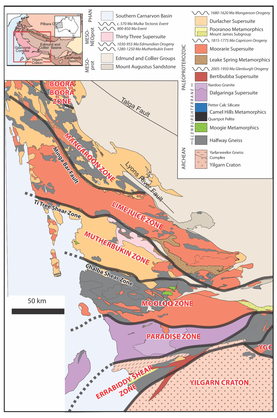
⑥ Using Th–U–Pb monazite geochronology to constrain emplacement ages of leucocratic granites

1. Introduction

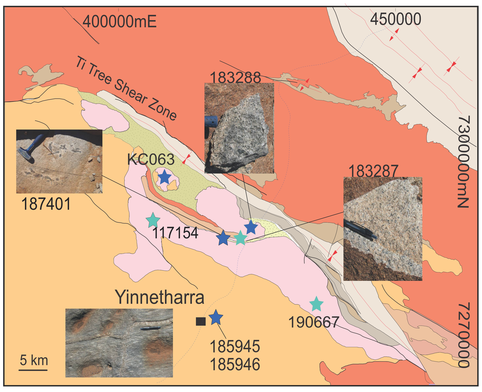
Leucocratic granites are low-temperature, crustal melts that lack direct mantle input, and consist of an amalgamation of partial melts from multiple sources. They are common in intracontinental and collisional settings (Harrison et al. 1999, Journ. Petr. v. 40; Kemp and Hawkesworth 2003, Treat. on Geochem.) commonly forming during crustal thickening by melting of pelitic rocks. However, determining the crystallisation ages of low-temperature leucocratic granites using U-Pb zircon geochronology can be problematic due to the scarcity of new zircon growth and abundance of xenocrystic zircon. In several instances SHRIMP U-Pb zircon dating of leucocratic granites of the Thirty Three Supersuite, Gascoyne Province, yielded problematic results. In this study we use U-Th-Pb monazite geochronology to determine the crystallisation ages of the Thirty Three Supersuite granites.



2. Regional Geology

The Gascoyne Province, Capricorn Orogen, is divided into several distinct structural and metamorphic zones reflecting the effects of four major Proterozoic intracontinental reworking events documented in the province. Two are accompanied by voluminous, high-temperature granitic magmatism: the 1820–1770 Ma Capricorn Orogeny and the 1680–1620 Ma Mangaroon Orogeny.

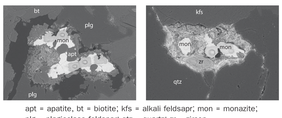
A third event (the 1030–950 Ma Edmundian Orogeny) was accompanied solely by leucocratic granitic magmatism of the Thirty Three Supersuite. Intrusion of these leucocratic granites and pegmatites coincided with deformation and metamorphism within a narrow structural corridor, in the centre of the Gascoyne Province (Sheppard et al. 2007, Journ. Met. Geol. v.25).



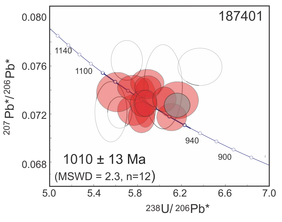
3. Local geology

The Thirty Three Supersuite crops out over an area 70 km long by 10 km wide, and is structurally bound to the north by the Ti Tree Shear Zone, the northern edge of the Mutherbukin Zone. The Thirty Three Supersuite comprises muscovite (–tourmaline) metamonzogranite, biotite-muscovite(–tourmaline) monzogranite and granodiorite, and a belt of muscovite-tourmaline and rare-element bearing pegmatites. Early indications were that the granites belonged to the Paleoproterozoic Durlacher Supersuite because sample KC063 yielded a zircon age population of 1652 ± 5 Ma (Culver 2001, Hons. Thesis unpub.) but the granites cut metamorphic fabrics subsequently dated at 1030–990 Ma using in situ monazite geochronology (Sheppard et al. 2007, Journ. Met. Geol. v25).

4. U–Th–Pb Geochronology

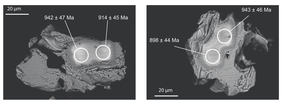


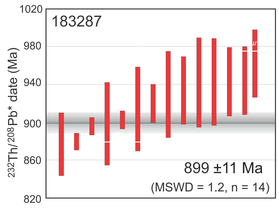
apt = apatite, bt = biotite; kfs = alkali feldspar; mon = monazite; plg = plagioclase feldspar; qtz = quartz; zr = zircon



Sample 187401

Typically, the monazites are anhedral >100 µm in diameter, and are associated with secondary apatite and retrogression coronas (e.g., Finger et al. 1998, Amer. Min. v. 83). The effect of post-magmatic alteration is not evident from the concordant age data ($^{238}U/^{206}Pb$) across the monazite grains. Twelve analyses of nine monazite grains yielded a single age component with a weighted mean $^{238}U/^{206}Pb$ date of 1010 ± 13 Ma (MSWD = 2.3).



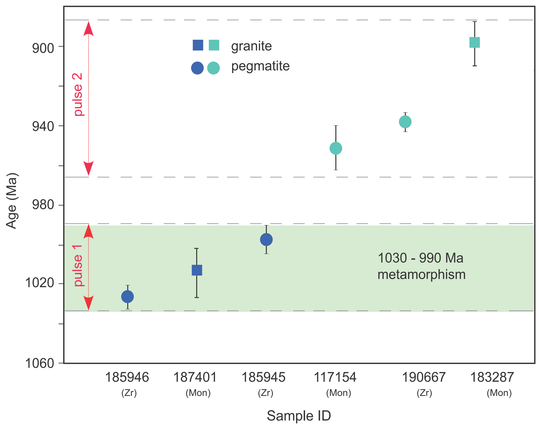


Sample 183287

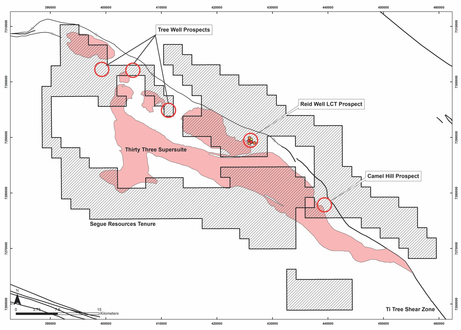
Monazites are unzoned, subhedral to anhedral, and yellow and transparent, with an average size of 60 µm. Fourteen analyses of six monazites yielded a weighted mean $^{232}Th/^{208}Pb$ date of 899 ± 11 Ma (MSWD = 1.2).

Summary of geochronology

The U-Th-Pb monazite geochronology indicates that leucocratic granite and pegmatite magmatism of the Thirty Three Supersuite spanned up to 150 million years, outlasting the regional metamorphism in the same structural corridor by ~100 million years. Our data suggests that the magmatism occurred in two pulses: 1036–992 Ma and 966–888 Ma, although it is possible that magmatism formed a continuum. In contrast to the older Moorarie and Durlacher Supersuites the Thirty Three Supersuite indicates a very low rate of magma generation spanning a remarkably long duration of c. 150 million years.



5. Segue Resources Ltd Gascoyne exploration



Why the Gascoyne Province?

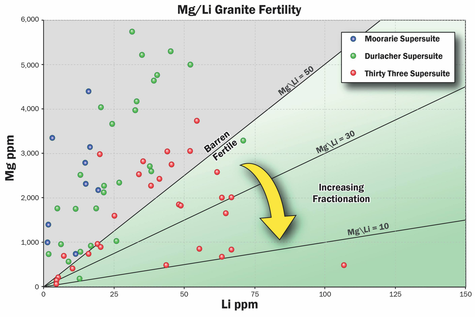
The Gascoyne Province presented a green fields opportunity to discover Li-Cs-Ta (LCT) enriched pegmatites based on recent advances in understanding owing to the 100k mapping program by the GSWA (Sheppard et al. 2010, Explan. Notes Gasc. Province, GSWA). The report included key field indicators of fertile-source granites for LCT pegmatites, such as leucocratic, and containing muscovite, tourmaline and garnet. A number of historical occurrences of pegmatites and production of alluvial Ta–Nb was documented. A single occurrence of lithium minerals (elbaite and lepidolite) was reported at the April Pegmatite.

Fertile granites are defined as peraluminous (A/CNK >1.0) and have Mg/Li ratios of <50, Nb/Ta ratios <8 (Selway et al. 2005, Expl. & Min. Geol. v.14. nos 1-4). Each of the main granitic lithologies in the project area were sampled and analysed for whole-rock geochemistry to determine if they met these geochemical criteria of fertility and fractionation.

Next phase of exploration

The Thirty Three Supersuite satisfied all requirements for being a fertile source granite for LCT pegmatites and became the focus of exploration efforts in the project area. Additional ground was pegged surrounding the Thirty Three Supersuite. A regional stream sediment survey was carried out to fingerprint the different granite suites within the project area and potentially highlight areas of enriched LCT pegmatites. In one location, there is a 10 km^2 area of anomalous Li–Cs–Ta–Nb–Be–Rb hosted in sedimentary rocks within 2-3 km of a granitic intrusion belonging to the Thirty Three Supersuite.

The next phase of work for the Gascoyne Lithium project will include follow up mapping, outcrop sampling and a close-spaced soil geochemical survey which should further evaluate the potential for LCT pegmatites and define targets for drill testing.



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EXPLORATION INCENTIVE SCHEME