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2020

Canada

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Publications in this series have not been edited; they are released as submitted by the author.

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INTRODUCTION

This multicomponent Open File presents zircon U-Pb results for 12 rock samples from select units in the Mount Nansen-Nisling River area (Figure 1), two samples from the Stewart River area, and one sample from the Dunite Peak area, Yukon, Canada. Sample locations for the Mount Nansen-Nisling River are shown on a detailed geology map in Figure 2, whereas the three other sample locations are shown on Figure 1. This analytical work was conducted as part of the Crustal Blocks activity of the Geomapping for Energy and Minerals (GEM) Cordillera Project of the Geological Survey of Canada, in large part to support the geological mapping in the Mount Nansen area, and enhance our understanding of the tectonic and metamorphic evolution of Yukon-Tanana terrane (YTT), mafic-ultramafic complexes, and the younger successor rocks built upon them in west-central Yukon. Bedrock geology of the Mount Nansen-Nisling River area consists primarily of a central domain of metamorphosed and poly-deformed Paleozoic basement intruded and overlapped by increasingly less deformed Mississippian to Cenozoic plutons and volcanic successions. More detailed information on the geology of the area can be found in Ryan et al. (2015; 2016).

Interpretations of the U-Pb results for individual rock samples are detailed in the Results section. Representative transmitted light and back-scattered electron (BSE)/ cathodoluminescence (CL) zircon images are shown for each sample, and zircon U-Pb results are illustrated in Tera-Wasserburg diagrams. The results and age interpretations for all samples are summarized in Table 1 (separate file). The full U-Pb datasets are provided as a separate Microsoft Excel file in Appendix A. Adobe PDF files containing BSE and CL images for all mounted zircon grains are presented in Appendix B. Grains are numbered and correspond to analysis spot names; the locations of SHRIMP (sensitive high resolution ion microprobe) analytical spots are depicted by ellipses.

REGIONAL GEOLOGICAL FRAMEWORK

The west side of the map area (see Figure 2) is dominantly underlain by polydeformed and metamorphosed YTT, mainly the pre-Devonian Snowcap assemblage. The Snowcap assemblage is characterized by amphibolite-facies quartzite, micaceous quartzite and psammitic quartz-muscovite-biotite (± garnet) schist and rare, decametre-thick lenses of marble. Common massive amphibolite and lesser garnet amphibolite are interpreted as metamorphosed mafic sills and dykes.

Devonian to Permian rocks

Prominent and extensive occurrences of amphibolite in this region are correlated to the Devono-Mississippian Finlayson assemblage. This unit is characterized by strongly foliated and compositionally layered amphibolite and garnet amphibolite. It locally interdigitates with the Snowcap assemblage and can be difficult to distinguish between units. Finlayson assemblage rocks are typically spatially associated with the Simpson Range suite (see following).

A large domain in the central Mount Nansen area is dominated by a monotonous sequence of grey to black, carbonaceous quartzite, psammite and phyllite that we correlate with the Stevenson Ridge

schist. The unit is distinguished from the Snowcap assemblage by its carbonaceous composition, though carbonaceous horizons do occur in other units.

Much of the eastern half of the map area is dominated by the Early Mississippian Simpson Range suite, as well constrained by ages in this report. The Simpson Range suite is characterized by highly

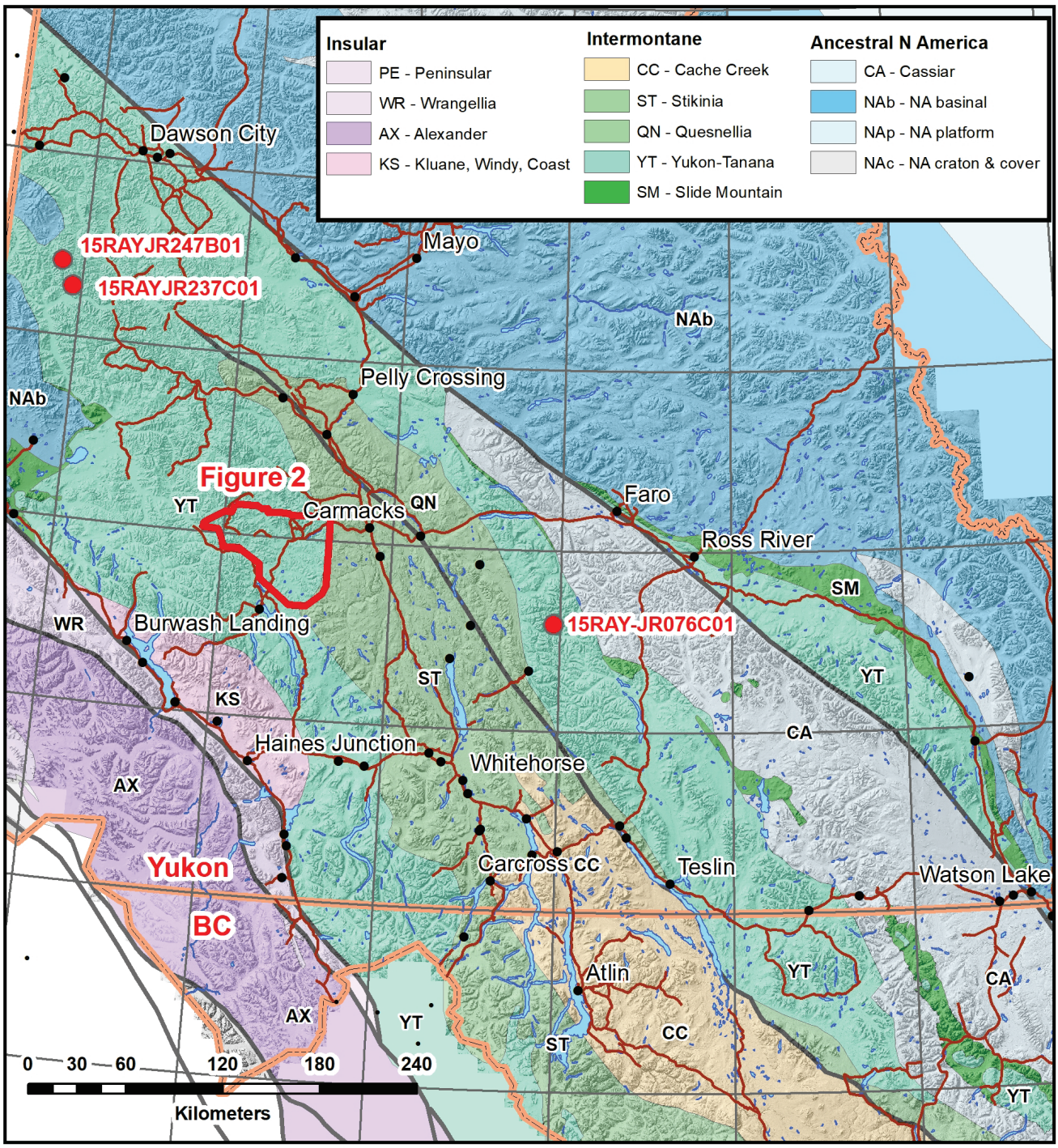


Figure 1 *A simplified terrane map of the Northern Canadian Cordillera (modified from Colpron and Nelson, 2011) showing the location of the Mount Nansen-Nisling River area (red outline), and geochronology samples outside that area (red dots).*

foliated to gneissic hornblende-biotite and biotite granodiorite to intermediate orthogneiss, and is commonly potassium-feldspar augen textured.

The Snowcap assemblage in the western part of the map is intruded locally by potassium-feldspar augen to equigranular granite that we correlate with the Permian Sulphur Creek suite, confirmed by ages in this report.

Mafic-ultramafic complexes

The Schist Creek complex (Ryan et al., 2016) occurs in the northwest part of the Mount Nansen area (Figure 2) and is dominated by serpentinite and peridotite with minor metagabbro. The complex appears juxtaposed with the Snowcap assemblage by faults. Mississippian intrusions occur on the southeast side of the complex, whereas Permian intrusions occur northwest of it.

Stikinia/Quesnellia

The Stikine plutonic suite is only exposed in the vicinity of Mount Nansen, and is characterized by weakly- to moderately-foliated white to beige hornblende-biotite granodiorite, diorite, and quartz monzodiorite; it is commonly alkali-feldspar porphyritic. The eastern side of the map area is dominated by the Aishihik batholith, which is composed of massive to weakly foliated white to beige hornblende-biotite granodiorite, monzogranite, quartz monzonite, and quartz monzodiorite of the Long Lake suite.

Mesozoic-Cenozoic successor rocks

Mount Nansen is underlain by well-preserved mid-Cretaceous aphyric and feldspar-phyric andesite to dacite breccias, flows and tuffaceous rocks of the Mount Nansen Group. Heterolithic quartz and feldspar-phyric felsic lapilli tuff, and rare flow-banded quartz-phyric rhyolite are less abundant. Mount Nansen Group has yielded U-Pb ages ranging between ca. 110 and 105 Ma (Klocking et al., 2016) making it comagmatic with the Whitehorse plutonic suite (Woodsworth et al., 1991). The middle Cretaceous Whitehorse plutonic suite is represented by two distinct phases in the map area. The voluminous Dawson Range phase is exposed around Mount Nansen, and is composed of white to beige, hornblende-biotite granodiorite and lesser granite, tonalite, quartz diorite, and diorite. It is characteristically blocky, hornblende-phyric, medium- to coarse-grained, and weakly foliated to unfoliated. To the west are the easternmost occurrences of the Maloney Creek phase of the Whitehorse suite, which comprise grey to beige biotite-hornblende monzogranite to granodiorite.

The late Cretaceous Casino suite is represented in the area by small scattered occurrences of porphyritic dacite to rhyolite. It is generally fine to medium grained, alkali feldspar-, plagioclase-, biotite- and quartz-porphyritic. Rhyolitic occurrences near Mount Nansen exhibit blebby white to smoky quartz phenocrysts, are more hypabyssal than volcanic in appearance, and are limonite and carbonate altered. The Casino suite interpretation is corroborated by an age in this report.

The Late Cretaceous Carmacks Group is present in the very northeast corner of the map area. It comprises an intermediate to mafic volcanic and volcaniclastic lower sequence, and a more mafic, flow-dominated upper sequence.

Paleogene rocks include the Rhyolite Creek complex and the Ruby Range suite. The Rhyolite Creek complex constitutes small erosional remnants of felsic and intermediate volcanic and hypabyssal rocks in the southwest part of the study area, and as sparsely dotted occurrences elsewhere. The felsic rocks are predominant while the intermediate are less abundant. The Ruby Range suite is characterized by fine- to medium-grained, massive light grey to pinkish biotite ± hornblende granodiorite with typical smoky grey quartz and is coeval with the Rhyolite Creek complex

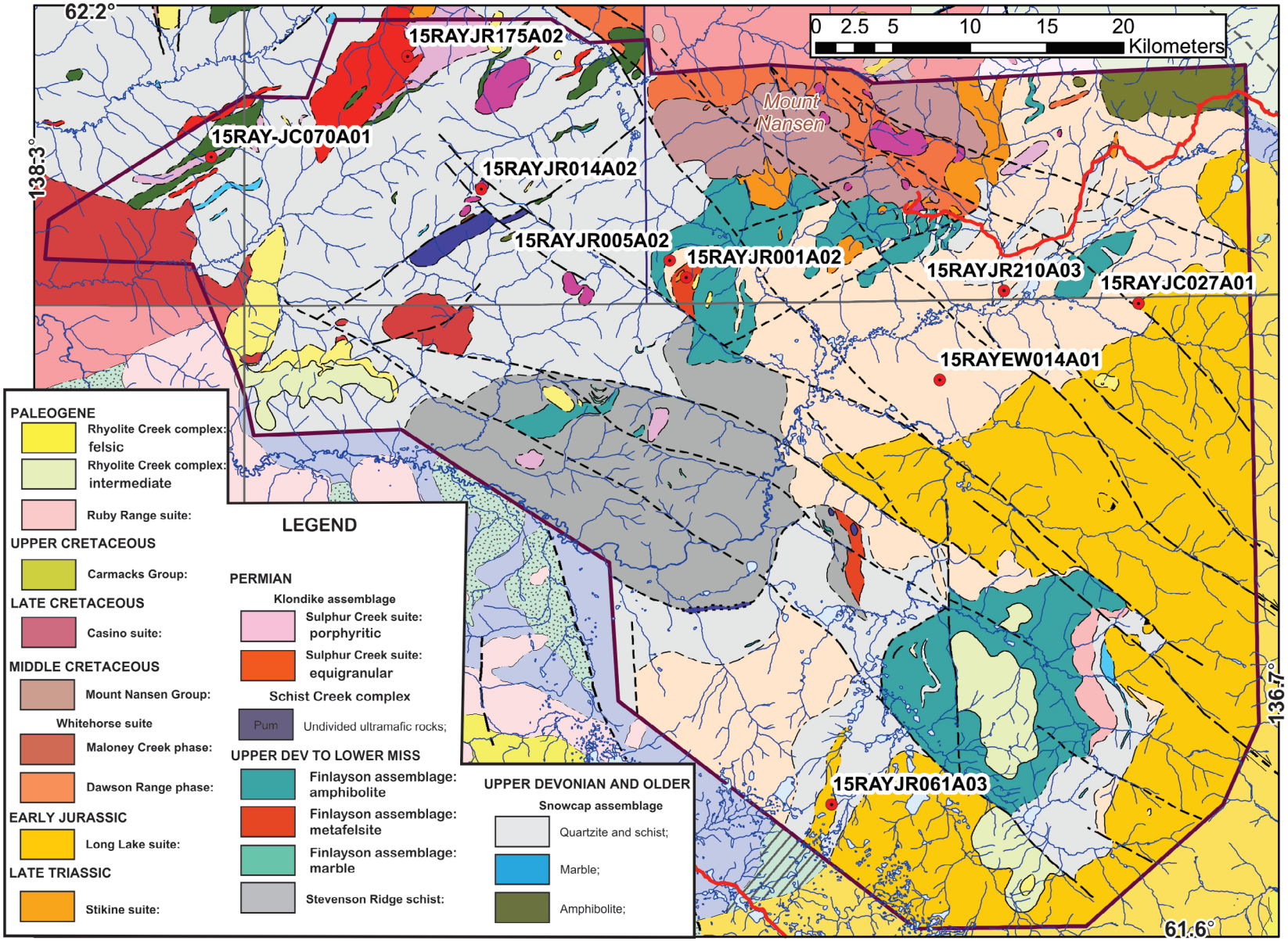


Figure 2 *Geology map of the Mount Nansen-Nisling River area (purple outline; modified from Ryan et al. (2016)), with the location of geochronology samples (red dots).*

U-Pb ANALYTICAL METHODS

All samples were disaggregated using standard crushing/pulverizing techniques followed by density separation using a Wilfley table and heavy liquids. A Frantz Magnetic Separator was used to isolate a zircon-rich non-magnetic separate.

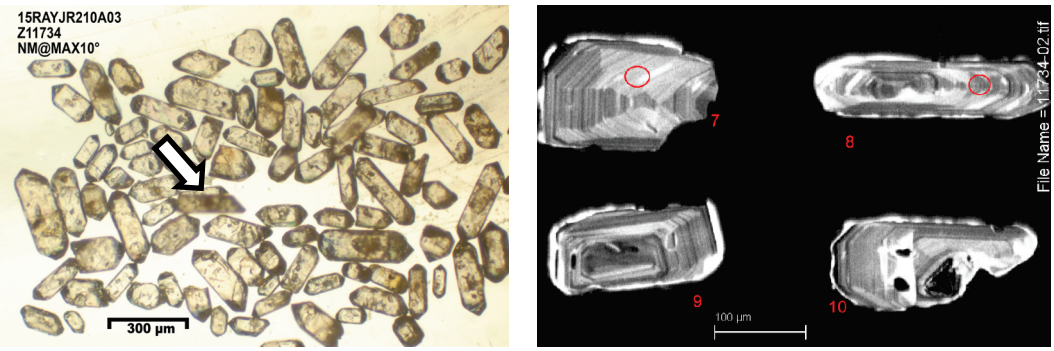
SHRIMP analytical procedures followed those described by Stern (1997), with standards and U-Pb calibration methods following Stern and Amelin (2003). Briefly, zircon grains were cast in 2.5 cm diameter epoxy mounts (GSC #813, 815, 817, 824) along with fragments of Temora 2 zircon primary standard, the accepted $^{206}Pb/^{238}U$ age of which is 416.8 ± 0.33 Ma (Black et al., 2004). Fragments of the GSC laboratory zircon standard (z6266, with $^{206}Pb/^{238}U$ age = 559 Ma) were also included on the mount as a secondary standard, analyses of which were interspersed among the sample analyses throughout the data sessions to verify the accuracy of the U-Pb calibrations. The mid-sections of the zircon grains were exposed using 9, 6, and 1 μm diamond compound, and the internal features of the grains (zoning, structures, alteration, etc.) were characterized in back-scattered electron mode (BSE) and/or cathodoluminescence mode (CL) utilizing a Zeiss Evo 50 scanning electron microscope (Appendix B). On the mass spectrometer, eleven masses including background were sequentially measured with a single electron multiplier. Off-line data processing was accomplished using SQUID2 (version 2.50.11.10.15, rev. 15 Oct 2011). The 1σ external errors of $^{206}Pb/^{238}U$ ratios reported in Appendix A incorporate the error in calibrating the reference material. Common Pb correction utilized the Pb composition of the surface blank (Stern, 1997). Details of each analytical session, including spot size, number of scans, primary reference material used, and calibration error, are given in the footnotes of Appendix A.

Analyses of secondary zircon reference material were interspersed between sample analyses to verify the accuracy of the U-Pb calibration. The measured $^{206}Pb/^{238}U$ ages of the secondary reference materials are reported for each session in the footnote of Appendix A for comparison against their published, accepted ages. The accepted $^{206}Pb/^{238}U$ age of z9910 is 441.2±0.4 Ma, based on 5 ID-TIMS fractions (B. Davis and V. McNicoll, unpublished data). The accepted $^{206}Pb/^{238}U$ age of z6266 is 559.0±0.2 Ma, based on 22 ID-TIMS fractions (Stern and Amelin, 2003).

Isoplot v. 4.15 (Ludwig, 2003) was used to calculate weighted mean ages and to generate Tera-Wasserburg plots. The error ellipses on the Tera-Wasserburg diagrams and the weighted mean errors are reported at the 95% confidence level. All weighted mean U-Pb ages reported are corrected for common Pb by the ^{207}Pb method. An evaluation of the long term reproducibility of $^{206}Pb/^{238}U$ age of secondary standard 9910 indicates that the minimum reproducibility precision of SHRIMP weighted mean U-Pb results is 1% (2σ, based on 51 analytical sessions, B. Davis pers. comm). In cases where the precision of the weighted mean calculation for individual samples falls below this threshold, the weighted mean 2σ error is augmented to 1%.

U-Pb RESULTS

Sample: 15RAYJR210A03
Sample Description: Highly-strained augen granodiorite
GSC lab number: z11734
SHRIMP mount: 813

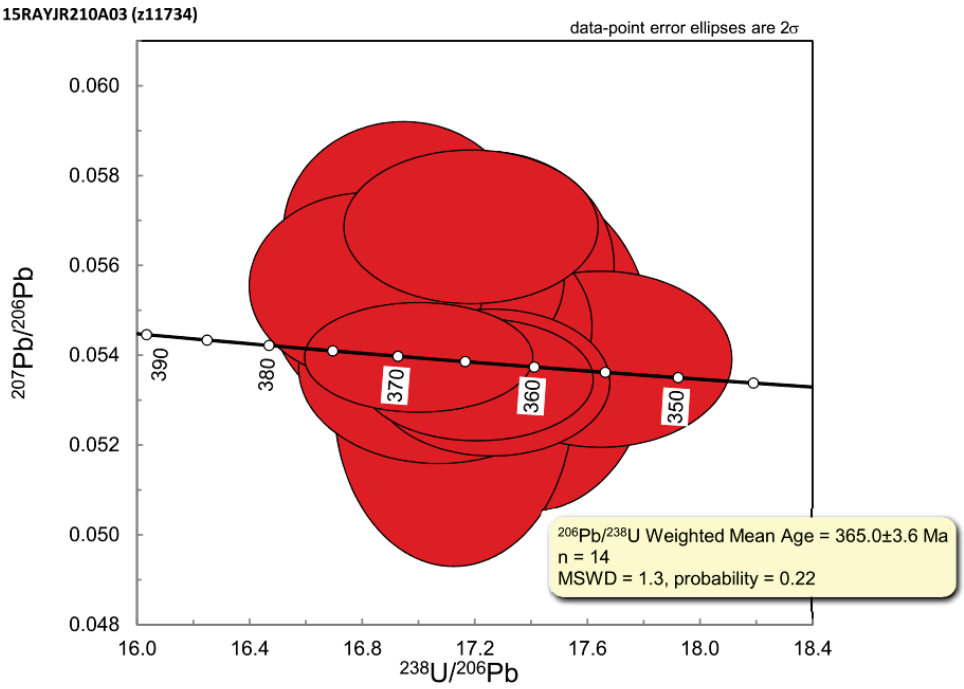


Zircon Description

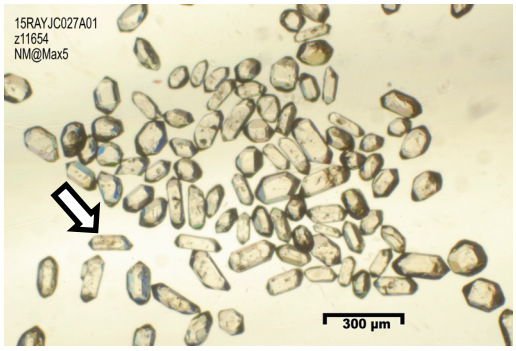
Zircon grains recovered from this augen granite are clear and range from colourless to pale brown, with a few grains displaying iron oxide staining around opaque inclusions (see white arrow on image on left). The grains are sub-equant to elongated prisms primarily displaying simple oscillatory zoning, with some displaying oscillatory sector zoning under CL (right image, upper left grain). Some grains (~10%) display a sub-rounded unzoned core surrounded by a simple oscillatory zoned rim.

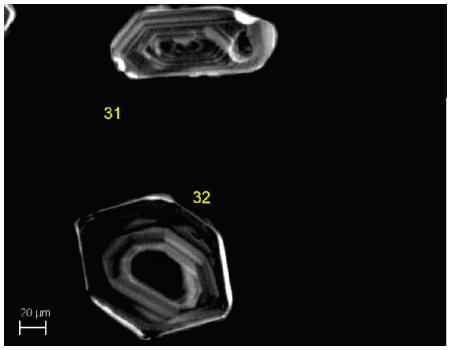
U-Pb Results and Interpretation

Fourteen analyses were performed on 14 separate zircon grains, targeting simple/sector oscillatory zoned grains or oscillatory zoned rims. These yielded a weighted mean $^{206}Pb/^{238}U$ age of 365.0±2.4 Ma (MSWD=1.3). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 365.0±3.6 Ma, interpreted as the igneous crystallization age of this augen granite, indicating it is an older phase of the Simpson Range suite.



Sample: 15RAYJC027A01
Sample Description: Potassium feldspar-hornblende augen granite
GSC lab number: z11654
SHRIMP mount: 815



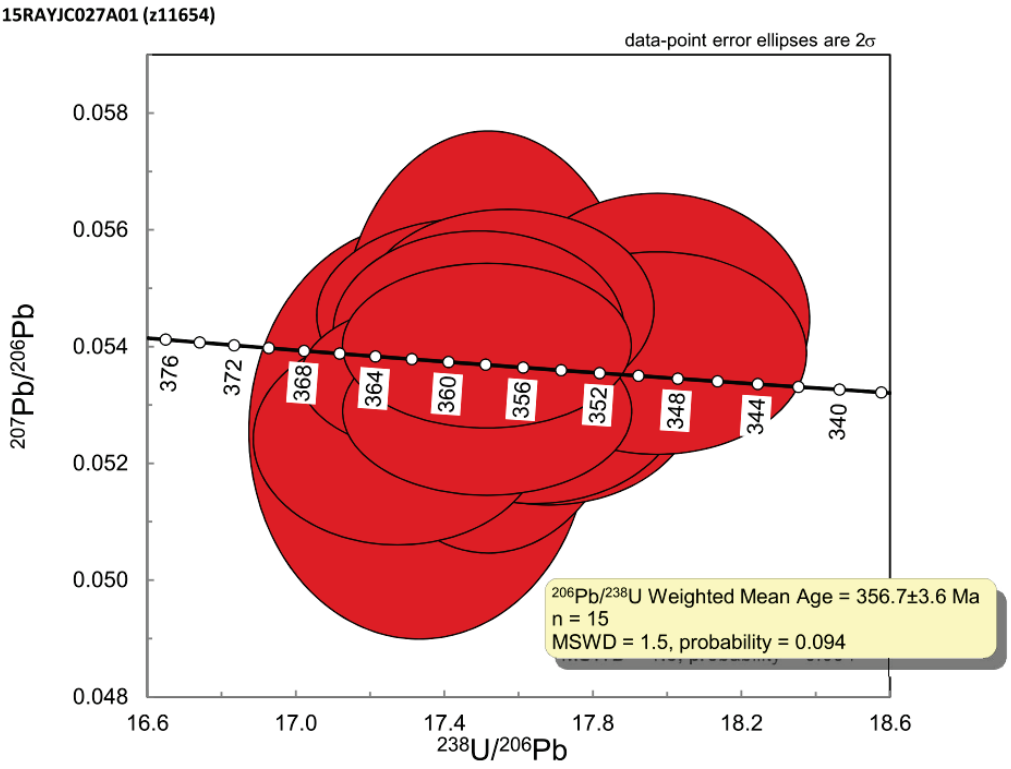


Zircon Description

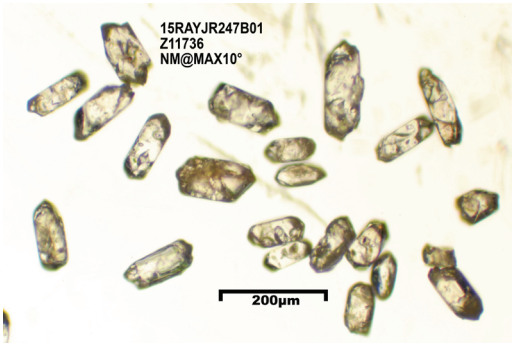
Zircon grains recovered from this sample are clear and colourless, with a few grains displaying iron oxide staining around opaque inclusions (see white arrow in image on left). The grains are euhedral to subhedral, sub-equant to regular prisms displaying simple oscillatory zoning under CL (right image).

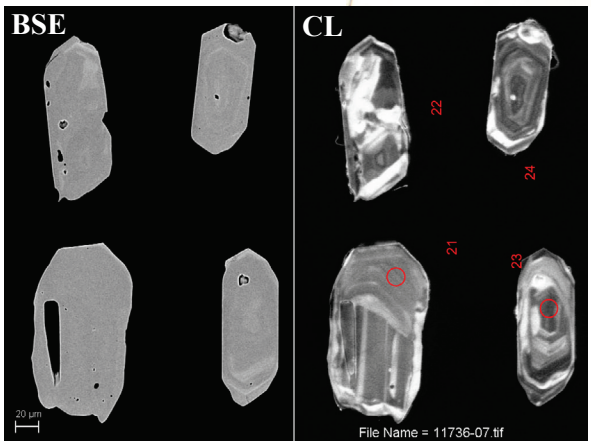
U-Pb Results and Interpretation

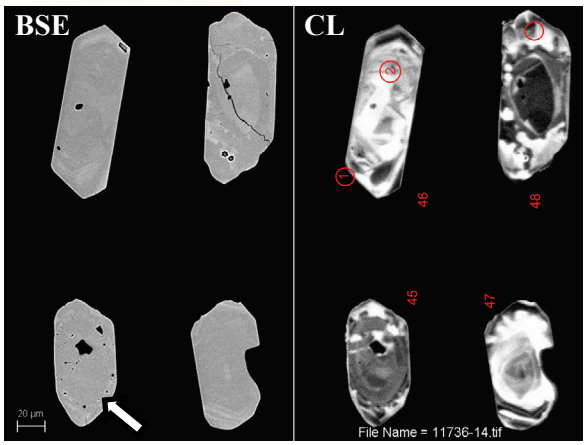
Fifteen analyses were performed on 15 separate zircon grains, yielding a weighted mean $^{206}Pb/^{238}U$ age of 356.7±2.3 Ma (MSWD=1.5). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 356.7±3.6 Ma, interpreted as the igneous crystallization age of this augen granite, belonging to the Simpson Range suite.



Sample: 15RAYJR247B01
Sample description: Deformed metamonzonite dyke
GSC lab number: z11736
SHRIMP mount: 817







Zircon Description

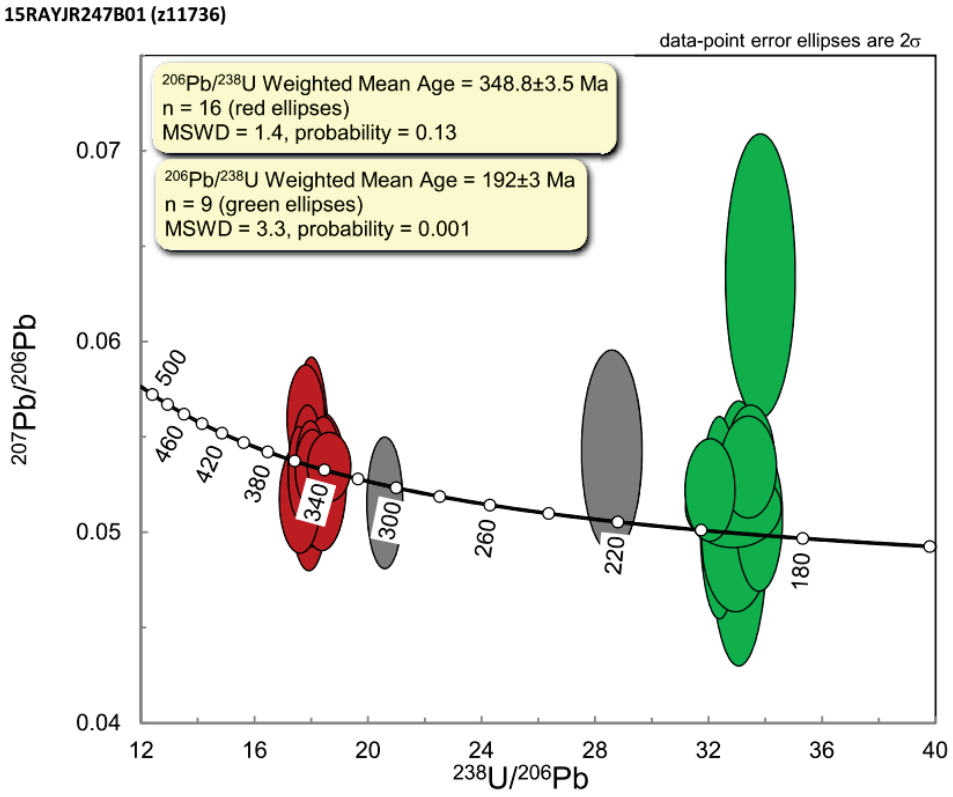
Zircon grains recovered from this sample are clear and colourless sub-equant to regular prisms, displaying fracturing and abundant clear inclusions (top image). Under CL (bottom images), grains display broad or oscillatory zoning, with irregular bright patches concentrated around inclusions or the rims of some grains; some of these bright areas could be due to fluorescence or charging from the inclusions as opposed to an inherent property of the zircon itself. In approximately 40% of grains, rims are defined by a line of inclusions creating a lacy or spongy appearance, visible under BSE (above; see white arrow, grain 45).

U-Pb Results and Interpretation

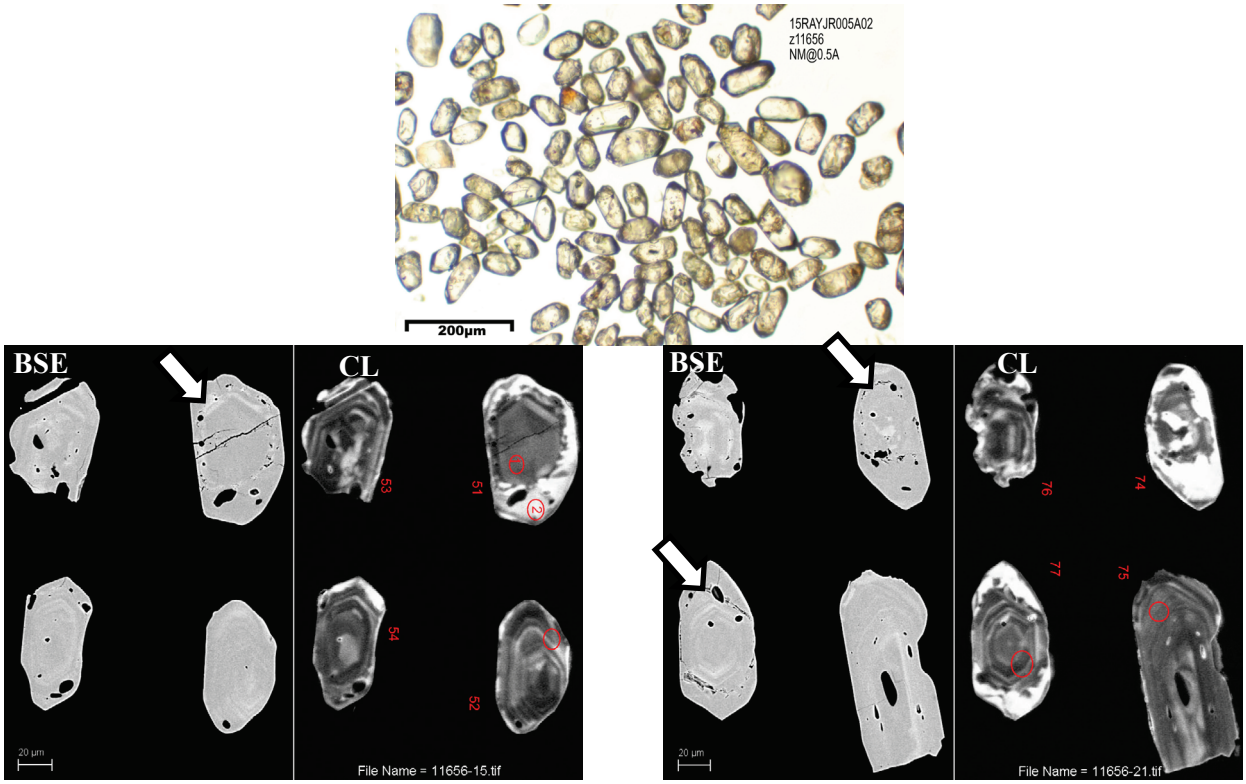
Twenty-seven analyses were carried out on 27 individual zircon grains. Sixteen of these analyses, targeting oscillatory or broadly zoned areas of zircon grains, yield a weighted mean $^{206}Pb/^{238}U$ age of 348.8±2.7 Ma (MSWD=1.4). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 348.8±3.5 Ma. The age is interpreted as the igneous crystallization age of the metamonzonite, possibly correlating with the Mississippian Simpson Range suite.

Nine analyses, targeting rims or bright patches on the grains, yield a younger $^{206}Pb/^{238}U$ weighted mean age of 192±3 Ma (MSWD=3.3). These analyses have low Th/U ratios (0.002-0.046), a possible indication that these young ages are metamorphic, which is consistent with known $^{40}Ar/^{39}Ar$ cooling ages in the Stewart River area (Joyce et al., 2015). The slightly elevated MSWD of 3.3 might reflect scatter outside of analytical error.

Two analyses (ca. 221 and 306 Ma) targeting slightly altered oscillatory zoned areas, were excluded from the weighted mean calculations as they may reflect Pb loss or mixing related to the ca. 192 Ma metamorphic event.



Sample: 15RAYJR005A02
Sample description: Very highly strained granodiorite
GSC lab number: z11656
SHRIMP mount: 817



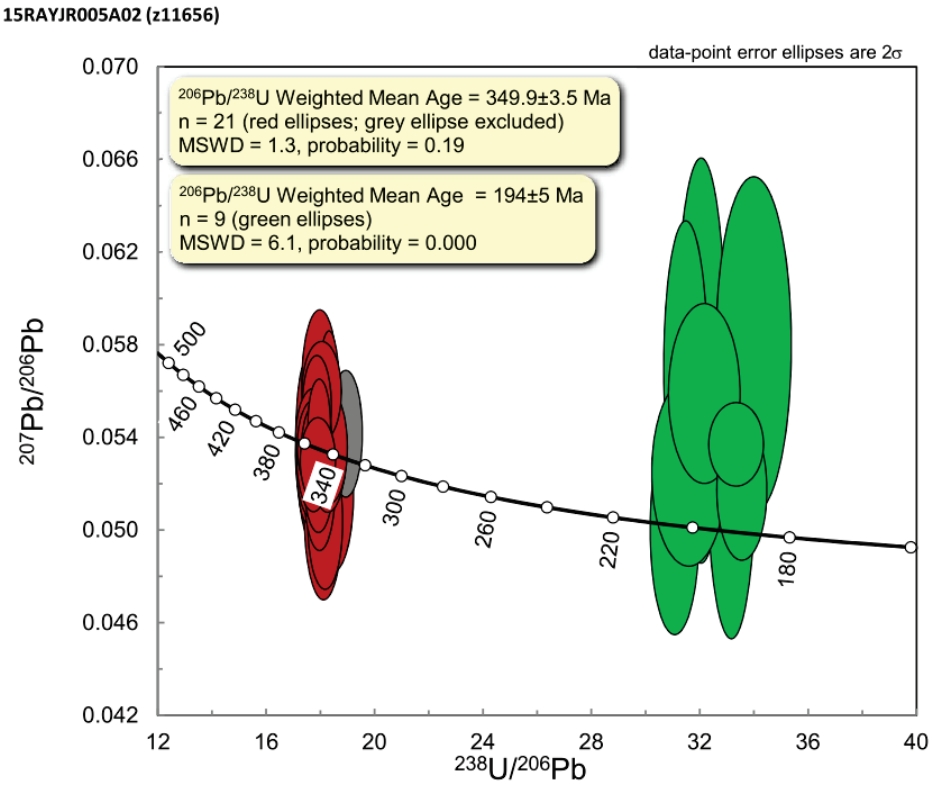
Zircon Description

Zircon grains recovered from this sample range from colourless to pale brown and have variable clarity, with a few grains displaying iron oxide staining around abundant fractures and opaque/clear inclusions (top image). Grains display sub-equant to regular prismatic morphology. Under CL (bottom images) zircon grains display sector or simple oscillatory zoning, with irregular bright patches concentrated around inclusions or the rims of some grains. Just like sample **15RAYJR247B01** (**z11736**; above), approximately 60% of grains have rims defined by a line of inclusions, visible under BSE (bottom images; see white arrows, grains 51, 74, 77). Larger (~5-10 µm) inclusions occur either in the rims or throughout the grain, creating a spongy appearance.

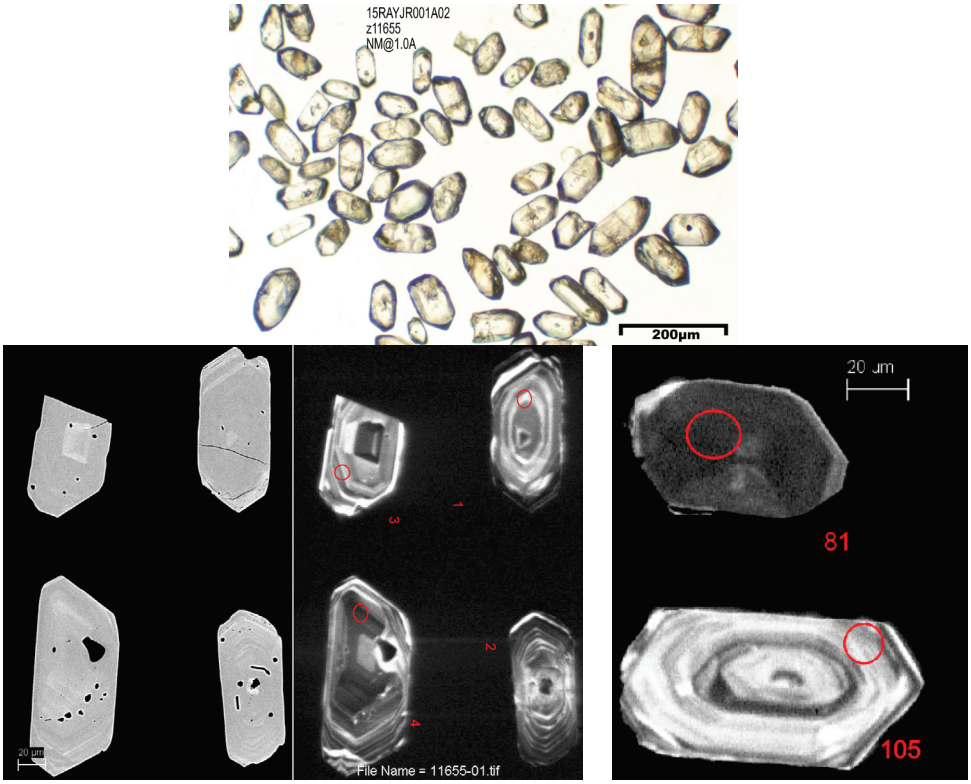
U-Pb Results and Interpretation

Thirty-one analyses were carried out on 30 individual zircon grains. Twenty-one of these analyses, targeting sector or simple-oscillatory zoned areas of zircon grains, yield a weighted mean $^{206}Pb/^{238}U$ age of 349.9±2.3 Ma (MSWD=1.3). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 349.9±3.5 Ma. The youngest analysis in this grouping was excluded from the mean as a statistical outlier. We interpret the 349.9±3.5 Ma age as the igneous crystallization age consistent with the Simpson Range suite.

Nine analyses, targeting rims, yield low Th/U ratios (0.002-0.021) and a younger weighted mean $^{206}Pb/^{238}U$ age of 194±5 Ma (MSWD=6.1). Due to the elevated MSWD of 6.1 this age should be more appropriately reported as ca. 194 Ma, interpreted as the approximate metamorphic age of this granodiorite. This is consistent with the more firmly constrained metamorphic age of 192±3 Ma of sample **15RAYJR247B01**, which contains morphological, chemical, and geochronological similarities to sample **15RAYJR005A02**.



Sample: 15RAYJR001A02
Sample description: Schistose, felsic metavolcanic rock
GSC lab number: z11655
SHRIMP mount: 817



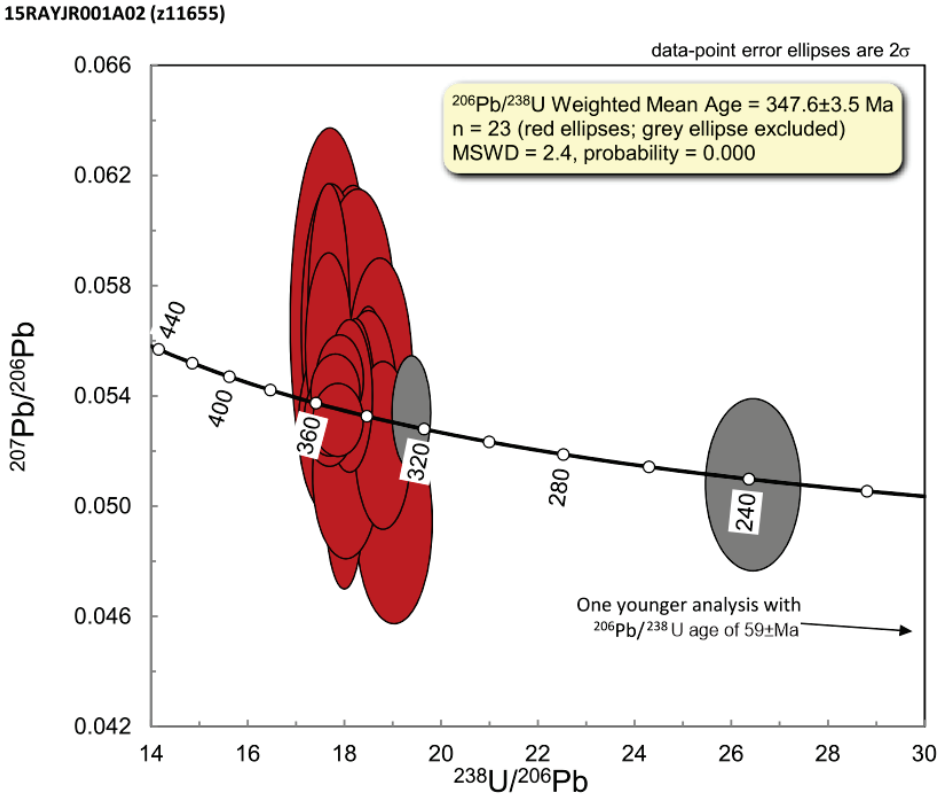
Zircon Description

Zircon grains recovered from this sample are colourless, sub-equant to regular prisms with variable clarity; some grains display iron oxide staining around fractures and inclusions (top image). Under CL (bottom images), grains display sector or simple oscillatory zoning (grains 1-4); one rare unzoned grain is present (grain 81).

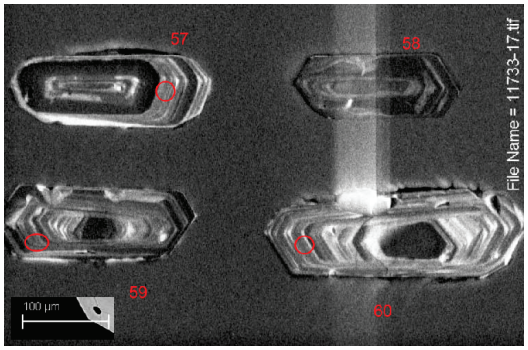
U-Pb Results and Interpretation

Twenty-six analyses were conducted on 26 separate zircon grains. Twenty-three of these analyses, targeting sector or simple oscillatory zoned areas of grains, yield a weighted mean $^{206}Pb/^{238}U$ age of 347.6±2.8 Ma (MSWD=2.4). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 347.6±3.5 Ma, interpreted as the igneous crystallization age of this sample. The youngest analysis in this grouping was excluded from the mean as a statistical outlier. This ca. 348 Ma age corroborates the interpretation by Ryan et al. (2016) that this rock represents a felsic member in the Finlayson volcanic assemblage, and is the same age within error as the nearby sample (**15RAYJR005A02**) of the Simpson Range suite.

The two youngest analyses target an oscillatory zoned grain (grain 105) and a rare unzoned grain (grain 81), yielding $^{206}Pb/^{238}U$ ages of 239±8 Ma and 59±2 Ma, respectively. Due to the irreproducibility of these young ages, the significance of these grains is unknown.


15RAYJR001A02 (z11655)
data-point error ellipses are 2σ
206Pb/238U Weighted Mean Age = 347.6±3.5 Ma
n = 23 (red ellipses; grey ellipse excluded)
MSWD = 2.4, probability = 0.000
One younger analysis with
206Pb/238U age of 59±Ma
440
400
360
320
280
240
0.066
0.062
0.058
0.054
0.050
0.046
0.042
14
16
18
20
22
24
26
28
30
207Pb/206Pb
238U/206Pb

Sample: 15RAYJR175A02
Sample description: Foliated augen metagranodiorite
GSC lab number: z11733
SHRIMP mount: 813

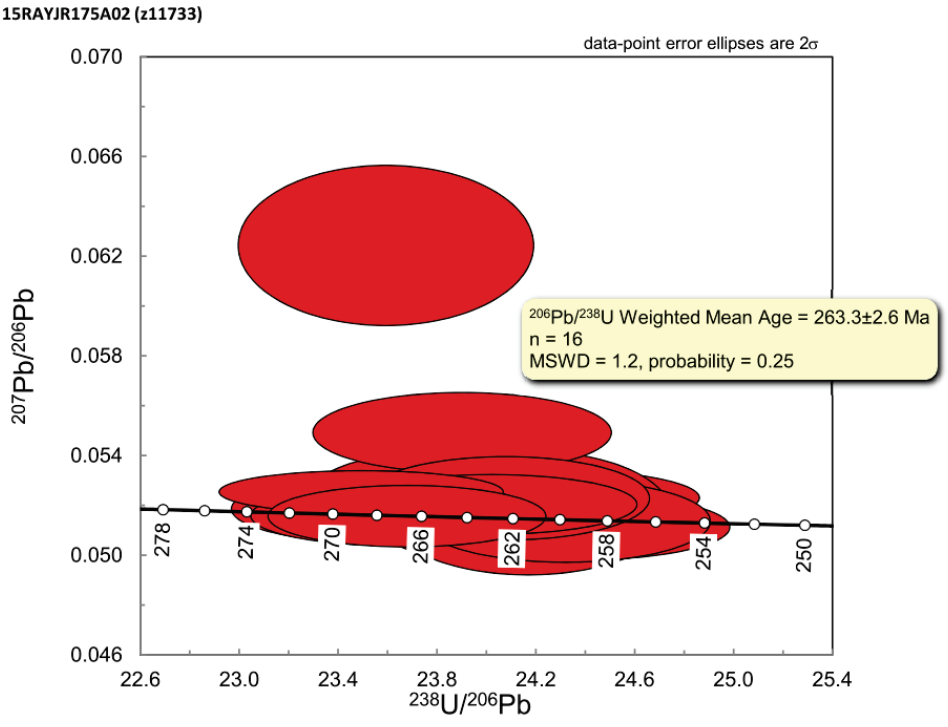


Zircon Description

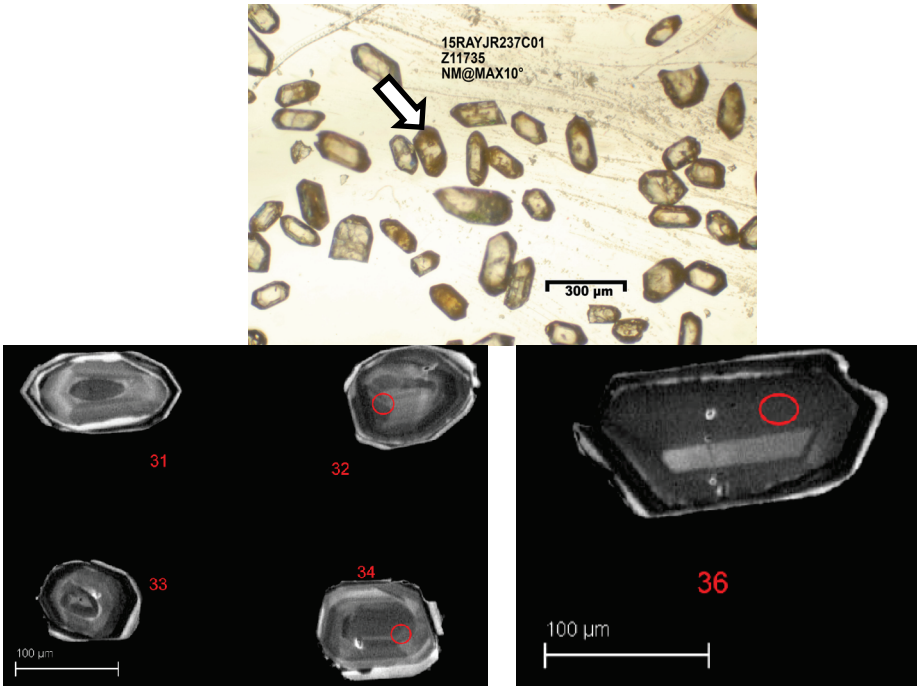
Zircon grains recovered from this sample are well-faceted, regular to elongated prisms. Most grains are turbid due to fractures, and colourless to pale brown. Approximately 10% of grains display an opaque sub-rounded core, surrounded by a pale brown, fractured, oscillatory-zoned rim (see white arrow on image on the left; zoning visible under CL, right image grains 59 and 60). The remaining grains range between colourless and pale brown, and display some fracturing and simple oscillatory zoning under CL (grain 57).

U-Pb Results and Interpretation

Sixteen analyses were performed on 16 separate zircon grains, targeting oscillatory zoned rims or grains, yielding a weighted mean $^{206}Pb/^{238}U$ age of 263.3±1.6 Ma (MSWD=1.2). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 263.3±2.6 Ma, interpreted as the igneous crystallization age of this metagranodiorite. This confirms a correlation of this rock with the middle Permian Sulphur Creek suite (Ryan et al., 2016).



Sample: 15RAYJR237C01
Sample description: Metamonzogranite dyke
GSC lab number: z11735
SHRIMP mount: 813



Zircon Description

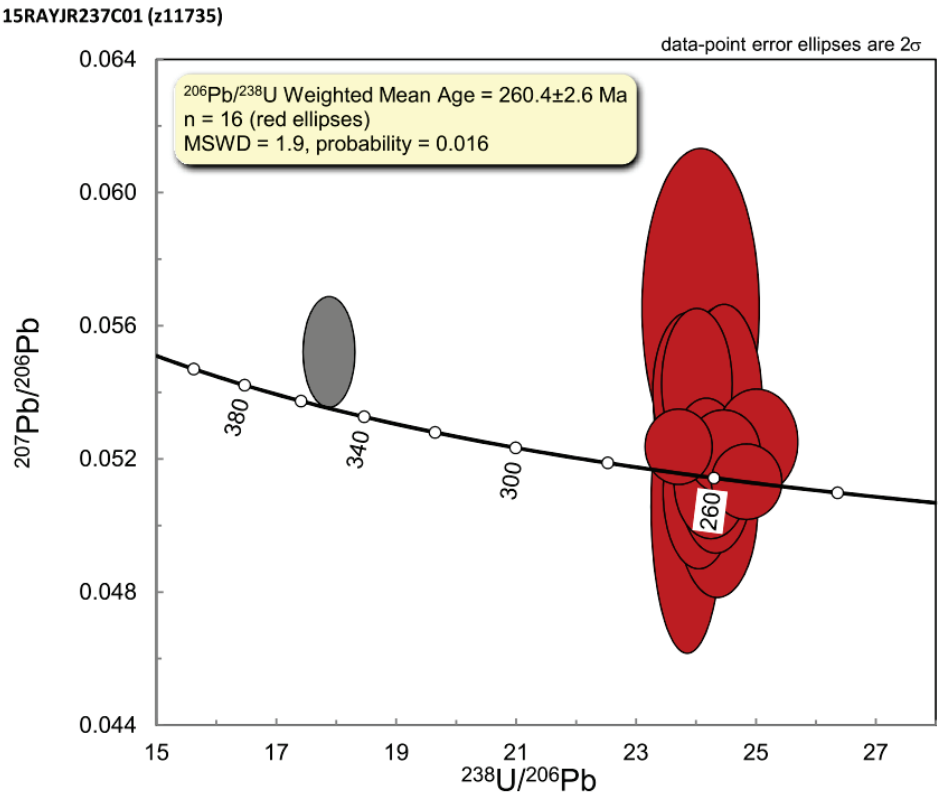
Zircon grains recovered from this sample are clear and colourless to pale brown with some fracturing; iron oxide staining is common around opaque inclusions (see white arrow on top image). Grains range between sub-equant to regular prisms displaying broad or simple oscillatory zoning under CL (bottom images; grains 31-34).

U-Pb Results and Interpretation

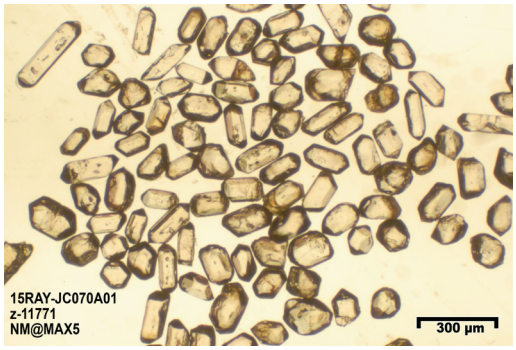
Seventeen analyses were conducted on 17 separate zircon grains. One of these analyses, targeting a broadly-zoned prism (grain 36), yields a $^{206}Pb/^{238}U$ age of 350±7 Ma .

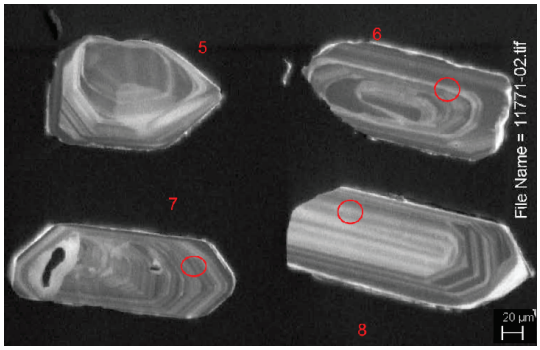
The remaining 16 analyses, targeting broad/oscillatory zoned prisms, yield a weighted mean $^{206}Pb/^{238}U$ age of 260.4±2.0 Ma (MSWD=1.9). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 260.4±2.6 Ma.

We interpret the 350±7 Ma age as inherited and the 260.4±2.6 Ma age as the crystallization age of the metamonzogranite, such that this sample correlates with the middle Permian Sulphur Creek suite, with possible Simpson Range suite inheritance.


15RAYJR237C01 (z11735)
data-point error ellipses are 2σ
206Pb/238U Weighted Mean Age = 260.4±2.6 Ma
n = 16 (red ellipses)
MSWD = 1.9, probability = 0.016
0.064
0.060
0.056
0.052
0.048
0.044
207Pb/206Pb
380
340
300
260
15
17
19
21
23
25
27
238U/206Pb

Sample: 15RAY-JC070A01
Sample description: Equigranular, foliated granodiorite
GSC lab number: z11771
SHRIMP mount: 824



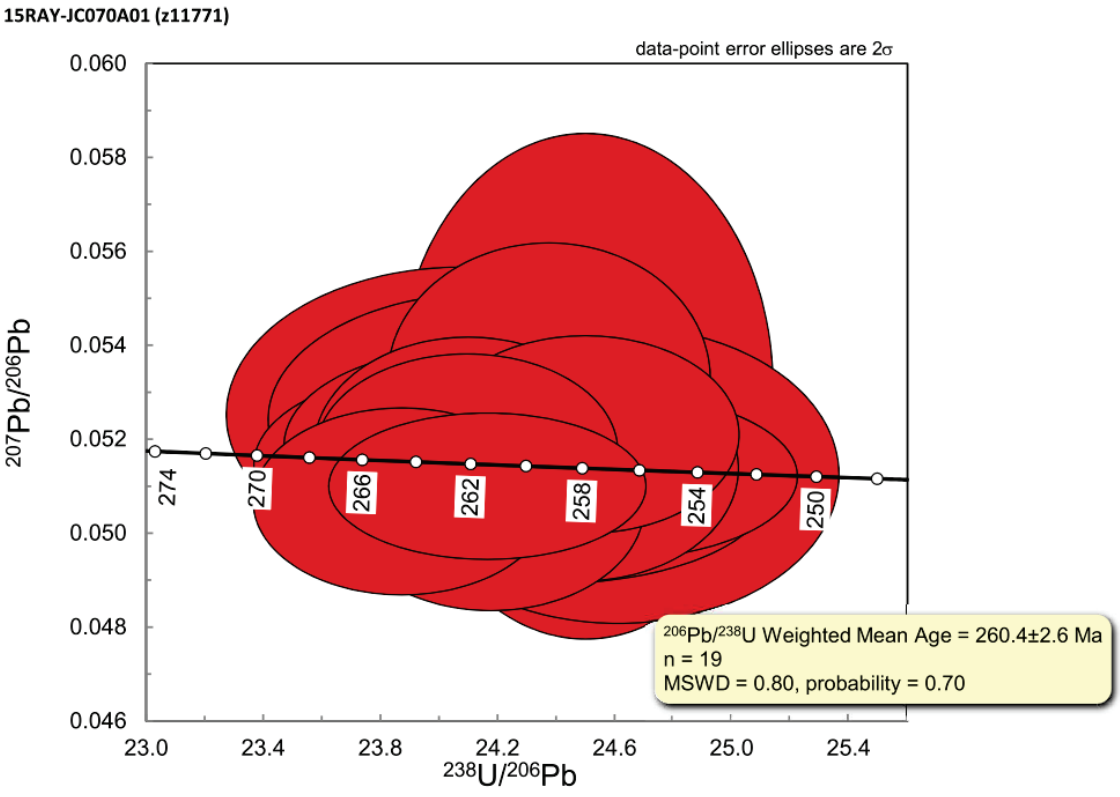


Zircon Description

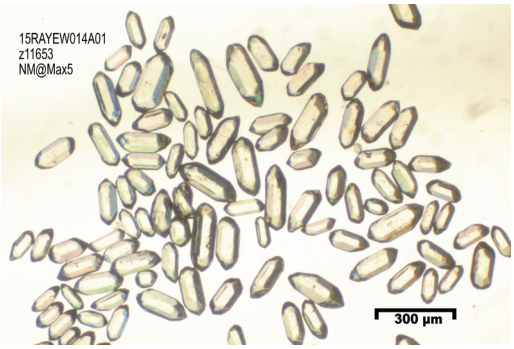
Zircon grains recovered from this sample are clear and colourless (left image), and range between sub-equant to elongated prisms with simple oscillatory zoning (right image); some opaque inclusions are present.

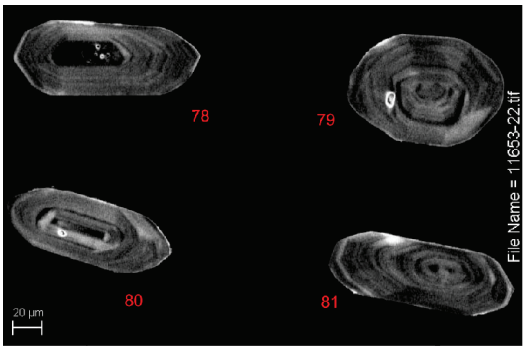
U-Pb Results and Interpretation

Nineteen analyses were performed on 19 separate zircon grains, yielding a weighted mean $^{206}Pb/^{238}U$ age of 260.4±1.2 Ma (MSWD=0.80). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 260.4±2.6 Ma, interpreted as the igneous crystallization age of this sample. This is interpreted to be an equigranular phase of the middle Permian Sulphur Creek suite.



Sample: 15RAYEW014A01
Sample description: Potassium feldspar augen quartz monzonite
GSC lab number: z11653
SHRIMP mount: 813



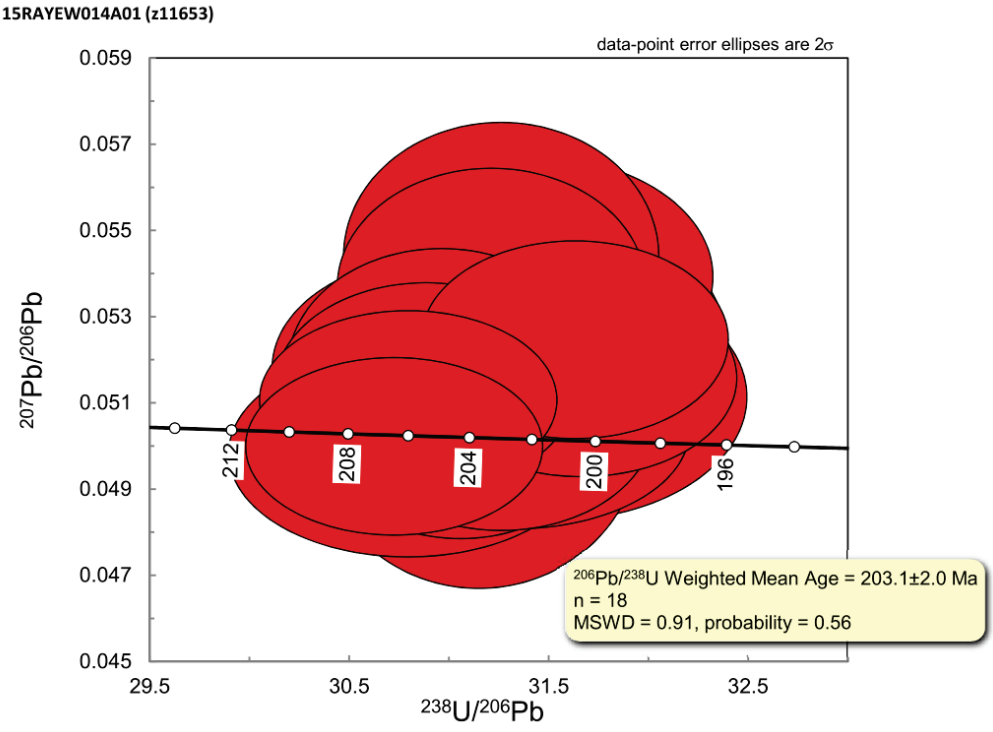


Zircon Description

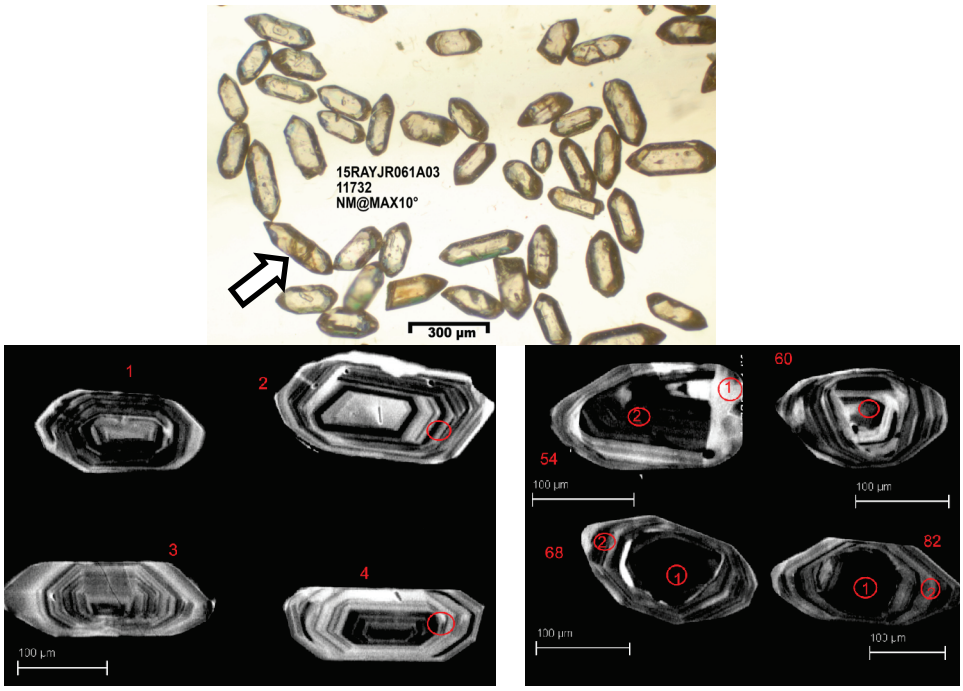
Zircon grains recovered from this monzonite are clear, colourless, well-faceted, elongated prisms (left image), displaying simple oscillatory zoning under CL (right image; grains 78, 80, 81). Some stubbier oscillatory-zoned prisms are also present (grain 79).

U-Pb Results and Interpretation

Eighteen analyses were performed on 18 separate zircon grains, yielding a weighted mean $^{206}Pb/^{238}U$ age of 203.1±1.0 Ma (MSWD=0.91). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 203.1±2.0 Ma, interpreted as the igneous crystallization age of this monzonite. This augen granite has an age typical of the Minto plutonic suite (Joyce et al., 2016).



Sample: 15RAYJR061A03
Sample description: Weakly foliated granodiorite
GSC lab number: z11732
SHRIMP mount: 813



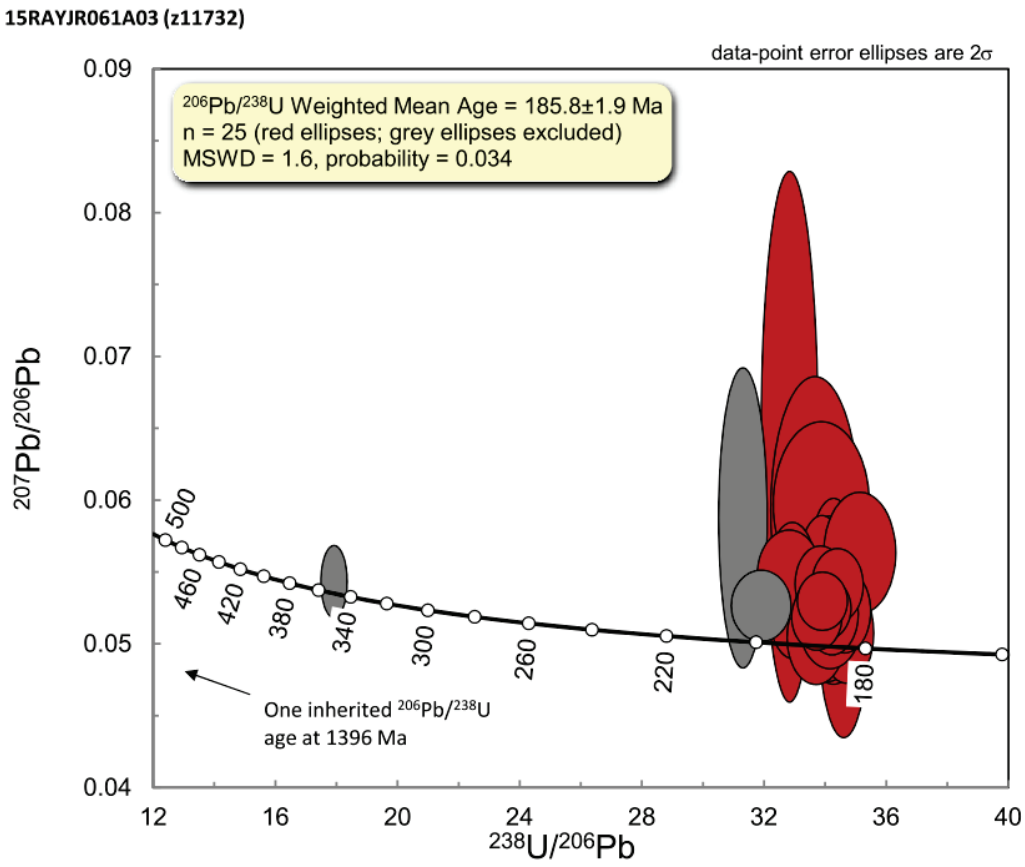
Zircon Description

Zircon grains recovered from this sample are clear and colourless, with a few grains displaying iron oxide staining around fractures and opaque inclusions (see white arrow on top image). Grains range from regular to elongated well-faceted prisms; rare grains are sub-equant. Under CL (bottom images), most grains display simple oscillatory zoning (grains 1-4). Rare grains (~5%) display an unzoned or oscillatory zoned core surrounded by an oscillatory zoned rim (grains 54, 60, 68, 82).

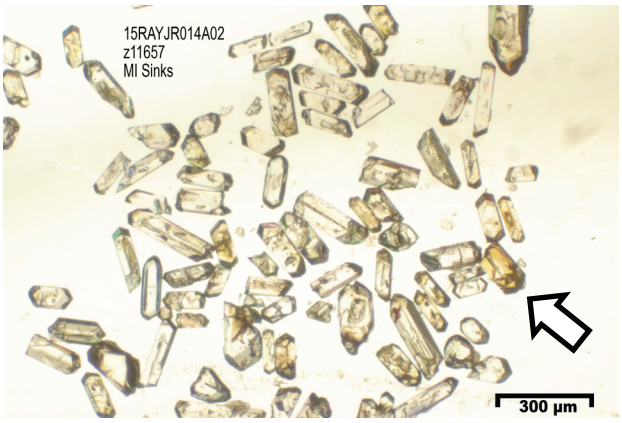
U-Pb Results and Interpretation

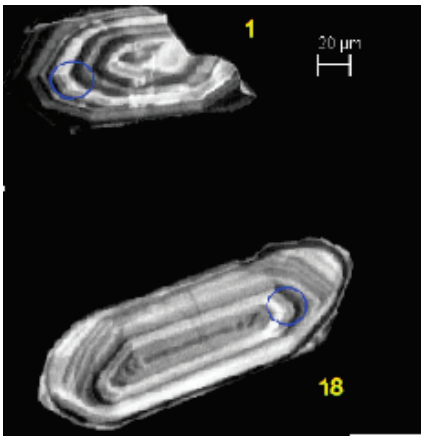
Twenty-nine analyses were conducted on 23 separate zircon grains. Two analyses, targeting unzoned cores, yield $^{206}Pb/^{238}U$ ages of 1396±28 Ma and 350±6 Ma (grain 82 and 68, respectively). Two additonal analyses, targeting oscillatory-zoned cores, yield $^{206}Pb/^{238}U$ ages of 201±4 Ma and 198±4 Ma (grain 60 and 54, respectively). Twenty-five analyses, targeting simple oscillatory zoned prisms and oscillatory zoned rims, yield a weighted mean $^{206}Pb/^{238}U$ age of 185.8±1.1 Ma (MSWD=1.6). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 185.8±1.9 Ma.

We interpret the 1396-198 Ma ages as inherited, and the 185.5±1.9 Ma age as the igneous crystallization age of this granodiorite, consistent with it being a phase of the Aishihik batholith of the Long Lake suite (as interpreted by Ryan et al., 2016).


15RAYJR061A03 (z11732)
data-point error ellipses are 2σ
206Pb/238U Weighted Mean Age = 185.8±1.9 Ma
n = 25 (red ellipses; grey ellipses excluded)
MSWD = 1.6, probability = 0.034
One inherited 206Pb/238U
age at 1396 Ma
207Pb/206Pb
238U/206Pb
0.09
0.08
0.07
0.06
0.05
0.04
12
16
20
24
28
32
36
40
500
460
420
380
340
300
260
220
180

Sample: 15RAYJR014A02
Sample description: Flow banded rhyolite
GSC lab number: z11657
SHRIMP mount: 815





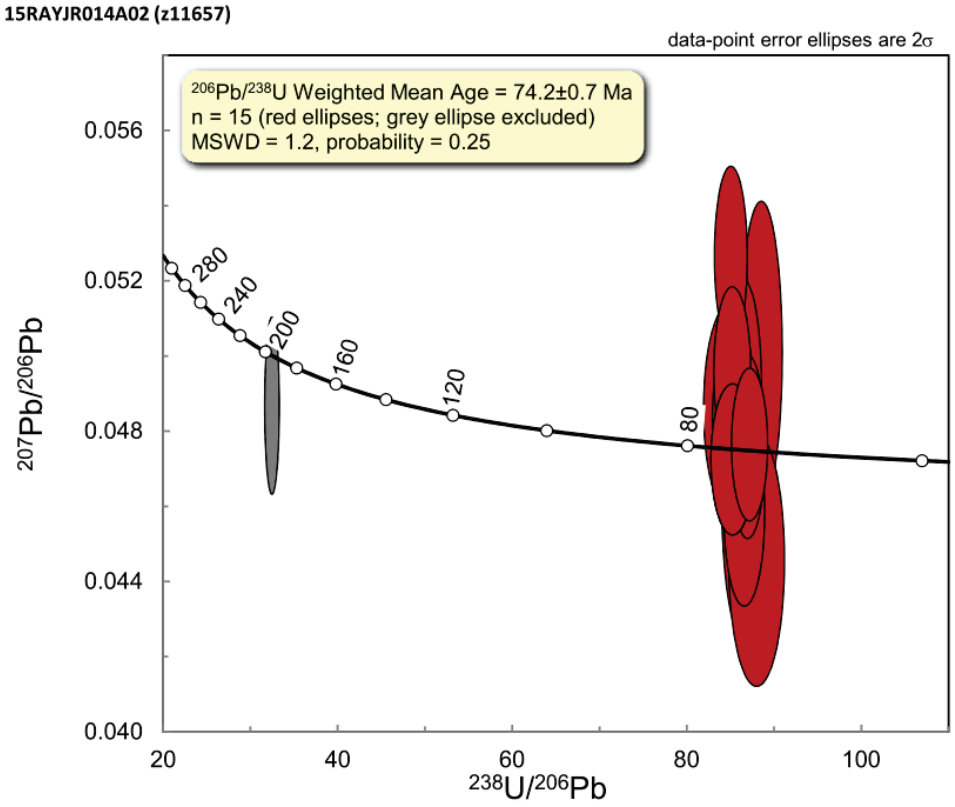
Zircon Description

Zircon grains recovered from this sample are clear and colourless, with a few grains displaying iron oxide staining around fractures and opaque inclusions (see white arrow on left image). Grains are primarily regular to elongate prisms, with some sub-equant grains also present, all displaying simple oscillatory zoning under CL (right image).

U-Pb Results and Interpretation

Sixteen analyses were performed on 16 separate zircon grains. A single analysis targeting a simple oscillatory-zoned prism, yields a $^{206}Pb/^{238}U$ age of 196±4 Ma (grain 18, right image). The remaining 15 analyses, also targeting simple oscillatory-zoned prisms, yield a weighted mean $^{206}Pb/^{238}U$ age of 74.2±0.5 Ma (MSWD=1.2). As this calculated error falls below the long term reproducibility threshold, this result is more appropriately reported as 74.2±0.7 Ma.

No morphological or chemical difference is observed between grain 18 and the remaining zircon grains in the sample. We interpret the 196±4 Ma age as inherited and the 74.2±0.7 Ma age as the crystallization age of the rhyolite. This age allows correlation of this rhyolite with the Casino suite (Selby and Creaser, 2001).


15RAYJR014A02 (z11657)
data-point error ellipses are 2σ
206Pb/238U Weighted Mean Age = 74.2±0.7 Ma
n = 15 (red ellipses; grey ellipse excluded)
MSWD = 1.2, probability = 0.25
0.056
0.052
0.048
0.044
0.040
207Pb/206Pb
280
240
200
160
120
80
20
40
60
80
100
238U/206Pb

Sample: 15RAY-JR076C01
Sample description: Foliated, equigranular, meta-trondhjemite
GSC lab number: z11772
SHRIMP mount: -

No zircon grains recovered from this sample.

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REFERENCES

Black, L.P., Kamo, S.L., Allen, C.M., Davis, D.W., Aleinikoff, J.N., Valley, J.W., Mundil, R., Campbell, I.H., Korsh, R.J., Williams, I.S., Foudoulis, C., 2004. Improved $^{206}Pb/^{238}U$ microprobe geochronology by monitoring of a trace-element-related matrix effect; SHRIMP, ID-TIMS, ELA-ICP-MS and oxygen isotope documentation for a series of zircon standards: Chemical Geology, 205, 115-140 p.

Colpron, M. and Nelson, J. L., 2011. A digital atlas of Terranes for the Northern Cordillera; BC GeoFile 2011-11.

Joyce, N.L., Ryan, J.J., Colpron, M., Hart, C.J.R., and Murphy, D.C., 2015. A compilation of $^{40}Ar/^{39}Ar$ age determinations for igneous and metamorphic rocks, and mineral occurrences from central and southeast Yukon; Geological Survey of Canada, Open File 7924, 1 .zip file. doi:10.4095/297446.

Joyce, N.L., Colpron, M., Allan, M.M., Sack, P.J., Crowley, J.L and Chapman, J.B., 2016. New U-Pb zircon dates from the Aishihik batholith, southern Yukon. In: Yukon Exploration and Geology 2015, K.E. MacFarlane and M.G. Nordling (eds.), Yukon Geological Survey, p. 131-149.

Klöcking, M., Mills, L., Mortensen, J. and Roots, C., 2016. Geology of mid-Cretaceous volcanic rocks at Mount Nansen, central Yukon, and their relationship to the Dawson Range batholith; Yukon Geological Survey, Open File 2016-25, 37 p. plus appendices.

Ludwig, K.R., 2003. User's manual for Isoplot/Ex rev. 3.00: a Geochronological Toolkit for Microsoft Excel. Special Publication, 4, Berkeley Geochronology Center, Berkeley, 70 p.

Ryan, J.J., Westberg, E.E., Chapman, J.B., Haggart, J.W., Hayward, N., Morneau, Y.E., Kellett, D.A., and Joyce, N.L., 2015. 2015 Report of activities for Ancient Faults and Their Controls on Mineralization in Northern British Columbia and Southern Yukon: GEM2 Cordillera Project; Geological Survey of Canada, Open File 7954, 18 p. doi:10.4095/297274.

Ryan, J.J ., Westberg , E.E., Williams, S.P., and Chapman, J.B., 2016. Geology, Mount Nansen–Nisling River area, Yukon; Geological Survey of Canada, Canadian Geoscience Map 292 (preliminary), scale 1:100 000. doi:10.4095/298835.

Selby, D., and Creaser, R.A., 2001. Late and Mid-Cretaceous mineralization in the Northern Canadian Cordillera: Constraints from Re-Os molybdenite dates; Economic Geology, v. 96, p. 1461 1467.

Stern, R.A., 1997. The GSC Sensitive High Resolution Ion Microprobe (SHRIMP): analytical techniques of zircon U-Th-Pb age determinations and performance evaluation: in Radiogenic Age and Isotopic Studies, Report 10, Geological Survey of Canada, Current Research 1997-F, 1-31 p.

Stern, R.A., and Amelin, Y., 2003. Assessment of errors in SIMS zircon U-Pb geochronology using a natural zircon standard and NIST SRM 610 glass. Chemical Geology, 197, 111-146 p.

Woodsworth, G. J., Anderson, R. G., and Armstrong, R. L., 1991. Plutonic regimes, in Gabrielse, H., and Yorath, C. J., eds., Geology of the Cordilleran Orogen in Canada; Geological Survey of Canada, Geology of Canada Series no. 4, 1991 p. 493-531, https://doi.org/10.4095/134105