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Introduction

The Geo-Mapping Frontiers project was initiated in 2011 within the Geo-mapping for Energy and Minerals (GEM) 2008-2013 program to advance the geological understanding of some of the more remote and poorly understood regions of Canada's north. The southern Rae area, mostly within the Akaitcho region of southeastern NWT (parts of NTS million sheets 65 and 75), was one of the areas targeted (Figure 1). As part of this project U-Pb zircon geochronological investigations were carried out on archival samples collected by the Geological Survey of Canada during Operation Thelon in the 1950's and 1960's (Heywood, 1961; Fraser, 1964; Wright, 1957; Taylor, 1959;,a,b,c Lord and Wright, 1967) and on samples collected in the summer of 2012 during a reconnaissance transect of the area. Both sets of samples were collected during spot locale observations accomplished by helicopter site visits, and hence there is limited context for inter-relationship between outcrops.

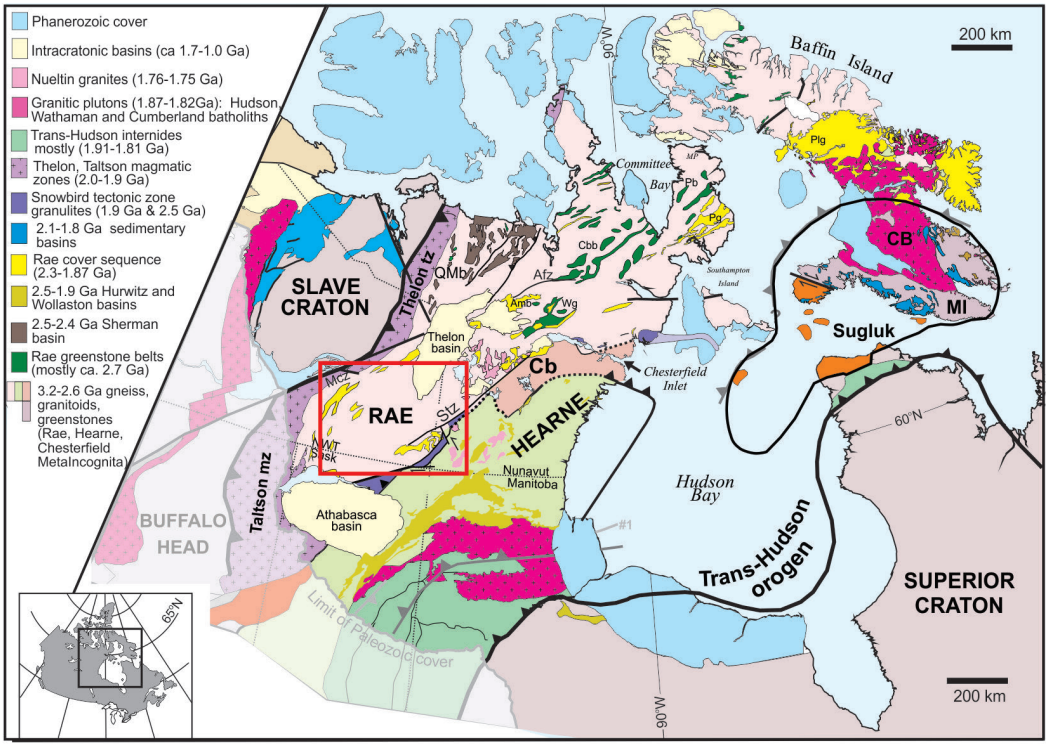

Figure 1. Regional geological map of northwest Laurentia. Area of Figure 2 highlighted by red box. Abbreviations: Amb = Amer belt; Afz = Amer fault zone, Cb = Chesterfield block, Cbb = Committee Bay belt; CB = Cumberland batholith; Cfz = Mcf = Macdonald fault, MI = Meta Incognita; Pb - Prince Albert Group, Pg = Pehnryn Group; Plg = Piling Group; QMb = Queen Maud block, Stz = Snowbird tectonic zone, Thelon tz = Thelon tectonic zone; Wg=Woodburn Group.

This report presents U-Pb ages of zircon for thirty samples that comprise a roughly east-west transect across the southern part of the Rae craton within the NWT (Hoffman, 1988). The locations of samples are shown in Figure 2 and a summary of age results is presented in Figure 3 and Table 1. Sample information and the interpretation of the U-Pb data are presented for each individual sample in following sections. The U-Pb analytical data are presented in Appendix 1 and documentation of the analytical run conditions are presented in Appendix 2.

Regional Geological Setting

The study area lies within the southern Rae craton of southeastern Northwest Territories. The area was mapped at a broad reconnaissance scale in the 1950's and 1960's (Heywood, 1961; Fraser, 1964) without the benefit of an accurate geochronological dating program or regional aeromagnetic coverage. The area is bounded on the west by the Taltson magmatic zone (Tmz; Figure 1), a continental collisional, Andean-type orogen formed during collision of the Paleoproterozoic Buffalo Head terrane with South Rae craton (Hoffman, 1988; McDonough et al., 2000 and references therein), and on the east by the Snowbird Tectonic zone, a ca. 1.90 Ga Paleoproterozoic suture that separates the Rae from Hearne craton (Berman et al., 2007 and references therein). The area is dominated by variably deformed Neoarchean and Paleoproterozoic magmatic and sedimentary rocks at amphibolite- to granulite-grade. More recent and detailed information, including U-Pb geochronological data, is available from adjacent areas of the

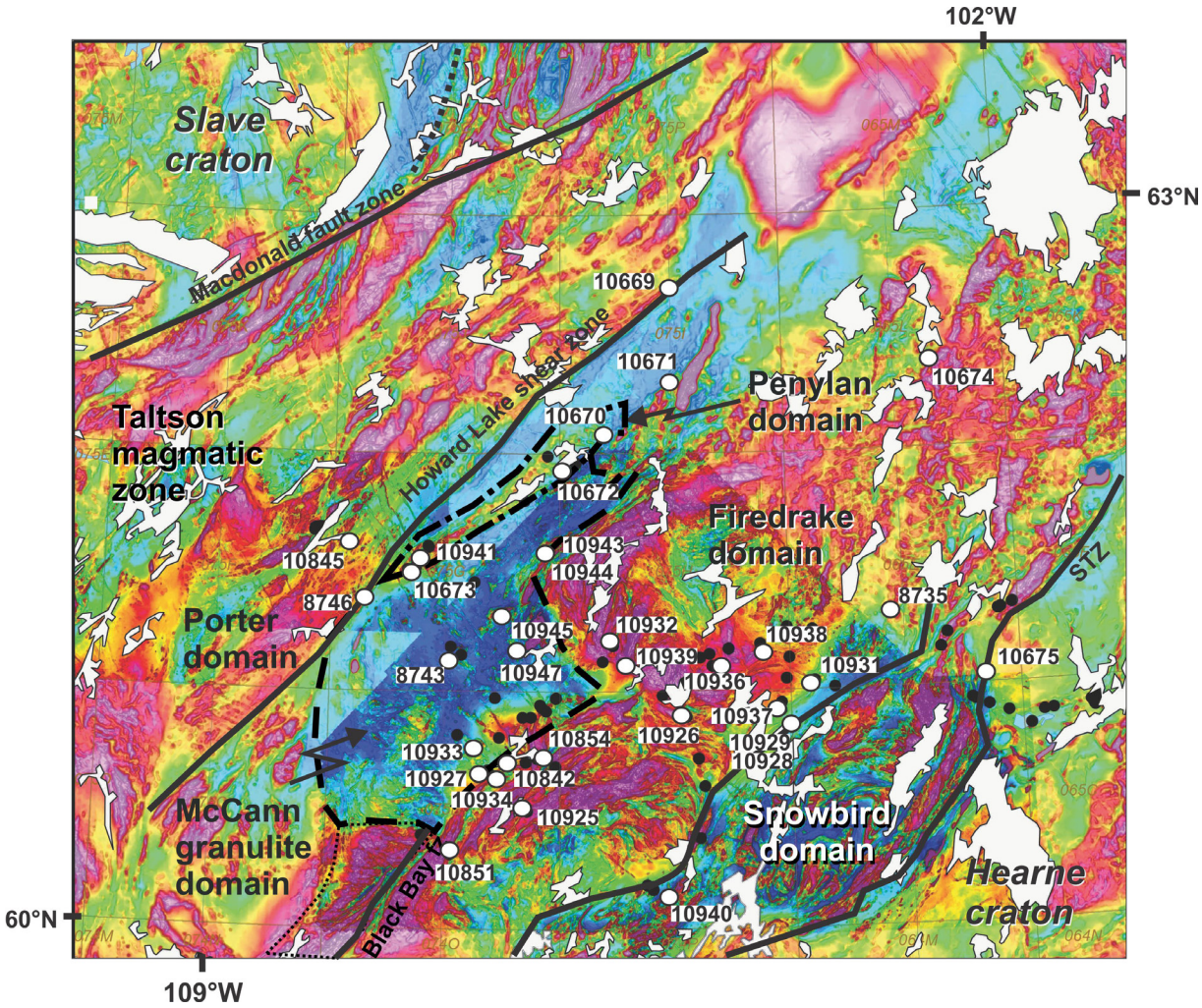

Figure 2. Map of the southern Rae craton showing regional aeromagnetic coverage and boundaries of principal tectonic domains (Pehrsson et al., in press). Locations of samples in this study are shown and identified by lab number. See Table 1 for sample details. White circles are geochronology sites. Black dots represent locales visited during the 2012 reconnaissance. Abbreviations: STZ-Snowbird Tectonic zone; fz = fault zone.

Snowbird domain in northern Saskatchewan and southeastern-most NWT (Ashton et al., 2013; Berman et al., 2013a; Martel et al., 2008; Martel and Pierce, 2006). In these areas the rocks are dominantly comprised of complexly reworked Neoarchean and Paleoproterozoic magmatic and sedimentary rocks that were deformed and metamorphosed at various times including 2.4-2.3 Ga (Arrowsmith), 1.92 Ga (Taltson), 1.90 Ga (Snowbird) and 1.85 Ga (Trans-Hudson) orogenies (Martel et al., 2008; Ashton et al., 2013; Berman et al., 2013a; Pehrsson et al., 2013). No modern geochronological data is available from the intervening area. K-Ar analyses published in early 1970's demonstrate that the area was thermally reset during the Paleoproterozic (Wanless et al., 1974).

The southern part of the Rae craton is transected by several prominent, crustal-scale faults (Howard Lake shear zone and Black Bay fault; Figure 2) and is overlain by Paleo-Mesoproterozoic sedimentary rocks of the intracontinental Thelon and Athabasca basins (Jefferson et al., 2007; Davis et al., 2011). It is intruded by Paleo- to Mesoproterozoic plutonic rocks of the ca 1.82 Ga Hudson and 1.75 Ga Nueltin suites (Peterson et al., 2002), as well as various generations of mafic dyke swarms (Buchan and Ernst, 2004; Morelli et al., 2009).

The southern Rae craton is informally divided herein into several distinct domains based on present geophysical character and isotopic and geologic data (Pehrsson et al., 2014).

Taltson Magmatic Zone

The Taltson magmatic zone on the west margin of southern Rae craton initiated at ca. 1.99 Ga as a magmatic arc formed via probable eastward dipping subduction beneath South Rae (Hoffman, 1988), or as a continental interior magmatic belt (Chacko et al., 2000). It evolved from early I-type magmatism (ca. 1986 Ma), to later voluminous collision-related S-type magmatism and associated high-grade metamorphism and deformation (Bostock et al., 1987, 1991; Thériault, 1992; McNicoll et al., 1994; Bostock and van Breemen, 1994; Plint and McDonough, 1995; McDonough, 1997; McDonough and McNicoll, 1997; Bostock and Loveridge, 1988; Ross et al., 1991). Rocks of the zone intrude southern Rae basement rocks which include both Archean and early Proterozoic units (McNicoll et al., 2000) and a ca. 2.0 Ga cover sequence found in southern NWT and Northern Saskatchewan.

Porter Domain

The Porter domain underlies the western part of the study area. It is a region of heterogeneous magnetic character typified by arcuate and linear northeast-trending magnetic anomalies of both high and low magnetic intensity. It is dominantly underlain by deformed and variably metamorphosed plutonic and gneissic rocks, and is unconformably overlain by clastic rocks of the ca. 1.9 Ga Nonacho group (Stockwell et al., 1968; Taylor, 1959a; Aspler and Donaldson, 1985). The basement, where known, consists of felsic plutonic and felsic-intermediate gneissic and metasedimentary rocks. Reconnaissance K-Ar ages of biotite, hornblende and muscovite yield cooling ages of 2.4-1.7 Ga (Skulski and Villeneuve, 1999; Canadian Geochronology Knowledgebase; http://atlas.rncan.gc.ca/site/english/maps/geochron/index.html) consistent with formation of the basement in the Archean or early Paleoproterozoic.

Immediately north of the study area, orthogneisses along strike of the Porter domain have Mesoarchean Nd model ages (Thériault, 1992), and may be correlative with the Mesoarchean Queen

Maud block of North Rae craton (Berman et al., 2013b; Davis et al. 2013; Davis et al. 2014; Tersmette, 2012).

Howard Lake shear zone

The eastern border of the Porter domain is defined by a linear magnetic break and topographic feature called the Howard Lake shear zone (Pehrsson et al., 2013). The 10 km-wide, northeast-trending shear zone is defined by a rectilinear magnetic fabric extending for nearly 100 km and is underlain by highly foliated to mylonitic rocks (ibid). It projects under sandstones of the Thelon basin near Boomerang Lake (Davidson and Ghandi, 1989). Mapped foliations dip moderately west and hand samples carry strong to intense protomylonitic to mylonitic foliation and lineation. East-side up sense of movement is inferred based on a change in metamorphic grade across the fault (Pehrsson et al., 2013).

Penylan domain

The Penylan domain is a narrow, linear feature of high, mottled magnetic character extending northeastward from the Howard Lake shear zone at Manchester Lake to northeast of Penylan Lake. Based on observations made during Operation Thelon it is underlain by foliated amphibolite to granulite-facies gabbroic-anorthosite, gabbro, granite and undifferentiated gneisses of unknown age. Taylor (unpublished notes) reported highly foliated units and fault scarps with slickensides along its northern and southern boundaries.

McCann granulite domain

The McCann granulite domain lies east of Penylan domain. It is characterized by a broad northeast-trending region of relatively smooth, low magnetic character and is underlain by foliated granulite-facies ortho- and paragneisses (Taylor, 1959b). The most prominent rock type included diatexitic and migmatitic orthopyroxene-garnet paragneisses, with outcrop-scale restitic units of iron formation, amphibolite, metapsammite and metawacke. A defining characteristic of the domain as a whole is the regional prevalence of blue quartz. A regional geochronological and metamorphic study suggests the paragneiss and basement were affected by the 2.45-2.3 Ga Arrowsmith orogen (Berman et al., 2013a; Pehrsson et al., 2013). Imprecise K-Ar ages of 2.05-1.95 Ga are reported by Wanless et al. (1974).

The McCann granulites are intruded by foliated felsic plutonic rocks and massive, unfoliated but metamorphosed mafic plutonic rocks, including the informally named Orpheus dyke-sill swarm (Hoadley, 1955; Taylor, 1959b). The north-trending Orpheus swarm is reported to be at garnet-clinopyroxene grade (Taylor, unpublished notes).

Southward, towards northern Saskatchewan, the low magnetic character of the McCann domain and dominant northwest-trending gneissosity and foliation transition to a more moderately magnetic area, reportedly underlain by less deformed Neoarchean felsic intrusive rocks. This area is contiguous with the Nolan domain of northern Saskatchewan (Ashton et al., 2005). The relationship with the McCann granulites is uncertain.

Black Bay fault zone

The McCann domain is bounded on the southeast side by a major crustal scale fault and lineament termed the Black Bay fault zone along its extension in northern Saskatchewan (Slimmons, 1989). This long-lived ductile to brittle-ductile structure trends northeast-ward and reorients fabrics in the adjacent domains. Gunning and Card (2005) report a Trans-Hudson age for monazite-bearing rare-element dykes within the structure in northern Saskatchewan. Recent work highlights that it has had an extended history, including possible Arrowsmith age ductile deformation (Halpin et al., 2010; Davis, unpublublished data) and later brittle faulting at or post-1.82 Ga (Ashton et al, 2013; Morelli et al., 2009). No data are reported from this domain in this report.

Firedrake domain

The Firedrake domain has a relatively high total magnetic field characterized by narrow linear magnetic patterns that outline intricate, kilometric-scale, arcuate patterns. The character of this apparent magnetic fabric varies with proximity to its western boundary. Along the western border near Rennie Lake, the pattern is dominated by north- to north-northwest-trending, tight to isoclinal folds. Farther south along the Black Bay fault the high magnetic pattern is distinctly rectilinear, and northeast-trending, parallel to the fault.

Away from the western boundary, east of Rennie Lake, the magnetic features are less tight in aspect, and refolded about open to tight north- and north-east trending axes, forming complex fishhook patterns. South and east of Rennie Lake, the magnetic character is more mottled, with a moderately high magnetic pattern characterized by lobate subdomains, each defined by narrow magnetic highs and lows that curve smoothly but terminate abruptly against adjacent subdomains. Compared to the Rennie Lake area, these regions have lower overall amplitude to the high magnetic signal and a shorter wavelength to the more easterly-trending arcuate magnetic features, although in places the transition appears gradual. A similar magnetic pattern, but dominated by more east-west trends, localized higher magnetic amplitude and a broader area of moderate, mottled magnetic intensity characterizes the Wholdaia Lake area to the south. In several areas the arcuate mottled pattern is more muted and is washed out, but still discernible.

The Firedrake domain is bounded on the southeast by the Snowbird domain and Snowbird tectonic zone (Martel et al., 2008). In the southeast the border is abrupt, with a sharp boundary between Firedrake mottled patterns and the characteristic arcuate magnetic lows of the Snowbird domain. Farther north the boundary is more gradual and characterized by a strong, northeast-trending banded moderate magnetic character. It appears likely that this feature is a fault, passing from ductile, to brittle-ductile southward.

The Firedrake domain is heavily till-covered with limited outcrop. The region is underlain by granitoid gneisses and granitic rocks (Wright, 1957a,b). Based on mapping during Operation Thelon the majority of the domain is underlain by upper amphibolite to granulite-facies metamorphosed felsic gneisses and granitoids. The high amplitude, narrow magnetic lineaments along the McCann domain boundary are reported by Taylor (unpublished notes) to be coincident with protomylonitic to mylonitic rocks and mafic-intermediate para- and orthogneisses. These units display strong foliations and gneissosity that are shallowly to moderately dipping. A large massive granitic body is reported to underlie a more muted

magnetic area in the centre of the domain.

Reconnaissance mapping in 2012 found that the majority of the bedrock comprised metamorphosed and deformed, amphibolite-granulite facies mafic-intermediate plutonic rocks, with subordinate paragneiss and granitic intrusions. Garnet-hornblende assemblages and relict clinopyoroxene were common in intermediate orthogneissic rocks. Several areas characterized by broader, washed out, lower magnetic intensity patterns are underlain by shallow-dipping biotite granite sheets. Several small, oval shaped magnetic highs were coincident with diorite-monzodiorite or syenite intrusions. A large, north-trending smooth magnetic high near the Snowbird tectonic zone is underlain by little deformed monzogranitic rocks.

Foliations in the Firedrake Lake area are largely shallowly-dipping and transected by moderately-dipping outcrop-scale shear zones and blastomylonites. Kinematic indicators and shear zone patterns and sense of movement suggest extension of a previously moderately-dipping stack.

Limited U-Pb or Ar isotopic data are available for the Firedrake domain. The southern part of the domain appears contiguous with the poorly-known, Archean Train Lake domain of northern Saskatchewan (Ashton and Card, 1998; Ashton et al., 1999). The latter is characterized by an upper amphibolite-facies granite-greenstone belt enveloped by leucocratic orthogneisses. In NWT, by contrast there is a much greater proportion of metasedimentary paragneisses and intermediate-mafic orthogneisses. A sample from the Wholdaia Lake area previously returned a 1750 Ma K-Ar age (Skulski and Villeneuve, 1999). Moderate pressure, upper amphibolite facies, garnet-biotite-bearing paragneiss near the McCann boundary record Trans-Hudson age monazite (ca. 1.86 Ga) and lack the Arrowsmith-age monazite characteristic of the McCann domain to the west (Berman et al., 2013a).

Snowbird domain and Snowbird Tectonic zone

Southeast of the Firedrake domain lies the Snowbird domain, a region of smooth magnetic highs and lows refolded about northeast trends adjacent to the Snowbird tectonic zone. Based on recent mapping and isotopic dating the domain is characterized granulite-grade Archean metavolcanic and metaplutonic rocks, infolded with upper amphibolite-grade Paleoproterozoic siliciclastic metasedimentary rocks and tectonically juxtaposed with Mesoarchean metaplutonic rocks along the Snowbird tectonic zone (Martel et al., 2008). The Mesoarchean Chipman panel is characterized by Paleoproterozoic high pressure granulite facies conditions (1.1-1.35 GPa; Baldwin et al., 2006), which extends northward along the Snowbird Tectonic zone to the Three Esker area where apparently similar, undated mylonitic to protomylonitic rocks (Hanmer et al., 1994; Hanmer, 1997) border the Firedrake domain directly.

Summary of Geochronological Results

Representative samples were analysed from each of the domains across the southern Rae: including one sample from Porter domain, three from Penylan domain, two from the Howard Lake shear zone, five from McCann Granulite domain, eighteen samples from the Firedrake domain and three from the Snowbird domain. Sample locations are indicated on Figure 2 and a summary of the age results are presented in Table 1 and Figure 3.

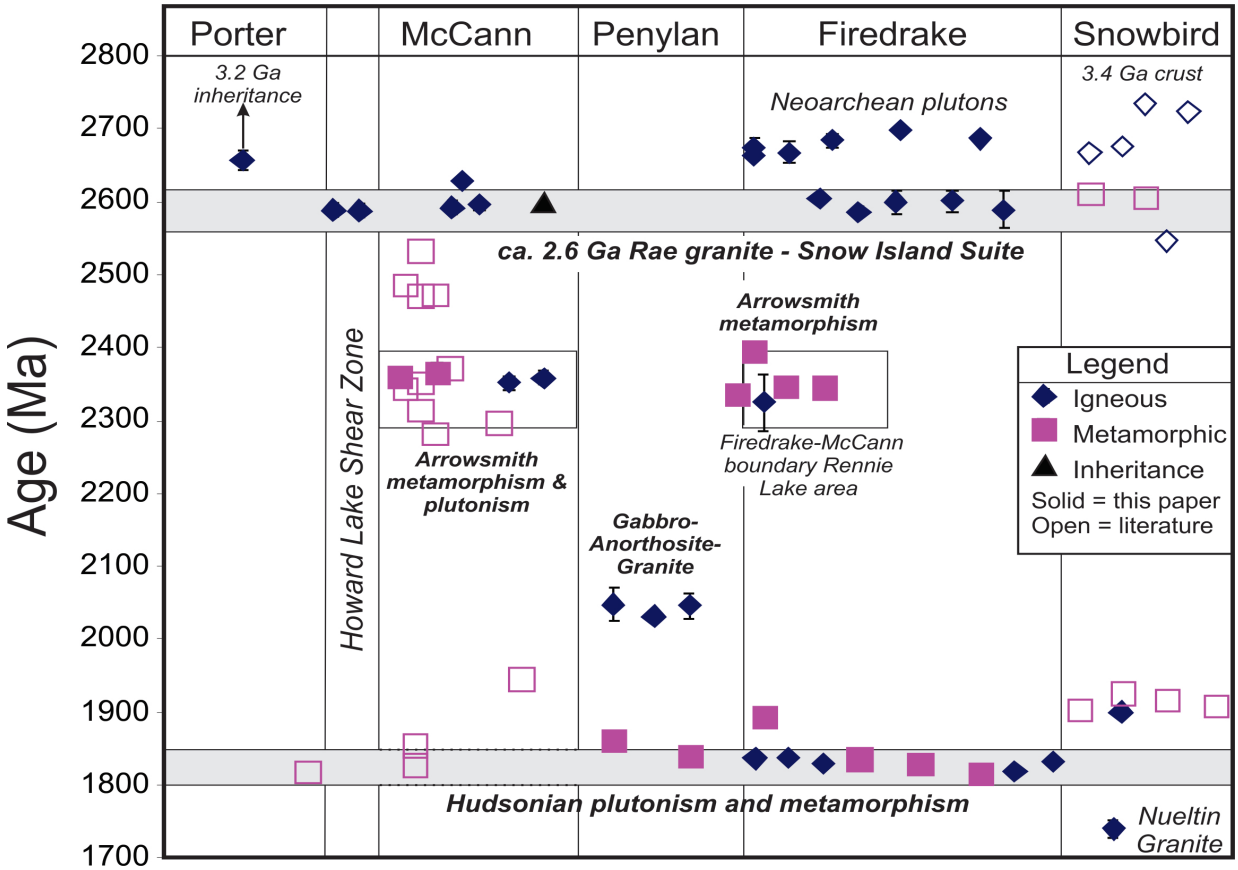

Figure 3: Summary of U-Pb age results from the southern Rae province grouped by geological domain. Previous data from the Snowbird domain (Martel et al., 2008) and the McCann domain (Berman et al., 2013) are included for comparison. Metamorphic ages from the McCann domain are from monazite in metaasedimentary rocks (Berman et al., 2013).

Porter Domain

A single sample of granitic gneiss from the Porter domain gave a poorly defined age of 2659 ± 13 Ma, with evidence for older 3.2 Ga inheritance. The evidence for Mesoarchean crust in this domain is consistent with Nd isotopic evidence for Mesoarchean crust north of the study area (Thériault 1992), which may be correlative with the Mesoarchean Queen Maud block of northern Rae craton (Berman et al., 2013b; Davis et al., 2013).

Penylan Domain

Two samples of amphibolite to granulite-facies anorthositic plutonic rocks and one sample of a granite from the Manchester Lake area yield crystallization ages of 2046 ± 18 Ma, 2048 ± 22 Ma and 2032 ± 5 Ma, respectively. The high magnetic signature of the Penylan domain represents a newly

Table 1: Summary table of age results in order by domain and sample. Domains: Porter, Penylan and McCann Domains.

Lab #	Sample #	Rock Type	Rock Description	UTM Zone	East	North	NTS Million	NTS 250	NTS 50	Age (Ma)	Positive Error (Ma)	Age Material	Age Method	Age Qualifier	Age Interpretation
Porter Domain															
10669	H68-1955	Plutonic	metamorphosed, mgr granitoid, chalky feldspars, altered, folaited	13	496944	6980693	75	I	14	2659.0	13.0	Zircon	U/Pb	Direct	Igneous Crystallization
10669	H68-1955	Plutonic	metamorphosed, mgr granitoid, chalky feldspars, altered, folaited	13	496944	6980693	75	I	14	3166.0	60.0	Zircon	U/Pb	Direct	Inheritance
Penylan Domain															
10670	F117-1955	Plutonic	metamorphosed, mgr anorthositic gabbro	13	472238	6885135	75	I	4	2048.0	22.0	Zircon	U/Pb	Direct	Igneous Crystallization
10670	F117-1955	Plutonic	metamorphosed, mgr anorthositic gabbro	13	472238	6885135	75	I	4	1862.0	10.0	Zircon	U/Pb	Direct	Metamorphic
10672	Bdelta149-1-1955	Plutonic	buff pink meta granite, mgr	13	454753	6869506	75	H	13	2032.0	5.0	Zircon	U/Pb	Direct	Igneous Crystallization
10941	PQB-60B-2012	Plutonic	hbl-cpx-gt quartz dioritie	13	391075	6834574	75	G	11	2046.0	18.0	Zircon	U/Pb	Direct	Igneous Crystallization
10941	PQB-60B-2012	Plutonic	hbl-cpx-gt quartz dioritie	13	391075	6834574	75	G	11	1840.3	9.5	Zircon	U/Pb	Direct	Metamorphic
McCann Domain															
10673	T359-1955	Plutonic	bl/w, meta diorite, S=Lmm foliation	13	374118	6812133	75	G	6	2596.0	7.0	Zircon	U/Pb	Minimum Direct	Igneous Crystallization
10673	T359-1955	Plutonic	bl/w, meta diorite, S=Lmm foliation	13	374118	6812133	75	G	6	2365	13.0	Zircon	U/Pb	Direct	Metamorphic
8743	T442-1955	Plutonic	med-cgr, felsic granitoid, blue quartz, opx-hbl-grt, recrystallized,	13	398836	6782299	75	G	2	2640-2680		Zircon	U/Pb	Estimate	Igneous Crystallization
8743	T442-1955	Plutonic	med-cgr, felsic granitoid, blue quartz, opx-hbl-grt, recrystallized,	13	398836	6782299	75	G	2	2352.9	6.2	Zircon	U/Pb	Maximum Estimate	Recrystallization
10947	PQB-80A-2012	Plutonic	blue quartz grt-opx diatexite, foliated	13	386575	6789017	75	G	3	2358.3	9.0	Zircon	U/Pb	Direct	Igneous Crystallization
10947	PQB-80A-2012	Plutonic	blue quartz grt-opx diatexite, foliated	13	386575	6789017	75	G	3	2599.1	7.2	Zircon	U/Pb	Direct	Inheritance
10945	PQB-78a-2012	Plutonic	bt granite dyke	13	407728	6804556	75	G	7	2351.6	9.5	Zircon	U/Pb	Direct	Igneous Crystallization
10933	PQB-90B-2012	Plutonic	lopx-bt,mangerite, foliated	13	397627	6743542	75	B	15	2628.0	4.8	Zircon	U/Pb	Direct	Igneous Crystallization
10671	E186-1955	Plutonic	granodiorite, hbl-bt,cpx bearing, foliated,	14	548269	6938052	65	J	9	2592.0	9.0	Zircon	U/Pb	Direct	Igneous Crystallization

Table 1 (continued): Summary table of age results in order by domain and sample. Domains: Howard Lake Shear Zone and Firedrake Domain.

Lab #	Sample #	Rock Type	Rock Description	UTM Zone	East	North	NTS Million	NTS 250	NTS 50	Age (Ma)	Positive Error (Ma)	Age Material	Age Method	Age Qualifier	Age Interpretation
Howard Lake Shear Zone															
10845	PQB-58b-2012	Plutonic	Sheared bt leucogranite, Howard Lake shear zone	13	358366	6811898	75	G	5	2590.4	3.9	Zircon	U/Pb	Direct	Igneous Crystallization
8746	C206-1955	Plutonic	cgr, megacrystic, mafic granodiorite, recrystallized, bt-hbl, foliated	13	351076	6800720	75	G	5	2591.0	3.3	Zircon	U/Pb	Direct	Igneous Crystallization
Firedrake Domain															
10934	PQB-14a-2012	Plutonic	Labyrinth hbl-bt granodiorite orthogneiss, feldspar porphyrytic locally, well foliated	13	411614	6726811	75	B	10	2589.0	26.0	Zircon	U/Pb	Direct	Igneous Crystallization
10842	PQB-14b-2012	Plutonic	Foliated hbl augen gneiss, Abitau domain	13	411615	6726810	75	B	10	1838.0	5.9	Zircon	U/Pb	Direct	Igneous Crystallization
10925	PBA-035A01-12	Plutonic	Taltson River hbl-tonalite orthogneiss, non magnetic, well foliated	14	350151	6801420	65	F	5	2686.7	5.7	Zircon	U/Pb	Direct	Igneous Crystallization
10851	PQB-84-2012	Metamorphic	Grt-bt migmatitic paragneiss,	13	393058	6687742	75	G	7	1836.3	4.6	Zircon	U/Pb	Direct	Metamorphic
10851	PQB-84-2012	Metamorphic	Grt-bt migmatitic paragneiss,	13	393058	6687742	75	G	7	2700.0		Zircon	U/Pb	Estimate	Detrital
10854	PQB-56a-2012	Plutonic	Foliated quartz diorite, McCann domain boundary NW Black Bay fault	13	437282	6770587	75	G	1	2325.0	39.0	Zircon	U/Pb	Direct	Igneous Crystallization
10854	PQB-56a-2012	Plutonic	Foliated quartz diorite, McCann domain boundary NW Black Bay fault	13	437282	6770587	75	G	1	1894.0	11.0	Zircon	U/Pb	Direct	Metamorphic
10927	PQB-88B-2012	Plutonic	Labyrinth rapids megacrystic granite	13	402668	6718662	75	B	10	2348.0	22.0	Zircon	U/Pb	Direct	Metamorphic
10927	PQB-88B-2012	Plutonic	Labyrinth rapids megacrystic granite	13	402668	6718662	75	B	10	2586.2	7.0	Zircon	U/Pb	Direct	Igneous Crystallization
10931	PQB-30-2012	Plutonic	leucogranite dyke, foliated	13	549808	6756831	75	A	16	1836.6	6.4	Zircon	U/Pb	Direct	Igneous Crystallization
10931	PQB-30-2012	Plutonic	leucogranite dyke, foliated	13	549808	6756831	75	A	16	2691.0	20.0	Zircon	U/Pb	Direct	Inheritance
10938	12PBA-55A1	Plutonic	Homogeneous pink leucogranite, sugary	13	525119	6782038	75	H	2	1819.0	4.4	Zircon	U/Pb	Direct	Igneous Crystallization
10926	PBA-61A1-12	Plutonic	Cpx-magnetite monzodiorite	13	505117	6750535	75	A	15	1829.4	2.4	Zircon	U/Pb	Direct	Igneous Crystallization
10928	12PBA-46A1	Plutonic	Protomylonitic hbl-bt granodiorite, hi mag	13	554350	6744908	75	A	16	2600.0	16.0	Zircon	U/Pb	Direct	Igneous Crystallization
10929	12-PBA-46B	Plutonic	bt-hbl tonalite-diorite orthogneiss, dm-cm layering, well foliated, low mag	13	554350	6744909	75	A	16	2601.0	14.0	Zircon	U/Pb	Direct	Igneous Crystallization
10936	12PBA-51B1	Plutonic	Magnetic hbl-bt tonalite orthogneiss	13	517430	6774105	75	H	2	2684.1	8.9	Zircon	U/Pb	Direct	Igneous Crystallization

Table 1 (continued): Summary table of age results in order by domain and sample. Domains: Firedrake and Snowbird Domains and Snowbird

Firedrake Domain

Lab #	Sample #	Rock Type	Rock Description	UTM Zone	East	North	NTS Million	NTS 250	NTS 50	Age (Ma)	Positive Error (Ma)	Age Material	Age Method	Age Qualifier	Age Interpretation
10937	12PBA-53A01	Plutonic	bt tonalite banded gneiss, foliated, comp layered	13	593744	6819080	65	E	6	2698.1	3.7	Zircon	U/Pb	Direct	Igneous Crystallization
8735	H4-1955	Plutonic	hypidiomorphic texture, minor recrystallization, hbl-plagio-clase, meta quartz diorite	13	603556	6791401	65	E	3	2604.5	5.0	Zircon	U/Pb	Direct	Igneous Crystallization
10932	PBA-92A1-2012	Plutonic	opx tonalite. Foliated, recrys-tallized	13	461473	6786169	75	H	4	1817.0	36.0	Zircon	U/Pb	Direct	Metamorphic
10932	PBA-92A1-2012	Plutonic	opx tonalite. Foliated, recrys-tallized	13	461473	6786169	75	H	4	2663.0		Zircon	U/Pb	Minimum Estimate	Igneous Crystallization
10939	PQB-40-2012	Sedimentary	bt-grt-sillimnaite schist with meta graded bedding and leucosome in pelitic layers	13	502546	6760968	75	A	15	1829.0	11.0	Zircon	U/Pb	Direct	Metamorphic
10939	PQB-40-2012	Sedimentary	bt-grt-sillimnaite schist with meta graded bedding and leucosome in pelitic layers	13	502546	6760968	75	A	15	2680.0	15.0	Zircon	U/Pb	Estimate	Detrital
10944	PQB-75A-2012	Plutonic	bt monzogranite, distintively rusty, well foliated	13	418515	6799581	75	G	7	2345.8	7.6	Zircon	U/Pb	Direct	Metamorphic
10944	PQB-75A-2012	Plutonic	bt monzogranite, distintively rusty, well foliated	13	418515	6799581	75	G	7	2674.0	14.0	Zircon	U/Pb	Direct	Igneous Crystallization
10943	PQB-75B-2012	Sedimentary	Orthopyroxene-Biotite Paragneiss	13	418515	6799581	75	G	7	2336.4	3.1	Zircon	U/Pb	Direct	Metamorphic
10943	PQB-75B-2012	Sedimentary	Orthopyroxene-Biotite Paragneiss	13	418515	6799581	75	G	7	2394.8	5.8	Zircon	U/Pb	Direct	Metamorphic
10674	W59-1955	Plutonic	cgr bt syenogranite, pink to red alteration	13	626470	6913874	65	L	7	1832.4	5.6	Zircon	U/Pb	Direct	gneous Crystallization

Snowbird Domain and Snowbird Tectonic Zone

Lab #	Sample #	Rock Type	Rock Description	UTM Zone	East	North	NTS Million	NTS 250	NTS 50	Age (Ma)	Positive Error (Ma)	Age Material	Age Method	Age Qualifier	Age Interpretation
10940	PQB-48b-2012	Plutonic	hbl-magnetite syenite	13	429498	6730103	75	B	9	1900.3	3.6	Zircon	U/Pb	Direct	Igneous Crystallization
10675	H26-1955	Plutonic	pink metagranite, cgr, hbl bearing	13	646816	6767641	65	E	1	1740.0	12.0	Zircon	U/Pb	Direct	Igneous Crystallization

identified 2.03-2.05 Ga magmatic complex in this part of the Rae. The plutons are 30-40 m.y. older than collisional magmatism in the adjacent Thelon and Taltson zones. They are similar in age to the 2038 ± 3 Ma age for the Hearne mafic dyke from the Great Lake shear zone (Perhsson et al., 1993). Detrital zircon with these ages occur within samples of the Amer and correlative sedimentary sequences on the Rae craton (Rainbird et al., 2010), and the intrusive rocks may be representative of wider spread regional magmatic events associated with extension within the Rae (Aspler and Chiarenzelli, 1997).

Two of the samples include recrystallized zircon with ages of 1840.3 ± 9.5 Ma and 1862 ± 10 Ma, which indicate partial recrystallization at that time. The amphibolite to granulite facies metamorphism recorded in these intrusive rock must be post-2.03 Ga and may be related to Hudsonian events that resulted in the zircon recrystallization.

McCann Domain

Samples of igneous plutonic rocks from the McCann domain yield ages of 2628 ± 4.8 to 2596 ± 7 Ma, typical of the widespread ca. 2.6 Ga Rae granites. Two samples of a younger plutonic rock and a diatexite have crystallization ages of 2351.6 ± 9.5 and 2358.3 ± 9.0 Ma. In addition a foliated quartz diorite included within the Firedrake domain, but adjacent to the Black Bay fault near the MaCann domain boundary has an imprecise age of 2325 ± 39 Ma. The McCann domain therefor preserves a record of Arrowsmith age magmatism and metamorphism. Slightly younger plutonic rocks at 2.33-2.28 Ga are known from the Beaverlodge domain in northern Saskatchewan, thought to be related to Arrowsmith orogeny (Hartlaub et al., 2007).

Firedrake Domain

Samples from the Firedrake Lake area yield Neoarchean and Paleoproterozoic ages. In the Rennie Lake area, near the McCann domain boundary, the plutonic rocks are Neoarchean, >2.66 Ga and 2674 ± 14 Ma, and a metasedimentary unit has dominantly Neoarchean detrital zircon. The rocks experienced a complicated metamorphic history with at least two metamorphic events at ca. 2.35-2.36 and at 1.83 Ga. The data indicate that this part of the Firedrake domain experienced both Arrowsmith and Hudsonian metamorphism.

Samples from the Firedrake Lake area yield similar ages. The oldest dated units have ages of 2684-2698 Ma. Three samples of granites yielded ages typical of the Snow Island suite, with ages of 2604.6 ± 5, 2600 ±16 and 2601 ± 14 Ma. This Neoarchean range of ages is typical of Neoarchean crust in the Rae. Granites of the 1.83 Ga Hudson suite have been identified with ages of 1832.4 ± 5.6 Ma, 1829.4 ± 2.4 Ma and 1819 ± 4.4 Ma and Hudsonian age metamorphic recrystallization of zircon is common. No evidence for 2.3-2.4 Ga metamorphism or plutonism is recorded in the domain east of Rennie lake.

Rocks from west and southwest of Wholdaia Lake display similar results. An orthogneiss has an age of 2686.7 ± 5.7 Ma and a paragneiss sample is dominated by detrital zircon of similar or slightly older age (ca. 2700 Ma) consistent with a Neoarchean depositional age. Metamorphic recrystallization of zircon in the paragneiss occurred at 1836.6 ± 6.4 Ma during Hudsonian metamorphism. Granites of both the 2.6 Ga Snow Island and 1.83 Ga Hudson suites were dated at 2586.2 ± 7 Ma and 1838 ± 5.9 Ma, respectively.

Snowbird Domain and Snowbird Tectonic zone

The two samples dated from this domain and along the Snowbird Tectonic zone are Paleoproterozoic and correspond to three different plutonic events. A syenite from west of Selwyn Lake yielded an age of 1900.3 ± 3.6 Ma, similar to the age of Chipman dykes (Flowers et al., 2008). A K- feldspar porphyritic granite that intrudes the Snowbird Tectonic zone northeast of Snowbird Lake has an age of 1740 ± 12 Ma, indicating it is part of the widespread post-tectonic Nueltin suite.

Summary

Crust in the southern Rae is dominated by Neoarchean plutonic and supracrustal rocks with ages between 2.65 and 2.7 Ga. With the exception of 3.2 Ga inheritance in one sample from the western-most Porter domain there is no direct evidence for crust older the ca. 2.8 Ga in the area. The widespread ~2.6 Ga plutonic event characteristic of the Rae is well represented east of the Howard Lake shear zone within the McCann and Firedrake domains, as are granites of the ca. 1.83 Ga Hudson suite. A significant 2.03-2.04 Ga plutonic event is documented in the Penylan domain. Evidence for magmatism and metamorphism of the ca. 2.5-2.3 Ga Arrowsmith orogeny is recorded within the McCann and western part of the Firedrake domain, whereas the 1.83 Hudsonian metamorphic event is evident in all domains.

Analytical Methods

Samples were processed by electropulse disaggregation using a CMT-100 instrument at Overburden Drilling in Ottawa, followed by sieving, and density separation using water panning at the Geochronology facility, GSC, Ottawa. SHRIMP analytical procedures followed those described by Stern (1997), with standards and U-Pb calibration methods following Stern and Amelin (2003). Details regarding the procedure, or any deviations from it, are noted in the section relating to specific samples. Briefly, zircons were cast in 2.5 cm diameter epoxy mounts (along with fragments of the GSC laboratory standard zircon; z6266, with $^{206}Pb/^{238}U$ age = 559 Ma). The mid-sections of the zircons were exposed using 9, 6, and 1 µm diamond compound, and the internal features of the zircons (such as zoning, structures, alteration, etc.) were characterized in back-scattered electron mode (BSE) utilizing a Zeiss Evo 50 scanning electron microscope. The count rates at eleven masses including background were sequentially measured with a single electron multiplier. Off-line data processing was accomplished using SQUID2 (version 2.22.08.04.30, rev. 30 Apr 2008). The 1σ external errors of $^{206}Pb/^{238}U$ ratios reported in the data table incorporate the error in calibrating the standard. Common Pb correction utilized the Pb composition of the surface blank (Stern, 1997). Yb and Hf concentration data were calculated using sensitivity factors derived from standard 6222 with values of 229 and 8200 ppm respectively. Isoplot v. 3.00 (Ludwig, 2003) was used to generate concordia plots and calculate regression ages and weighted means. The error ellipses on the concordia diagrams and the weighted mean errors are reported at 95% confidence intervals. Run condition for individual analytical sessions are given in Appendix 2.

Acknowledgements

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Report of Geochronological Results by Domain and Sample

Porter Domain Samples:

Z10669: Granite Gneiss

Sample Number:	H68-1955
Lab Number:	10669
Rock Type	Plutonic
Description	granite gneiss
Geological Province	Churchill/Rae
Geological Domain	Porter
Location	Zone 13 E496944 N6980693
Map Sheet	75L
Sampling History	Heywood, 1955
Age	2659 ± 13 Ma
Interpretation	Igneous Crystallization
Age	3166 ± 60 Ma
Interpretation	Inheritance

Geological Field Relationships

This sample was taken from an outcrop at the foot of a major escarpment, near a small river. The outcrop location lies within the strongly linear, northeast-trending moderately- to highly magnetic domain of the Howard Lake shear zone. The exact location coincides with a northeast-trending, narrow magnetic low within the overall domain. The mapped outcrop was described as comprising a sheared, recrystallized metamorphic rock possibly derived from the Dubawnt series. A strong foliation and schistosity was noted as trending 070/45 E. Field notes suggest it did not appear to be sheared granite, which characterized an outcrop 200 ft upriver, although it was noted to comprise red- weathering lenses and white kaolinite derived from feldspar and brown metacrysts of feldspar, quartz, and chlorite.

Rock Description

In hand sample the specimen is a brick red and white, medium-grained, recrystallized and highly deformed granodiorite. Quartz and feldspars define an S>L foliation and grain shape fabric. Quartz is elongate 5-10:1 and defines both distinct coherent domains and mosaics with K-feldspar and plagioclase to 2 mm, suggesting the original rock was inequigranular in texture. Plagioclase feldspars are highly kaolinitized and the matrix displays abundant hematite alteration, presumably after mafic minerals, which are no longer discernable.

Zircon Description

Zircons recovered were of poor quality, highly turbid and light to dark brown in colour. Abundant fractures are present. Crystals are euhedral to subhedral with some rounding of terminations (Figure 10669-1). The SEM BSE images show distinct oscillatory zoning in most grains. In some cases the zoning is accentuated by secondary alteration (Figure 10669-2A, 2B).

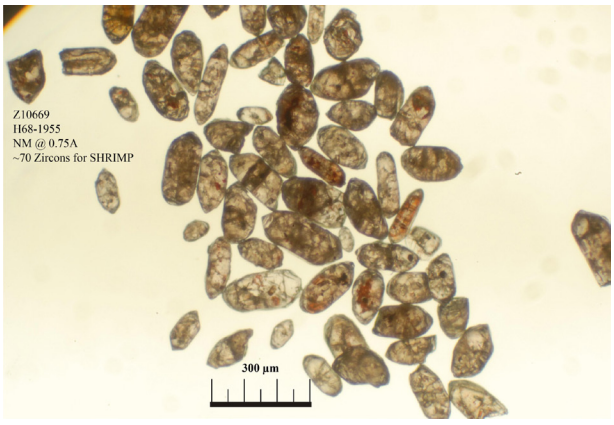

Figure 10669-1: Transmitted light photomicrograph of ziron population. Scale bar in centre is 300 µm.

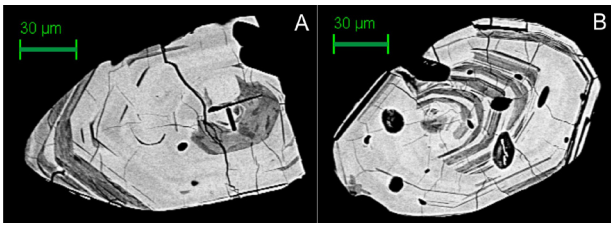

Figure 10669-2A, 2B: SEM BSE images of two ziron grains depicting oscillatory zoning. Scale bar in top right is 30 µm.

Results and Interpretations

Owing to the extensive alteration only a small number of zircon were analysed. Five analyses of oscillatory zoned zircon have concordant ages with a weighted mean age of 2659 ± 13 Ma (MSWD = 0.50, probability = 0.74). A single analysis has an imprecise age of 3166 ± 66 Ma. The former is the best estimate for the crystallization age of the rock and the Mesoarchean zircon is interpreted to be inherited from older crust.

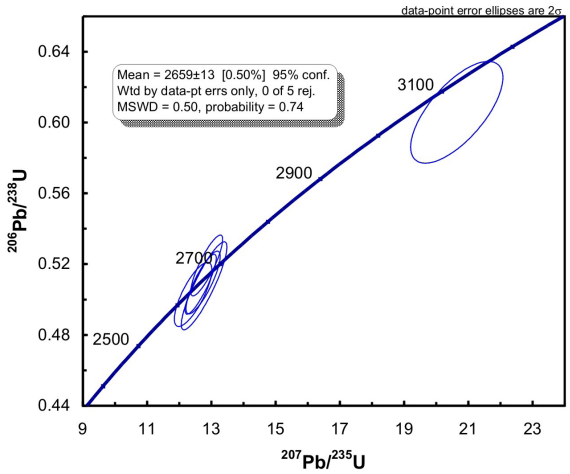

Figure 10669-3: Concordia diagram displaying cluster of five concordant analyses and a single older analyses.

Penylan Domain Samples:

Z10670: Anorthositic Gabbro

Sample Number:	F117-1955
Lab Number:	10670
Rock Type	Plutonic
Description	Anorthositic gabbro
Geological Province	Churchill/Rae
Geological Domain	Penylan
Location	Zone 13 E472238 N6885135
Map Sheet	75L
Sampling History	Sampled by Heywood, 1955
Age	2048 ± 22
Interpretation	Igneous Crystallization
Age	1862 ± 10
Interpretation	Metamorphic recrystallization

Geological Field Relationships

This sample was taken from an outcrop east of the Howard Lake shear zone, in a low magnetic area of the Penylan domain, which was well exposed with abundant outcrop. The rock in outcrop was reported as a possible anorthosite, dark brown weathering in colour, with a gneissic to well-foliated appearance. The rock was described as coarse-grained, comprising grey plagioclase and 10% fine grained biotite in clots. It was speculated that the rock forms a boundary phase to adjacent gabbro and granite outcrops. The foliation was reported as 360/80 E.

Rock Description

The hand sample is a medium- to coarse-grained, inequigranular, metamorphosed anorthositic gabbro, characterized by 80% coarse (1 cm) plagioclase laths in a finer matrix of

recrystallized mosaic plagioclase (up to 0.1mm). In thin section sericite and epidote replace the larger plagioclase laths. Twenty percent of the modal mineralogy comprises brown biotite (13%) and green hornblende (5%) that replace an original mafic mineral, most likely clinopyroxene which occurs in the biotite-hornblende clots and within interstices between plagioclase laths. Trace quartz and chlorite were noted.

Figure 10670-1: Photograph of hand sample; scale along bottom is 6 cm.

Zircon Description

A small number (~50) of moderate quality zircon were recovered from the sample. Grains are dominantly subhedral with slightly rounded faces and terminations. The grains are clear and colourless to light brown. Mineral inclusions are rare and minor fractures are observed. Grains range in size from size from 50 to 200 µm (Figure 10670-2).

Figure 10670-2: Trasmitted light photograph of ziron population. Scale bar at lower left side is 300 µm.

The SEM BSE images show variable textures. A few grains show distinct zonation with low uranium dark grain interiors and higher uranium, brighter margins (Figure 10670-3A). Some grains exhibit high uranium interiors and lower uranium margins. Most of the interiors and margins are mottled and homogenous, although some show faint evidence of oscillatory zoning (Figure 10670-3B).

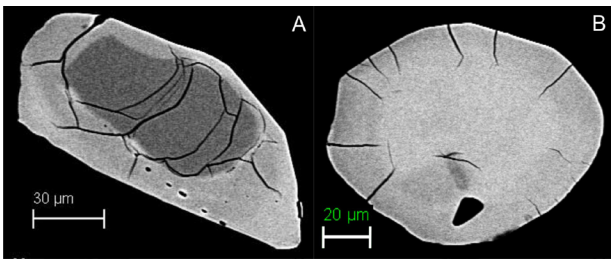

Figure 10670-3A,3B: SEM BSE image of two ziron grains displaying variable textures; (A) distinct zonation and (B) faint oscillatory zoning. Scale bar at lower left is (A) 30 µm and (B) 20 µm.

Results and Interpretation

The U-Pb results fall into two age groups (Figure 10670-4). Three analyses have overlapping dates with a weighted mean $^{207}Pb/^{206}Pb$ age of 2048 ± 22 (MSWD = 0.68, probability = 0.50). Fourteen of the fifteen remaining analyses have overlapping concordant dates with a weighted mean age of 1862 ± 10 Ma (MSWD = 1.3, probability = 0.19). One grain with a slightly older age is excluded. The older zircon has higher Th/U ratios of 0.6 compared to 0.01-0.4 for the 1862 Ma zircon. Some of the younger population exhibit oscillatory zoning. Two possible age interpretations may be considered: 1) the younger population represents the crystallization age of the rock and the older 2048 Ma age is an inherited component; or 2) the age of the rock is given by the older age and the younger age reflects a recrystallization. Based on the low Th/U ratios and irregular recrystallization, the younger zircon is interpreted

to reflect metamorphic recrystallization with the 2048 ± 22 Ma age reflecting the time of igneous crystallization.

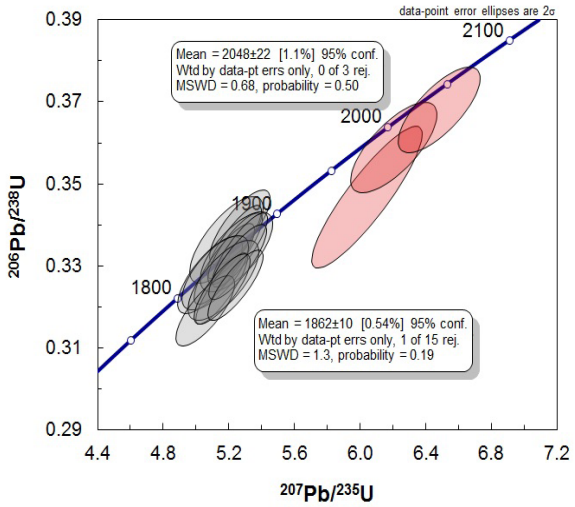

Figure 10670-4: Concordia diagram illustrating two age groups of the ziron population. Grey ellipses are low Th/U recrystallized domains, red ellipses higher Th/U domains.

Z10672: Monzogranite

Sample Number:	Bdelta149-1-1955
Lab Number:	10672
Rock Type	Plutonic
Description	Monzogranite
Geological Province	Churchill/Rae
Geological Domain	Penylan
Location	Zone 13 E454753 N6869506
Map Sheet	75H
Sampling History	Sampled in 1955
Age	2032 ± 5 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

This small sample is coincident with a moderate high in the total field magnetic map within the southern margin of the Penylan domain. No original field notes exist for the sample, which was described in archive summary tables as a granite.

Rock Description

In hand sample the rock is a buff pink, medium-grained, inequigranular quartz monzogranite with rare 1 cm K-feldspar augen. Mafic mineralogy consists of up to 10% biotite (0.25-1 mm), which defines the moderate S>L foliation. K-feldspar occurs as augen (up to 10 mm) which are parallel to the biotite foliation and as groundmass crystals (<3mm, 30%). Matrix quartz and plagioclase (<2 mm, 30% and 25% respectively) are recrystallized. One 2 mm crystal of garnet was observed. No thin section was available for the sample.

Zircon Description

Zircon recovered from this rock is of poor to moderate quality, subhedral to sub-rounded, stubby to elongate prismatic crystals (aspect ratio of 1.5-3:1). The grains are clear to moderately turbid and colourless to light brown with some showing iron staining. There are abundant inclusions, some fracturing and some zoning visible. They range in size from 50 µm to 200 µm (Figure 10672-2).

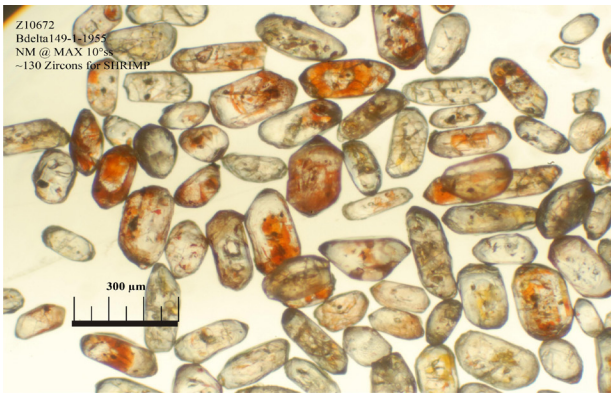

Figure 10672-2: Transmitted light photograph of ziron population. Scale bar in lower left is 300 µm.

In SEM BSE imaging most of the grains are characterized by a bright interior with a concentric, darker altered margin. Relict zoning can be seen

in the alteration zones. The boundaries between the bright interiors and dark margins are well defined (Figure 10672-3A). Faint concentric zoning can be sometimes seen within the otherwise homogenous brighter interior (Figure 10672-3B).

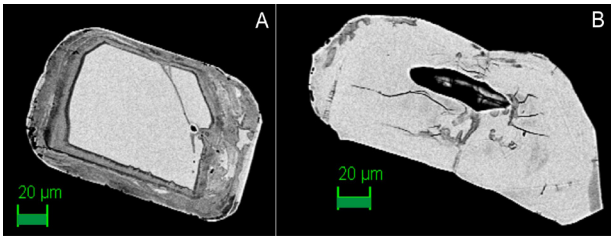

Figure 10672-3A,3B: SEM BSE image of 2 ziron grains. (A) Displays dark, well defined margins between bright interior. (B) Illustrates faint concentric zoning.

Results and Interpretation

Twelve analyses of twelve zircon grains yield a single age population with a weighted mean $^{207}Pb/^{206}Pb$ age of 2032 ± 5 Ma (MSWD = 2.0, probability = 0.027; Figure 10672-3). The zircons have relatively high uranium contents (300-1100 ppm) and a small range of Th/U ratios of 0.5-0.6. The zircons exhibit oscillatory zoning typical of igneous crystals and the age is interpreted as the time of igneous crystallization.

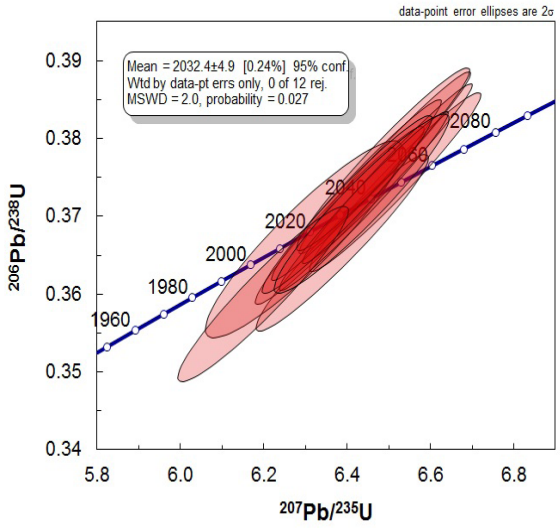

Figure 10672-3 U-Pb Concordia diagram for sample 10672. Error ellipses are 2σ.

Z10941: Quartz Diorite

Sample Number:	PQB-60b-2012
Lab Number:	10941
Rock Type	Plutonic
Description	hbl-cpx-qtz diorite
Geological Province	Churchill/Rae
Geological Domain	Penylan
Location	Zone 13 E391075 N6834574
Map Sheet	75G
Sampling History	Sally Pehrsson, 2012
Age	2046 ± 18 Ma
Interpretation	Igneous Crystallization
Age 1	1840.3 ± 9.5 Ma
Interpretation1	Metamorphic Recrystallization

Geological Field Relationships

The sample location is from the southwest end of the Penylan domain, on the northeast shore of Manchester Lake, NWT. The outcrop area is underlain by a layered, white to grey-weathering, medium-grained anorthosite-quartz diorite-tonalite complex. The rock is foliated and metamorphosed but not strongly recrystallized. The more mafic end-members have discrete layers defined by alternating garnet-hornblende and clinopyroxene-hornblende assemblages that are variably retrograded to hornblende-biotite. Twinned, possible primary clinopyroxene was noted in one garnet-hornblende sample. Fine-grained, mafic enclaves occur within the quartz diorite. All the aforementioned phases are transected by northeast-trending, moderately west-dipping high strain zones demarked by intense S-L foliation with aligned garnet, hornblende and biotite. Coarse-grained pink pegmatite cuts the high strain zones but is also locally deformed by them.

Rock Description

Sample PQB-60b-2012 comes from the hornblende-clinopyroxene quartz diorite phase of the Manchester Lake complex.

Figure 10941-1: Photograph of outcrop from which sample 60b was taken. Qtz diorite is grey material injected by later pink granite veins.

Zircon Description

Zircons occur as colourless to slightly brown euhedral to subhedral crystals (Figure 10941-2).

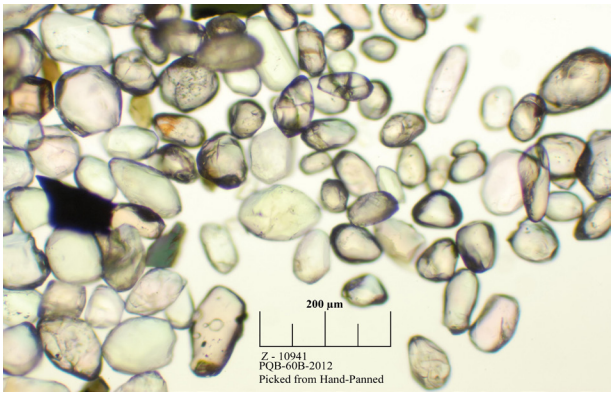

Figure 10941-2: Transmitted light photograph of zircon population.

BSE images reveal darker homogenous to weakly zoned cores with brighter recrystallized outer rims (Figure 10941-3). The bright outer zones are irregular and are interpreted to represent recrystallization of magmatic zircon.

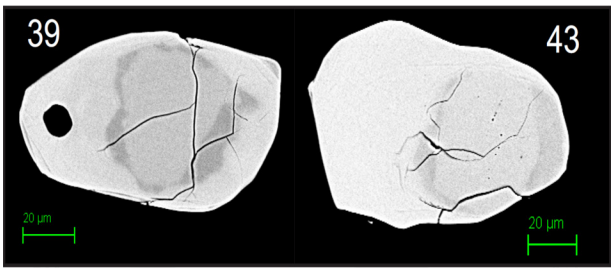

Figure 10941-3: SEM BSE images of grains 39 and 43, respectively. Each display darker, homogenous to weakly zoned core with brighter outer rims.

Results and Interpretation

Twenty-six analyses were carried out on thirty grains. Analyses of rim material have higher uranium content and lower ytterbium. Five of six analyses yield a weighted mean $^{207}Pb/^{206}Pb$ age of 1840.3 ± 9.5 Ma (MSWD = 1.3, probability = 0.25). One reversely discordant analysis has a slightly younger $^{207}Pb/^{206}Pb$ age and was excluded from the average. The remaining analyses (open ellipses) spread slightly below Concordia between the weighted mean age of the six oldest analyses at 2046 ± 18 Ma (MSWD = 2.1, probability = 0.059), and the age of the rim. The spread is interpreted as partial recrystallization of 2046 ± 18 Ma igneous zircon during an 1840.3 ± 9.5 Ma metamorphism.

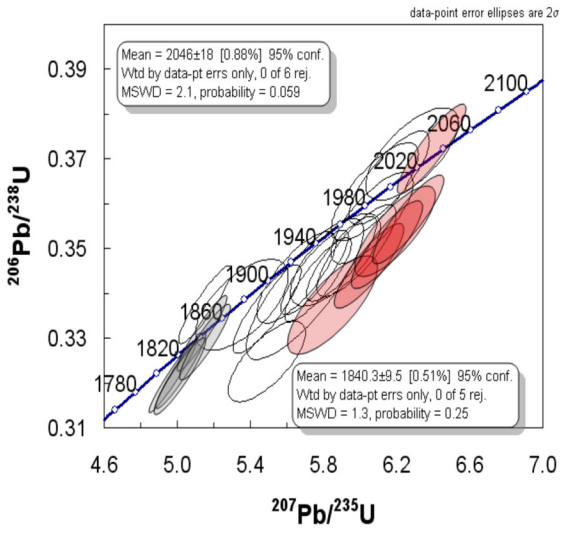

Figure 10941-4: Concordia diagram illustrating older core ages (red) and younger rims (grey).

McCann Domain Samples:

Z10673: Diorite

Sample Number:	T359-1955
Lab Number:	10673
Rock Type	Plutonic
Description	Diorite
Geological Province	Churchill/Rae
Geological Domain	McCann
Location	Zone 13 E374118 N6812133
Map Sheet	75G
Sampling History	Sampled in 1955
Age	2596 ± 7 Ma
Interpretation	Igneous Crystallization
Age1	2365 ± 13 Ma
Interpretation1	Metamorphic Recrystallization

Geological Field Relationships

The sample was collected from the south boundary of the highly magnetic southern Penylan domain, near the south shore of Manchester Lake. The rock in outcrop was described as a quartz gabbro with bluish quartz. It was noted to be banded with a foliation dipping 65 degrees to the northwest. Adjacent outcrops were described as medium-grained, partly gneissic diorite-gabbro, with biotite observed locally.

Rock Description

In hand sample the rock is a black and white layered, recrystallized diorite with a strong foliation. The foliation is defined by 2-7 mm compositional layering (plagioclase and hornblende-rich layers) and alignment of hornblende and biotite. A strong lineation defined by elongate plagioclase rods and aligned hornblende crystals is also prominent. In thin section the rock is composed of recrystallized plagioclase subgrains (55%-up to 0.5 mm) and hornblende (40%- up to 0.7 mm) in well-defined compositional layers with minor biotite (5%) replacing hornblende. Hornblende and biotite are in elongate crystals or recrystallized subgrain aggregates parallel to the compositional layering. Rare quartz is found within plagioclase-rich layers, along with epidote and sericite. Trace oxides occur in hornblende laths with one relict clinopyroxene crystal noted.

Figure 10673-1: Photograph of hand sample; scale bar along bottom is 7cm.

Zircon Description

Zircon is poor to moderate quality, subhedral to rounded, stubby to elongate prismatic crystals (aspect ratio of 1.5-3:1). Grains are moderately turbid, light brown to dark brown in colour and highly fractured. Grain size ranges from 100 x 100 µm to 100 x 300 µm (Figure 10673-2).

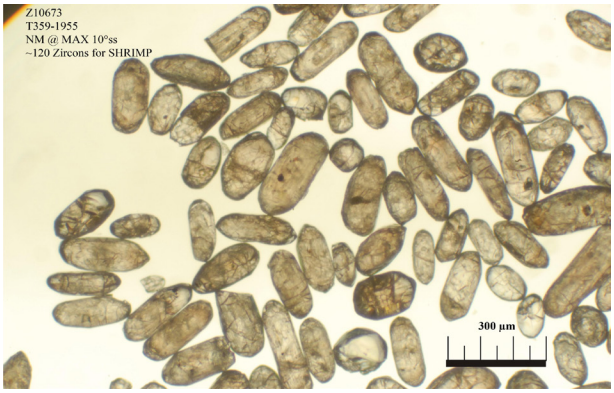

Figure 10673-2: Transmitted light photograph of ziron population.

The SEM BSE images reveal a highly fractured zircon population. Concentric zoning is present and the grains generally display brighter interiors and darker margins (Figure 10673-3). Faint oscillatory zoning can be seen in some of the brighter interiors (Figure 10673-3C). Areas of extensive alteration varying in size and location can be seen throughout most grains.

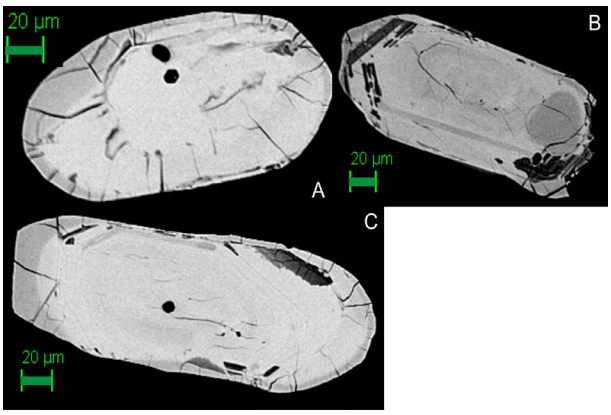

Figure 10673-3A,3B,3C: SEM BSE images of three zircon grains.

Results and Interpretation

Thirty-nine analyses were made on thirty-six grains. Analyses of the brighter, oscillatory zoned zircon yield a range of concordant to near concordant analyses that spread between 2.46 and 2.599 Ga (Figure 10673-4). These zircon all have high uranium contents (200-1000 ppm) and moderate Th/U ratios (0.2-0.8). The analyses do not define a single age population. The spread in ages is interpreted to reflect Paleoproerozoic lead-loss at the time of formation of the darker recrystallized zones. The best estimate of the age is given by the weighted mean of the three oldest analyses at 2596 ± 7 (MSWD = 0.64, probability = 0.53), although this is a minimum age as it cannot be determined that these analyses didn't undergo some degree of lead-loss.

The darker zircon zones have much lower uranium (30-50 ppm) and ytterbium (90-120 ppm) contents and yield ages between 2.32 and 2.41 Ga (Figure 10673-4). This group does not yield a statistically robust age and includes some degree of excess scatter. The thirteen youngest analyses yield a weighted mean age of 2365 ± 13 Ma (MSWD = 1.7, probability = 0.053). Two analyses with ages >2.4 Ga were excluded and these may include a component of the older higher uranium zircon possibly due to incomplete resetting of the U-Pb system during recrystallization. The 2365 ± 13 Ma age is taken as the best estimate of the time of zircon recrystallization.

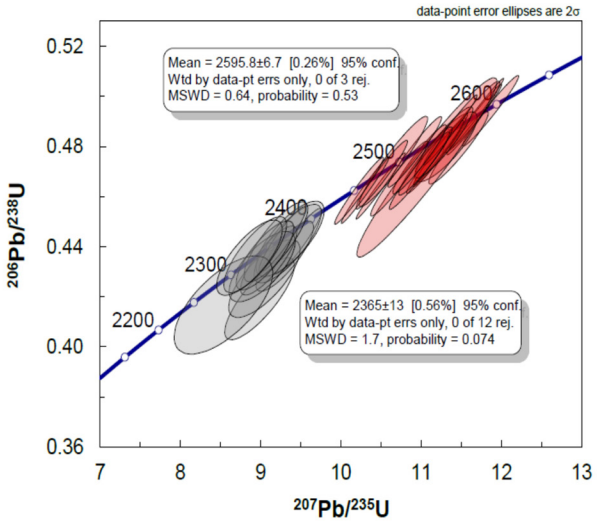

Figure 10673-4: Concordia diagram. Red ellipses are analyses of brighter, oscillatory zoned zircon; grey ellipses are analyses of darker low U zircon.

Z8743: Felsic Granitoid Gneiss

Sample Number:	T442-1955
Lab Number:	8743
Rock Type	Plutonic
Description	Felsic Granitoid Gneiss
Geological Province	Churchill/Rae
Geological Domain	McCann
Location	Zone 13 E398836 N6782299
Map Sheet	75G
Sampling History	Sampled in 1955
Age	2600 – 2670 Ma
Interpretation	Igneous Crystallization bracketed
Age1	2352.9 ± 6.2 Ma
Interpretation1	Metamorphic Recrystallization

Geological Field Relationships

The sample is from an outcrop in the distinctive low magnetic McCann granulite domain. The outcrop was described as consisting of a white-weathering medium-grained garnet-quartz-feldspar gneiss with the characteristic blue quartz found throughout much of the McCann domain.

Rock Description

In hand sample the rock is a medium-grained, well foliated, buff to white-weathering gneiss (Figure 8743-1). It displays an inequigranular, but recrystallized texture with large, elongate 0.5-2 cm pink-grey K-feldspar augen, in a matrix of granoblastic quartz, plagioclase, feldspar and rare garnets. Translucent-grey blue quartzose bands appear to parallel the foliation defined by flattened augen.

In thin section the rock is a meta-monzogranite and displays a strong grain shape fabric and foliation defined by the K-feldspar augen in a finer matrix of plagioclase-quartz and K-feldspar. Quartzofeldspathic minerals in the foliation bands (defined by percentages of quartz and K-feldspar) have abundant <1 mm subgrains nucleated on grain boundaries. Approximately 5% of matrix feldspar show perthitic texture. Rare zircon, magnetite, muscovite and biotite (<2%) were noted and no garnet was confirmed in thin section. Quartz in the finer-grained foliation bands locally displays grain boundary migration oblique to the foliation, suggestive of post-foliation strain. Distinctive optically continuous quartz domains are oblique to or parallel the quartzofeldspathic matrix and its foliation, and may represent deformed original phenocrysts. Subsequent field of examination of outcrops near this original station were found to be deformed orthopyroxene-garnet charnockites.

Figure 8743-1: Photgraph of hand sample T442-1955.

Zircon Description

Zircon from this sample are of poor to moderate quality, subhedral to rounded, equant to elongate prismatic crystals (aspect ratio of 1.5-3:1). They are moderately turbid and light brown to dark brown in colour. Their size ranges from 100 x 100 µm to 150 x 300 µm (Figure 8743-2).

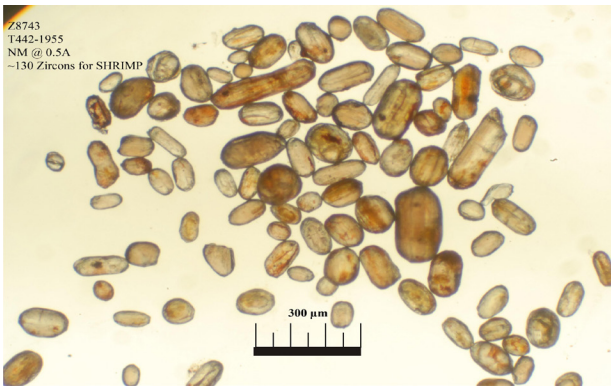

Figure 8743-2: Transmitted light photograph of zircon population.

Most of the grains show significant alteration in SEM BSE images; which may develop preferentially along original oscillatory zoning or more irregularly (Figure 8743-3). Some grains are mainly bright and homogenous with dark zones of alteration and traces of oscillatory zoning (Figure 8743-3A and 3B). Others show homogenous brighter interiors surrounded by dark altered oscillatory margins. On some grains, a bright margin of zircon forms a narrow rim and extends in an irregular form into the grain interior (Figure 8743-3C).

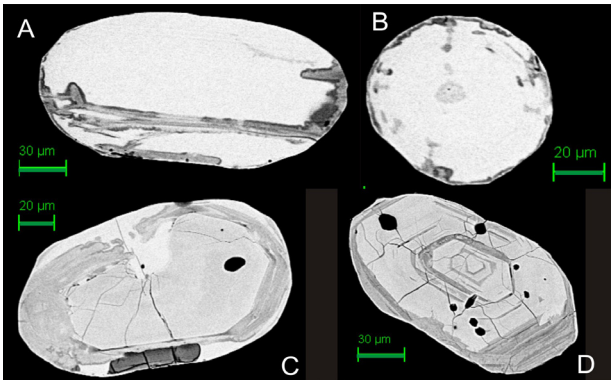

Figure 8743-3: SEM BSE images of typical zircon grains showing high degree of alteration and oscillatory growth zoning.

Results and Interpretation

Results for this sample are complicated and difficult to interpret. Analyses plot along the concordia curve between 2.35 Ga and 2.66 Ga. Uranium content ranges from 85 to 1900 ppm, with one analysis of an altered zircon having a uranium content of 5600 ppm. There is no systematic correlation of age with uranium or thorium composition, nor can ages be predicted based on zircon textures. The five youngest analyses from four zircon grains define a population with a weighted mean $^{207}Pb/^{206}Pb$ age of 2352.9 ± 6.2 Ma (MSWD = 1.12, probability = 0.35). Analyses extend along the Concordia to 2.67 Ga but no distinct mode is evident. The sample is likely older than ~2.6 Ga and could be as old as, or older than, the oldest zircon determined in the sample at 2660 ± 22 Ma. The 2352.9 ± 6.2 Ma is interpreted as the time of a metamorphic overprint, although this should be treated as a maximum estimate as the disturbance could be younger if zircon is only partially reset.

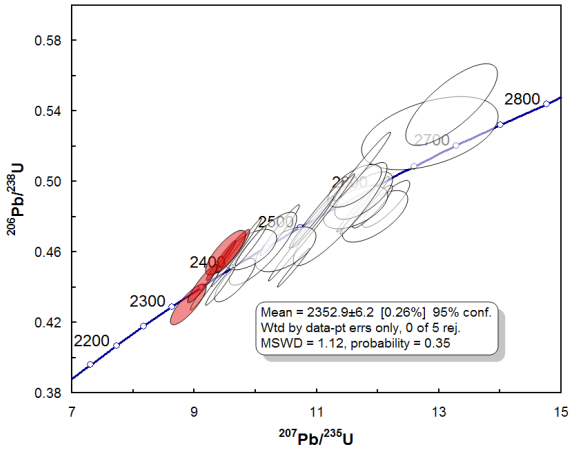

Figure 8743-4: Concordia diagram showing spread in ages between recrystallization at 2.35 Ga and original age at >2.66 Ga

10947: Diorite Dyke

Sample	PQB-80a-2012
Lab Number:	10947
Rock Type	Plutonic
Description	Diorite Dyke
Geological Province	Churchill/Rae
Geological Domain	McCann

Location	Zone 13 E386575 N6789017
Map Sheet	75G
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2599.1 ± 7.2 Ma
Interpretation	Inheritance
Age1	2358.3 ± 9.0 Ma
Interpretation1	Igneous Crystallization

Geological Field Relationships

The sample location is from the southwest of Dymond Lake, NWT within the smooth low magnetic region characteristic of the McCann domain. The outcrop area is characterized by a highly deformed megacrystic granodiorite with a shallow dipping foliation overlain by a foliated garnet-orthopyroxene-blue quartz diatexite with inclusions of metawacke, banded iron formation, chert, and psammite. The main foliation in the diatexite is also shallow and is crosscut at a low angle by an orthopyroxene-clinopyroxene fine-grained diorite dyke. The dyke itself has a weak internal foliation, subparallel to that of the host diatexite. The dyke and the main foliation are cut by granite pegmatite dykes. All units have blue quartz if they are quartz-bearing. The main foliation is cut by steep dm-scale ductile shears that locally have subparallel granite veins. Both the late granitic veins and mylonite in the shears do not have blue quartz.

Rock Description

Sample PQB-80a-2012 comes from the diorite dyke (Figure 10947-1). In thin section it is a fine-grained quartz diorite with 30% mafic minerals comprised of orthopyroxene, clinopyroxene, magnetite and biotite. Biotite replaces the orthopyroxene and clinopyroxene but is aligned in the main foliation. Orthopyroxene and clinopyroxene are heavily altered and ragged and also aligned parallel to the main foliation. Titanite rims the magnetite and is elongate in the foliation.

Figure 10947-1: Photograph of outcrop. Material sampled is from lower part of photograph. Pick of hammer for scale.

Zircon Description

Zircons consist of subhedral, equant to prismatic crystals (Figure 10947-1). BSE images indicate diffuse zoning with cores, often with oscillatory zoning, surrounded by irregular brighter rims (Figure 10947-2). The brighter zones have transitional boundaries with the core suggesting recrystallization of zircon.

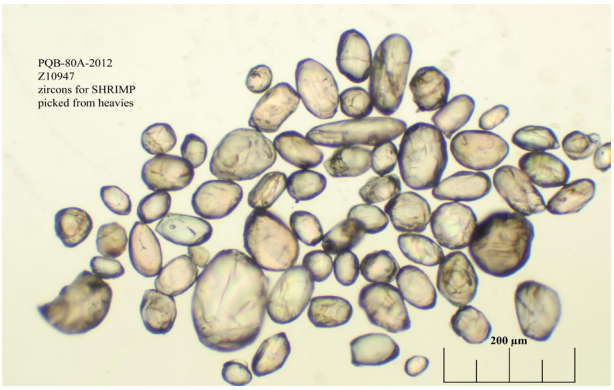

Figure 10947-2: Transmitted light photograph of zircon population. Scale in lower right is 200 µm.

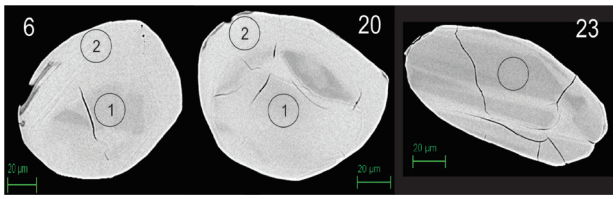

Figure 10947-3: BSE images of typical grains showing bright rims over darker cores. Grain numbers referenced to data table. Individual analyses identified by circles.

Results and Interpretation

Five analyses of the brighter rim material yield a weighted mean age of 2358.3 ± 9.0 Ma (MSWD = 3.8, probability = 0.004) with excess scatter (Figure 10947-4). These zones typically have lower Th/U and ytterbium content. A subset of the zircon core material defines a second age population. Seven of the eight oldest analyses of which give a weighted mean age of 2599.1 ± 7.2 Ma (MSWD = 2.0, probability = 0.062). One grain yielded a discordant older age of 2.66 Ga. The remaining analyses spread along the concordia curve between 2.6 Ga and 2.36 Ga. Interpretation of the age of this rock is not straightforward. The preferred interpretation is that the brighter rim material represents igneous growth and the diorite intruded at 2358 Ma, with the Neoarchean zircon representing inherited material. This interpretation is based on field observations of the timing of the intrusion of the dyke relative to development of the metamorphic fabric in the diatextite. The field relationships suggest a syn-metamorphic intrusion. It is also possible that the sample did not contain primary igneous zircon and that the 2358 Ma zircon represents recrystallization of inherited material during the regional metamorphism.

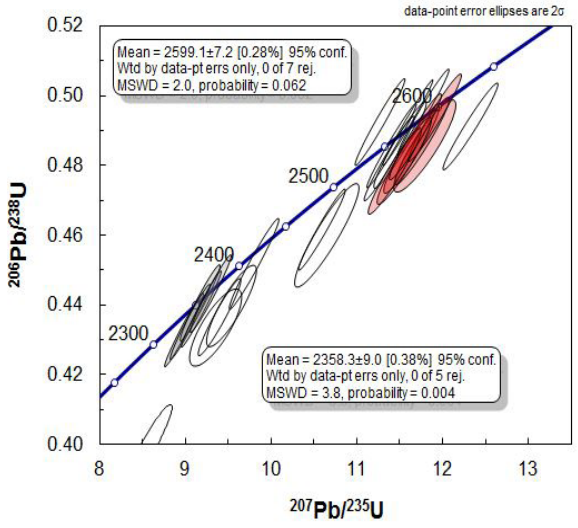

Figure 10947-4: Concordia diagram. Red ellipses represent analyses of cores with ages of ~2599 Ma. Grey ellipses are of bright rim material at 2358 Ma.

Z10945: Granite Sheet

Sample	PQB-78a-2012
Lab Number:	10945
Rock Type	Plutonic
Description	Granite Sheet
Geological Province	Churchill/Rae
Geological Domain	McCann
Location	Zone 13 E407728 N6804556
Map Sheet	75G
Sampling History	S.J. Pehrsson, August 2012
Age	2351.6 ± 9.5 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is from south of Dymond Lake, NWT within a smooth low magnetic region characteristic of the McCann domain. The outcrop area is characterized by a well foliated, white-weathering garnet-orthopyroxene–diatexite with numerous enclaves of metawacke, banded iron formation, chert, and psammite. The main foliation in the diatexite is shallowly dipping (30°) and northwest trending and is defined by elongate garnet-orthopyroxene clusters and the alignment of enclaves. The host diatexite foliation is crosscut by a pegmatite dyke. All the aforementioned units have blue quartz if they are quartz-bearing. The pegmatite and diatexite are crosscut by a shallow dipping (<20°) fine-grained, thorium-rich biotite granite sheet that does not have blue quartz. This dyke has a weak biotite foliation that is south-southwest trending and moderately west-dipping.

Rock Description

Sample PQB-78a-2012 comes from a fine-grained granite sheet that lacks blue quartz. In thin section the unit is a fine-grained, equigranular monzogranite characterized by 10% biotite and 2% magnetite. Quartz and plagioclase feldspar have minor subgrain development on grain boundaries. Intergrown chlorite and biotite replace an earlier phenocryst phase, that based on its shape may have been hornblende. Biotite is aligned in the foliation that is also defined by a 2:1 quartz grain shape fabric.

Figure 10945-1: Photograph of outcrop showing fine-grained granite sheet (pink). Hammer in bottom left hand corner for scale.

Zircon Description

Zircon occur as clear colourless elongate subhedral to euhedral prisms (Figure 10945-2). In BSE images the grains exhibit broad, relatively diffuse zoning parallel to the long axis (Figure 10945-3).

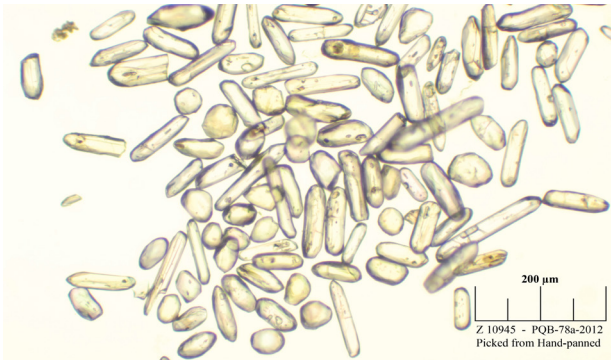

Figure 10945-2: Transmitted light photograph of zircon population. Scale in bottom right is 200 µm.

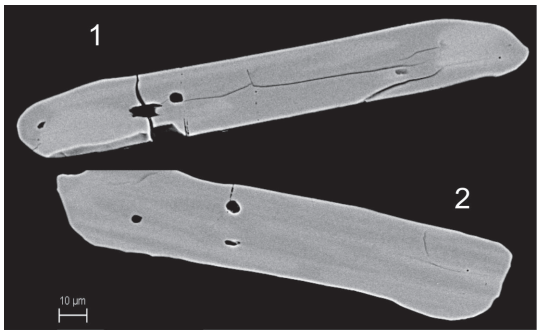

Figure 10945-3: SEM BSE images of grains 1 and 2 displaying diffuse zoning parallel to long axis.

Results and Interpretation

Twelve analyses yield a single population with a weighted mean age of 2351.6±9.5 Ma (MSWD = 1.6, probability = 0.095; Figure 10945-3). Based on the zircon morphology this is taken as the crystallization age of the granite.

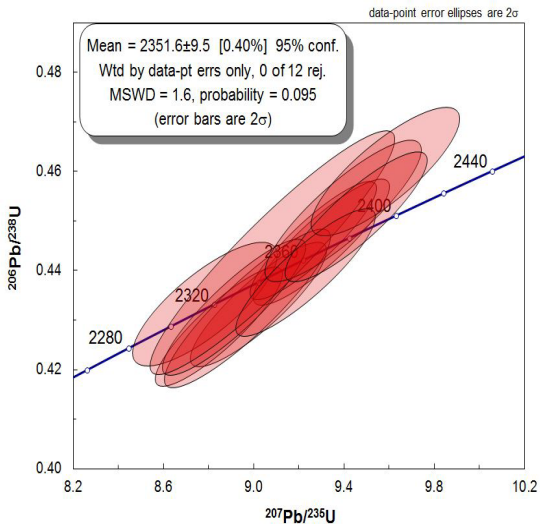

Figure 10945-4: Concordia diagram. Analyses define a single age population of 2351.6 ± 9.5 Ma.

Z10933: Mangerite

Sample	PQB-90b-2012
Lab Number:	10933
Rock Type	Plutonic
Description	Mangerite
Geological Province	Churchill/Rae
Geological Domain	McCann
Location	Zone 13 E397627 N6743542
Map Sheet	75B
Sampling History	S.J. Pehrsson, August 2012
Age	2628 ± 4.8
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is from west of Insula Lake, NWT within a high magnetic zone within the otherwise smooth low magnetic region characteristic of the McCann domain. The outcrop is underlain by a medium- to coarse-grained, white-weathering, orthopyroxene mangerite. The composition of the unit grades to a more granitic charnockite in places and one side of the outcrop carries an inequigranular to megacrystic, chunky textured garnet-orthopyroxene charnockite. The garnet-orthopyroxene clots are rimmed by biotite. Plagioclase in hand samples had the distinctive greasy appearance of granulite rocks. All the phases are well foliated and lineated, with the lineation defined by elongate quartz-feldspar aggregates.

Rock Description

Sample PQB-90b-2012 is of the garnet-orthopyroxene mangerite. In thin section the sample is a medium to coarse-grained with garnet, orthopyroxene and biotite. It is inequigranular with large 0.5 cm K-feldsphar phenocrysts in a finer groundmass of equal plagioclase and K-feldspar and 10-15% quartz. Clusters of medium- to fine-grained garnet and orthopyroxene are elongate in the foliation and rimmed by brown biotite, which is also elongate in the foliation. Isolated orthopyroxene grains in the matrix are mostly replaced by biotite. Accessory magnetite was observed and trace amounts of zircon.

Figure 10933-1: Photograph of outcrop where sample 90b was acquired. Grey mechanical pencil in bottom left corner for scale.

Zircon Description

Zircon occurs as relatively large (110-300 µm) prisms of moderate to poor quality (Figure 10933-2). Grains are pale brown to colourless, subhedral and typically highly fractured.

Figure 10933-2: Transmitted light photo of zircon population. Scale in bottom right is 300 µm.

BSE images show most grains exhibit diffuse oscillatory zoning typical of igneous growth (Figure 10933-3). In many grains zoning is diffuse and may be partially recrystallized. Many grains have metamict zones that follow igneous zoning.

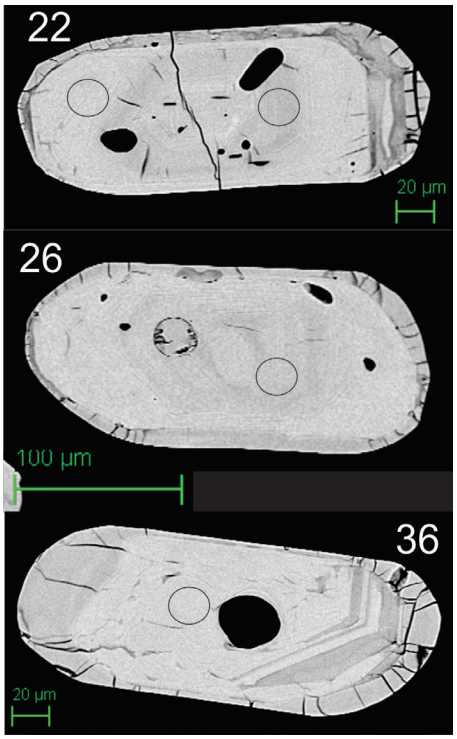

Figure 10933-3: SEM BSE image of grains 22, 26 and 36 displaying diffuse oscillatory zoning.

Results and Interpretation

Twenty-five analyses yield a range of near concordant ages ranging from 2798 Ma to 2360 Ma (Figure 10933-4). The single oldest analyses at 2798 Ma is distinctly older than the others and is interpreted to be inherited. Seven analyses define a cluster at the upper end of the range with a weighted mean age of 2628 ± 4.8 Ma (MSWD = 0.97, probability = 0.44). This is interpreted as the best estimate for the crystallization age of the rock. The remaining analyses, generally of more diffuse zones, spread to younger ages along a shallow discordia line consistent with resetting at ca. 2.0-1.8 Ga.

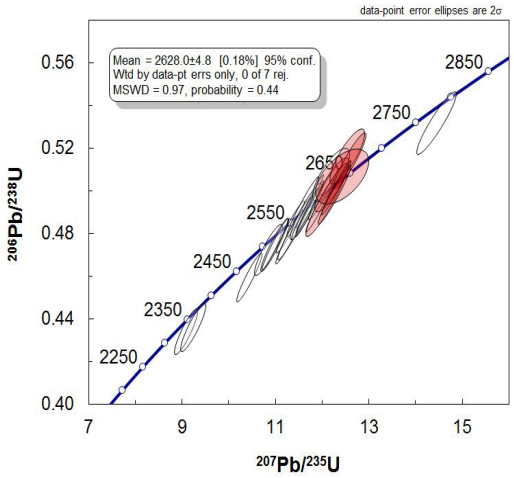

Figure 10933-4: Concordia diagram. Analysis on 25 zircon grains yield a range of near concordant ages from 2798 Ma to 2360 Ma. Cluster of red ellipses define a weighted mean age of 2628 ± 4.8 Ma interpreted as the crystallization age of the rock.

Z10671: Granodiorite

Sample Number:	E186-1955
Lab number:	10671
Rock Type	Plutonic
Description	Granodiorite
Geological Province	Churchill/Rae
Geological Domain	McCann
Location	Zone 14 E548269 N6938052
Map Sheet	65J
Sampling History	Sampled in 1955 by Eade
Age	2592 ± 9 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample was collected from a small outcrop within an otherwise poorly exposed area near the margin of the Thelon basin. The sample locale corresponds to a moderately high magnetic region, within the overall low of the McCann domain. In outcrop the rock was described as a granitic gneiss with hornblende and biotite, and

carrying a northeast striking, steep foliation.

Rock Description

In hand sample the rock is a medium-grained, dark brown, recrystallized orthogneiss with a strong foliation defined by biotite and hornblende and feldspar grain shape fabric. Larger clots of hornblende contain a green mineral in the core. The fresh surface had a somewhat greasy-green texture suggestive of original granulite facies.

Figure 10671-1: Photograph of hand sample E186.

In thin section, the sample is a metamorphosed granodiorite gneiss displaying a distinct symplectite texture. The rock is composed of plagioclase, K-feldspar and quartz with hornblende, biotite, clinopyroxene, ilmenite and titanite. Larger tabular laths of hornblende define the foliation and are strongly zoned with fine-grained, plagioclase-hornblende-clinopyroxene intergrowths in the core and coarser-grained, monomineralic hornblende rims. Hornblende in the rims is of a different composition, with different pleochroism. Biotite occurs as both randomly oriented laths around the hornblende clots, and as aligned laths within the quartzofeldspathic matrix. Ilmenite occurs as euhedral grains in contact with plagioclase only within the symplectitic cores of the hornblende clots. A single grain of spinel was also noted within the symplectitic core. In the matrix it is separated from recrystallized mosaic plagioclase by thin rims of titanite. All the aforementioned textures are consistent with moderate-high pressure decompression reactions.

Zircon Description

The zircons recovered are of moderate overall quality and are subhedral to round-tipped, prismatic to elongate crystals (aspect ratio 2-3:1). They have low to moderate turbidity and are light brown to brown in colour. Some iron-staining is present. Opaque and colourless inclusions are present and the grains are highly fractured. They range in size from 100 to 400 µm (Figure 10671-2).

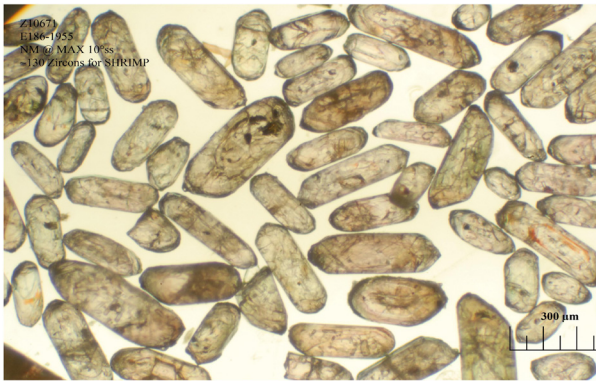

Figure 10671-2: Transmitted light image of zircons from sample 10671. Scale in bottom right is 300 µm.

In SEM BSE imaging a majority of the zircons exhibit concentric zoning with weakly defined boundaries (Figure 10671-3A). Faint oscillatory zoning is present in the outer margins of many of the zircons (Figure 10671-3B and 3C). Alteration marked by dark zones is locally developed particularly in the outer zones of many grains. Radial fracturing can also be seen in a good portion of the zircon population (Figure 10671-3A).

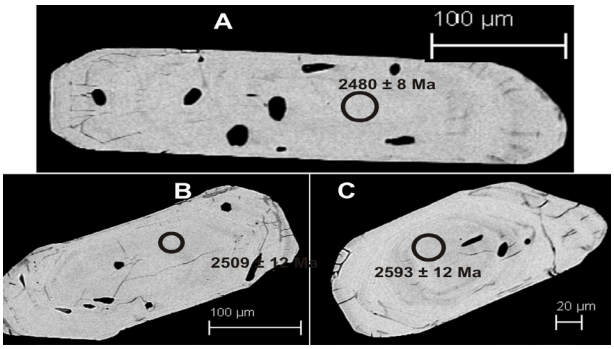

Figure 10671-3: SEM BSE images of representative zircons from sample 10671 (A) grain 16, (B) grain 25 and (C) grain 78.

Results and Interpretation

Nineteen analyses were completed on nineteen grains. The results show a spread of near concordant ages between 2605 Ma and 2450 Ma. The distribution of data lie along a reference discordia between an upper intercept at ~2.6 Ga and a lower intercept of ~1.85 Ga (Figure 10671-4). The five oldest analyses give a weighted mean age of 2592 ± 9 Ma (MSWD = 2.0, probability = 0.095), which provides an estimate for the upper intercept of the array, and igneous crystallization age of the rock. A lower intercept cannot be precisely determined to constrain the exact time of lead-loss.

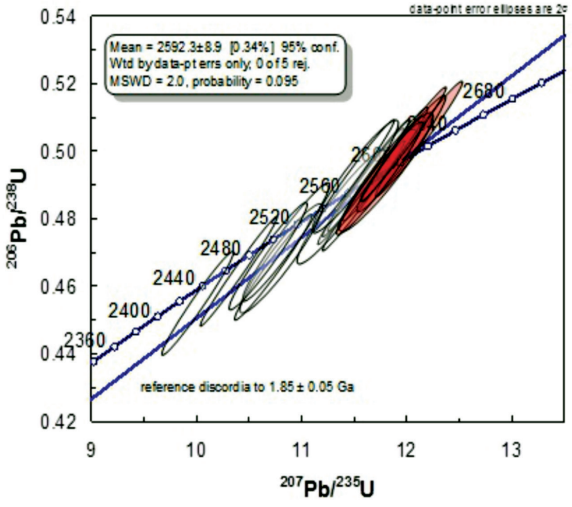

Figure 10671-4: Concordia diagram for sample 10671. Blue line is reference Discordia drawn from 2.59 to 1.85 Ga.

Howard Lake shear zone

Z10845: Granite

Sample	PQB-58b-2012
Lab Number:	10845
Rock Type	Plutonic
Description	Granite
Geological Province	Churchill/Rae
Geological Domain	Howard Lake Shear zone
Location	Zone 13 E358366 N6811898
Map Sheet	75G
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2590.4 ± 3.9 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is from the distinct straight linear, magnetic high area characterizing the Howard Lake shear zone, west of Manchester Lake, NWT. The outcrop is underlain by a medium pink-weathering, medium- to fine-grained, foliated to mylonitic leucogranite. Enclaves of a fine-grained biotite granodiorite were noted in the main unit, that itself has a distinctive flaggy texture. Pegmatite sheets and dykes were abundant and crosscut the moderately west-dipping, northeast-trending tectonite fabric in the host rock. The pegmatites themselves are boudinaged and S-folded about an orientation subparallel to the main fabric. The main fabric in the host leucogranite is an SL fabric with the foliation and lineation defined by stretched quartz aggregates to ribbons, biotite alignment and feldspar elongation. Epidote veinlets crosscut the main fabric at an oblique orientation, as do discrete brittle-ductile chloritic shears, suggesting reactivation at decreasing temperature. Zones

of brick-red weathering overprint the outcrop in some areas.

Rock Description

Sample PQB-58b-2012 comes from a strongly foliated medium-grained leucogranite. In thin section it is a leucocratic granite with 5% biotite and trace epidote and zircon. The main foliation is defined by elongate quartz and feldspar aggregates, the former stretched to 5:1 or greater. Numerous subgrains are developed on plagioclase grain boundaries. Within the quartz aggregates grains are aligned consistently oblique to the main foliation and display undulatory extinction that is not recovered. Quartz is abundantly dusted with fine hematite and plagioclase is altered to sercite in many instances.

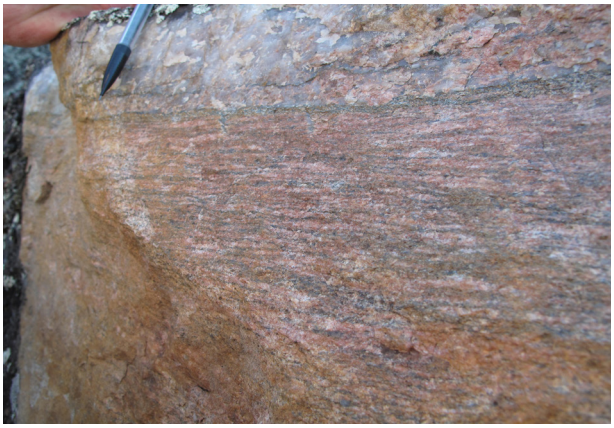

Figure 10845-1: Close-up photo of outcrop to clearly demonstrate strong foliation of sample 58b. Pencil in top right for scale

Zircon Description

Zircons occur as colourless to pale brown, sub to euhedral, prismatic grains (Figure 10845-2). Most grains are clear with only fractures and minor turbidity. In BSE images the grains have variably well-developed oscillatory zoning, consistent with an igneous origin. Some zones appear to be recrystallized and appear as homogenous bright zones. None of these areas were analysed.

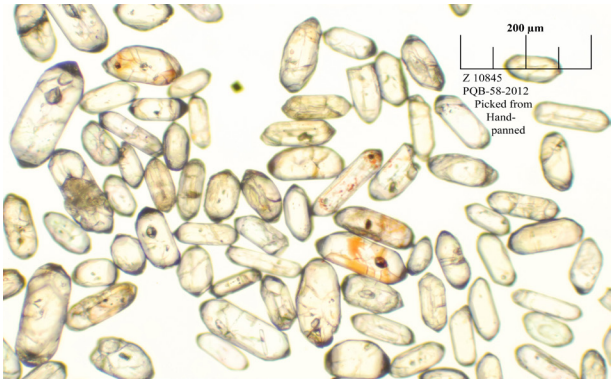

Figure 10845-2: Transmitted light photo of zircon population. Scale in upper right is 200 µm.

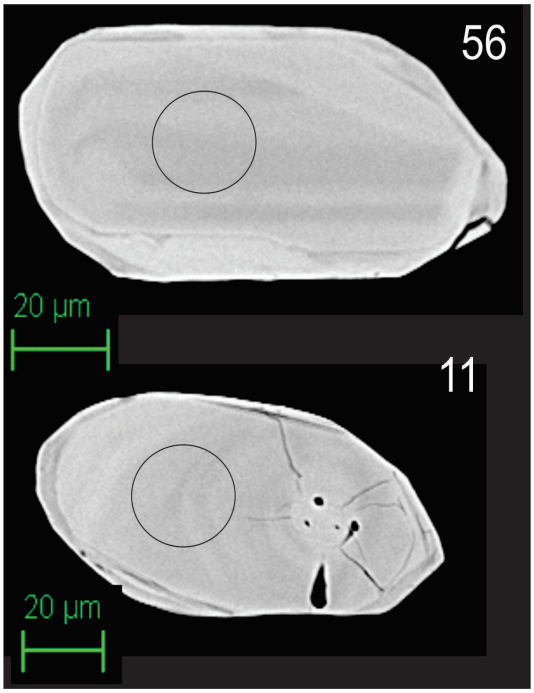

Figure 10845-3: SEM BSE image of grains 56 and 31 displaying well developed zoning.

Results and Interpretation

The data form a single age population with eighteen concordant analyses yielding a weighted mean age of 2590.4 ± 3.9 Ma (MSWD = 1.4, probability = 0.14). Two analyses with high common Pb are discordant and were excluded from the calculation although their $^{207}Pb/^{206}Pb$ ages overlap with the concordant analyses. The result is interpreted as the crystallization age of

the granite.

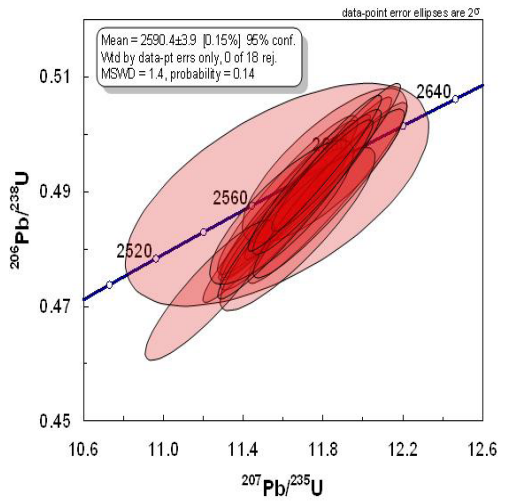

Figure 10845-4: Concordia diagram. Eighteen analyses yield a single age population of 2590.4 ± 3.9 Ma indicated by red ellipses.

Z8746: Granodiorite

Sample Number:	C206-1955
Lab Number:	8746
Rock Type	Plutonic
Description	Granodiorite
Geological Province	Churchill/Rae
Geological Domain	Howard Lake shear zone
Location	Zone 13 E351076 N6800720
Map Sheet	75G
Sampling History	Sampled in 1955
Age	2591.0 ± 3.3 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample was taken from an outcrop located on the southeast edge of the moderately to highly magnetic, strongly linear domain defining the Howard Lake shear zone. No field notes exist for this sample, but a map manuscript from the 1958 field season characterizes the rock as a foliated granitoid.

Rock Description

In hand specimen the rock is a coarse-grained, megacrystic, mafic monzogranite with a prominent SL foliation defined by a grain shape foliation of elongate quartzofeldspathic minerals and a very strong lineation. K-feldspar and plagioclase augen (up to 2 cm) occur in a finer matrix of (2 mm or less) hornblende, biotite, quartz, plagioclase and K-feldspar. Two grains of magnetite were noted. Some augens display finer-grained, recrystallized tails suggestive of shear strain accommodation. Hornblende and biotite lie in the foliation and define a mineral lineation. No thin section is available for this sample. Based on the hand specimen, the rock is classified as a deformed, megacrystic hornblende-biotite monzogranite (Figure 8746-1).

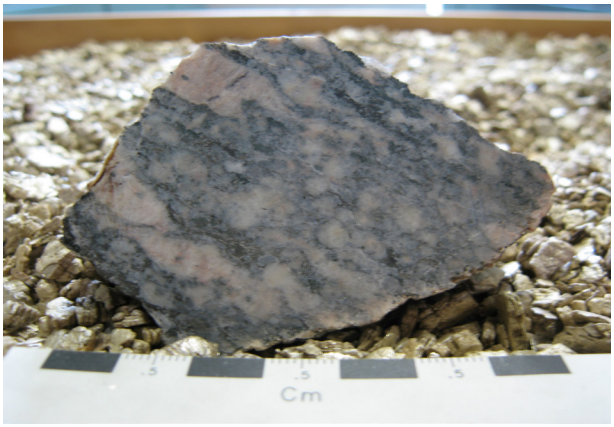

Figure 8746-1: Photo of hand sample 8746.

Zircon Description

The zircon are moderate to good quality and consist of well faceted to subhedral prismatic crystals (aspect ratio 2:1). The grains are clear to moderately turbid and colourless to light brown. Unidentified inclusions are present in some grains while most are extensively fractured. They range in long dimension from 50 to 250 µm (Figure 8746-2). BSE images reveal well developed oscillatory

zoning typical of igneous zircon (Figure 8746-3).

Figure 8746-2: Transmited light image of zircon population. Scale in bottom left is 300 µm.

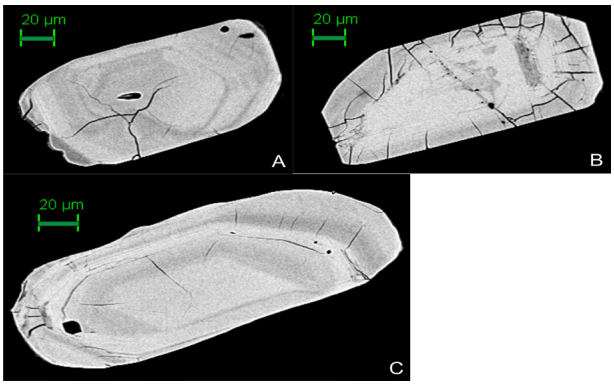

Figure 8746-3: SEM BSE image of three zirons displaying well developed oscillatory zoning.

Results and Interpretation

Seventeen analyses of oscillatory-zoned crystals yield a weighted mean age of 2586 ± 5 (MSWD = 2.7, probability = 0.000). The data show some excess scatter which may be due to the presence of slightly older xenocrysts or minor lead-loss (Figure 8746- 4). There is no textural evidence for xenocrystic material observed in the BSE images. Assuming minor lead-loss and rejection of the four youngest analyses yields a weighted mean $^{207}Pb/^{206}Pb$ age of 2691.0 ±3.3 Ma (MSWD = 1.04, probability = 0.41). Given the simple zoning patterns, typical for igneous zircon, the age is interpreted as the time of magmatic crystallization of the rock.

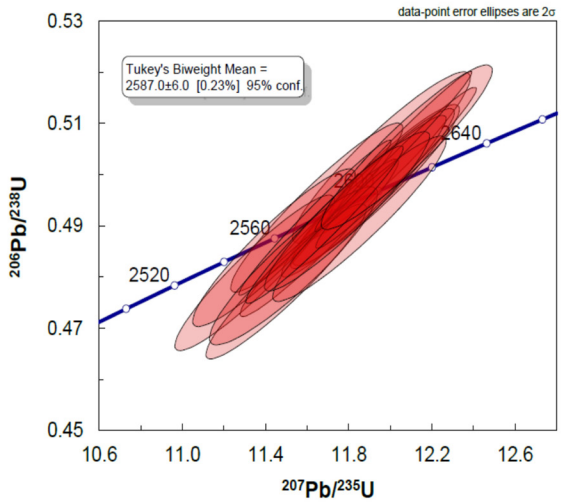

Figure 8746-4: Concordia diagram for sample 8746.

Firedrake domain samples:

Z10934: Hornblende Granitic Orthogneiss

Sample Number:	PQB-14a-2012
Lab Number:	10934
Rock Type	Plutonic
Description	Hornblende Granitic Orthogneiss
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E411614 N6726811
Map Sheet	75B
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2589 ± 26 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample is from the southeast end of Labyrinth Lake, NWT, immediately southeast of the prominent magnetic low defining the Black Bay fault zone. The locale is underlain by variably deformed granitoid rocks of dioritic to granitic composition, transected by dm-scale high strain

zones wherein the protolith is highly foliated to protomylonitic and sheath folds of intrusive granitic veinlets are apparent. The earliest discernable phase (Phase 1) is a hornblende-biotite, recrystallized monzogranite orthogneiss with concordant sulphidic fine-grained mafic layers (deformed dykes?). This is intruded by a porphyritic to augen feldspar monzogranite (Phase 2), which is strongly foliated and deformed with Phase 1. Both phases are intruded by discrete dykes of fine-grained, leucogranite that are locally themselves, cut by strain zones (Phase 3). The youngest phase is a leucocratic granitic pegmatite that crosscuts the axial plane of folds and sheath folds in the deformation zones but carries a weak oblique foliation.

Rock Description

Sample 14a comes from Phase 1 of the outcrop. It is hornblende and biotite-bearing. The two phases form clots that appear to be retrograde from an earlier mineral.

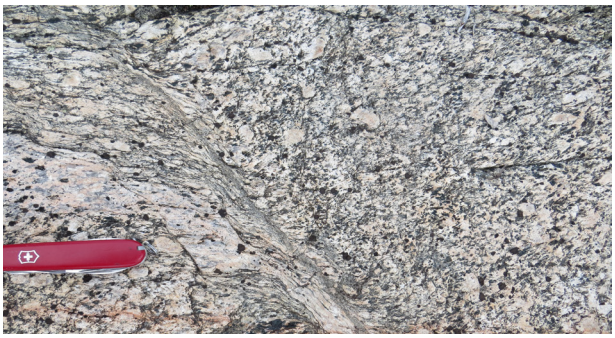

Figure 10934-1: Field photograph of outcrop where sample 10934 was obtained.

Zircon Description

Zircons occur as light brown, elongate prismatic crystals (Figure 10934-2).

BSE images reveal internal oscillatory zoning typical of igneous growth (Figure 10934-3). Some grains (e.g. grain 20, Figure 10934-3) have darker external rims. All grains are extensively fractured and locally altered.

Figure 10934-2: Transmitted light photo graph of zircon population. Scale in center is 300 µm.

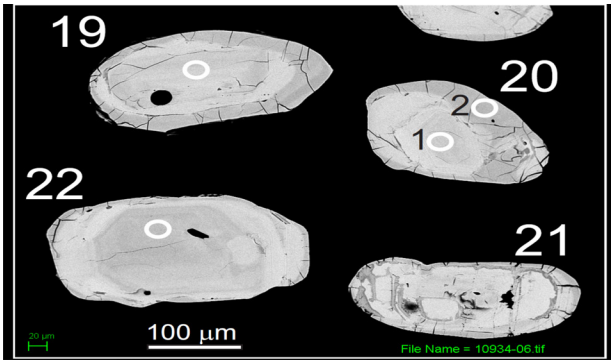

Figure 10934-3: SEM BSE imagge of grains 19-22 that display fracturing, diffuse zoning and darker rims.

Results and Interpretation

Zircon analyses plot on a discordant array in a concordia diagram and define a regression line (Figure 10934-4) with an upper intercept at 2589 ± 26 Ma and a lower intercept at 1862 ± 110 Ma (MSWD = 1.5, Probability of fit = 0.092). The upper intercept is interpreted as the crystallization age of the pluton and the lower intercept age is interpreted to reflect partial lead-loss during the regional 1.80-1.84 Ga metamorphism of the area. The dark rim material from grain 20 is closest in age to the lower intercept and presumably represents recrystallized material. Two analyses from two separate grains have ages of ca. 2.35 Ga and were excluded from the regression.

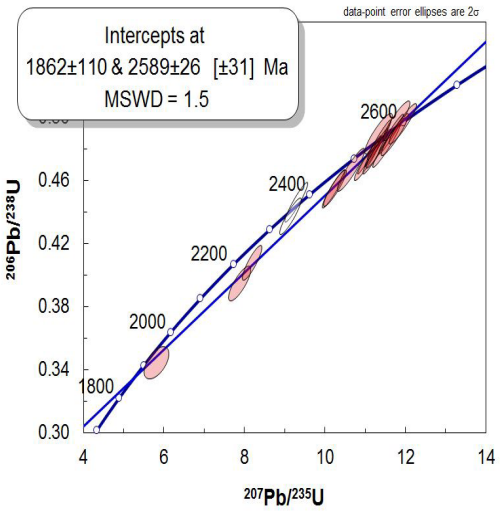

Figure 10934-4: Concordia diagram illustrating Pb-loss from upper intercept age of 2589 Ma. Red ellipses used to calculate discordia line.

Z10842: Foliated Hornblende Monzogranite

Sample Number:	PQB-14b-2012
Lab Number:	10842
Rock Type	Plutonic
Description	Foliated Hornblende Monzogranite
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E411615 N6726810
Map Sheet	75B
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	1838.0 ± 5.9 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is from the southeast end of Labyrinth Lake, NWT, immediately southeast of the prominent magnetic low defining the Black Bay fault zone. The outcrop is described in detail under the previous sample description. Sample PQB-14b-2012 is from the porphyritic to augen feldspar monzogranite (Phase 2), which is strongly foliated and deformed together with a hornblende-biotite, recrystallized monzogranite orthogneis (Phase 1), which yielded an age of 2589 ± 26 Ma. Both phases are intruded by discrete dykes of fine-grained, leucogranite that are locally themselves, cut by strain zones (Phase 3). The youngest phase (4) is a leucocratic granitic pegmatite that crosscuts the axial plane of folds and sheath folds in the deformation zones but carries a weak oblique foliation. Neither of the younger phases from this outcrop have been dated

Rock Description

Sample 14b comes from Phase 2 of the outcrop. The sample is a foliated hornblende-bearing augen granitoid with distinctive blue quartz (Figure 10842-1).

Figure 10842-1: Field photograph of outcrop that sample PQB-14b-2012 was collected from.

Zircon Description

Zircon occurs as pale brown, euhedral, prismatic to equant crystals (Figure 10842-2). Oscillatory zoning is prominent under optical microscope being marked by turbid zones of more metamict material within higher uranium growth zones. Some crystals exhibit cores.

BSE images highlight the oscillatory zoning (Figure 10842-3; grain 6) typical of many of the

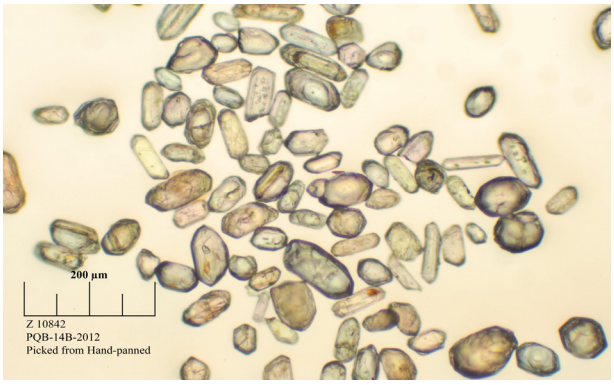

Figure 10842-2: Transmitted light image of zircon population. Scale in bottom right is 200 um.

crystals and interpreted to indicate igneous crystallization. Internal zoning is less pronounced in other crystals (e.g. grain 87).

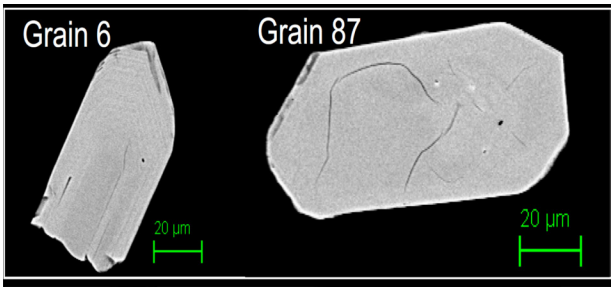

Figure 10842-3: SEM BSE image of grains 6 and 87.

Results and Interpretation

Twelve of thirteen concordant analyses yield a weighted mean age of 1838.0 ± 5.9 Ma (MSWD = 1.7, probability = 0.058) interpreted as the igneous crystallization age of the pluton. A single analysis has an older concordant age of 2234 ± 46 Ma, interpreted to be inherited.

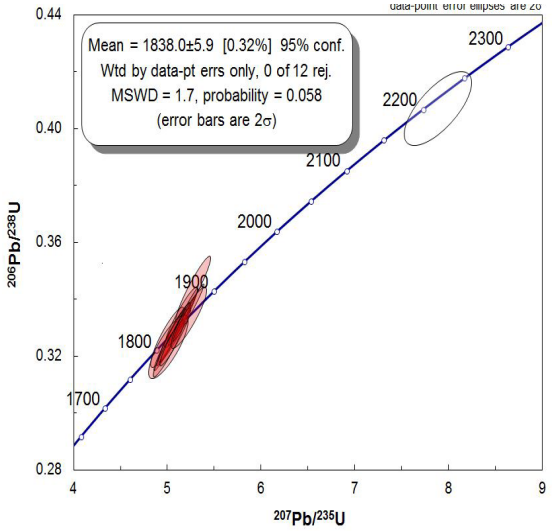

Figure 10842-4: Concordia diagram for sample 10925. Red ellipses represent igneous crystallization age of the pluton.

Z10925: Opx-Hbl-Bt Tonalite Orthogneiss

Sample	PBA-035A01-12
Lab Number:	10925
Rock Type	Plutonic
Description	Opx-hbl-bt tonalite orthogneiss
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	14 E350151 N6801420
Map Sheet	65G
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2686.7 ± 5.7 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is a low magnetic part of the Wholdaia domain, southeast of Labyrinth Lake, in NWT. The outcrop area is underlain by a grey-weathering, sugary, recrystallized hornblende-biotite granitoid orthogneiss ranging in composition from tonalite to granodiorite. The unit carries two foliations, a compositional

layering (Sm), defined by hornblende-biotite and variations in quartz-feldspar percentage and a transecting oblique foliation defined by biotite alignment (Sm+1). Relict orthopyroxene was also noted, cored by hornblende. Intrafolial folds within Sm defined by folded concordant granite veinlets were locally observed. Fine-grained mafic lenses occur as distributed enclaves and as lenses with irregular apophyses. The latter cross-cut the gneissosity, suggested the mafic lenses are dismembered dykes. The enclaves were locally folded about Sm+1, but also transposed into a second composite Sm/Sm+1 foliation in dm-scale, northeast-trending zones of higher strain. The Sm+1 foliation is axial planar to local open to tight fold packets bounded by discrete shears filled by coarse-grained granite.

Rock Description

Sample PBA-035A01-12 comes from the host orthogneiss unit and is representative of the oldest components within the outcrop.

Figure 10925-1: Photograph of orthogneiss. Pencil on right hand side for scale.

Zircon Description

Zircons occur as colourless to strongly altered and turbid prismatic crystals. Grains are typically elongate, with rounded terminations (Figure 10925-2). BSE images indicate most crystals have well developed oscillatory zoning consistent with igneous crystallization (Figure 10925-3). Some grains have brighter margins which transect the oscillatory zoning (grains 28, 31) and indicate partial recrystallization of the zircon.

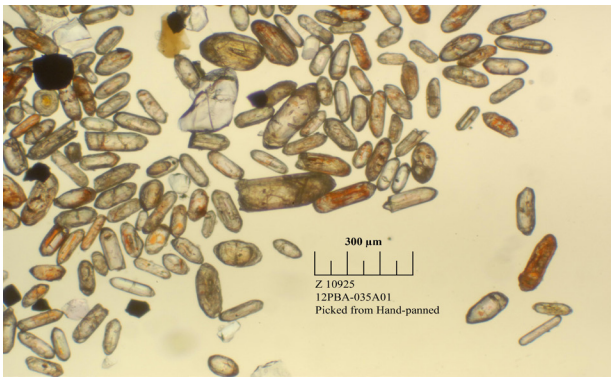

Figure 10925-2: Transmistted light photo of zircon population. Scale in center is 300 µm.

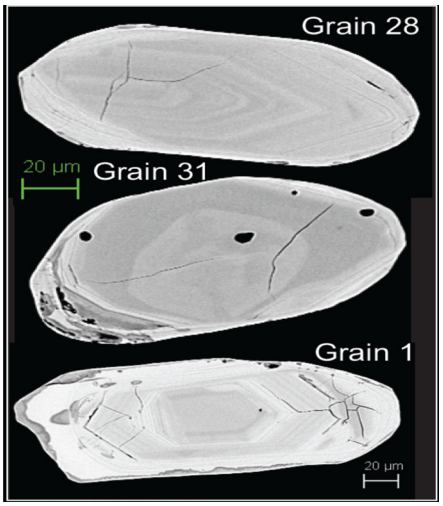

Figure 10925-3: SEM BSE image of grains 1, 28 and 31 displaying well-developed oscillatory zoning.

Results and Interpretation

Eighteen analyses yield a range of concordant to discordant ages (Figure 10925-4). The data scatter along a reference discordia line between a cluster of ten concordant analyses with a weighted mean $^{207}Pb/^{206}Pb$ age of 2686.7 ± 5.7 (MSWD = 1.3, probability = 0.22) and a lower intercept consistent with a Hudsonian overprint at ~1830 Ma. The upper intercept age is interpreted as the

crystallization age of the plutonic protolith of the orthogneiss. Discordance may be related to partial recrystallization during Hudsonian metamorphism as evidenced by the narrow recrystallized zones on the outer parts of some crystals.

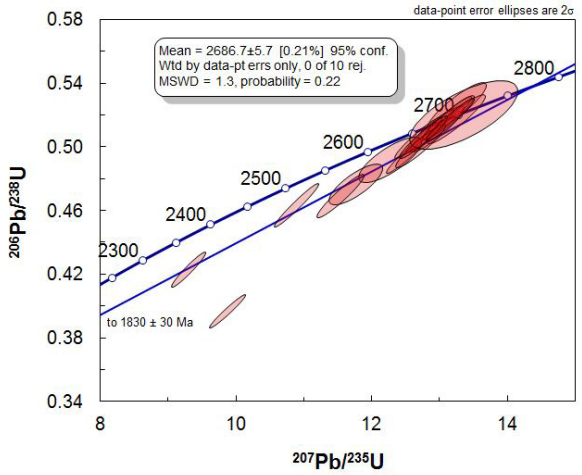

Figure 10925-4: Concordia diagram displays range of concordant to discordant ages. Age based on weighted mena of ten concordant ages.

Z10851: Migmatitic Paragneiss

Sample	PQB-84-2012
Lab Number:	10851
Rock Type	Metamorphic
Description	Migmatitic Paragneiss
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E393058 N6687742
Map Sheet	75G
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	1836.3 ± 4.2 Ma
Interpretation	Metamorphic Crystallization
Note	Detrital population dominated by ~2.7 Ga zircon

Geological Field Relationships

The sample is from a low magnetic area of the Firedrake domain, east of the Black Bay fault. The outcrop is underlain by grey- to rusty-weathering garnet-biotite-sillimanite quartzofeldspathic schist with discrete garnet-rich and biotite-rich cm-scale compositional layers and concordant white-weathering layers of garnet-muscovite bearing trondjhemite. A discrete layer of calc-silicate and biotite-magnetite-rich layers indicate remnants of primary compositional layering. The compositional layering and a biotite-sillimanite foliation (Sm) trend northeast and are transected by a WNW-trending, discrete biotite crenulation (Sm+1) cleavage. The Sm foliation locally carries intrafolial folds.

Rock Description

Sample PQB-84-2012 is of a garnet-biotite quartzofeldspathic schist layer in the migmatitic paragneiss (Figure 10851-1).

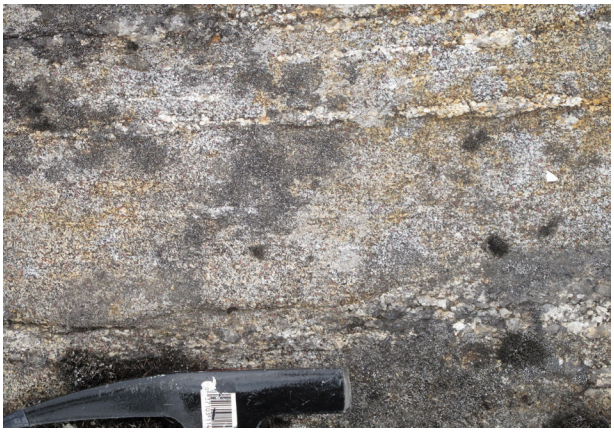

Figure 10851-1: Outcrop photo where sample PQB-84-2012 was taken. Hammer head in bottom left for scale.

Zircon Description

Zircons occur as subhedral to rounded, prismatic crystals (Figure 10851-2). Most are highly fractured and slightly turbid. BSE images indicate that most grains have prominent

oscillatory zoning (Figure 10851-3). A small proportion of grains have brighter, flat BSE response in recrystallized domains or rims. Only three of these zones were large enough

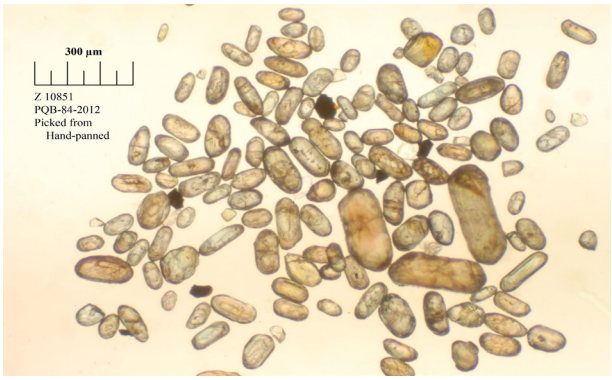

Figure 10851-2: Transmitted light image of zircon population. Scale in top right is 300 um.

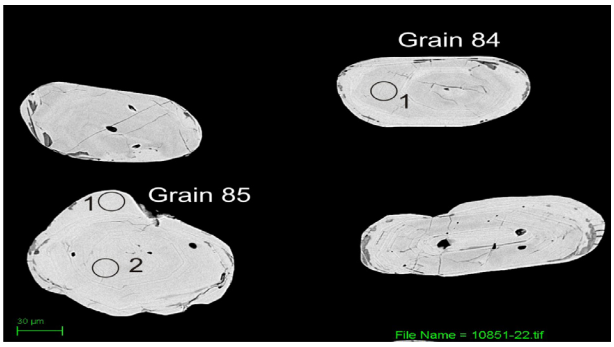

Figure 10851-3: SEM BSE image of typical zircon showing brighter rim domains. Ellipses indicate analysis locations.

Results and Interpretation

The analyses of the oscillatory-zoned zircon yield variably discordant results, with most analyses having $^{207}Pb/^{206}Pb$ ages between 2650 and 2740 Ma (Figure 10851-4). Three analyses targeted on the bright zones with flat BSE response yield distinct compositions with very low thorium and Th/U ratio, high hafnium, and low ytterbium. The weighted mean $^{207}Pb/^{206}Pb$ age of the three analyses of 1836.3 ± 4.2 Ma is interpreted as the time of metamorphic recrystallization or growth, consistent with the very low Th/U of these zones. Twenty-two analyses of the oscillatory zoned grains define a linear regression with an upper intercept age of 2709 ± 17 Ma with a fixed lower intercept equivalent to the metamorphic age (Figure 10851-2). Since the zircon is from a metasedimentary rock and detrital in origin, the upper intercept of the regression indicates that the source of most of the zircon in the rock was from ca. 2.7 Ga material. This would be consistent with the metasedimentary unit being Neoarchean in age. This is the best estimate for the maximum age of the sedimentary rock.

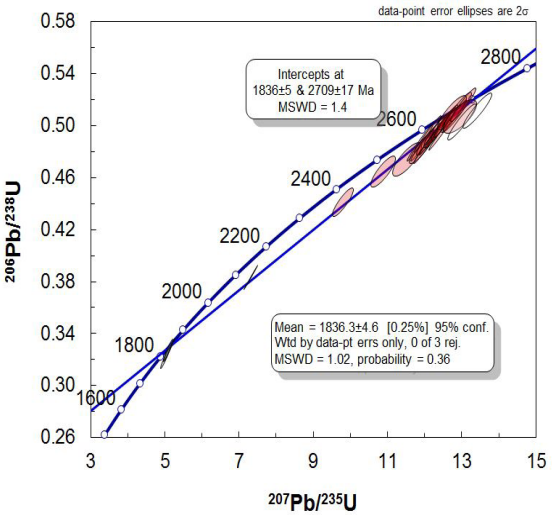

Figure 10851-4: Concordia diagram showing discordant array of data pinned by cluster of concordant analyses at ca 2700 Ma. Three analyses of recrystallized zircon pin lower end of discordia. at 1836.3 Ma.

Z10854: Foliated Quartz Diorite

Sample	PQB-56a-2012
Lab Number:	10854
Rock Type	Plutonic
Description	Foliated Quartz Diorite
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E437282 N6770587
Map Sheet	75G
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2325 ± 39 Ma
Interpretation	Igneous Crystallization
Age1	1894 ± 11 Ma
Interpretation1	Metamorphic Recrystallization

Geological Field Relationships

The sample is from the north of Labyrinth Lake, NWT within a mottled magnetic high region along the Black Bay fault zone, bordering the McCann domain. The outcrop is underlain by a flaser textured garnet-orthopyroxene granodioritic orthogneiss with rare coarse-grained hornblende-orthopyroxene diorite. This unit is intruded by mafic-intermediate rocks, including three subphases. The first subphase is a fine-grained, foliated biotite-hornblende quartz diorite, that is in turn intruded by two distinct subphases, a medium-grained hornblende diorite and a medium-grained biotite-hornblende tonalite. The mafic-intermediate rocks crosscut the moderately dipping gneissosity in the orthogneiss but carry a south-southwest-trending, shallow west-dipping foliation defined by aligned hornblende and/or biotite. A strong, south-west plunging lineation defined by biotite and stretched quartz is found in the complex, which is also cut by pink leucogranite dykes.

Rock Description

Sample PQB-56a-2012 comes from the fine-grained quartz diorite subphase of the mafic-intermediate complex. In thin section it is a fine-grained quartz diorite with a prominent foliation defined by elongate biotite and hornblende. An olive green biotite replaces hornblende that is coexisting with brown biotite. Locally, hornblende is highly embayed and corroded, forming atoll relics. Epidote and titanite are accessory phases with the titanite occurring as rims on titanomagnetite. One relict garnet porphyroblast was noted.

Figure 10854-1: Photograph of sample site outcrop showing

Zircon Description

Zircon occurs as sub to euhedral tabular to prismatic grains (Figure 10854-2).

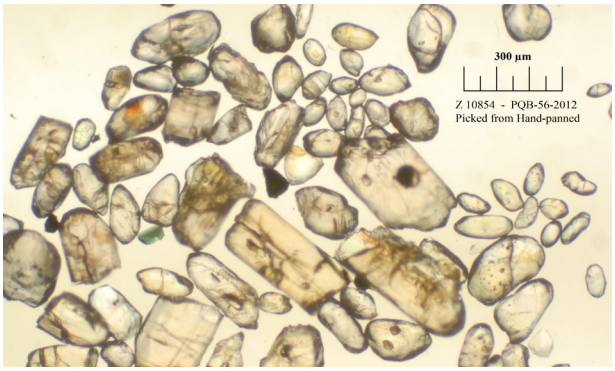

Figure 10854-2: Transmitted light photograph of zircon population. Scale in top right is 300 µm.

BSE images reveal brighter rims on irregularly to oscillatory zoned cores (Figure 10854-3). In many cases the zoning in the grain interiors is diffuse and not well preserved.

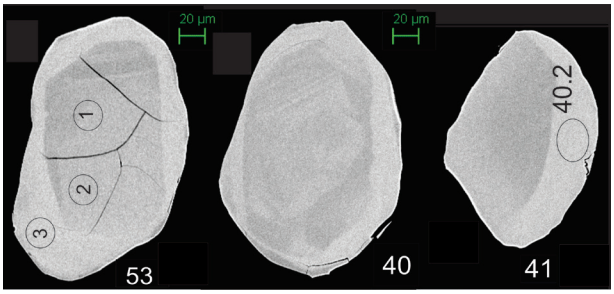

Figure 10854-3: SEM BSE images of grains 53, 40 and 41 displaying bright rims on irregular to oscillatory-zoned cores.

Results and Interpretation

The bright rims yield the youngest ages (Figure 10854-4) with the seven youngest analyses giving a weighted mean age of 1894 ± 11 Ma (MSWD = 1.9, probability = 0.071). Twenty-five analyses of oscillatory zoned and diffusely zoned cores spread along the concordia curve and define a regression line with an upper intercept age of 2325 ± 39 Ma (MSWD = 0.91, Probability of fit = 0.59) anchored at the lower intercept at 1894 ± 11 Ma. The upper intercept is taken as the best estimate of the crystallization age of the quartz diorite and the lower intercept the timing of metamorphism in the area.

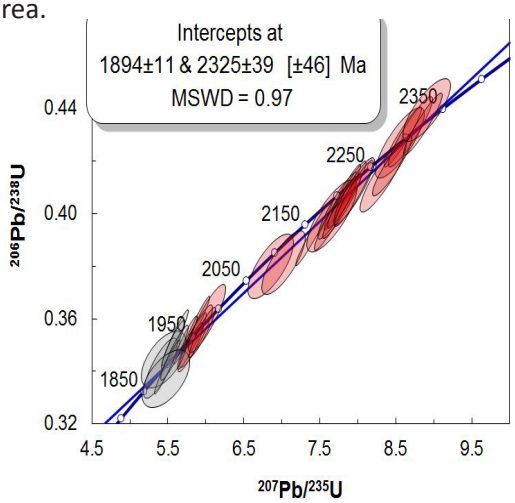

Figure 10854-4: Concordia diagram illustrating discordia array defined by analsyes of bright rims (grey ellipses) and analyses of oscillatory zoned zircon (red ellipses)

Z10927: Augen Monzogranite

Sample	PQB-88b-2012
Lab Number:	10927
Rock Type	Plutonic
Description	Augen Monzogranite
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E402668 N6718662
Map Sheet	75B
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2586±7.0 Ma
Interpretation	Igneous Crystallization
Age	2348 ± 22 Ma
Interpretation	Metamorphic Recrystallization

Geological Field Relationships

The sample is from the linear magnetic low of the Black Bay fault, on the boundary between the Firedrake and McCann domains. The sample is from a rapid on the Labyrinth River, southwest of where it drains from the end of Labyrinth Lake. The outcrop area at the rapids is underlain by a variably deformed, biotite augen monzogranite that displays a flaser to mylonitic texture. The overall fabric is an SL tectonite with an oblique lineation and shear sense indicators defining west-side up to the east sense of movement. Blue-grey to pink pegmatite layers are also deformed in the fabric.

Rock Description

Sample PQB-88b-2012 was collected from the deformed augen monzogranite.

Figure 10927-1: Photograph of outcrop.

Zircon Description

Zircon occur as large, pale brown, slightly turbid, subhedral prismatic crystals (Figure 10927-2). Internal zoning is characterized by broad oscillatory growth zones (Figure 10927-3).

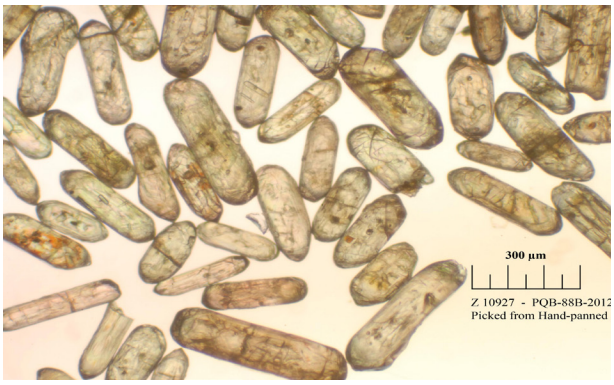

Figure 10927-2: Transmitted light photo of zircon population. Scale in bottom right is 300 um.

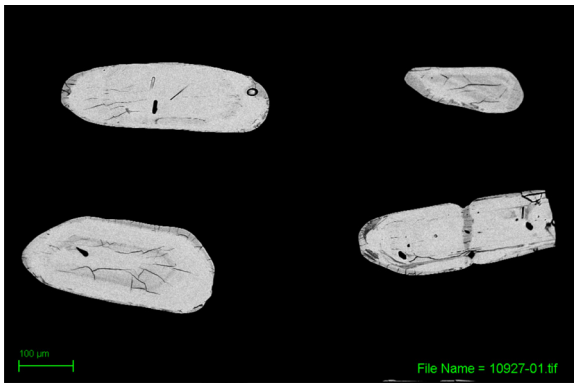

Figure 10927-3: SEM BSE image of zircon showing broad oscillatory growth zones.

Results and Interpretation

Analyses yield a range of ages spread along the concordia curve between 2.2 and 2.6 Ga (Figure 10927-4). The older analyses are from areas with broad oscillatory zoning, and the seven oldest analyses yield an age of 2586.2 ± 7.0 Ma (MSWD = 2.2, probability = 3.9%). This is interpreted as the crystallization of the granite. Regression of all 17 analyses yield a discordia line with imprecise intercepts at 2555 ± 44 and 2046 ± 150 Ma. A group of five of the six youngest analyses are characterized by lower Th/U ratios (<.12) and yield an age of 2348 ± 22 (MSWD = 2.4, probability = 0.05), interpreted to reflect metamorphic recrystallization. The other analyses spread between these two ages and are interpreted to record variable lead-loss at 2.35 Ga from igneous zircon. A single analysis has a younger age of 2229 Ma and may include a younger lead-loss component.

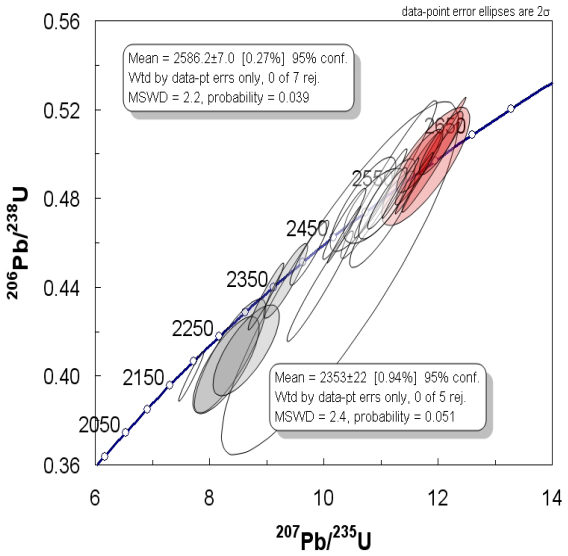

Figure 10927-4: Concordia diagram showing analyses of oscillatory-zoned material (red). Lower Th/U analyses shown in grey.

Z10931: Foliated Biotite Leucogranite

Sample	PQB-30-2012
Lab Number:	10931
Rock Type	Plutonic
Description	Foliated Biotite Leucogranite
Geological Province	Churchill/Rae
Geological Domain	Firedrake domain
Location	Zone 13 E549808 N6756831
Map Sheet	75A
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	1836.6 ± 6.4 Ma
Interpretation	Igneous Crystallization
Age1	2691 ± 20
Interpretation1	Inheritance

Geological Field Relationships

The sample is from southwest of Boyd Lake, NWT within a mottled magnetic high region characterized by arcuate linear highs and lows. The sample location is from a broad diffuse medium-magnetic region in the centre of one of the arcuate domains. The outcrop is underlain by a flaser textured garnet-orthopyroxene granodioritic orthogneiss with rare coarse-grained hornblende-orthopyroxene diorite. This unit is intruded by three phases of plutonic rocks. Phase 1 is a fine-grained, foliated biotite-hornblende quartz diorite that is in turn intruded by Phase 2, composed of medium-grained hornblende diorite and biotite-hornblende tonalite. These two phases crosscut the moderate dipping gneissosity in the orthogneiss but carry a south-southwest-trending, shallow west-dipping foliation defined by aligned hornblende and/or biotite. Discrete dm-wide zones of high strain are parallel to this foliation and display a strong, south-west plunging biotite mineral and quartz stretching lineation. A series of foliated biotite leucogranite sheets and pegmatites are the third intrusive phase. They crosscut the foliation in Phases 1 and 2 but are deformed and foliated, defining trains of asymmetric folds and transected by ductile extensional shears.

Rock Description

Sample PQB-30-2012 comes from one of the crosscutting leucogranite sheets (Phase 3). In thin section it is a mafic-poor, fine-grained, weakly recrystallized quartz granite with a prominent foliation defined by elongate brown biotite (2%) and elongate quartz subgrains with internal aligned subgrains. The matrix is composed of fine-grained recrystallized quartz, plagioclase and K-feldspar. Muscovite laths replace biotite. Apatite and zircon are trace accessary phases.

Figure 10931-1: Field photograph of outcrop showing pink weathering leucogranite dyke.

Zircon Description

Zircons occur as sub to euhedral elongate prisms (Figure 10931-2). Crystals are pale brown to colourless and have numerous fractures and alteration zones.

BSE images reveal two distinct zircon zones: internal cores with oscillatory zoning, and an outer, generally darker rim with a homogenous or

broadly zoned pattern (Figure 10931-3). Locally preserved zoning in the outer rim argues for crystallization from a melt.

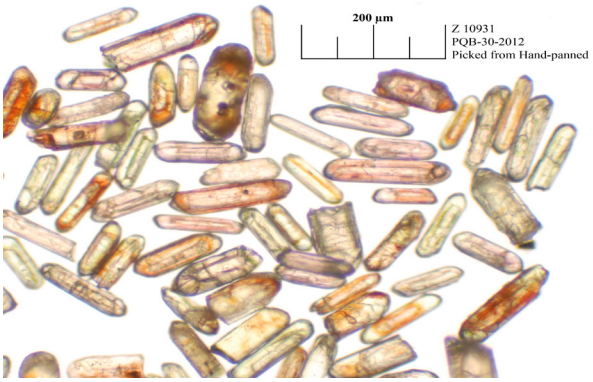

Figure 10931-2: Transmitted light photo of zircon population. Scale in top right is 200 µm.

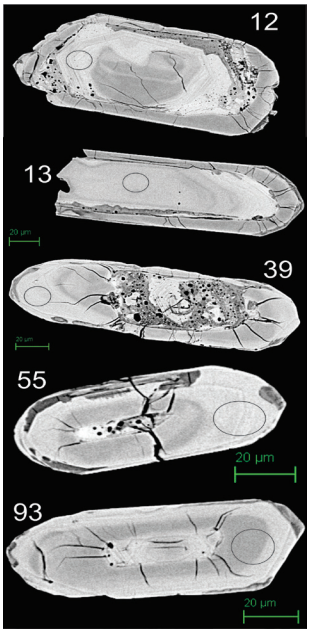

Figure 10931-3: SEM BSE image of grains 12, 13, 39, 55 and 93.

Results and Interpretation

Analyses were undertaken on both zircon zones. The outer rim material have very low thorium content, relatively high hafnium (>11000 ppm) and low Th/U ratios. Six analyses yield a weighted mean age of 1836.6 ± 6.4 (MSWD = 0.85, probability = 0.51). Oscillatory-zoned core material yield a range of discordant ages with a distinct cluster at ~2.7 Ga. Analyses with intermediate ages between 1.85 and 2.7 Ga may be the result of mixtures caused by overlap of two zones by the beam position, or partial lead-loss. Regression of the data anchored at the lower intercept defined by the weighted mean age gives an upper intercept age of 2691 ± 20 Ma (MSWD = 1.5). Two interpretations of the data are possible. The first is that the core material dates the rock at 2691 ± 20 Ma and that the younger rim material reflects recrystallization and growth during a younger metamorphic event. The very low Th/U ratios of this generation of zircon is consistent with metamorphic growth, however some of the textural evidence for zoning is most consistent with growth from a melt. Based on this textural evidence it is probable that the age of the intrusion is given by the 1836.6 ± 6.4 Ma rims and that the Neoarchean core material is inherited. The latter interpretation is consistent with the geological information that indicates the leucogranite post-dates granulite grade metamorphism in the host rocks.

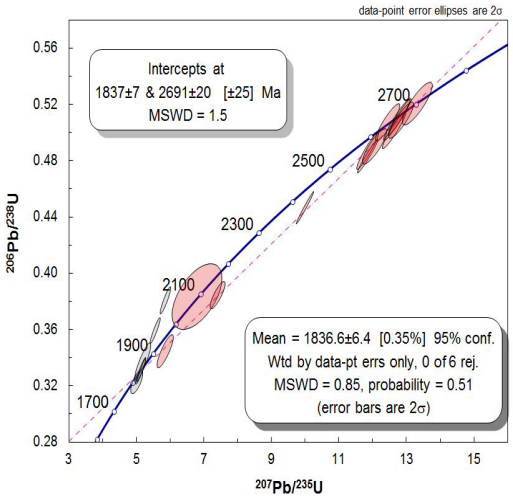

Figure 10931-4: Concordia diagram for sample 10931. Red ellipses = oscillatory-zoned cores; grey ellipses = outer rim material.

Z10938: Pink leucogranite

Sample	12PBA-55A1
Lab Number:	10938
Rock Type	Plutonic
Description	Pink leucogranite
Geological Province	Churchill/Rae
Geological Domain	Firedrake domain
Location	Zone 13 E525119 N6782038
Map Sheet	75H
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	1819.0 ± 4.4 Ma
Interpretation	Igneous Crystallization
Age1	~>2.53-2.69 Ga
Interpretation1	Inheritance

Geological Field Relationships

The sample is from southwest of Boyd Lake, NWT, within a mottled magnetic high region characterized by arcuate linear highs and lows. The outcrop area is a large flat-topped ridge, standing about 30 m higher than the surrounding area. It comprises a remarkably homogeneous, light pink granite which is equigranular and sugary in texture, with 2-10% biotite. From gamma ray analysis the granite is thorium- and uranium-poor compared to most others and has a low magnetic susceptibility. It carries a weak biotite foliation that is southwest- to west trending and shallowly dipping (20-40 degrees). A prominent cross parting, steep and northeast-trending was also noted.

Rock Description

The sample is a fine-grained, weakly inequigranular monzogranite with 10% K-feldspar phenocrysts to 0.25 cm in a finer grained groundmass of plagioclase, quartz and K-feldspar. Quartz is thoroughly recrystallized throughout and plagioclase shows numerous subgrains developed. The sample carries 2% fine elongate brown biotite laths defining the foliation. Zircon and monazite are accessory phases, the latter in a few instances elongate parallel to the foliation.

Figure 10938-1: Field photograph of outcrop where sample 10938 was taken. Granite is pink material. Rock hammer in centre for scale.

Zircon Description

Zircon occurs as euhedral, prismatic grains. Crystals are generally quite altered and pale brown to colourless with common inclusions and fractures. BSE images indicate fine-scale oscillatory zoning which is present in most crystals with alteration following the growth zoning (Figure 10938- , grain 40, 54, 56). The texture is typical of igneous zircon growth. A small subset of

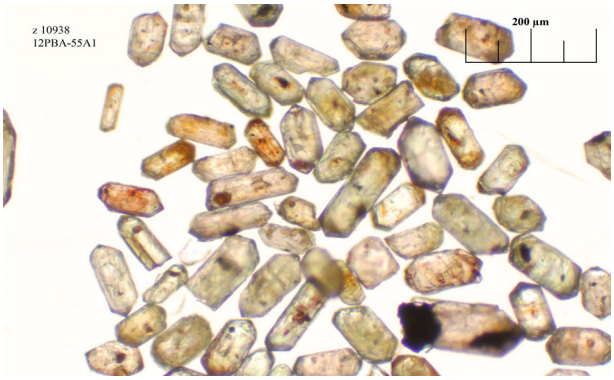

Figure 10938-2: Transmitted light image of zircon population. Scale in top right is 200 µm.

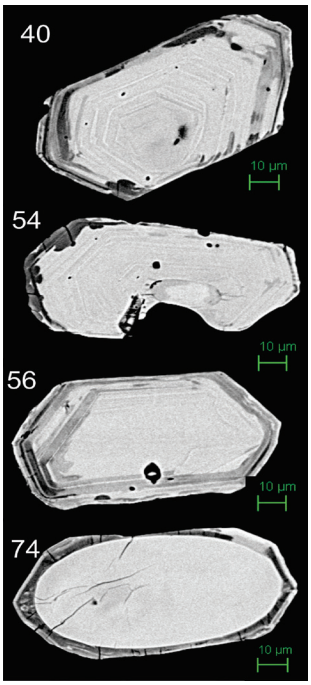

Figure 10938-3: SEM BSE image of zircon grains 40, 54, 56 and 74 that display well-developed oscillatory zoning (i.e. grain 40) to grains that exhibit broader zoning (i.e. grain 74).

grains do not exhibit this zoning and have more homogeneous zoning (e.g. grain 74 Figure 10938-3).

Results and Interpretation

Sixteen analyses of the dominant oscillatory zircon zones yield a cluster of concordant ages with a weighted mean age of 1819.0 ± 4.4 (MSWD = 2.2, probability = 0.004), interpreted as the age of the monzogranite (Figure 10938-4). These zircons have high Th/U ratios between 1 and 2. A small number of analyses have older Neoarchean ages between 2.53 and 2.69 Ga, indicating Neoarchean inheritance. These grains have lower Th/U ratios and do not exhibit the detailed oscillatory zoning typical of the magmatic zircon in this sample (Grain 74, Figure 10938-3).

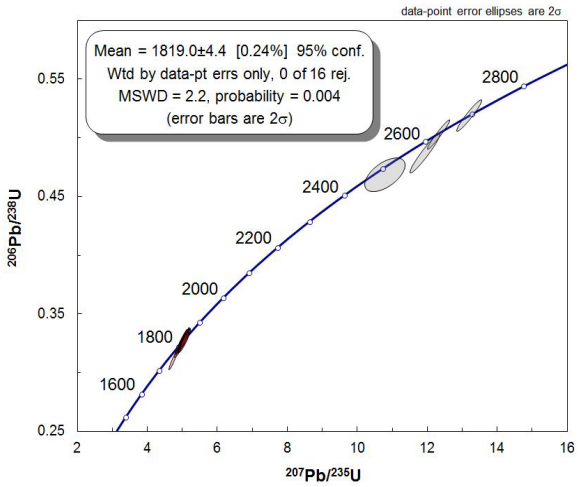

Figure 10938-4: Concordia diagram for sample 10938. Oscillatory zoned analyses are concordant at 1819 Ma, with Neoarcehan inheritance.

Z10926: Clinopyroxene Monzonite

Sample	12PBA-61A1
Lab Number:	10926
Rock Type	Plutonic
Description	Clinopyroxene Monzonite
Geological Province	Churchill/Rae
Geological Domain	Firedrake domain
Location	Zone 13 E505117 N6750535
Map Sheet	75A
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	1829.4 ± 2.4 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is from southeast of Rennie Lake, NWT, within a smooth very high magnetic region within the center of an arcuate magnetic fabric of the Firedrake domain. The outcrop is underlain by a highly magnetic, medium- to coarse-grained, layered clinopyroxene-

Figure 10926-1: Photograph of outcrop taken in the field. Magnetic pencil in centre for scale.

hornblende monzonite-monzodiorite unit. Enclaves of medium-grained clinopyroxene diorite occur within the monzonite, which is inequigranular and recrystallized. Foliation and layering in the unit is defined by compositional layers, clinopyroxene-poor monzonite veinlets and elongate clinopyroxene-clots. Rare large clinopyroxene phenocrysts up to 2 cm were noted. The unit and its foliation are crosscut by very fine-grained mafic dykelets that are gently cross-folded along with the host. The foliation is crosscut at a high angle by granite dykes.

Rock Description

The sample is a recrystallized clinopyroxene-hornblende monzonite, with several, large twinned clinopyroxene phenocrysts, 25-50 mm, in a matrix of finer-grained clinopyroxene, hornblende, K-feldspar, plagioclase and 5-10% quartz. Quartz is recrystallized and feldspars have abundant subgrains. Foliation is defined by compositional segregation into clinopyroxene-hornblende aggregates and elongate K-feldspar or plagioclase aggregates.

Zircon Description

Zircons occur as pale brown to colourless, subhedral prismatic grains (Figure 10926-2). BSE images reveal annular growth zoning, often marked by alteration, typical of igneous crystallization (Figure 10926-3).

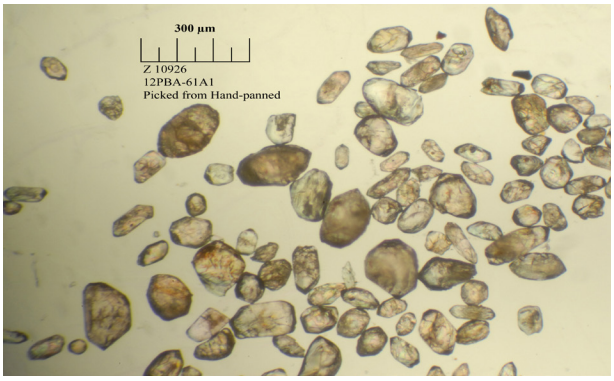

Figure 10926-2: Transmitted light photograph of zircon population of sample 10926. Scale in top right is 300 µm.

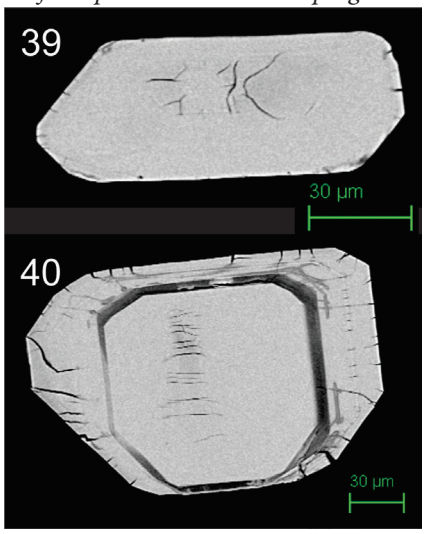

Figure 10926-3: SEM BSE image of zircon grains 39 and 40.

Results and Interpretation

Twenty analyses yield a single concordant age population with a weighted mean age of 1829.4 ± 2.4 Ma (MSWD = 1.13, probability = 0.32; Figure 10926-4).

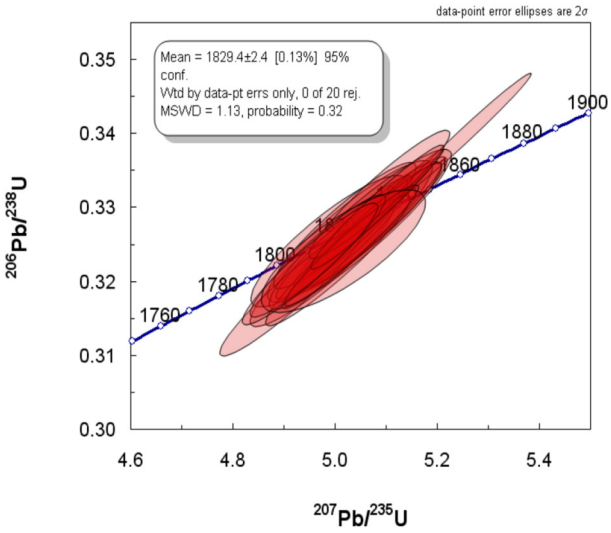

Figure 10926-4: Concordia diagram. Analysis of zircon grains yield a single concordant age of 1829.4 ± 2.4 Ma.

Z10928: Biotite Tonalite Orthogneiss

Sample	12PBA-46A1
Lab Number:	10928
Rock Type	Plutonic
Description	Biotite Tonalite Orthogneiss
Geological Province	Churchill/Rae
Geological Domain	Firedrake domain
Location	Zone 13 E554350 E6744908
Map Sheet	75A
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2600 ± 16 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is from south of Firedrake Lake, NWT, within a narrow linear magnetic low defining one of the arcuate magnetic subdomains of Firedrake domain. The outcrop is underlain by 5 discernable lithologies. The first is a banded, medium-grained biotite tonalite orthogneiss that displays a strong gneissic layering (cm-scale) that is deformed into tight to isoclinal dm-scale intrafolial folds. Bounding the folds and parallel to their axial surface is a strong northeast-trending biotite foliation (Sm+1) and locally transposed gneissic layering. The unit has a low magnetic susceptibility. The second phase is a more homogeneous, but well foliated, finer grained garnet-hornblende quartz diorite orthogneiss that is interlayered with unit 1 on a metre-scale. The third phase borders Phase 1 and is a white-weathering garnet-biotite paragneiss characterized by a strong gneissic layering and biotite foliation that trends south-east, oblique to the main gneissosity in phase 1. The fourth phase is a white-weathering, medium- to coarse-grained garnet-biotite muscovite leucocratic granite. Biotite-muscovite foliation in this phase is subparallel to that of phase 3. Phase five is a chunky textured, medium-grained pink leucogranite that occurs as dykes crosscutting the gneissic foliation in Phases 1-4 but is subparallel to the axial surface of folds of the gneissosity and Sm+1 biotite foliation. Dykelets of this phase also lie within en echelon sinistral shears.

Rock Description

Phase 1 was sampled for geochronological analysis. It is a medium-grained, recrystallized, biotite tonalite orthogneiss. Compositional layering defined by biotite percentage is noted, with biotite distributed throughout but more abundant in distinct bands. The biotite laths are aligned in the layering and locally oblique to the layering. Recrystallized plagioclase and quartz are generally equigranular and of uniform size, except in a few clots of coarser grain size that lack biotite. These may represent incipient melt pods.

Zircon Description

Zircon occurs as pale brown subhedral prisms

(Figure 10928-1). Most grains are fractured and discoloured. BSE images show internal oscillatory zoning typical of igneous zircon.

Figure 10928-1: Transmitted light photograph of zircon population. Scale in bottom right is 300 µm.

Results and Interpetation

Zircon analyses yield a range of ages from 2.6 to 2.3 Ga. The data cluster at the older age with the seven oldest analyses yielding a weighted mean age 2600 ± 16 Ma (MSWD = 2.8, probability = 0.009) interpreted as the best estimate of the age of the gneiss. Younger analyses are interpreted to reflect variable lead-loss from the 2.6 Ga crystallization age; although it is not possible to be certain when in the Paleoproterozoic the lead-loss occurred.

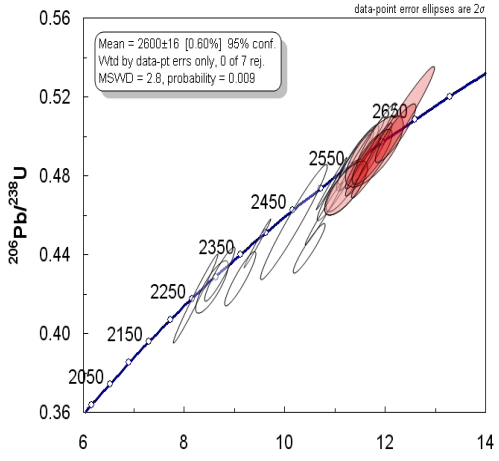

Figure 10928-2: Concordia diagram for sample 10928. Cluster of analyses at 2600 Ma (red ellipses) used to calculate weighted mean. Open ellipses indicate Pb-loss.

Z10929: Quartz Diorite Orthogneiss

Sample	12PBA46B1
Lab Number:	10929
Rock Type	Plutonic
Description	Quartz diorite orthogneiss
Geological Province	Churchill/Rae
Geological Domain	Firedrake domain
Location	Zone 13 E554350 N6744909
Map Sheet	75A
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2601 ± 14 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is from south of Firedrake Lake, NWT, within a narrow, linear magnetic low defining one of the arcuate magnetic subdomains of Firedrake domain. The outcrop is underlain by five lithologies. The oldest phase is a banded, medium-grained biotite tonalite orthogneiss that displays a strong gneissic layering (cm-scale) . The second phase is a more homogeneous, but well foliated, finer-grained garnet-hornblende quartz diorite orthogneiss that is interlayered with unit 1 on a metre-scale. The third phase borders Phase 1 and is a white-weathering garnet-biotite paragneiss characterized by a strong gneissic layering and biotite foliation that trends south-east, oblique to the main gneissosity in unit 1. The fourth phase is a white-weathering, medium- to coarse-grained garnet-biotite muscovite leucocratic granite. Biotite-muscovite foliation in this phase is subparallel to that of phase 3. Phase five is a chunky textured, medium-grained pink leucogranite that occurs as dykes crosscutting the gneissic foliation in phases 1-4 but is subparallel

to the axial surface of folds of the gneissosity and Sm+1 biotite foliation. Dykelets of this phase also lie within en echelon sinistral shears.

Rock Description

A sample of the medium- to fine-grained, hornblende-garnet quartz diorite (Phase 2) was collected for analysis. This unit is interleaved with the biotite tonlaite orthogneiss described above. Plagioclase and quartz are thoroughly recrystallized. Hornblende is elongate parallel to the main foliation. Garnet is subhedral and poikiloblastic. Biotite is a minor constituent and is found replacing hornblende. Magnetite and epidote are accessory phases, the latter adjacent to the biotite.

Zircon Description

Zircons occur as cloudy, pale brown subhedral prisms (Figure 10292-1). Internal oscillatory zoning is marked my differential alteration. Grain surfaces are in part resorbed. BSE images indicate a high degree of alteration in the grains with many grains preserving only remnant domains of non-altered zircon. Oscillatory zoning is common although some grain have more homogenous patterns (Figure 10292- 2).

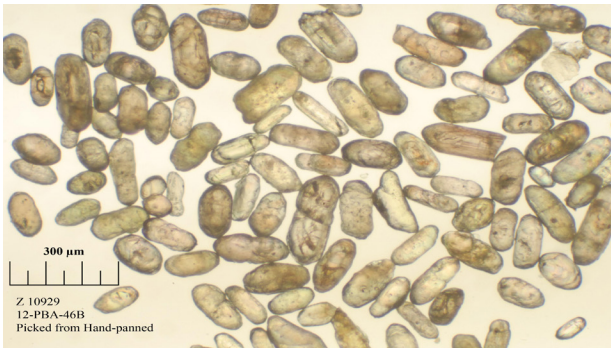

Figure 10929-1: Tranmistted light photograph of zircon population for sample 10929. Scale in bottom left is 300 µm.

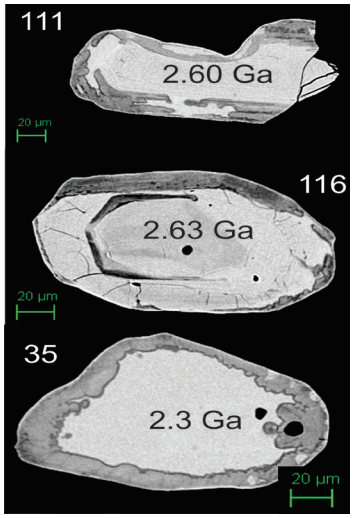

Figure 10929-2: BSE SEM image of zircon grains 111, 116 and 35. Ages are indicated in centre of grain (below).

Results and Interpretation

Zircon analyses yield a range of ages from 2304 Ma to 2627 Ma. There is a correlation between age and composition with younger analyses typically having high hafnium contents and lower Th/U ratios (Figure 10929 -3). The weighted mean of the six oldest analyses gives an age of 2601 ± 14 Ma (MSWD = 1.5, POF = 0.18), which is taken as the best estimate for the crystallization age of the granite. The spread of younger ages is taken to indicate partial lead-loss and recrystallization in the Paleoproterozoic, sometime at or after 2.3 Ga.

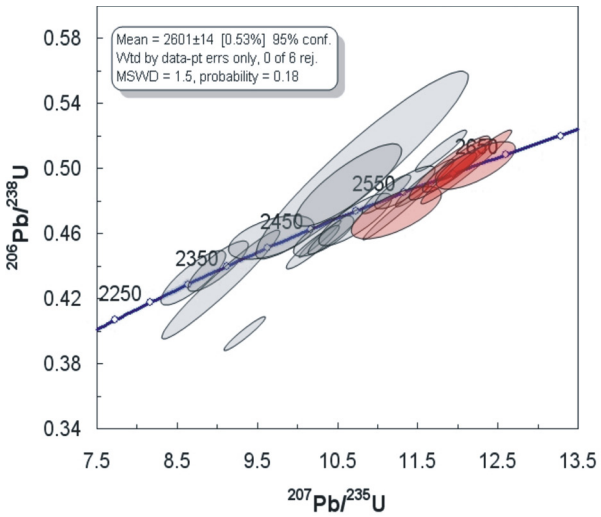

Figure 10929-3: Concordia diagram showing spread of results along concordia. Six oldest analsyes (red ellipses) used to calcu-cate weighted mean.

Z10936: Tonalite Orthogneiss

Sample	12PBA51B1
Lab Number:	10936
Rock Type	Plutonic
Description	Tonalite Orthogneiss
Geological Province	Churchill/Rae
Geological Domain	Firedrake domain
Location	Zone 13 E517430 N6774105
Map Sheet	75H
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2684.1 ± 8.9 Ma
Interpretation	Igneous Crystallization
Age1	ca. 1.82 Ga
Interpretation1	lead-loss

Geological Field Relationships

The sample location is from south-southeast of Firedrake Lake, NWT, within a fishhook-shaped magnetic domain defined by an isoclinally folded linear magnetic high within an overall magnetic low. The NW-trending isoclinal fold is refolded at the km-scale by northeast open folds. The outcrop is from the open, northeast-trending hinge area, and is underlain by a moderately magnetic biotite-tonalite orthogneiss with an equigranular texture (Figure 10936-1). The unit has a dominant northwest-trending shallowly dipping gneissosity and foliation (Sm) that is folded about m-scale north-west trending, steeply southeast-plunging, tight folds. These folds are refolded about open, northeast-trending crosswarps with steep axial surfaces. The tonalite is crosscut by a few fine-grained, pink leucogranite dykes that are parallel to the northeast trending axial surfaces.

Rock Description

The sample is a biotite tonalite orthogneiss, which is heavily altered. It is characterized by recrystallized plagioclase and minor quartz with 10-15% biotite and trace relict, anhedral grains of orthopyroxene. Magnetite and titanite are accessory minerals and trace zircon was noted. More than 50% of the biotite laths are altered to chlorite and most of the quartz and feldspar are heavily sericitized. Biotite laths define the main Sm foliation as do long axes of the anhedral orthopyroxene.

Figure 10936-1: Outcrop photo where sample 10936 was taken. Rock hammer (80 CM) on right hand side as scale.

Zircon Description

Zircons occur as subhedral to euhedral, pale brown to colourless prisms (Figure 10936-2). BSE images indicate regular oscillatory zoning typical of igneous zircon (Figure 10936-3). A number of grains have altered thin rims which may represent a distinct zircon growth event; however these were too narrow to be analysed.

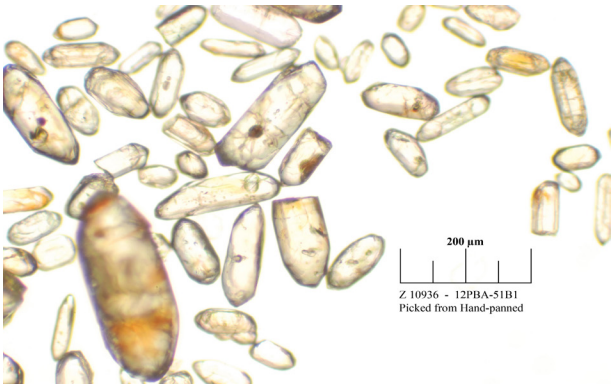

Figure 10936-2: Transmitted light photograph of zircon population. Scale in bottom right is 200 µm.

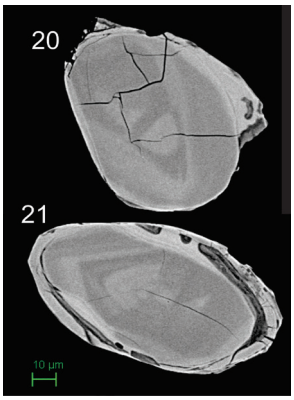

Figure 10936-3: BSE SEM image of zircon grains 20 and 21 displaying oscillatory zoning.

Results and Interpretation

Analyses of oscillatory zoned material give a range of ages dominantly between 2.71 Ga and 2.55 Ga, with a single discordant result at 2.36 Ga (Figure 10936-4). A weighted mean of the nine oldest analyses yields an age of 2684.1 ± 8.9 Ma (MSWD = 1.5, POF = 0.14), interpreted as the crystallization age of the pluton. The younger data lie along a discordia line with an upper intercept of 2669 ± 24 and a lower intercept at 1820 ± 270 Ma (MSWD = 3.4), consistent with variable lead-loss from the 2684 ± 8.9 Ma crystallization age at ca 1.8 Ga.

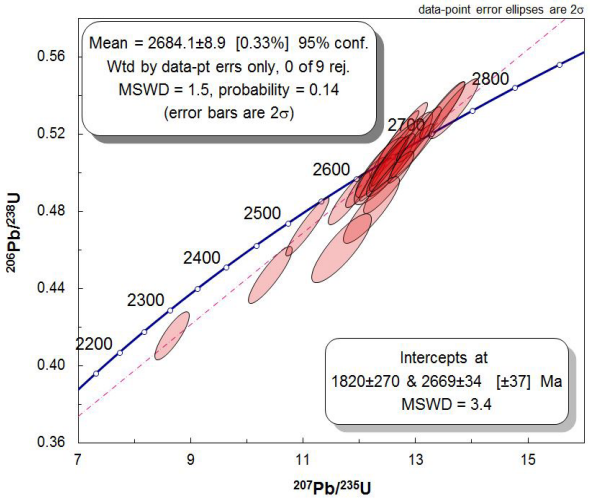

Figure 10936-4: Concordia diagram showing cluster of concordant analyses at 2684 Ma with Pb-loss trajectory consistent with partial resetting in the Paleoproterozoic.

Z10937: Tonalite Orthogneiss

Sample	12PBA-53A1
Lab Number:	10937
Rock Type	Plutonic
Description	Tonalite orthogneiss
Geological Province	Churchill/Rae
Geological Domain	Firedrake domain
Location	Zone 13 E593744 N6819080
Map Sheet	65E
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2698.1 ± 3.7 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is from south of Firedrake Lake, NWT, within a low-medium magnetic mottled domain that transects a linear high magnetic arcuate subdomain in the Firedrake domain. The outcrop is underlain by four phases. The first is a medium-grained, banded biotite-hornblende tonalite orthogneiss that shows compositional variation and gneissosity (Sg) on a dm- to m-scale to more granodioritic and granitic compositions. The unit has distinct leucocratic and more mafic bands, the latter are characterized by increased hornblende abundance. The second phase occurs as distinct, medium-grained, dm-thick mafic layers underlain by hornblende-biotite metadiorite to metagabbro. These are foliated but homogenous. The third phase comprises medium-coarse grained, foliated leucogranite sheets subparallel to Sg. Similar granitic but more weakly foliated dykelets are parallel to ductile shears with an intense Sm shear fabric. This fabric transects Sg at various angles and the associated dykelets have epidote alteration along their margins. The fourth phase comprises K-feldspar porphyritic dykes

that transect the outcrop and Sm shears. These are thorium- and uranium-rich, highly magnetic and are unfoliated. The northwest-trending, moderately north dipping Sg fabric is observed to be folded about m-scale northeast-trending and plunging open to tight folds with an axial planar north-northeast-trending biotite foliation (Sm+1) and fracture cleavage.

Rock Description

The sample is of Phase 1, and is a medium-grained, recrystallized tonalite orthogneiss. It has 10% brown-green biotite and 5% hornblende that are unaligned and distributed in cm-scale compositional bands with a groundmass of plagioclase and quartz. Rare irregular patches are mafic-free and have coarser plagioclase. Magnetite is an accessory phase (<5%), as is epidote. Trace zircon was noted. Grain boundaries of quartz subgrains within larger quartz patches are aligned roughly subparallel to Sm. Plagioclase is heavily sericitized.

Figure 10937-1: Close-up photograph of the outcrop where sample 10937 was obtained. Pencil on left hand side for scale.

Zircon Description

Zircons occur as euhedral to subhedral prisms of variable quality (Figure 10937- 2). Most grains show well developed oscillatory zoning in BSE images (Grains 25 and 3 Figure 10937- 3). A few

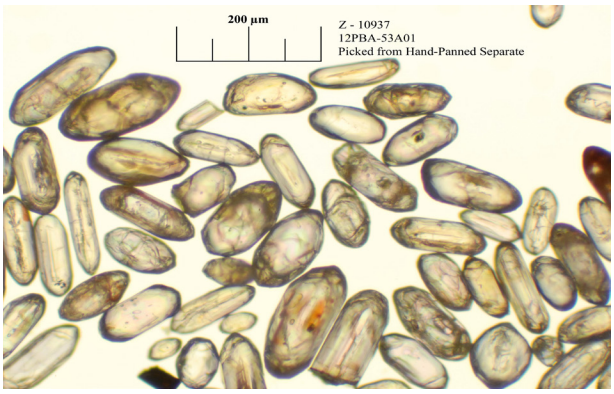

Figure 10937-2: Transmitted light photograph of zircon population for sample 10937; scale is 200 µm.

grains have brighter more homogenous zones (e.g. 4 in Figure 10937- 3) that in some cases overprint the oscillatory zoning (e.g. grains 3 and 95).

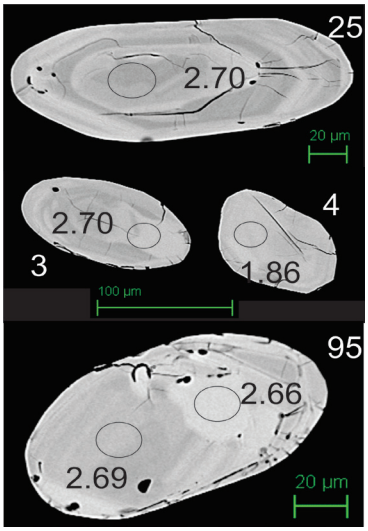

Figure 10937-3: BSE SEM image of grains 25, 3, 4 and 95.; ages are indicated within grains (below).

Results and Age Interpretation

The twelve oldest ages of oscillatory zoned zircon give a weighted mean of 2698.1 ± 3.7 Ma (MSWD = 0.78, POF = 0.66), interpreted as the age of the pluton (Figure 10937- 4). The youngest analyses (grain 4) have an age of 1.86 Ga and are interpreted to reflect metamorphic recrystallization. Two other analyses of brighter more homogenous zones (3 and 95.2) have ages similar to the crystallization age or only slightly younger, so it is not clear that these zones all represent recrystallization in the Proterozoic.

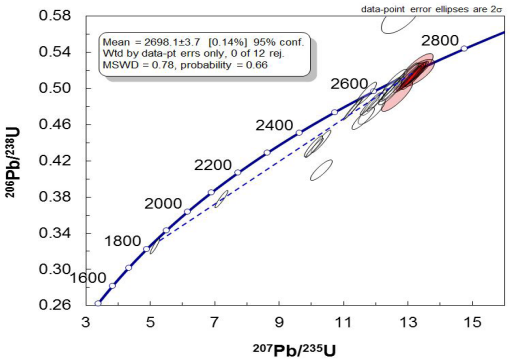

Figure 10937-4: Concordia diagram showing cluster of concordant analyses used to calculate weighted mean (red ellipses). Analyses with with variable lead loss (open ellipse)

Z8735: Quartz Diorite

Sample	H4-1955
Lab Number:	8735
Rock Type	Plutonic
Description	Quartz diorite
Geological Province	Churchill/Rae
Geological Domain	Firedrake domain
Location	Zone13 E603556 N6791401
Map Sheet	65E
Sampling History	Sampled by Hoadley in 1955
Age	2604.6 ± 5.0 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location corresponds to the edge of a mottled, broad, moderately magnetic high within the Boyd Lake map area. The sample was collected from a small outcrop in an area of abundant boulders and felsenmeer. In outcrop the sample was reported to be a massive, medium- to coarse-grained hornblende diorite with local abundant garnetiferous layers. Local gradation in outcrop to more quartzose compositions was also noted.

Rock Description

The rock is recrystallized and does not display a noticeable foliation in the small hand specimen in archive (Figure 8735-1). Elongation of weakly recrystallized hornblende into one band is noticeable. In thin section it displays a hypidiomorphic texture, with minor recrystallization and is dominated by hornblende and plagioclase crystals up to 10 mm. Minor quartz (7%) occurs as small < 2 mm crystals. Magnetite grains up to 1 mm in diameter occur as inclusions in hornblende and in the matrix along with minor ilmenite and pyrite. Garnet occurs as subhedral grains (up to 5 mm) in the matrix or in hornblende. Partial rims of titanite on ilmenite were noted. Based on thin section examination the rock is classified as a meta-quartz diorite. The slight greenish cast in hand sample relates to minor chlorite growth on hornblende and sericite replacement of the plagioclase.

Figure 8735-1: Photograph of hand sample H4-1995.

Zircon Description

The zircons from this sample are of moderate overall quality, well faceted to subhedral, prismatic grains (aspect ratio of 2:1). Many grains are fragments. The grains are clear to moderately turbid and colourless to light brown. They range in long dimension from 100 µm to 400 µm (Figure 8735-2).

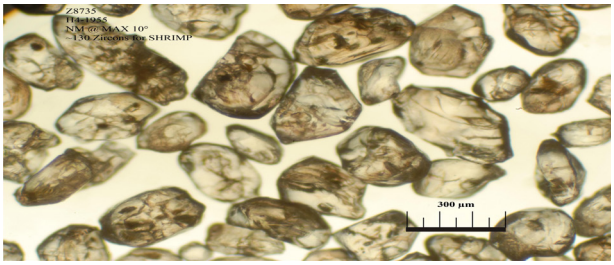

Figure 8735-2: Transmitted light image of pre-mount zircons from sample 8735.

In SEM BSE imaging a brighter homogenous interior is generally observed and is sometimes surrounded by a darker margin. These light-dark boundaries tend to be weakly defined. In some cases the margins are not concentric and intrude into the interior of the grain (Figure 8735-3A). The majority of grains appear homogenous with no apparent zoning (Figure 8735-3B).

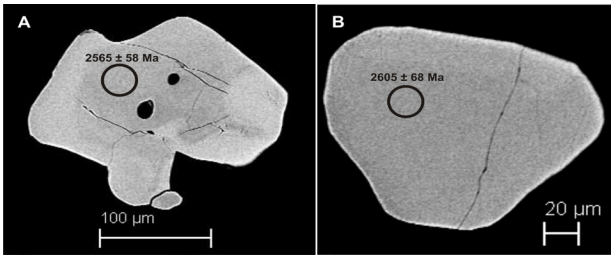

Figure 8735-3: SEM BSE images of representative zircons from sample 8735 A) Grain 1 B) Grain 6.

Results and Interpretation

Sixteen analyses were determined from fifteen grains. A weighted mean $^{207}Pb/^{206}Pb$ age of 2604.6 ± 5.0 Ma (MSWD = 1.6, probability = 0.071) determined from 14 of these analyses is interpreted as the crystallization age of the sample (Figure 8735-4). Two grains have younger $^{207}Pb/^{206}Pb$ ages and were statistically rejected as outliers. The younger ages for these analyses are consistent with a Paleoproterozoic lead-loss event**.** Two analyses are notably discordant to a zero age lower intercept, however, this is due to an analytical calibration issue determining the Pb/U ratio as the measured UO/U ratios are outside of the calibration range for the analytical session. This should not affect the measured $^{207}Pb/^{206}Pb$ ratio of these analyses, and they are included in the age calculation.

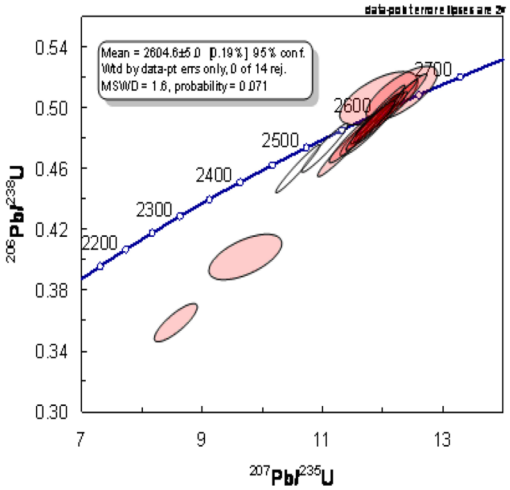

Figure 8735-4: U-Pb Concordia plot for sample 8735. Error ellipses are 2σ.

Z10932: Tonalite

Sample	12PBA092
Lab Number:	10932
Rock Type	Plutonic
Description	Tonalite
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E461473 N6786169
Map Sheet	75B
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	>2663 Ma
Interpretation	Minimum age of igneous crystallization
Age1	1817 ± 36 Ma
Interpretation1	Metamorphic Recrystallization

Geological Field Relationships

The sample location is from the region west of Rennie Lake, NWT, characterized by

intensely refolded linear magnetic highs and lows. The collected sample is medium-grained orthopyroxene-biotite tonalite orthogneiss with well-developed compositional layering. The unit varies from gneissic to homogeneous, foliated tonalite and contains sparse layers of garnet-orthopyroxene-biotite paragneiss. Foliation and layering strike ENE and dip moderately to the SE.

Zircon Description

Zircons are of variable size and quality. Larger grains are fractured, altered and turbid (Figure 10932-2). Smaller grains tend to be clearer and better quality. Grains are subhedral, and equant to prismatic. BSE images show most grains to have moderate and broad zoning (Figure 10932-3). A

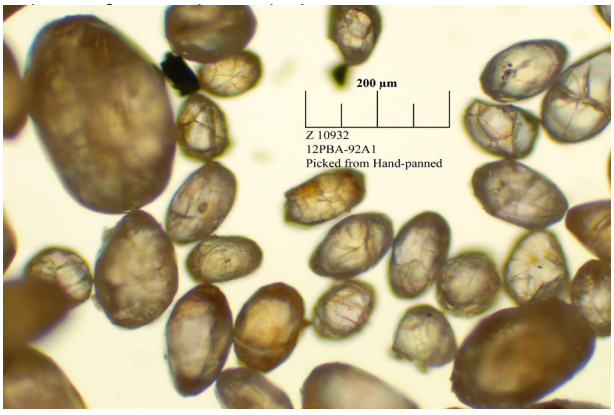

Figure 10932-1: Transmitted light photograph of zircon population for sample 10932; scale in centre is 200 µm.

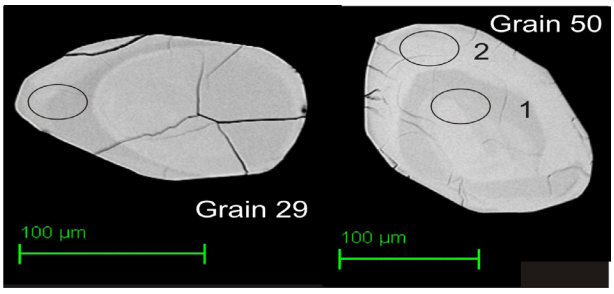

Figure 10932-2: BSE SEM image of zircon grains 29 and 50. Spots are indicated by numbered circles on grains.

Results and Interpretation

The data are variably discordant ranging in age from 2663 Ma to 1800 Ma (Figure 10932-3). The youngest results were determined from analyses of the dark rims described above. Five analyses yield an age of 1817 ± 36 Ma. This is interpreted to reflect metamorphic crystallization. A precise igneous crystallization age for the pluton cannot be estimated. The oldest zircon has an age of 2663 Ma which is taken as a minimum age. Many of the grains plot along Concordia at intermediate ages inconsistent with a simple two-stage episodic lead-loss model. It is possible that lead-loss occurred during the interval between 2.4 and 2.2 Ga although the current data set does not constrain this.

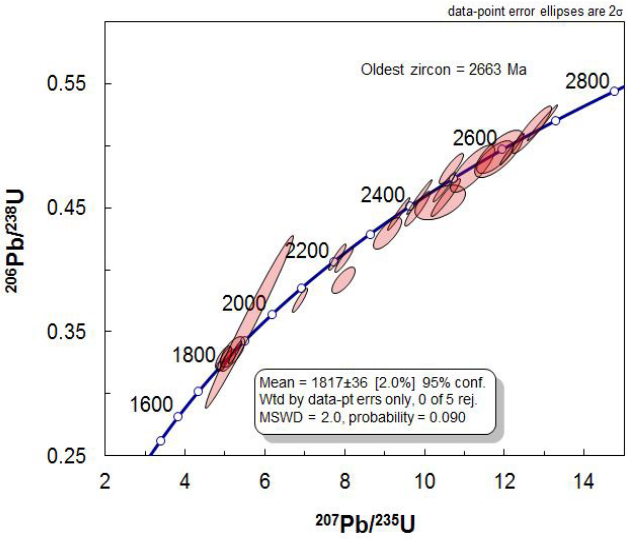

Figure 10932-3: Concordia diagram illustrating range of near concordant ages between 1817 Ma and 2663 Ma.

Z10939: Migmatitic Metasediment

Sample	PQB-40-2012
Lab Number:	10939
Rock Type	Metasedimentary
Description	Migmatitic Metasediment
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E502546 N6760968
Map Sheet	75A
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	1829 ± 11 Ma
Interpretation	Metamorphic Recrystallization
Age1	2680 ± 20 Ma
Interpretation1	Detrital

Geological Field Relationships

The sample location is from the Rennie domain, south of Rennie Lake, NWT. The outcrop area was characterized by intensely refolded linear magnetic highs and lows. The sampled unit comes from a magnetic low area. The outcrop area was underlain by biotite +/- garnet-sillimanite schist displaying dm- to cm-scale variations in grain size (medium- to fine-grained) (Figure 10939-1). Biotite percentage and presence or absence of garnet and sillimanite define bedding. Bedding and aligned biotite are subparallel and define a Sm foliation that is shallowly northwest-dipping and folded by close to tight, F2 mesoscale folds. The F2 folds and bedding are gently crosswarped by north-northeast plunging open F3 folds. White-weathering medium-grained trondjhemite occurs as dm-scale layers at the finer-grained top of some beds and was interpreted to represent remobilized but locally-derived melt.

Rock Description

In thin section the schist is a fine-medium-grained rock characterized by quartz-plagioclase-K-feldspar-biotite in well-defined gradation from coarser more biotite poor layers to finer, more biotite rich layers. Garnet porphyroblasts as anhedral, atoll relics occur throughout but are more abundant in the finer layers. Opaques, tourmaline and zircon are trace phases. Chlorite replaces garnet locally and one porphyroblast of cordierite was noted rimming atoll garnet. No sillimanite was stable in thin section.

Figure 10939-1: Outcrop photo of sample 10939; pen on right side for scale.

Zircon Description

Zircons occur as pale brown, clear to turbid subhedral prismatic crystals (Figure 10939-2). Mechanical rounding is not strong.

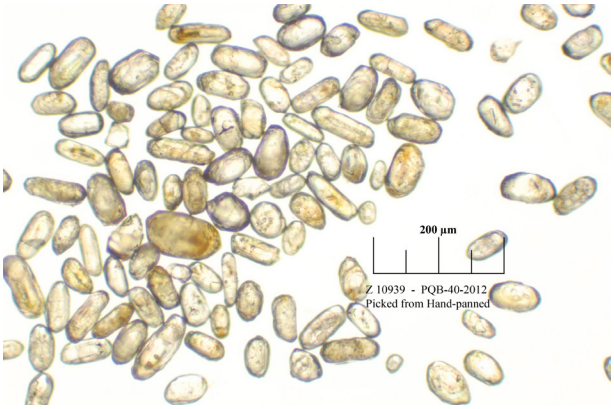

Figure 10939-2: Transmitted light photograph of zircon population; scale on right is 200 µm.

BSE imaging reveals a range of internal zoning dominated by oscillatory zoning typical of igneous zircon (Figure 10939-3). A subset of grains have flat, non-zoned brighter rims.

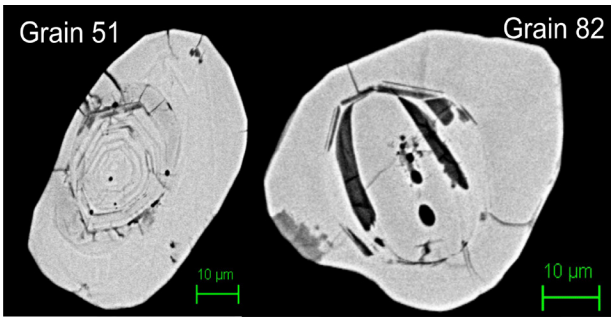

Figure 10939-3: BSE SEM image of zircon grains 51 and 82 displaying cores with broad rims.

Results and Interpretation

Most of the analyses have Archean ages between 2.58 and 2.69 Ga (Figure 10939-4). Four analyses of the brighter rim material yield distinct compositions with low ytterbium, thorium and high hafnium, typical of metamorphically recrystallized zircon. The three analyses with lowest ytterbium content yield a weighted mean age of 1829 ± 11 Ma interpreted as the time of metamorphic recrystallization. The fourth analysis has a slightly older age of 1876 ± 26 Ma and is thought to include a portion of the core material. Linear regression of the older zircon with a fixed lower intercept of 1829 ± 11 Ma yields an upper intercept age of 2680 ± 20 Ma (MSWD =1.5 POF =0.085). The fact that all of the grains lie along a single discordia line pinned at the time of metamorphic recrystallization argues that the detrital zircon in the rock are dominantly from Neoarchean sources at 2680 ± 20 Ma.

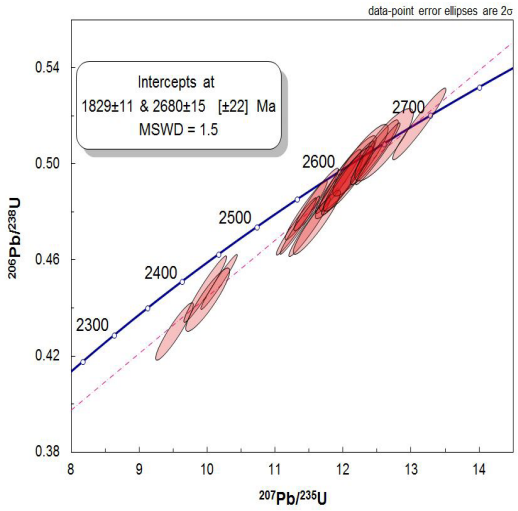

Figure 10939-4: Concordia diagram showing discordant array of analyses. The discordia line (dashed) is pinned by the age of concordant rim analyses (not shown).

Z10944: Deformed Granite

Sample	PQB-75a-2012
Lab Number:	10944
Rock Type	Plutonic
Description	Deformed Granite
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E418515 N6799581
Map Sheet	75G
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2674 ± 14 Ma
Interpretation	Igneous Crystallization
Age1	2345.8 ± 7.6 Ma
Interpretation1	Metamorphic Recrystallization

Geological Field Relationships

The sample location is from the Firedrake-McCann domain boundary, west of Rennie Lake, NWT. The outcrop area was characterized by intensely linear magnetic highs and lows abruptly

bounded by a broad magnetic low to the west. The sampled unit comes from a linear magnetic high area. The outcrop was underlain by highly deformed rusty laminated garnet-orthopyroxene biotite psammite and paragneiss crosscut and deformed together with a Th-K-rich, rusty, coarse-grained granite. The granite and paragneiss carry a foliation defined by biotite that trends southwest and dips shallowly west. Both the granite, local pegmatite and the paragneiss are cut by discrete ductile shears that trend east-west and carry a shallow west-plunging mineral lineation. The outcrop is strongly hematized and plagioclase is locally altered to kaolinite.

Rock Description

Sample 75a is of the rusty foliated granite described above.

Zircon Description

Zircons occur as pale brown, fractured subhedral equant to prismatic crystals (Figure 10944-1). Crystal faces are poorly developed and most grains are ovoid in shape. BSE imaging reveals that many grains have fine to broad oscillatory zoning, in some cases with darker homogenous rims (Figure 10944-2). Individual grains may exhibit flat homogenous zoning, either representing complete grains of similar character to the zircon rim material, or grains for which the depth of polish did not expose the core.

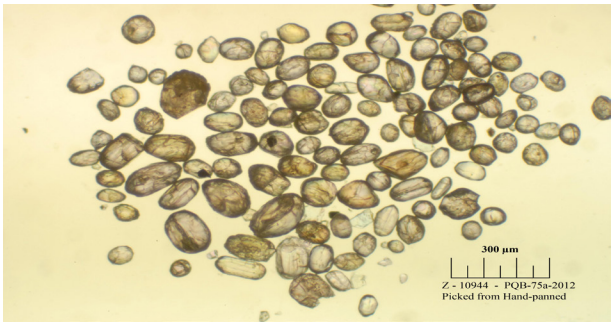

Figure 10944-1:Transmitted light photograph of zircon poplulation for sample 10944. Scale in bottom right is 300 µm.

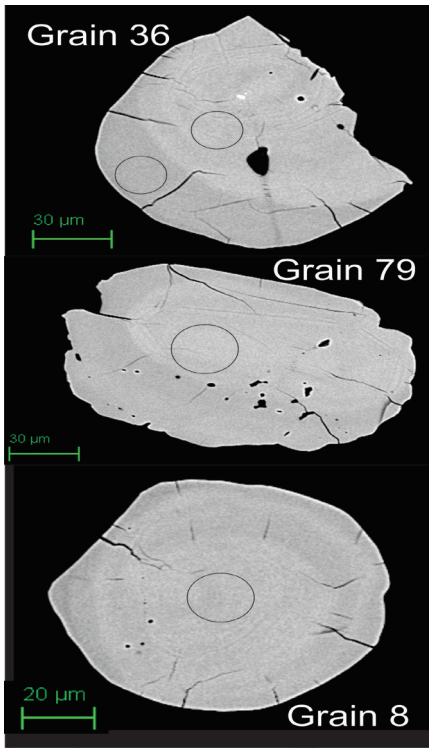

Figure 10944-2: BSE SEM image of grains 36, 79 and 8 with fine to broad oscillatory zoning.

Results and Interpretation

Zircon with the flat homogenous zoning have ages of 2.27-2.41 Ga and most have distinctly lower ytterbium contents (<100 ppm). Ten of the eleven youngest analyses of these zircon yield a weighted mean $^{207}Pb/^{206}Pb$ age of 2345.8 ± 7.6 Ma (MSWD = 1.8, probability = 0.059), interpreted as the age of metamorphism of the sample. Zircon cores and oscillatory-zoned zircon have older ages that plot along the concordia from the metamorphic age to 2.74 Ga (Figure 10944-3). Seven of the nine oldest analyses define a weighted mean age of 2674 ± 14 Ma (MSWD = 1.4, probability = 0.20). Analyses between these two endmember ages are interpreted to reflect partial lead-loss from the older age during metamorphic recrystallization. The two older analyses with $^{207}Pb/^{206}Pb$ ages of 2.74 and 2.76 are significantly older and are interpreted to reflect inherited material.

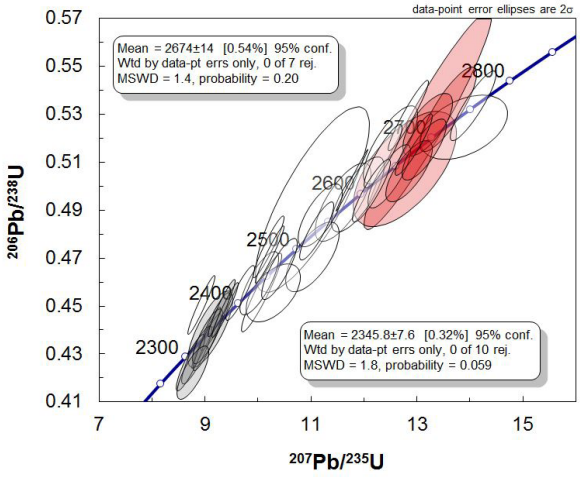

Figure 10944-3: Concordia diagram showing two groups of zircon. Red ellipses = dominantly oscillatroy zoned zircon cores; grey ellipses flat homogenously zoned zircon; open ellipses = excluded from age calculation.

Z10943: Orthopyroxene-Biotite Paragneiss

Sample	PQB-75b-2012
Lab Number:	10943
Rock Type	Metasedimentary
Description	Orthopyroxene-Biotite Paragneiss
Geological Province	Churchill/Rae
Geological Domain	Firedrake
Location	Zone 13 E418515 N6799581
Map Sheet	75G
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	2336.4 ± 3.1 Ma
Interpretation	Metamorphic Recrystallization
Age1	2394.8 ± 5.8 Ma
Interpretation1	Minimum age of Metamorphic Recrystallization 1

Geological Field Relationships

The sample location is from the Firedrake-McCann domain boundary, west of Rennie Lake, NWT. The area is characterized by intensely linear magnetic highs and lows abruptly bounded to the west by the characteristic broad magnetic low of the McCann domain. The sampled unit comes from a linear magnetic high area. The outcrop is underlain by highly deformed rusty laminated garnet-orthopyroxene biotite psammite and paragneiss crosscut and deformed together with a Th-K-rich, rusty, coarse-grained granite. The granite and paragneiss carry a foliation defined by biotite that trends southwest and dips shallowly west. The granite, local pegmatite dykes and the paragneiss are cut by discrete, dm- to m-scale steep ductile shears that trend east-west and carry a shallow west-plunging mineral lineation. The outcrop is strongly hematized and plagioclase is locally altered to kaolinite.

Rock Description

Sample PQB-75B-2012 is a sample of the sheared paragneiss. In thin section the paragneiss is comprised of quartz and feldspar, displaying a fine- to medium-grain size. Biotite occurs in discrete compositional bands and is strongly aligned in the main foliation. Orthopyroxene occurs as small anhedral to elongate porphyroblasts within biotite-rich layers and parallel to Sm. Rare sillimanite occurs as rims on the orthopyroxene. Zircon, monazite and opaques are accessory phases. Biotite is heavily replaced by chlorite in some layers.

Zircon Description

Zircons occur as colourless to pale brown, subhedral prismatic grains (Figure 10943-2). Many have extensive fractures. Larger grains tend to be of inferior quality.

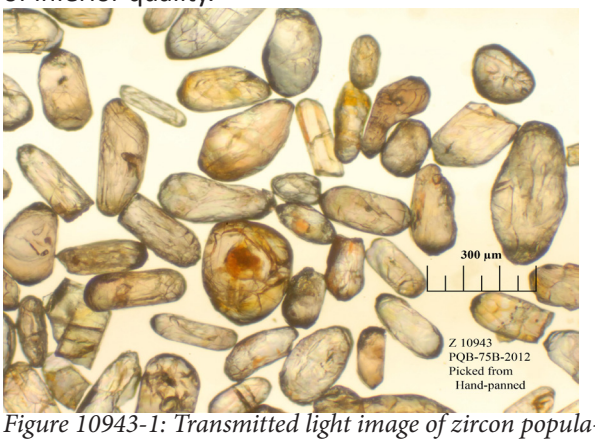

Figure 10943-1: Transmitted light image of zircon population; scale in bottom right is 300 µm.

BSE images exhibit a range of internal textures. Some grains have a more or less homogeneous bright response with little evidence for internal zoning. Other grains exhibit irregular dark and bright zones. Bright zones appear younger and are interpreted to represent partial recrystallization of the darker zones (e.g. Figure 10943-3).

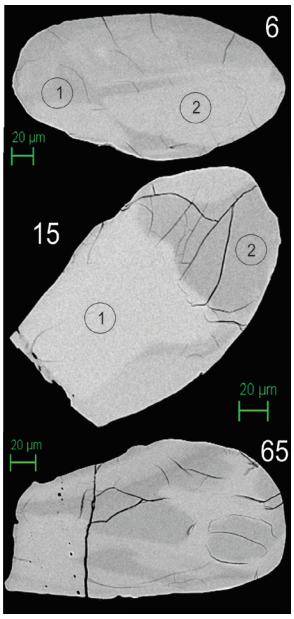

Figure 10943-2:BSE SEM image of zircon grains 6, 15 and 65.

Results and Interpretation

Zircon ages are mostly concordant and plot between 2334 and 2412 Ma, with two discordant results from one grain with older ages (Figure 10943-4). The spread in ages precludes a simple age interpretation. In general analyses of the darker zones have lower ytterbium contents (<80 ppm) and older ages of ca. 2.4 Ga, whereas the brighter zones have higher ytterbium contents (>130 ppm) and younger ages, consistent with the textural relationships described above. None of the grains have textures diagnostic of igneous crystallization and all may be metamorphic in origin. However, discrete populations cannot be statistically resolved within the group of analyses. This suggests that the analyses represent mixtures of at least two end member age groups. The maximum age of the brighter zones is estimated at 2336.4 ± 3.1 Ma (MSWD = 1.04, probability = 0.37) based on the average of the four youngest analyses. This age is similar to the metamorphic age determined in the cross-cutting granite sample PQB-75a-2012. The weighted mean of the eight older analyses (excluding grain 37) is 2394.8 ± 5.8 (MSWD = 1.7, probability = 0.10) which is taken as the minimum age estimate of the lower ytterbium, darker zircon zones. Since this unit is cross-cut by a ca. 2674 Ma granite the low ytterbium zircon cannot be detrital in origin but most likely represents an earlier metamorphic event, or partial lead-loss at 2.34 Ga.

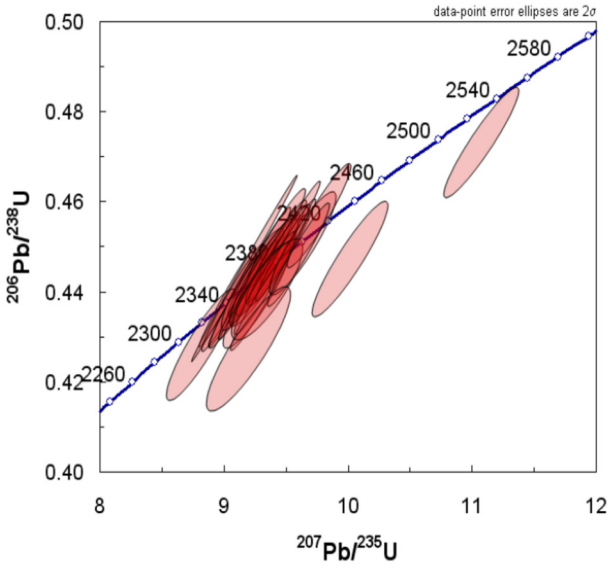

Figure 10943-3: Concordia diagram of sample 10943. Analysis of zircon grains yield mostly concordant ages that plot between 2334 and 2412 Ma

Z10674: Biotite Syenogranite

Sample Number:	W59-1955
Lab Number:	10674
Rock Type	Plutonic
Description	Biotite syenogranite
Geological Province	Churchill/Rae
Geological Domain	Snowbird
Location	Zone 13 E626470 N6913874
Map Sheet	65L
Sampling History	Sampled in 1955 by GM Wright
Age	1832.4 ± 5.6 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample was collected from an area of good outcrop within a magnetically high area of the Rae, north of Carey Lake. The outcrop was described as consisting of red, massive subhomogeneous granite, with biotite and K-feldspar.

Rock Description

In hand sample it is a coarse-grained, brick red, biotite syenogranite, with red mottled alteration on dark red K-feldspar. The sample shows brecciation on one margin and yellow alteration along a chlorite filled seam (Figure 10674-1). In thin section it consists of orthoclase (55%), plagioclase (15%) and quartz (15%) with biotite (10%). Additional accessory minerals noted (2% total) include apatite, epidote, titanite, zircon and fluorite with minor sericite and chlorite alteration on groundmass minerals. Magnetite is the oxide phase (3%) noted.

Figure 10674-1: Photo of rock sample W59-1955.

Zircon Description

The selected zircons are of good to excellent quality, well faceted and stubby to prismatic crystals (aspect ratio of 1.5-2:1). They are mostly clear and colourless to light brown. Some iron-staining is present, as well as abundant unidentified inclusions and minimal fracturing. Their size ranges from 50 µm to 200 µm (Figure 10674-2).

The SEM BSE images reveal faint oscillatory zoning of varying brightness. Some of the zoning occurs as coarse bands around a central core (Figure 10674-3A). More fine-scale zoning is present in some grains as well (Figure 10674-3B). Minimal fracturing is present in the zircon population (Figure 10674-3A and 3B).

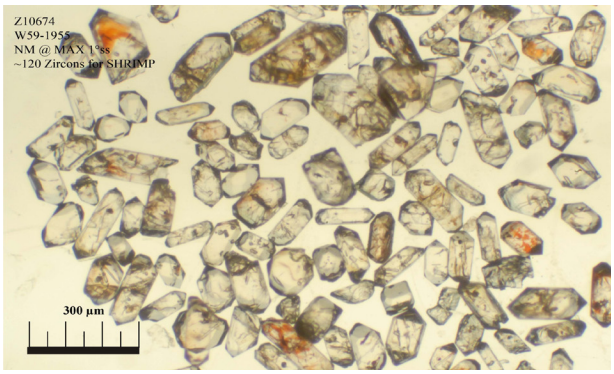

Figure 10674-2: Transmitted light photograph of zircon population; scale in bottom left is 300 µm.

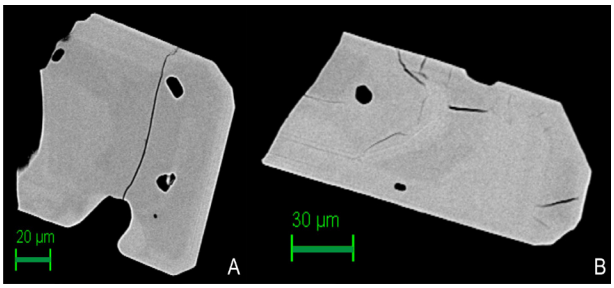

Figure 10674-3A, 3B: BSE SEM image of zircon grains. (A) Faint oscillatory zoning with varying brightness. Zoning around core occurs as coarse bands; (B) fine-scale zoning.

Results and Interpretation

A total of thirty-three zircon grains were analyzed. Thirty-one of the analyses are concordant (Figure 10674-4)and define a single age population with a weighted mean $^{207}Pb/^{206}Pb$ age of 1832.4 ± 5.6 Ma (MSWD = 1.14, probability = 0.26). This age is interpreted as the time of igneous crystallization of the rock. The two zircon analyses that were not included in the weighted mean have older ages of 1.927-1.944 Ga, and are considered to be inherited grains. The zircon exhibit a range of uranium contents from 40 to 1000 ppm with Th/U ratios between 0.5 and 2.2. The majority of zircon has Th/U ratios between 0.5 and 1.3. There is no correlation of age with uranium and thorium contents.

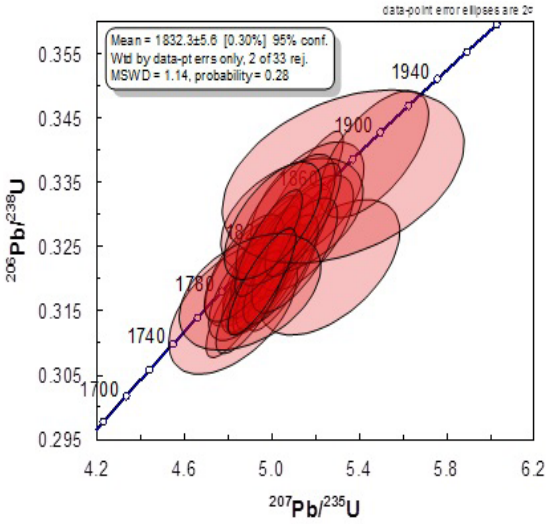

Figure 10674-4: Concordia diagram. Analysis on zircon grains defines a single age population of 1832.4 ± 5.6 Ma.

Snowbird domain and Snowbird tectonic zone samples:

Z10940: Syenite

Sample Number:	PQB-48b-2012
Lab Number:	10940
Rock Type	Plutonic
Description	Syenite
Geological Province	Churchill/Rae
Geological Domain	Snowbird
Location	Zone 13 E429498 N6730103
Map Sheet	75B
Sampling History	Sampled by S.J. Pehrsson, August 2012
Age	1900.3 ± 3.6 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

The sample location is a low magnetic part of the Snowbird domain, right at its western boundary with the Firedrake domain, in NWT. The outcrop is underlain by a flaser textured, recrystallized, foliated, hornblende-garnet diorite to granodiorite orthogneiss that is intruded by two different plutonic units. Unit 1 is a sugary, recrystallized, light pink, fluorite-magnetite-hornblende granite. The granite is weakly foliated, subconcordant with the layering and foliation in the orthogneiss. Unit 2 is a massive, fine-grained purple-brown magnetite-hornblende syenite dyke that intrudes the orthogneiss and crosscuts its foliation at a high angle.

Rock Description

Sample PQB-48b-2012 comes from the syenite dyke described above.

Zircon Description

Zircons range in size from 50 to over 300 µm in length (Figure 10940-1). Grains are typically pale brown, euhedral, equant to elongate prisms. Fractures and secondary alteration are common. BSE images show generally flat, homogenous interiors, with some grains showing annular zoning patterns (Figure 10940-2).

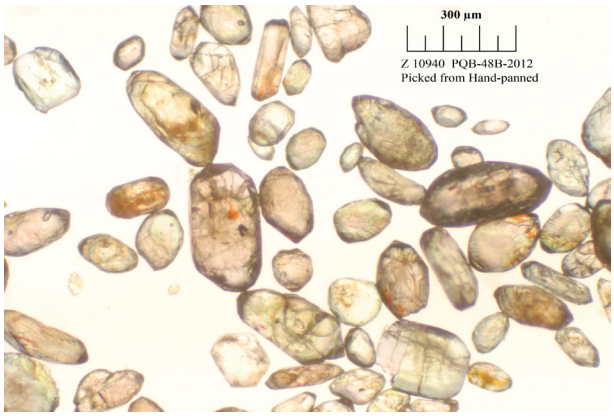

Figure 10940-1: Transmitted light photograph of zircon population for sample 10940. Scale bar is 300 µm.

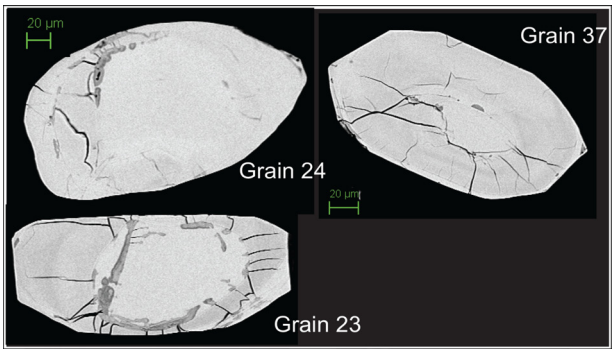

Figure 10940-2: BSE SEM image of zircon grains 24, 37 and 23 displaying rather homogenous interiors. Some show annular zoning.

Results and Interpretation

Thirteen analyses yield concordant ages with a weighted mean $^{207}Pb/^{206}Pb$ age of 1900.3 ± 3.6 Ma (MSWD = 1.8, probability = 0.043; Figure 10940-3). Grains of this age population exhibit weak oscillatory zoning (e.g. grains 23 and 37; Figure 10940-2) and the age is interpreted to be the crystallization age of the syenite. Nine analyses

have older concordant ages ranging from 2134 Ma to 2599 Ma, and are interpreted to represent xenocrysts. There is no indication texturally that the older material occurs as cores to the younger zircon (e.g. grain 24; Figure 10940-2), rather they appear as distinct grains. This may indicate that they were not resident in the magma for extended periods of time before crystallization. The inheritance includes earliest Paleoproterozoic ages of 2.3-2.5 Ga.

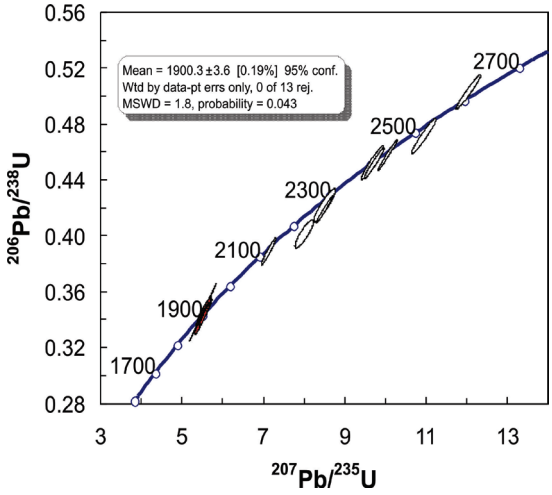

Figure 10940-3: Concordia diagram showing cluster of concordant zircon analyses at 1900 Ma, with inherited zircon between 2.1 and 2.6 Ga

Z10675: Monzogranite

Sample Number:	H26-1955
Lab Number:	10675
Rock Type	Plutonic
Description	Pink monzogranite
Geological Province	Churchill/Rae
Geological Domain	Snowbird
Location	Zone13 E646816 N6767641
Map Sheet	65E
Sampling History	Sampled in 1955 by Hoadley
Age	1740 ± 12 Ma
Interpretation	Igneous Crystallization

Geological Field Relationships

This sample was collected from an area of excellent outcrop near the Snowbird Tectonic zone at the border between the Rae and Hearne domains. The locale corresponds to a smooth ovoid magnetically moderate domain that appears to transect the banded magnetic high of the Snowbird Tectonic zone. The magnetic signature has offset margins, suggesting a later fault transects the unit. The outcrop was described as comprising a coarse-grained, homogenous pink granite. The archived field notes describe small angular inclusions of a darker, undetermined material, as well as xenoliths of a light red-brown quartzite within the granite.

Rock Description

In hand sample the rock is a massive, coarse-grained light pink monzogranite with 15% mafic minerals including biotite (5%) and hornblende (10%; Figure 10675-1). The sample is inequigranular with coarser K-feldspar phenocrysts up to 1 cm in a finer quartz-feldspar groundmass, typically 0.25 cm. Two crystals of fluorite were observed in the sample. No foliation is evident. Minor fractures filled with epidote transect the rock. No thin section was available.

Figure 10675-1: Photo of hand sample H26-1995

Zircon Description

The zircon selected are of moderate overall quality and are well faceted, equant to elongate prismatic crystals (aspect ratio of 2-3:1). The grains are clear to moderately turbid and colourless to light brown with some iron-staining. Abundant inclusions and fracturing are present in most grains. They range in size from 100 x 200 µm to 150 x 400 µm (Figure 10675-2).

In SEM BSE imaging the zircons predominantly exhibit well defined concentric zoning with diffusive boundaries between zones (Figure 10675-3A). A relatively small population of grains exhibit distinct core-rim relationships (Figure 10675-3B). In this example the core is preferentially altered and it could not be analysed.

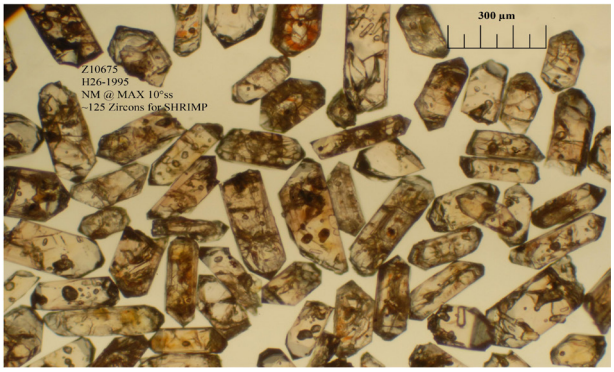

Figure 10675-2: Transmitted light photograph of zircon population for sample 10675. Scale in top right is 300 µm.

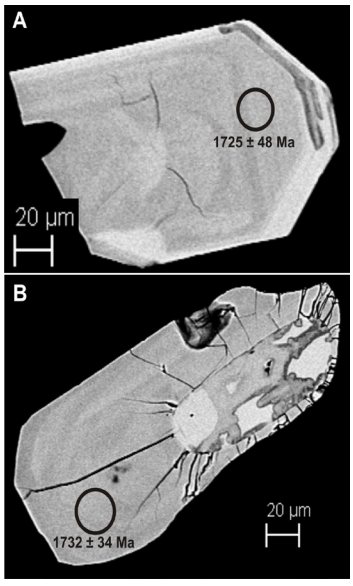

Figure 10675-3A, 3B: BSE SEM image of zircon grains. Circle indicates area of analysis, annotated with the resulting age and error. .

Results and Interpretation

Twenty-two analyses of twenty-two grains define a single age population with a weighted mean age of 1740 ± 12 Ma (MSWD = 2.0, probability = 0.005; Figure 10675-4). All the grains have low uranium contents (50-200 ppm) and Th/U ratios of 0.5-0.9, consistent with a single population. The low probability of fit indicates some excess scatter in the data set. Rejection of the three youngest analyses, which may have had some lead-loss, yields an age of 1746 ± 11 MSWD = 1.3, probability = 0.21), interpreted as the time of igneous crystallization. This sample is similar in age, and is correlated with the Nueltin plutonic suite.

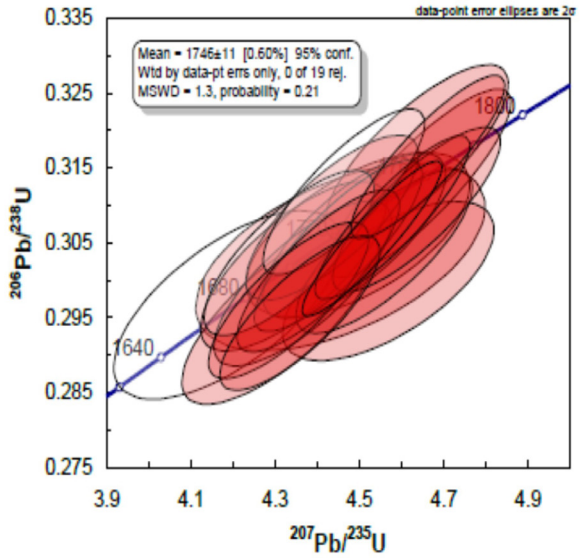

Figure 10675-4: Concordia diagram for sample 10675. Analysis of 19 grains defined a single age population of 1740 ± 12 Ma displayed by red ellipses. Three analyses excluded from the calculation of the weighted mean are shown as open ellipses.

References

Ashton, K.E., Hartlaub, R.P., Bethune, K.M., Heaman, L.M., Rayner, N., and Niebergall, G.R., 2013, New depositional age constraints for the Murmac Bay group of the southern Rae craton, Canada: Precambrian Research, v. 232, p. 70-88.

Ashton, K.E., Card, C.D., and Modeland, S., 2005. Geology of the Tazin-Tsalwor Lake Area (southern Nolan and north-central Zemlak Domains) (Parts of NTS 74N/10, 11, 12, 13, 14, and 15) at 1:50 000 scale. Summary of Investigations 2005-4.2 Geological map 1.3; 2005.

Ashton, K.E., Card, C.D., Heaman, L.M., Coolican, J., 1999. Rae Northeast: analytical update and new field results from the north-central Train Lake Domain. In: Summary of Investigations 1999, Volume 2, Saskatchewan Geological Survey, Sask. Energy Mines, Misc. Rep. 99-4.2, pp. 3–16

Ashton, K.E., Card, C.D., 1998. Rae Northeast: a reconnaissance of the Rae Province northeast of Lake Athabasca. In: Summary of Investigations 1998, Saskatchewan Geological Survey, Sask. Energy Mines, Misc. Rep. 98-4, pp. 3–16.

Aspler, L.B., and Chiarenzelli, J.R., 1997, Initiation of ~ 2.45-2.1 Ga intracratonic basin sedimentation of the Hurwitz Group, Keewatin Hinterland, Northwest Territories, Canada: Precambrian Research, v. 81, no. 3-4, p. 265-297.

Aspler, L.B., and Donaldson, J.A., 1985, The Nonacho Basin (Early Proterozoic), Northwest Territories, Canada: sedimentation and deformation in a strike-slip setting. *in* Biddle K.T., C.N., ed., Strike-slip deformation, basin formation, and sedimentation, SEPM, Tulsa; Special Publication 37, p.193-209.

Baldwin, J.A., Bowring, S.A., Williams, M.L., Mahan, K.H., 2006. Geochronological constraints on the evolution of high-pressure granulites from an integrated electron microprobe and ID-TIMS geochemical study Lithos, 88, pp. 173–200

Berman, R.G., Pehrsson, S., Davis, W.J., Ryan, J.J., Qui, H., and Ashton, K.E., 2013a, The Arrowsmith orogeny: Geochronological and thermobarometric constraints on its extent and tectonic setting in the Rae craton, with implications for pre-Nuna supercontinent reconstruction: Precambrian Research, v. 232, p. 44-69.

Berman, R.G., Percival, J.A., Harris, J.R., 2013b, Geo-Mapping Frontiers' Chantrey project: Reconnaissance geology and economic potential of a transect across the Thelon tectonic zone, Queen Maud block, and adjacent Rae craton: Geological Survey of Canada, Open file 7394.

Berman, R. G., Davis, W. J., & Pehrsson, S., 2007, Collisional Snowbird tectonic zone resurrected: Growth of Laurentia during the 1.9 accretionary phase of the Hudsonian orogeny. Geology, 35, p. 911-914.

Bostock, H.H., and Loveridge, W.D., 1988, Geochronology of the Taltson Magmatic Zone and its eastern cratonic margin, District of Mackenzie: Geological Survey of Canada, Paper, v. 88-2, p. 59-65.

Bostock, H., & van Breemen, O., 1994, Ages of detrital and metamorphic zircons and monazites from a pre-taltson magmatic zone basin at the western margin of rae province. Canadian Journal of Earth Sciences, 31, 1353-1364.

Bostock, H.H., van Breemen, O., and Loveridge, W.D., 1991, Further Geochronology of Plutonic Rocks in northern Taltson Magmatic Zone, District of Mackenzie, N.W.T: Geological Survey of Canada, Paper, v. 90-2, p. 67-78.

Bostock, H.H., van Breemen, O., and Loveridge, W.D., 1987, Proterozoic geochronology in the Taltson Magmatic Zone, N.W.T: Geological Survey of Canada, Paper, v. 87-2, p. 73-80.

Buchan, K.L., and Ernst, R.E., 2004, Diabase dyke swarms and related units in Canada and adjacent regions, Geological Survey of Canada, "A" Series Map 2022A, 39 pages (1 sheet).

Chacko, T., De, S.K., Creaser, R.A., and Muehlenbachs, K., 2000, Tectonic setting of the Taltson magmatic zone at 1.9-2.0 Ga: A granitoid-based perspective: Canadian Journal of Earth Sciences, V. 37, p. 1597-1609.

Davidson, G. I., and Gandhi, S. S., 1989, Unconformity-related U-au mineralization in the middle proterozoic thelon sandstone, boomerang lake prospect, northwest territories, canada. Economic Geology, V. 84, 143-157.

Davis, W.J., Berman, R.G., and MacKinnon, A., 2013, U-Pb geochronology of archival rock samples from the Queen Maud Block, Thelon Tectonic Zone and Rae Craton, Kitikmeot region, Nunavut, Canada: Geological Survey of Canada, Open File 7409.

Davis, W.J., Berman, R.G., Nadeau, L., and Percival, J., 2014. U-Pb zircon geochronology of a transect across the Thelon tectonic zone, Queen Maud region, and adjacent Rae craton, Kitikmeot Region, Nunavut, Canada; Geological Survey of Canada, Open File 7652.

Davis, W.J., Gall, Q., Jefferson, C.W., and Rainbird, R.H., 2011, Fluorapatite in the Paleoproterozoic Thelon Basin: Structural-stratigraphic context, in situ ion microprobe U-Pb ages, and fluid-flow history: Bulletin of the Geological Society of America, v. 123, p. 1056-1073.

Flowers, R.M., Bowring, S.A., Mahan, K.H., Williams, M.L., and Williams, I.S., 2008, Stabilization and reactivation of cratonic lithosphere from the lower crustal record in the western Canadian shield: Contributions to Mineralogy and Petrology, v. 156, p. 529-549.

Fraser, J.A., 1964, Geological Notes On northeastern District of Mackenzie, Northwest Territories: Geological Survey of Canada, Paper 63-40, 20 pp..

Gunning, M.H., Card, C.D., 2005. Transects across the Black Bay Shear Zone and Hoidas-Nisikkatch Rare-element Trend, Northwest Saskatchewan. Saskatchewan Industry and Resources, Open File Report 2004-2, 40 pp.

Halpin, K., Ansdell, K.M., and Pearson, J., 2010, Complex vein relationships and origin of the Hoidas Lake REE deposit, Saskatchewan, Canada: Abstracts with Programs - Geological Society of America, v. 42, p. 334-335.

Hanmer, S., 1997, Geology of the Striding-Athabasca mylonite zone, northern Saskatchewan and southeastern district of Mackenzie, Northwest Territories: Geological Survey of Canada, Bulletin 501, 92 pp.

Hanmer, S., Parrish, R., Williams, M., and Kopf, C., 1994, Striding-Athabasca mylonite zone: complex Archean deep-crustal deformation in the east Athabasca mylonite triangle, northern Saskatchewan: Canadian Journal of Earth Sciences, v. 31, p. 1287-1300.

Hartlaub, R.P., Heaman, L.M., Chacko, T., and Ashton, K.E., 2007, Circa 2.3-Ga magmatism of the arrowsmith Orogeny, Uranium City region, western Churchill Craton, Canada: Journal of Geology, v. 115, p. 181-195.

Heywood, W.W., 1961, Geological Notes, northern District of Keewatin: Geological Survey of Canada, Paper 61-18, 9pp..

Hoadley, J.W., 1955, Abitau Lake, District of Mackenzie, Northwest Territories: Geological Survey of Canada, Paper 55-10.

Hoffman,P.F., 1988, United plates of America, the birth of a craton: Early Proterozoic assembly and growth of Laurentia. Earth Planet. Sci., Ann. Rev., 16, p. 543–603

Jefferson, C.W., Thomas, D.J., Gandhi, S.S., et al., 2007, Unconformity-associated uranium deposits of the Athabasca Basin, Saskatchewan and Alberta, Geological Survey of Canada Bulletin 588, 1 p.

Lord, C. S., and Wright, G. M., 1967, Geology, southeastern barren grounds, Districts of Keewatin and Mackenzie. Geological Survey of Canada, "A" series map, 1216A, scale 1:1 000 000.

Ludwig, K.R., 2003, Using Isoplot/Ex, Version 3, A Geochronological Toolkit for Microsoft Excel: Berkeley Geochronology Ctr. Spec. Pub. 4.

Martel, E., and Pierce, K., 2006, An ArcView 3.5 digital geological atlas of the Snowbird Lake area, NTS 65D; Northwest Territories Geoscience Office, NWT Open File 2006-02.

Martel, E., van Breemen, O., Berman, R.G., and Pehrsson, S., 2008, Geochronology and tectonometamorphic history of the Snowbird Lake area, Northwest Territories, Canada: new insights into the architecture and significance of the Snowbird tectonic zone: Precambrian Research, v. 161, no. 3-4, p. 201-230.

McDonough, M. R., 1997, Structural controls and age constraints on sulphide mineralization, southern Taltson magmatic zone, northeastern Alberta. in Exploring for minerals in Alberta: Geological Survey of Canada geoscience contributions, Canada-Alberta Agreement on Mineral Development (1992-1995), Macqueen, R W (ed.), Geological Survey of Canada, Bulletin 500, p. 13-29.

McDonough, M.R., and McNicoll, V.J., 1997, U-Pb age constraints on the timing of deposition of the Waugh Lake and Burntwood (Athabasca) groups, southern Taltson magmatic zone, northeastern Alberta: Geological Survey of Canada, Current Research, v. 1997-F, p. 101-111.

McDonough, M.R., McNicoll, V.J., Schetselaar, E.M., and Grover, T.W., 2000, Geochronological and kinematic constraints on crustal shortening and escape in a two-sided oblique-slip collisional and magmatic orogen, Paleoproterozoic Taltson magmatic zone, northeastern Alberta: Canadian Journal of Earth Sciences, v. 37, no. 11, p. 1549-1573.

McNicoll, V.J., Thériault, R.J., and McDonough, M.R., 2000, Taltson basement gneissic rocks: U-Pb and Nd isotopic constraints on the basement to the Paleoproterozoic Taltson magmatic zone, northeastern Alberta: Canadian Journal of Earth Sciences, v. 37, no. 11, p. 1575-1596.

McNicoll, V.J., McDonough, M.R., and Grover, T. W., 1994, U-Pb geochronological studies in the southern Taltson magmatic zone, northeastern Alberta (in Lithoprobe; Alberta basement transects)Lithoprobe Report, 37:270-273

Morelli, R.M., Hartlaub, Ashton, K.E., and Ansdell, K.M., 2009, Evidence for enrichment of subcontinental lithospheric mantle from Paleoproterozoic intracratonic magmas; geochemistry and U/Pb geochronology of Martin Group igneous rocks, western Rae Craton, Canada: Precambrian Research, 175(1-4):1-15

Pehrsson, S.J., van Breemen, O., and Hanmer, S., 1993, Ages of diabase dyke intrusions, Great Slave Lake shear zone, Northwest Territories: Geological Survey of Canada, Paper, v. 93-2, p. 23-28.

Pehrsson, S.J.; Percival, J.A.; Davis, W.J.; McCurdy, M.W.; Berman, R.G.; Hilary, E.M.; Kiss, F.; MacKinnon, A.; Jefferson, C.W. 2014. Operation GEM South Rae: Reconnaissance geology of the most poorly known part of the Churchill Province, Northwest Territories and Nunavut. Geological Survey of Canada Open File 7410, 12p.

Pehrsson, S.J., Currie, M., Ashton, K.E., Harper, C.T., Paul, D., Pana, D., Berman, R.G., Bostock, H., Corkery, T., Jefferson, C.W., Tella, S., 2013 Bedrock geology compilation and regional synthesis of south Rae and parts of Hearne domains, Churchill Province, Northwest Territories, Saskatchewan, Nunavut, Manitoba and Alberta; Geological Survey of Canada, Open File 5744, 2 sheets, doi:10.4095/292232

Peterson, T.D., van Breemen, O., Sandeman, H., Cousens, B., 2002, Proterozoic (1.85–1.75 Ga) igneous suites of the Western Churchill Province: granitoid and ultrapotassic magmatism in a reworked Archean hinterland. Precambrian Res., 119, p. 73–100

Plint, H.E., and McDonough, M.R., 1995, 40Ar/39Ar and K-Ar age constraints on shear zone evolution, southern Taltson magmatic zone, northeastern Alberta: Canadian Journal of Earth Sciences, v. 32, p. 281-291.

Rainbird, R.H., Davis, W.J., Pehrsson, S.J., Wodicka, N., Rayner, N., and Skulski, T., 2010, Early

Paleoproterozoic supracrustal assemblages of the Rae domain, Nunavut, Canada: Intracratonic basin development during supercontinent break-up and assembly: Precambrian Research, v. 181, p. 167-186.

Ross, G.M., Parrish, R.R., Villeneuve, M.E., and Bowring, S.A., 1991, Geophysics and Geochronology of the Crystalline Basement of the Alberta Basin, western Canada: Canadian Journal of Earth Sciences, v. 28, p. 512-522.

Skulski, T., and Villeneuve, M., 1999, Geochronological compilation of the Rae and Hearne provinces, Geological Survey of Canada, Open File 3706, 1 diskette/disquette.

Slimmon, W.L. (1989): Compilation bedrock geology, Fond-du-Lac, NTS area 74O. 1:250 000 map with marginal notes, Sask. Energy Mines, Rep. 247.

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

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, v. 197, p. 111-142.

Stockwell, C.H., Henderson, J.F., Brown, I.C., Wright, G.M., and Barnes, F.Q., 1968: Geology, Reliance, District of Mackenzie, Geological Survey of Canada, "A" Series Map 1123A, 1 sheet.

Taylor, F.C., 1959a: Nonacho Lake, District of Mackenzie, Northwest Territories, Geological Survey of Canada, Preliminary Map 10-1959, 1 sheet.

Taylor, F.C., 1959b: Penylan Lake-Firedrake Lake, District of Mackenzie, Northwest Territories, Geological Survey of Canada, Preliminary Map 8-1959, 1959; 1 sheet.

Taylor, F.C., 1959c: Wholdaia Lake West, District of Mackenzie, Northwest Territories, Geological Survey of Canada, Preliminary Map 9-1959, 1 sheet.

Taylor, F.C., Bostock, H.H., and Baer, A.J., 1970: Geology, Wholdaia Lake, District of Mackenzie, Geological Survey of Canada, "A" Series Map 1199A, 1 sheet 1:250000.

Thériault, R.J., 1992, Nd isotopic evolution of the Taltson magmatic zone, Northwest Territories, Canada: insights into early Proterozoic accretion along the western margin of the Churchill Province: Journal of Geology, v. 100, no. 4, p. 465-475.

Tersmette, D.B. 2012. Geology, geochronology, thermobarometry, and tectonic evolution of the Queen Maud block, Churchill craton, Nunavut, Canada. unpublished MSc. Thesis, University of Alberta.

Wanless, R.K., Stevens, R.D., Lachance, G.R., and DeLabio, R.N., 1974, Age Determinations and Geological Studies K-Ar Isotopic Ages, Report 12: Geological Survey of Canada, Paper, v. 74-2.

Wright, G.M., 1957a: Eastern District of Mackenzie, Northwest Territories, Geological Survey of Canada, Preliminary Map 17-1956, 1 sheet.

Wright, G.M., 1957b, Geological notes on eastern District of Mackenzie, Northwest Territories: Geological Survey of Canada, Paper, v. 56-10, p. 1-23.