22 | 1 | 5 | 153 | 231 | 17 | 5841 | 10159 | 0.875 | 635 | 10 | 0.032 | 1.6% | ok |
| **R018213 (2013-393) Deep Creek Volcs** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AU21E172 | 548 | 6 | 548 | 6 | 552 | 6 | 739 | 20 | 0.089 | 1.2% | 0.064 | 1.9% | 0.788 | 11.19 | 0.13 | 0.01 | 16 | 1 | 5 | 179 | 182 | 522 | 3745 | 10019 | 0.874 | 564 | 9 | 0.028 | 1.6% | Variable U/Pb |
| AU21E173 | 547 | 9 | 547 | 9 | 556 | 9 | 985 | 81 | 0.090 | 1.7% | 0.072 | 4.0% | 0.893 | 11.11 | 0.19 | 0.00 | 8 | 1 | 2 | 60 | 96 | 25 | 1094 | 9986 | 0.874 | 647 | 16 | 0.033 | 2.4% | Through grain @ end |
| NO28B030 | 550 | 10 | 550 | 10 | 550 | 10 | 540 | 40 | 0.089 | 1.9% | 0.058 | 3.6% | 0.716 | 11.23 | 0.21 | 0.00 | 9 | 1 | 2 | 94 | 102 | 77 | 1300 | 7413 | 0.873 | 549 | 10 | 0.028 | 1.9% | Fe-Ti phase throughout |
| NO28B037 | 552 | 11 | 552 | 11 | 554 | 11 | 654 | 40 | 0.090 | 1.9% | 0.061 | 3.7% | 0.760 | 11.15 | 0.22 | 0.00 | 7 | 0 | 1 | 45 | 72 | 204 | 2404 | 8437 | 0.874 | 580 | 17 | 0.029 | 2.9% | Fe-Ti phase throughout- common Pb @ begin |
| NO28B042 | 557 | 8 | 557 | 8 | 557 | 8 | 545 | 17 | 0.090 | 1.4% | 0.058 | 1.6% | 0.726 | 11.09 | 0.15 | 0.00 | 98 | 6 | 38 | 1329 | 1054 | 15 | 167 | 10264 | 0.874 | 542 | 8 | 0.027 | 1.4% | Pb loss in high U 1st half |
| NO28B039 | 558 | 8 | 558 | 8 | 564 | 9 | 864 | 25 | 0.091 | 1.5% | 0.068 | 2.4% | 0.855 | 10.94 | 0.17 | 0.02 | 9 | 1 | 2 | 63 | 97 | 4 | 202 | 8955 | 0.874 | 606 | 12 | 0.030 | 1.9% | minor common Pb |
| NO28B035 | 561 | 12 | 561 | 12 | 563 | 12 | 668 | 50 | 0.091 | 2.2% | 0.062 | 4.7% | 0.778 | 10.96 | 0.24 | 0.00 | 7 | 0 | 2 | 59 | 86 | 6 | 148 | 7549 | 0.874 | 545 | 18 | 0.027 | 3.3% | minor Pb loss in high U middle |
| NO28B040 | 568 | 8 | 568 | 8 | 570 | 9 | 646 | 31 | 0.092 | 1.5% | 0.061 | 2.9% | 0.779 | 10.83 | 0.16 | 0.01 | 14 | 1 | 3 | 123 | 160 | 643 | 3632 | 7977 | 0.875 | 591 | 12 | 0.030 | 2.0% | Fe-Ti phase throughout |
| NO28B043 | 569 | 8 | 569 | 8 | 570 | 8 | 653 | 23 | 0.093 | 1.4% | 0.061 | 2.2% | 0.783 | 10.81 | 0.16 | 0.02 | 16 | 1 | 2 | 85 | 182 | 7 | 19 | 12848 | 0.875 | 573 | 12 | 0.029 | 2.1% | slightly older @ end |
| NO28B029 | 571 | 9 | 571 | 9 | 572 | 9 | 588 | 36 | 0.093 | 1.6% | 0.060 | 3.3% | 0.762 | 10.78 | 0.17 | 0.00 | 6 | 0 | 1 | 44 | 65 | 10 | 763 | 8837 | 0.875 | 585 | 13 | 0.029 | 2.2% | ok |
| NO28B034 | 573 | 9 | 573 | 9 | 573 | 9 | 541 | 32 | 0.093 | 1.5% | 0.058 | 2.9% | 0.748 | 10.75 | 0.16 | 0.00 | 8 | 0 | 2 | 54 | 87 | 8 | 6 | 8278 | 0.875 | 568 | 11 | 0.028 | 2.0% | ok |
| NO28B032 | 573 | 10 | 573 | 10 | 574 | 10 | 602 | 35 | 0.093 | 1.8% | 0.060 | 3.3% | 0.770 | 10.74 | 0.19 | 0.03 | 5 | 0 | 1 | 23 | 50 | 7 | 11 | 7684 | 0.875 | 608 | 18 | 0.031 | 2.9% | ok |
| NO28B033 | 574 | 7 | 574 | 7 | 578 | 7 | 763 | 16 | 0.094 | 1.2% | 0.065 | 1.5% | 0.836 | 10.66 | 0.13 | 0.01 | 32 | 2 | 6 | 178 | 342 | 49 | 2171 | 10171 | 0.875 | 631 | 10 | 0.032 | 1.6% | common Pb @ begin, high Fe throughout |
| NO28B031 | 577 | 10 | 577 | 10 | 581 | 10 | 806 | 45 | 0.094 | 1.7% | 0.066 | 4.3% | 0.859 | 10.60 | 0.18 | 0.02 | 5 | 0 | 1 | 32 | 57 | 482 | 3023 | 8424 | 0.876 | 630 | 16 | 0.032 | 2.5% | Fe-Ti phase throughout - common Pb |

Table 3. (cont.)

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age (207 corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | $^{204}Pb$ (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | $^{56}Fe$ (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018218 (2013-390) Hall Fm** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NO28B008 | 537 | 6 | 537 | 6 | 537 | 6 | 571 | 14 | 0.087 | 1.2% | 0.059 | 1.3% | 0.708 | 11.51 | 0.14 | 0.00 | 28 | 2 | 3 | 101 | 328 | 33 | 226 | 11916 | 0.872 | 553 | 10 | 0.028 | 1.8% | ok |
| NO28B009 | 541 | 7 | 541 | 7 | 543 | 7 | 655 | 17 | 0.088 | 1.3% | 0.061 | 1.6% | 0.744 | 11.39 | 0.15 | 0.01 | 25 | 2 | 4 | 144 | 286 | 12 | 49 | 10212 | 0.873 | 554 | 10 | 0.028 | 1.8% | ok |
| NO28B022 | 560 | 13 | 560 | 13 | 560 | 13 | 552 | 63 | 0.091 | 2.3% | 0.059 | 5.8% | 0.733 | 11.02 | 0.25 | 0.01 | 14 | 1 | 2 | 66 | 170 | 13 | 20 | 10785 | 0.874 | 518 | 24 | 0.026 | 4.6% | used small concordant part |
| NO28B020 | 562 | 7 | 562 | 7 | 563 | 7 | 612 | 17 | 0.091 | 1.3% | 0.060 | 1.6% | 0.758 | 10.95 | 0.14 | 0.00 | 37 | 2 | 8 | 318 | 438 | 8 | 38 | 12080 | 0.874 | 562 | 9 | 0.028 | 1.5% | variable U/Pb |
| AU21E218 | 565 | 7 | 565 | 7 | 567 | 7 | 674 | 47 | 0.092 | 1.2% | 0.062 | 2.2% | 0.785 | 10.88 | 0.13 | 0.02 | 27 | 2 | 3 | 103 | 316 | 13 | 140 | 12456 | 0.875 | 611 | 12 | 0.031 | 2.0% | younger in 2nd half |
| NO28B016 | 569 | 18 | 652 | 8 | 652 | 8 | 569 | 18 | 0.106 | 1.3% | 0.059 | 1.7% | 0.866 | 9.40 | 0.12 | 0.00 | 32 | 2 | 4 | 142 | 319 | 7 | 0 | 11649 | 0.881 | 639 | 11 | 0.032 | 1.7% | strongly reverse discordant |
| NO28B010 | 569 | 7 | 569 | 7 | 570 | 7 | 607 | 17 | 0.092 | 1.2% | 0.060 | 1.5% | 0.766 | 10.82 | 0.13 | 0.00 | 44 | 3 | 5 | 199 | 504 | 4 | 9 | 13373 | 0.875 | 571 | 9 | 0.029 | 1.6% | older in 2nd half |
| AU21E219 | 575 | 7 | 575 | 7 | 580 | 7 | 838 | 42 | 0.094 | 1.3% | 0.067 | 2.0% | 0.870 | 10.62 | 0.13 | 0.00 | 12 | 1 | 2 | 71 | 128 | 11 | 12 | 9448 | 0.876 | 636 | 12 | 0.032 | 1.8% | ok |
| NO28B021 | 576 | 7 | 576 | 7 | 576 | 7 | 574 | 19 | 0.094 | 1.3% | 0.059 | 1.8% | 0.763 | 10.69 | 0.14 | 0.00 | 15 | 1 | 2 | 68 | 162 | 12 | 5 | 11177 | 0.875 | 583 | 11 | 0.029 | 1.9% | ok |
| NO28B019 | 583 | 8 | 583 | 8 | 583 | 8 | 573 | 22 | 0.095 | 1.3% | 0.059 | 2.0% | 0.772 | 10.56 | 0.14 | 0.00 | 15 | 1 | 1 | 53 | 168 | 14 | 10 | 12133 | 0.876 | 591 | 13 | 0.030 | 2.1% | reverse discordant @ end |
| NO28B014 | 648 | 11 | 648 | 11 | 648 | 12 | 663 | 13 | 0.106 | 1.8% | 0.062 | 1.2% | 0.900 | 9.45 | 0.17 | 0.04 | 64 | 4 | 12 | 370 | 595 | 12 | 974 | 8963 | 0.881 | 661 | 10 | 0.033 | 1.5% | common Pb @ begin |
| NO28B015 | 1357 | 19 | 1357 | 19 | 1359 | 19 | 1391 | 17 | 0.235 | 1.4% | 0.088 | 1.8% | 2.861 | 4.26 | 0.06 | 0.00 | 40 | 4 | 13 | 189 | 180 | 15 | 31 | 11755 | 0.940 | 1394 | 24 | 0.071 | 1.7% | close do concordant - probably slight common Pb |
| NO28B018 | 1408 | 21 | 1408 | 21 | 1413 | 22 | 1484 | 18 | 0.245 | 1.5% | 0.093 | 1.9% | 3.136 | 4.08 | 0.06 | 0.01 | 20 | 2 | 2 | 32 | 78 | 17 | 5 | 8797 | 0.945 | 1487 | 31 | 0.076 | 2.1% | slightly discordant - probably common Pb |
| NO28B013 | 1715 | 7 | 1495 | 18 | 1513 | 19 | 1715 | 7 | 0.265 | 1.2% | 0.105 | 0.7% | 3.832 | 3.78 | 0.05 | 0.02 | 75 | 8 | 9 | 124 | 283 | 6 | 40 | 10205 | 0.954 | 1406 | 22 | 0.072 | 1.5% | Pb loss, slight 204 |
| NO28B011 | 1730 | 9 | 1465 | 20 | 1487 | 21 | 1730 | 9 | 0.259 | 1.4% | 0.106 | 1.0% | 3.788 | 3.85 | 0.05 | 0.00 | 44 | 5 | 4 | 58 | 175 | 15 | 42 | 11117 | 0.952 | 1444 | 26 | 0.074 | 1.8% | Pb loss |
| NO28B017 | 1787 | 5 | 1800 | 19 | 1800 | 20 | 1787 | 5 | 0.322 | 1.1% | 0.109 | 0.6% | 4.852 | 3.10 | 0.03 | 0.01 | 158 | 17 | 25 | 274 | 510 | 10 | 6 | 13757 | 0.982 | 1807 | 23 | 0.094 | 1.3% | reverse discordant @ end |
| NO28B012 | 2376 | 6 | 1779 | 31 | 1861 | 33 | 2376 | 6 | 0.335 | 1.8% | 0.153 | 0.7% | 7.041 | 2.99 | 0.05 | 0.00 | 295 | 45 | 1 | 65 | 958 | 36 | 299 | 13885 | 0.988 | 485 | 24 | 0.024 | 5.0% | Pb loss, more so in higher U 2nd half |

**Table 4.** Isotopic and age data from LA-ICPMS analysis of zircons in samples R018223 from the Luina Group south of Luina.

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age (207 corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | $^{204}Pb$ (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | 56Fe (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018223 (2013-388) Crescent Spur Sst** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SE18B325 | 358 | 5 | 358 | 5 | 369 | 5 | 1106 | 16 | 0.059 | 1.4% | 0.076 | 1.6% | 0.620 | 16.99 | 0.23 | 0.12 | 61 | 5 | 13 | 971 | 1096 | 32 | 1439 | 11895 | 0.860 | 287 | 6 | 0.014 | 2.0% | common Pb |
| AU21E184 | 450 | 6 | 450 | 6 | 451 | 6 | 572 | 37 | 0.073 | 1.3% | 0.059 | 1.7% | 0.591 | 13.79 | 0.18 | 0.01 | 34 | 2 | 3 | 108 | 484 | 3 | 316 | 12141 | 0.866 | 548 | 11 | 0.016 | 2.9% | took most concordant interval |
| MY04C326 | 482 | 7 | 482 | 7 | 484 | 8 | 633 | 22 | 0.078 | 1.6% | 0.061 | 1.0% | 0.654 | 12.81 | 0.20 | 0.01 | 98 | 6 | 6 | 689 | 1442 | 25 | 692 | 12412 | 0.869 | 183 | 4 | 0.023 | 2.4% | Pb loss in 2nd half |
| AU21E179 | 521 | 9 | 521 | 9 | 525 | 10 | 762 | 35 | 0.085 | 1.8% | 0.065 | 1.6% | 0.756 | 11.79 | 0.22 | 0.00 | 58 | 4 | 2 | 322 | 666 | 14 | 423 | 14371 | 0.872 | 123 | 4 | 0.024 | 2.3% | Off concordia, common Pb |
| SE18B322 | 536 | 8 | 536 | 8 | 536 | 8 | 565 | 30 | 0.087 | 1.4% | 0.059 | 2.8% | 0.705 | 11.53 | 0.17 | 0.00 | 23 | 1 | 5 | 180 | 265 | 7 | 892 | 10987 | 0.872 | 523 | 12 | 0.008 | 2.8% | ok |
| MY04C277 | 544 | 5 | 544 | 5 | 544 | 5 | 555 | 27 | 0.088 | 0.9% | 0.059 | 1.3% | 0.713 | 11.35 | 0.10 | 0.00 | 21 | 1 | 3 | 120 | 236 | 11 | 23 | 10414 | 0.873 | 546 | 9 | 0.047 | 2.7% | ok |
| MY04C293 | 556 | 5 | 556 | 5 | 557 | 5 | 628 | 33 | 0.090 | 1.0% | 0.061 | 1.6% | 0.755 | 11.08 | 0.11 | 0.01 | 23 | 1 | 2 | 74 | 246 | 4 | 9 | 13003 | 0.874 | 521 | 12 | 0.052 | 2.3% | Pb/U age |
| MY04C306 | 557 | 4 | 557 | 4 | 558 | 4 | 609 | 32 | 0.090 | 0.8% | 0.060 | 1.5% | 0.750 | 11.06 | 0.09 | 0.02 | 40 | 2 | 7 | 239 | 420 | 8 | 531 | 10445 | 0.874 | 535 | 9 | 0.037 | 3.5% | ok |
| MY04C278 | 559 | 29 | 347 | 10 | 349 | 10 | 559 | 29 | 0.056 | 2.8% | 0.059 | 1.3% | 0.451 | 17.96 | 0.50 | 0.02 | 131 | 8 | 4 | 488 | 2208 | 14 | 2626 | 8853 | 0.859 | 169 | 5 | 0.025 | 2.9% | Pb loss, slight commoN Pb |
| MY04C274 | 561 | 5 | 561 | 5 | 562 | 5 | 584 | 21 | 0.091 | 0.8% | 0.059 | 0.9% | 0.747 | 10.98 | 0.09 | 0.00 | 112 | 7 | 1 | 175 | 1170 | 11 | 230 | 15451 | 0.874 | 83 | 5 | 0.028 | 2.2% | common Pb in 1st hal |
| AU21E175 | 570 | 8 | 570 | 8 | 576 | 8 | 870 | 54 | 0.093 | 1.3% | 0.068 | 2.6% | 0.876 | 10.71 | 0.14 | 0.03 | 31 | 2 | 6 | 229 | 362 | 15 | 567 | 12147 | 0.875 | 566 | 13 | 0.006 | 3.3% | Variable U/Pb |
| MY04C330 | 590 | 7 | 590 | 7 | 591 | 7 | 612 | 47 | 0.096 | 1.3% | 0.060 | 2.2% | 0.797 | 10.42 | 0.13 | 0.02 | 44 | 3 | 5 | 167 | 434 | 7 | 37 | 14101 | 0.876 | 568 | 15 | 0.073 | 6.2% | Pb loss in middle |
| MY04C303 | 591 | 7 | 591 | 7 | 598 | 8 | 923 | 43 | 0.097 | 1.3% | 0.070 | 2.1% | 0.936 | 10.28 | 0.13 | 0.03 | 39 | 3 | 9 | 332 | 383 | 5 | 103 | 12667 | 0.877 | 497 | 14 | 0.058 | 1.9% | common Pb, 204 corr brings to concordia |
| AU21E203 | 609 | 6 | 609 | 6 | 611 | 6 | 735 | 35 | 0.100 | 1.0% | 0.064 | 1.6% | 0.875 | 10.05 | 0.10 | 0.02 | 25 | 2 | 3 | 98 | 254 | 8 | 19 | 12618 | 0.878 | 592 | 11 | 0.024 | 4.4% | Variable U/Pb |
| SE18B344 | 621 | 10 | 621 | 10 | 626 | 10 | 868 | 30 | 0.102 | 1.6% | 0.068 | 2.9% | 0.956 | 9.80 | 0.15 | 0.01 | 13 | 1 | 0 | 5 | 122 | 5 | 9 | 11150 | 0.879 | 1425 | 88 | 0.020 | 2.3% | off concordia, likely due to common Pb |
| MY04C323 | 644 | 4 | 644 | 4 | 644 | 4 | 660 | 21 | 0.105 | 0.7% | 0.062 | 1.0% | 0.892 | 9.52 | 0.06 | 0.00 | 22 | 1 | 5 | 151 | 211 | 15 | 0 | 12816 | 0.880 | 637 | 9 | 0.060 | 1.5% | ok |
| SE18B345 | 658 | 7 | 658 | 7 | 658 | 7 | 635 | 17 | 0.107 | 1.0% | 0.061 | 1.6% | 0.902 | 9.31 | 0.10 | 0.00 | 33 | 2 | 4 | 124 | 316 | 15 | 9 | 12483 | 0.882 | 639 | 12 | 0.035 | 2.8% | ok |
| AU21E197 | 718 | 7 | 718 | 7 | 718 | 8 | 718 | 28 | 0.118 | 1.0% | 0.063 | 1.3% | 1.029 | 8.48 | 0.09 | 0.01 | 37 | 2 | 2 | 54 | 319 | 2 | 20 | 13408 | 0.886 | 699 | 14 | 0.032 | 2.0% | ok |
| SE18B326 | 839 | 11 | 839 | 11 | 843 | 12 | 959 | 22 | 0.140 | 1.4% | 0.071 | 2.1% | 1.368 | 7.16 | 0.10 | 0.00 | 36 | 3 | 6 | 135 | 256 | 46 | 561 | 11000 | 0.896 | 849 | 20 | 0.009 | 2.0% | mix along concordia @ beginning |
| SE18B321 | 852 | 10 | 852 | 10 | 854 | 11 | 916 | 20 | 0.142 | 1.3% | 0.070 | 1.9% | 1.358 | 7.06 | 0.09 | 0.01 | 26 | 2 | 2 | 54 | 198 | 7 | 17 | 10971 | 0.897 | 862 | 23 | 0.028 | 2.1% | slightly off concordia -common Pb? |
| MY04C273 | 898 | 19 | 654 | 6 | 659 | 7 | 898 | 19 | 0.108 | 1.0% | 0.069 | 0.9% | 1.024 | 9.29 | 0.09 | 0.01 | 61 | 4 | 4 | 161 | 584 | 7 | 301 | 13743 | 0.882 | 480 | 21 | 0.016 | 2.3% | Pb loss, some common Pb |
| AU21E177 | 967 | 12 | 967 | 12 | 970 | 13 | 1041 | 42 | 0.162 | 1.3% | 0.074 | 2.1% | 1.656 | 6.16 | 0.08 | 0.02 | 31 | 2 | 3 | 61 | 214 | 2 | 51 | 13236 | 0.906 | 962 | 26 | 0.040 | 1.9% | slight common Pb |
| MY04C279 | 977 | 39 | 619 | 10 | 627 | 11 | 977 | 39 | 0.102 | 1.7% | 0.072 | 1.9% | 1.009 | 9.79 | 0.17 | 0.01 | 15 | 1 | 1 | 33 | 145 | 6 | 4 | 12634 | 0.879 | 731 | 25 | 0.056 | 2.4% | Pb loss, slight common Pb |
| MY04C310 | 979 | 7 | 979 | 7 | 981 | 7 | 1034 | 18 | 0.164 | 0.7% | 0.074 | 0.9% | 1.671 | 6.08 | 0.04 | 0.00 | 38 | 3 | 7 | 161 | 229 | 8 | 13 | 10283 | 0.907 | 826 | 12 | 0.030 | 1.8% | ok |
| AU21E178 | 982 | 9 | 982 | 9 | 987 | 10 | 1093 | 21 | 0.165 | 1.0% | 0.076 | 1.1% | 1.732 | 6.05 | 0.06 | 0.02 | 56 | 4 | 5 | 109 | 347 | 1 | 40 | 11493 | 0.908 | 956 | 18 | 0.030 | 1.9% | Slight common Pb |
| AU21E191 | 992 | 9 | 992 | 9 | 993 | 9 | 1027 | 14 | 0.167 | 0.9% | 0.073 | 0.7% | 1.687 | 6.00 | 0.05 | 0.01 | 101 | 7 | 25 | 513 | 621 | 17 | 29 | 10851 | 0.908 | 965 | 13 | 0.044 | 2.5% | ok |
| AU21E200 | 1015 | 11 | 1015 | 11 | 1015 | 11 | 1000 | 33 | 0.171 | 1.1% | 0.073 | 1.6% | 1.706 | 5.86 | 0.06 | 0.00 | 17 | 1 | 3 | 68 | 100 | 8 | 5 | 8393 | 0.910 | 1006 | 16 | 0.134 | 1.5% | ok |
| SE18B340 | 1015 | 11 | 1015 | 11 | 1019 | 11 | 1106 | 17 | 0.171 | 1.1% | 0.076 | 1.7% | 1.805 | 5.84 | 0.07 | 0.03 | 28 | 2 | 6 | 128 | 171 | 18 | 332 | 9595 | 0.910 | 988 | 16 | 0.092 | 1.3% | common Pb, use U/Pb age |
| AU21E202 | 1031 | 13 | 1031 | 13 | 1032 | 13 | 1051 | 35 | 0.174 | 1.3% | 0.074 | 1.8% | 1.779 | 5.76 | 0.07 | 0.00 | 38 | 3 | 6 | 116 | 210 | 4 | 5 | 9484 | 0.911 | 1012 | 18 | 0.060 | 1.8% | ok |
| AU21E194 | 1031 | 12 | 1031 | 12 | 1033 | 13 | 1081 | 37 | 0.174 | 1.2% | 0.075 | 1.8% | 1.809 | 5.75 | 0.07 | 0.00 | 38 | 3 | 6 | 133 | 238 | 12 | 77 | 11724 | 0.911 | 1041 | 17 | 0.043 | 2.4% | Pb loss in 2nd half |
| MY04C320 | 1037 | 7 | 1037 | 7 | 1038 | 7 | 1069 | 13 | 0.175 | 0.7% | 0.075 | 0.6% | 1.808 | 5.72 | 0.04 | 0.01 | 138 | 10 | 16 | 339 | 773 | 8 | 168 | 10796 | 0.912 | 903 | 12 | 0.078 | 2.2% | |
| SE18B342 | 1044 | 39 | 774 | 14 | 782 | 14 | 1044 | 39 | 0.129 | 1.8% | 0.074 | 3.9% | 1.317 | 7.76 | 0.14 | 0.00 | 4 | 0 | 1 | 24 | 34 | 22 | 133 | 7814 | 0.891 | 689 | 20 | 0.026 | 2.2% | |
| MY04C297 | 1050 | 10 | 1050 | 10 | 1063 | 10 | 1326 | 17 | 0.179 | 0.9% | 0.085 | 0.9% | 2.113 | 5.58 | 0.05 | 0.06 | 113 | 10 | 27 | 702 | 663 | 14 | 710 | 10921 | 0.914 | 792 | 15 | 0.045 | 1.4% | |
| MY04C319 | 1051 | 8 | 1051 | 8 | 1051 | 8 | 1054 | 17 | 0.177 | 0.8% | 0.074 | 0.8% | 1.819 | 5.65 | 0.05 | 0.00 | 106 | 8 | 19 | 361 | 573 | 8 | 164 | 10996 | 0.913 | 1015 | 14 | 0.048 | 1.8% | |
| MY04C314 | 1052 | 8 | 1052 | 8 | 1054 | 8 | 1091 | 18 | 0.178 | 0.7% | 0.076 | 0.9% | 1.858 | 5.63 | 0.04 | 0.00 | 57 | 4 | 6 | 110 | 338 | 56 | 3170 | 10910 | 0.913 | 1078 | 18 | 0.048 | 1.6% | |
| MY04C302 | 1057 | 7 | 1057 | 7 | 1058 | 8 | 1075 | 13 | 0.178 | 0.7% | 0.075 | 0.6% | 1.850 | 5.61 | 0.04 | 0.00 | 51 | 4 | 10 | 183 | 291 | 6 | 20 | 9212 | 0.914 | 1065 | 14 | 0.053 | 1.3% | |
| MY04C325 | 1058 | 6 | 1058 | 6 | 1058 | 6 | 1047 | 12 | 0.178 | 0.6% | 0.074 | 0.6% | 1.825 | 5.61 | 0.03 | 0.00 | 73 | 5 | 8 | 152 | 421 | 9 | 38 | 11721 | 0.914 | 1032 | 13 | 0.122 | 2.0% | |
| MY04C285 | 1060 | 23 | 1031 | 12 | 1033 | 13 | 1060 | 23 | 0.174 | 1.2% | 0.075 | 1.1% | 1.789 | 5.76 | 0.07 | 0.01 | 53 | 4 | 2 | 47 | 344 | 10 | 34 | 13182 | 0.911 | 1035 | 27 | 0.027 | 1.7% | |
| MY04C329 | 1062 | 7 | 1062 | 7 | 1062 | 7 | 1037 | 13 | 0.179 | 0.7% | 0.074 | 0.6% | 1.823 | 5.58 | 0.04 | 0.01 | 88 | 7 | 21 | 409 | 522 | 6 | 149 | 8237 | 0.914 | 1046 | 14 | 0.050 | 1.7% | |
| MY04C316 | 1065 | 6 | 1065 | 6 | 1065 | 7 | 1047 | 11 | 0.180 | 0.6% | 0.074 | 0.6% | 1.839 | 5.56 | 0.03 | 0.00 | 106 | 8 | 10 | 192 | 619 | 5 | 29 | 12654 | 0.914 | 1064 | 14 | 0.079 | 1.4% | |
| MY04C305 | 1066 | 8 | 1066 | 8 | 1066 | 8 | 1023 | 17 | 0.180 | 0.8% | 0.073 | 0.8% | 1.818 | 5.56 | 0.04 | 0.00 | 32 | 2 | 5 | 87 | 183 | 12 | 9 | 11969 | 0.914 | 1092 | 16 | 0.051 | 1.6% | |
| MY04C298 | 1077 | 16 | 852 | 10 | 859 | 11 | 1077 | 16 | 0.143 | 1.2% | 0.075 | 0.8% | 1.481 | 7.01 | 0.09 | 0.03 | 140 | 10 | 6 | 400 | 991 | 20 | 443 | 14601 | 0.897 | 320 | 7 | 0.053 | 1.7% | |
| SE18B330 | 1081 | 12 | 1081 | 12 | 1082 | 13 | 1113 | 20 | 0.183 | 1.2% | 0.077 | 2.0% | 1.933 | 5.47 | 0.06 | 0.00 | 22 | 2 | 3 | 65 | 127 | 5 | 3 | 10680 | 0.916 | 1095 | 22 | 0.049 | 2.7% | |
| MY04C301 | 1081 | 26 | 785 | 8 | 794 | 8 | 1081 | 26 | 0.131 | 1.0% | 0.075 | 1.3% | 1.364 | 7.63 | 0.08 | 0.00 | 78 | 6 | 12 | 628 | 667 | 25 | 568 | 12037 | 0.892 | 397 | 9 | 0.044 | 2.7% | |

Table 4. (cont.)

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age (207 corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | $^{204}Pb$ (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | 56Fe (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SE18B339 | 1084 | 11 | 1084 | 11 | 1084 | 11 | 1082 | 13 | 0.183 | 1.0% | 0.075 | 1.3% | 1.905 | 5.46 | 0.06 | 0.00 | 43 | 3 | 7 | 127 | 239 | 11 | 15 | 11531 | 0.916 | 1054 | 15 | 0.059 | 2.8% | |
| AU21E193 | 1086 | 10 | 1086 | 10 | 1086 | 10 | 1097 | 21 | 0.183 | 0.9% | 0.076 | 1.0% | 1.925 | 5.45 | 0.05 | 0.01 | 33 | 2 | 7 | 128 | 185 | 6 | 22 | 11740 | 0.916 | 1098 | 15 | 0.042 | 1.4% | |
| MY04C281 | 1093 | 7 | 1093 | 7 | 1094 | 7 | 1101 | 13 | 0.185 | 0.6% | 0.076 | 0.6% | 1.943 | 5.41 | 0.04 | 0.00 | 58 | 4 | 11 | 205 | 321 | 15 | 488 | 9524 | 0.917 | 1086 | 14 | 0.026 | 2.3% | |
| MY04C291 | 1096 | 11 | 1096 | 11 | 1098 | 11 | 1139 | 35 | 0.186 | 1.0% | 0.078 | 1.7% | 1.990 | 5.38 | 0.05 | 0.00 | 39 | 3 | 11 | 186 | 199 | 10 | 87 | 10673 | 0.917 | 1073 | 19 | 0.053 | 1.8% | |
| MY04C292 | 1097 | 7 | 1097 | 7 | 1098 | 7 | 1125 | 14 | 0.186 | 0.6% | 0.077 | 0.7% | 1.975 | 5.39 | 0.03 | 0.00 | 49 | 4 | 4 | 76 | 269 | 9 | 290 | 7485 | 0.917 | 1129 | 16 | 0.053 | 1.6% | |
| AU21E183 | 1101 | 16 | 1065 | 9 | 1067 | 10 | 1101 | 16 | 0.180 | 0.9% | 0.076 | 0.8% | 1.892 | 5.56 | 0.05 | 0.00 | 64 | 5 | 16 | 290 | 355 | 8 | 46 | 11215 | 0.914 | 1055 | 14 | 0.053 | 1.6% | |
| MY04C315 | 1104 | 15 | 1156 | 8 | 1156 | 8 | 1104 | 15 | 0.196 | 0.7% | 0.076 | 0.8% | 2.066 | 5.09 | 0.04 | 0.00 | 47 | 4 | 8 | 149 | 251 | 17 | 3 | 12380 | 0.922 | 1104 | 15 | 0.004 | 6.4% | |
| MY04C327 | 1105 | 8 | 1105 | 8 | 1105 | 8 | 1095 | 18 | 0.187 | 0.7% | 0.076 | 0.9% | 1.959 | 5.35 | 0.04 | 0.00 | 23 | 2 | 5 | 90 | 120 | 15 | 60 | 10194 | 0.918 | 1061 | 19 | 0.055 | 1.8% | |
| AU21E180 | 1106 | 15 | 1106 | 15 | 1108 | 16 | 1144 | 40 | 0.187 | 1.4% | 0.078 | 2.0% | 2.013 | 5.33 | 0.07 | 0.02 | 44 | 3 | 5 | 80 | 224 | 23 | 769 | 11152 | 0.918 | 1166 | 26 | 0.028 | 2.6% | |
| SE18B328 | 1106 | 17 | 1106 | 17 | 1109 | 17 | 1171 | 26 | 0.188 | 1.5% | 0.079 | 2.7% | 2.044 | 5.33 | 0.08 | 0.00 | 14 | 1 | 2 | 37 | 73 | 11 | 3 | 9390 | 0.918 | 1157 | 32 | 0.055 | 1.6% | |
| SE18B329 | 1108 | 11 | 1108 | 11 | 1110 | 11 | 1154 | 12 | 0.188 | 1.0% | 0.078 | 1.2% | 2.029 | 5.32 | 0.05 | 0.03 | 99 | 8 | 12 | 253 | 579 | 5 | 22 | 11732 | 0.918 | 1048 | 17 | 0.049 | 1.3% | |
| MY04C321 | 1110 | 16 | 983 | 8 | 988 | 9 | 1110 | 16 | 0.166 | 0.9% | 0.077 | 0.8% | 1.749 | 6.04 | 0.05 | 0.01 | 74 | 6 | 13 | 309 | 487 | 15 | 381 | 12009 | 0.908 | 884 | 13 | 0.059 | 2.2% | |
| SE18B332 | 1132 | 11 | 1132 | 11 | 1132 | 11 | 1114 | 9 | 0.192 | 1.0% | 0.077 | 0.9% | 2.031 | 5.21 | 0.05 | 0.00 | 76 | 6 | 2 | 57 | 417 | 10 | 53 | 12674 | 0.920 | 840 | 20 | 0.054 | 1.3% | |
| MY04C296 | 1142 | 29 | 1057 | 10 | 1061 | 11 | 1142 | 29 | 0.179 | 1.0% | 0.078 | 1.5% | 1.919 | 5.59 | 0.06 | 0.01 | 23 | 2 | 5 | 103 | 138 | 7 | 11 | 9476 | 0.914 | 1037 | 18 | 0.046 | 1.4% | |
| AU21E186 | 1147 | 25 | 852 | 9 | 862 | 9 | 1147 | 25 | 0.143 | 1.0% | 0.078 | 1.3% | 1.539 | 6.99 | 0.07 | 0.00 | 43 | 3 | 8 | 250 | 298 | 19 | 1025 | 11507 | 0.897 | 633 | 13 | 0.056 | 2.0% | |
| SE18B324 | 1147 | 33 | 494 | 8 | 506 | 8 | 1147 | 33 | 0.082 | 1.6% | 0.078 | 3.3% | 0.879 | 12.24 | 0.19 | 0.04 | 63 | 5 | 16 | 671 | 760 | 56 | 2739 | 10666 | 0.870 | 452 | 11 | 0.053 | 2.7% | |
| MY04C324 | 1148 | 20 | 1059 | 8 | 1063 | 9 | 1148 | 20 | 0.179 | 0.8% | 0.078 | 1.0% | 1.930 | 5.58 | 0.05 | 0.01 | 56 | 4 | 7 | 151 | 346 | 5 | 67 | 12469 | 0.914 | 1007 | 17 | 0.032 | 1.4% | |
| MY04C322 | 1157 | 8 | 1157 | 8 | 1157 | 8 | 1129 | 15 | 0.197 | 0.7% | 0.077 | 0.7% | 2.095 | 5.09 | 0.04 | 0.01 | 41 | 3 | 5 | 100 | 216 | 5 | 31 | 11008 | 0.922 | 978 | 22 | 0.057 | 1.4% | |
| AU21E188 | 1160 | 21 | 1048 | 10 | 1053 | 10 | 1160 | 21 | 0.177 | 0.9% | 0.079 | 1.1% | 1.921 | 5.64 | 0.05 | 0.01 | 47 | 4 | 14 | 267 | 271 | 7 | 21 | 10301 | 0.913 | 1043 | 14 | 0.071 | 1.7% | |
| SE18B334 | 1165 | 9 | 935 | 8 | 944 | 8 | 1165 | 9 | 0.158 | 0.9% | 0.079 | 0.9% | 1.712 | 6.34 | 0.06 | 0.02 | 83 | 7 | 10 | 324 | 527 | 28 | 190 | 10840 | 0.904 | 597 | 11 | 0.089 | 1.2% | |
| AU21E182 | 1170 | 19 | 1111 | 12 | 1113 | 12 | 1170 | 19 | 0.189 | 1.1% | 0.079 | 1.0% | 2.052 | 5.30 | 0.06 | 0.00 | 107 | 8 | 11 | 232 | 618 | 6 | 114 | 13649 | 0.918 | 1043 | 18 | 0.027 | 1.7% | |
| AU21E185 | 1184 | 13 | 1184 | 13 | 1184 | 14 | 1201 | 30 | 0.202 | 1.1% | 0.080 | 1.5% | 2.229 | 4.96 | 0.06 | 0.00 | 66 | 5 | 3 | 58 | 366 | 4 | 22 | 13570 | 0.924 | 1144 | 27 | 0.051 | 1.8% | |
| AU21E199 | 1208 | 11 | 1208 | 11 | 1209 | 12 | 1224 | 32 | 0.206 | 1.0% | 0.081 | 1.6% | 2.307 | 4.85 | 0.05 | 0.00 | 123 | 10 | 19 | 283 | 573 | 3 | 119 | 13165 | 0.926 | 1190 | 20 | 0.054 | 1.3% | |
| AU21E198 | 1228 | 58 | 974 | 17 | 984 | 18 | 1228 | 58 | 0.165 | 1.8% | 0.081 | 3.0% | 1.848 | 6.06 | 0.11 | 0.02 | 14 | 1 | 3 | 46 | 80 | 3 | 2 | 8799 | 0.907 | 1105 | 27 | 0.058 | 2.4% | |
| MY04C287 | 1247 | 31 | 689 | 8 | 705 | 9 | 1247 | 31 | 0.116 | 1.2% | 0.082 | 1.6% | 1.307 | 8.66 | 0.11 | 0.00 | 61 | 5 | 15 | 616 | 500 | 15 | 599 | 12208 | 0.885 | 476 | 11 | 0.061 | 1.7% | |
| AU21E187 | 1283 | 17 | 1154 | 10 | 1161 | 11 | 1283 | 17 | 0.197 | 0.9% | 0.084 | 0.9% | 2.274 | 5.07 | 0.05 | 0.01 | 82 | 7 | 8 | 180 | 424 | 5 | 189 | 12533 | 0.922 | 953 | 15 | 0.055 | 1.7% | |
| AU21E195 | 1388 | 15 | 1388 | 15 | 1390 | 16 | 1424 | 28 | 0.241 | 1.1% | 0.090 | 1.5% | 2.984 | 4.16 | 0.05 | 0.00 | 26 | 2 | 5 | 70 | 104 | 14 | 101 | 10651 | 0.943 | 1383 | 23 | 0.056 | 1.4% | |
| AU21E181 | 1416 | 19 | 1416 | 19 | 1416 | 20 | 1396 | 24 | 0.246 | 1.4% | 0.089 | 1.3% | 3.002 | 4.07 | 0.06 | 0.00 | 36 | 3 | 6 | 73 | 142 | 23 | 228 | 12240 | 0.945 | 1442 | 27 | 0.084 | 2.4% | |
| AU21E196 | 1429 | 52 | 552 | 9 | 573 | 9 | 1429 | 52 | 0.093 | 1.7% | 0.090 | 2.7% | 1.156 | 10.75 | 0.18 | 0.06 | 48 | 4 | 8 | 506 | 544 | 28 | 1359 | 12267 | 0.875 | 325 | 9 | 0.055 | 1.3% | |
| AU21E192 | 1456 | 48 | 905 | 16 | 928 | 16 | 1456 | 48 | 0.155 | 1.8% | 0.091 | 2.5% | 1.951 | 6.46 | 0.11 | 0.01 | 8 | 1 | 2 | 39 | 52 | 57 | 6947 | 9626 | 0.903 | 1032 | 24 | 0.052 | 1.4% | |
| MY04C304 | 1488 | 35 | 1058 | 13 | 1080 | 14 | 1488 | 35 | 0.182 | 1.3% | 0.093 | 1.8% | 2.339 | 5.48 | 0.07 | 0.00 | 21 | 2 | 5 | 99 | 123 | 17 | 152 | 8457 | 0.915 | 1146 | 22 | 0.035 | 2.0% | |
| MY04C282 | 1543 | 16 | 1119 | 11 | 1142 | 12 | 1543 | 16 | 0.194 | 1.1% | 0.096 | 0.9% | 2.559 | 5.16 | 0.05 | 0.00 | 68 | 7 | 15 | 264 | 382 | 6 | 54 | 10702 | 0.921 | 1173 | 18 | 0.054 | 1.4% | |
| AU21E176 | 1682 | 28 | 1038 | 19 | 1072 | 20 | 1682 | 28 | 0.181 | 1.9% | 0.103 | 1.5% | 2.574 | 5.53 | 0.10 | 0.01 | 73 | 7 | 9 | 201 | 425 | 27 | 478 | 11793 | 0.915 | 933 | 25 | 0.054 | 1.7% | |
| SE18B323 | 1710 | 20 | 1710 | 20 | 1712 | 20 | 1730 | 10 | 0.304 | 1.2% | 0.106 | 1.1% | 4.443 | 3.29 | 0.04 | 0.02 | 150 | 16 | 15 | 266 | 484 | 11 | 525 | 10153 | 0.973 | 1087 | 19 | 0.052 | 1.3% | |
| MY04C272 | 1717 | 16 | 1578 | 12 | 1590 | 12 | 1717 | 16 | 0.280 | 0.8% | 0.105 | 0.9% | 4.057 | 3.57 | 0.03 | 0.00 | 48 | 5 | 10 | 136 | 178 | 17 | 154 | 11131 | 0.961 | 1532 | 21 | 0.074 | 1.8% | |
| MY04C328 | 1764 | 12 | 1725 | 13 | 1729 | 13 | 1764 | 12 | 0.308 | 0.8% | 0.108 | 0.6% | 4.576 | 3.25 | 0.03 | 0.01 | 148 | 16 | 41 | 447 | 459 | 11 | 8 | 9699 | 0.975 | 1714 | 21 | 0.051 | 1.6% | |
| AU21E201 | 1777 | 20 | 1777 | 20 | 1779 | 20 | 1795 | 26 | 0.318 | 1.1% | 0.110 | 1.4% | 4.807 | 3.15 | 0.03 | 0.00 | 49 | 5 | 3 | 38 | 168 | 10 | 3 | 12902 | 0.980 | 1640 | 39 | 0.042 | 2.4% | |
| MY04C283 | 1794 | 14 | 1553 | 13 | 1575 | 13 | 1794 | 14 | 0.277 | 0.9% | 0.110 | 0.8% | 4.186 | 3.61 | 0.03 | 0.00 | 194 | 21 | 25 | 393 | 666 | 74 | 764 | 12213 | 0.960 | 1180 | 21 | 0.122 | 1.4% | |
| SE18B343 | 1833 | 20 | 1602 | 39 | 1624 | 40 | 1833 | 20 | 0.286 | 2.5% | 0.112 | 2.2% | 4.424 | 3.49 | 0.09 | 0.00 | 26 | 3 | 8 | 117 | 105 | 18 | 19 | 8791 | 0.965 | 1524 | 34 | 0.054 | 1.3% | |
| SE18B333 | 1894 | 9 | 1549 | 14 | 1581 | 15 | 1894 | 9 | 0.278 | 1.0% | 0.116 | 0.7% | 4.443 | 3.60 | 0.03 | 0.03 | 214 | 25 | 8 | 169 | 756 | 13 | 147 | 18009 | 0.961 | 880 | 22 | 0.134 | 1.2% | |
| MY04C295 | 2145 | 10 | 1800 | 13 | 1843 | 14 | 2145 | 10 | 0.331 | 0.8% | 0.134 | 0.6% | 6.095 | 3.02 | 0.02 | 0.00 | 47 | 6 | 9 | 102 | 145 | 18 | 211 | 12240 | 0.986 | 1786 | 23 | 0.053 | 1.3% | |
| MY04C284 | 2309 | 12 | 2348 | 18 | 2348 | 17 | 2309 | 12 | 0.439 | 0.7% | 0.147 | 0.7% | 8.895 | 2.28 | 0.02 | 0.00 | 48 | 7 | 10 | 87 | 115 | 8 | 18 | 11987 | 1.039 | 2328 | 32 | 0.050 | 2.2% | |
| MY04C300 | 2511 | 5 | 2559 | 18 | 2559 | 17 | 2511 | 5 | 0.487 | 0.7% | 0.165 | 0.3% | 11.110 | 2.05 | 0.01 | 0.00 | 213 | 35 | 22 | 162 | 445 | 2 | 56 | 12210 | 1.062 | 2550 | 32 | 0.032 | 1.8% | |
| SE18B341 | 2976 | 8 | 2391 | 28 | 2544 | 28 | 2976 | 8 | 0.484 | 1.1% | 0.219 | 0.6% | 14.631 | 2.07 | 0.02 | 0.01 | 105 | 23 | 25 | 188 | 217 | 102 | 3504 | 10286 | 1.060 | 2549 | 38 | 0.056 | 1.5% | |
| MY04C309 | 3208 | 6 | 2772 | 34 | 2930 | 31 | 3208 | 6 | 0.575 | 1.1% | 0.254 | 0.4% | 20.122 | 1.74 | 0.02 | 0.01 | 135 | 34 | 12 | 109 | 256 | 8 | 214 | 10923 | 1.102 | 2334 | 47 | 0.056 | 1.3% | |

**Table 5.** Isotopic and age data from LA-ICPMS analysis of zircons in samples R018272 from the Luina Group collected from outcrop at Godkin Ridge.

| Analysis | Preferred age | ±1 ster | $^{206}Pb/^{238}U$ age ($^{207}$ corr) | ±1 ster | $^{206}Pb/^{238}U$ | ±1 ster | $^{207}Pb/^{206}Pb$ age | ±1 ster | $^{206}Pb/^{238}U$ ratio | ±1 RSE | $^{207}Pb/^{206}Pb$ ratio | ±1 RSE | $^{207}Pb/^{235}U$ ratio (calc) | $^{238}U/^{206}Pb$ ratio | ±1 std err | $^{204}Pb$ (ppm) | $^{206}Pb$ (ppm) | $^{207}Pb$ (ppm) | $^{208}Pb$ (ppm) | $^{232}Th$ (ppm) | $^{238}U$ (ppm) | $^{49}Ti$ (ppm) | $^{56}Fe$ (ppm) | $^{178}Hf$ (ppm) | common Pb at age of zirc | $^{208}Pb/^{232}Th$ age | ±1 ster | $^{208}Pb/^{232}Th$ ratio | ±1 RSE | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R018272 (2014-001) Crescent Spur Sst** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| JA31A017 | **599** | 8 | **599** | 8 | **599** | 8 | **605** | 23 | **0.097** | 1.3% | **0.060** | 2.1% | **0.807** | **10.26** | 0.14 | 0.00 | 27 | 2 | 8 | 253 | 271 | 9 | 34 | 9605 | 0.877 | **581** | 10 | **0.029** | 1.8% | ok |
| FE05B007 | **606** | 7 | **606** | 7 | **611** | 8 | **822** | 22 | **0.099** | 1.3% | **0.066** | 2.1% | **0.911** | **10.07** | 0.13 | 0.00 | 48 | 3 | 3 | 96 | 467 | 4 | 596 | 11914 | 0.878 | **588** | 15 | **0.030** | 2.6% | Discordant- common Pb? Pb loss? |
| JA31A012 | **609** | 8 | **609** | 8 | **609** | 9 | **632** | 31 | **0.099** | 1.4% | **0.061** | 2.9% | **0.831** | **10.09** | 0.14 | 0.00 | 23 | 1 | 6 | 193 | 220 | 6 | 0 | 9591 | 0.878 | **603** | 11 | **0.030** | 1.9% | ok |
| JA31A011 | **609** | 12 | **609** | 12 | **610** | 13 | **666** | 45 | **0.099** | 2.1% | **0.062** | 4.2% | **0.845** | **10.07** | 0.21 | 0.00 | 20 | 1 | 5 | 168 | 215 | 18 | 639 | 9130 | 0.878 | **574** | 19 | **0.029** | 3.2% | used concordant part |
| FE05B016 | **611** | 27 | **611** | 27 | **635** | 29 | **1487** | 62 | **0.104** | 4.5% | **0.093** | 6.6% | **1.327** | **9.66** | 0.43 | 0.01 | 8 | 1 | 4 | 47 | 70 | 589 | 4416 | 9582 | 0.880 | **1659** | 71 | **0.086** | 4.3% | small interval w/ lowest common Pb |
| FE05B019 | **618** | 10 | **618** | 10 | **621** | 10 | **757** | 30 | **0.101** | 1.6% | **0.064** | 2.9% | **0.899** | **9.89** | 0.16 | 0.01 | 15 | 1 | 3 | 117 | 165 | 8 | 1088 | 9143 | 0.879 | **600** | 14 | **0.030** | 2.4% | younger in 2nd half |
| JA31A016 | **624** | 9 | **624** | 9 | **625** | 9 | **668** | 31 | **0.102** | 1.4% | **0.062** | 2.9% | **0.868** | **9.82** | 0.14 | 0.00 | 13 | 1 | 3 | 79 | 129 | 5 | 14 | 9682 | 0.879 | **617** | 16 | **0.031** | 2.5% | ok |
| FE05B017 | **628** | 7 | **628** | 7 | **630** | 8 | **712** | 17 | **0.103** | 1.2% | **0.063** | 1.6% | **0.894** | **9.74** | 0.12 | 0.00 | 29 | 2 | 4 | 113 | 295 | 16 | 121 | 10470 | 0.879 | **646** | 11 | **0.032** | 1.7% | slight common Pb |
| JA31A007 | **631** | 9 | **631** | 9 | **631** | 9 | **627** | 31 | **0.103** | 1.5% | **0.061** | 2.9% | **0.860** | **9.72** | 0.15 | 0.02 | 16 | 1 | 4 | 107 | 150 | 7 | 619 | 9546 | 0.879 | **656** | 14 | **0.033** | 2.2% | ok |
| FE05B013 | **632** | 8 | **632** | 8 | **641** | 8 | **1018** | 20 | **0.105** | 1.3% | **0.073** | 1.9% | **1.055** | **9.56** | 0.12 | 0.03 | 24 | 2 | 4 | 119 | 239 | 57 | 12574 | 8447 | 0.880 | **763** | 16 | **0.038** | 2.1% | common Pb, Fe incl. |
| FE05B014 | **634** | 9 | **634** | 9 | **641** | 9 | **936** | 26 | **0.105** | 1.5% | **0.070** | 2.6% | **1.013** | **9.56** | 0.14 | 0.02 | 11 | 1 | 2 | 67 | 110 | 21 | 237 | 8509 | 0.880 | **619** | 16 | **0.031** | 2.5% | common Pb |
| FE05B015 | **636** | 7 | **636** | 7 | **638** | 7 | **712** | 13 | **0.104** | 1.1% | **0.063** | 1.2% | **0.905** | **9.61** | 0.11 | 0.02 | 38 | 2 | 11 | 363 | 374 | 14 | 501 | 10881 | 0.880 | **614** | 9 | **0.031** | 1.4% | ok |
| FE05B011 | **642** | 8 | **642** | 8 | **642** | 8 | **652** | 18 | **0.105** | 1.3% | **0.061** | 1.7% | **0.886** | **9.55** | 0.12 | 0.01 | 18 | 1 | 3 | 88 | 179 | 5 | 256 | 10036 | 0.880 | **630** | 11 | **0.032** | 1.8% | ok |
| FE05B009 | **649** | 9 | **649** | 9 | **651** | 10 | **730** | 16 | **0.106** | 1.5% | **0.064** | 1.5% | **0.933** | **9.41** | 0.14 | 0.00 | 57 | 4 | 16 | 528 | 595 | 16 | 247 | 8673 | 0.881 | **637** | 11 | **0.032** | 1.7% | slight common Pb |
| FE05B010 | **660** | 8 | **660** | 8 | **667** | 9 | **924** | 22 | **0.109** | 1.3% | **0.070** | 2.2% | **1.050** | **9.18** | 0.12 | 0.02 | 14 | 1 | 3 | 85 | 131 | 15 | 15 | 7745 | 0.882 | **727** | 13 | **0.037** | 1.8% | slight common Pb |
| JA31A006 | **665** | 11 | **665** | 11 | **666** | 11 | **695** | 35 | **0.109** | 1.7% | **0.063** | 3.3% | **0.939** | **9.19** | 0.15 | 0.00 | 18 | 1 | 5 | 143 | 166 | 6 | 0 | 9232 | 0.882 | **690** | 15 | **0.035** | 2.2% | ok |
| JA31A018 | **670** | 14 | **670** | 14 | **673** | 14 | **802** | 41 | **0.110** | 2.1% | **0.066** | 3.9% | **1.000** | **9.08** | 0.19 | 0.02 | 14 | 1 | 2 | 49 | 129 | 9 | 3 | 10604 | 0.883 | **707** | 24 | **0.036** | 3.4% | slight common Pb |
| JA31A014 | **671** | 14 | **671** | 14 | **671** | 15 | **606** | 58 | **0.110** | 2.2% | **0.060** | 5.4% | **0.908** | **9.12** | 0.20 | 0.00 | 5 | 0 | 1 | 18 | 42 | 18 | 0 | 7423 | 0.882 | **650** | 27 | **0.033** | 4.1% | ok |
| JA31A013 | **693** | 11 | **693** | 11 | **693** | 11 | **695** | 29 | **0.113** | 1.6% | **0.063** | 2.8% | **0.979** | **8.81** | 0.14 | 0.00 | 40 | 2 | 9 | 227 | 318 | 11 | 42 | 9259 | 0.884 | **680** | 15 | **0.034** | 2.2% | Reverse discordant in 2nd half |
| FE05B020 | **725** | 8 | **725** | 8 | **727** | 8 | **815** | 10 | **0.119** | 1.1% | **0.066** | 0.9% | **1.091** | **8.37** | 0.09 | 0.01 | 96 | 6 | 10 | 271 | 795 | 18 | 787 | 9581 | 0.887 | **715** | 11 | **0.036** | 1.5% | ok |
| JA31A019 | **748** | 14 | **748** | 14 | **749** | 14 | **795** | 51 | **0.123** | 1.9% | **0.066** | 4.9% | **1.115** | **8.11** | 0.15 | 0.00 | 72 | 5 | 8 | 234 | 666 | 6 | 599 | 11112 | 0.889 | **723** | 18 | **0.036** | 2.5% | small concordant interval, common Pb inc. in middle |
| JA31A015 | **1400** | 13 | **974** | 16 | **993** | 17 | **1400** | 13 | **0.167** | 1.7% | **0.089** | 1.4% | **2.039** | **6.00** | 0.10 | 0.00 | 49 | 4 | 5 | 99 | 290 | 52 | 991 | 9680 | 0.908 | **887** | 20 | **0.045** | 2.3% | Pb loss, use 7/6 age |
| FE05B008 | **1557** | 11 | **1187** | 14 | **1209** | 15 | **1557** | 11 | **0.206** | 1.2% | **0.096** | 1.2% | **2.745** | **4.85** | 0.06 | 0.03 | 56 | 5 | 12 | 231 | 287 | 25 | 2499 | 9517 | 0.927 | **1098** | 19 | **0.056** | 1.7% | common Pb, possibly Pb loss? |
| FE05B012 | **1659** | 21 | **1659** | 21 | **1661** | 21 | **1687** | 13 | **0.294** | 1.3% | **0.103** | 1.4% | **4.192** | **3.40** | 0.04 | 0.00 | 64 | 7 | 32 | 350 | 208 | 35 | 2164 | 8042 | 0.968 | **1634** | 23 | **0.084** | 1.4% | took concordant part, Hg incl. @ begin |
| JA31A009 | **1705** | 20 | **1705** | 20 | **1708** | 20 | **1738** | 9 | **0.303** | 1.2% | **0.106** | 1.0% | **4.451** | **3.30** | 0.04 | 0.01 | 88 | 9 | 17 | 173 | 281 | 6 | 14 | 9464 | 0.973 | **1744** | 28 | **0.090** | 1.6% | just off concordia, slight common Pb? |
| JA31A010 | **1768** | 23 | **1768** | 23 | **1768** | 24 | **1769** | 7 | **0.315** | 1.3% | **0.108** | 0.8% | **4.705** | **3.17** | 0.04 | 0.07 | 144 | 16 | 14 | 154 | 471 | 3 | 57 | 7500 | 0.979 | **1756** | 33 | **0.091** | 1.9% | Pb loss in 2nd half |
| JA31A020 | **1799** | 22 | **1799** | 22 | **1799** | 22 | **1797** | 9 | **0.322** | 1.2% | **0.110** | 0.9% | **4.875** | **3.11** | 0.04 | 0.04 | 84 | 9 | 8 | 101 | 262 | 15 | 313 | 11648 | 0.982 | **1594** | 38 | **0.082** | 2.4% | ok |
| JA31A008 | **1878** | 26 | **1878** | 26 | **1878** | 26 | **1870** | 9 | **0.338** | 1.4% | **0.114** | 1.0% | **5.334** | **2.96** | 0.04 | 0.00 | 107 | 12 | 15 | 164 | 335 | 28 | 0 | 9756 | 0.990 | **1826** | 32 | **0.095** | 1.7% | Pb loss in 2nd half |
| FE05B018 | | | **698** | 8 | **749** | 9 | **1993** | 16 | **0.123** | 1.2% | **0.122** | 1.8% | **2.082** | **8.11** | 0.10 | 0.87 | 234 | 29 | 43 | 257 | 1823 | 22 | 1472 | 12857 | 0.889 | **2900** | 101 | **0.154** | 3.5% | Use w/ caution - full of common Pb |