Metamorphic zircon, trace elements and thermal history of the ca. 3.75 Ga Nuvvuagittuq supracrustal belt (Porpoise Cove), Québec (Canada)

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The Nuvvuagittuq supracrustal belt (NSB) in northwestern Québec is one of the oldest granitoid gneiss complexes thus far discovered. Emplacement ages for intrusive dikes at the Porpoise Cove outcrops of the NSB cluster at 3.75 Ga, which overlaps in age with better known Eoarchean terranes like the Isua supracrustal belt (3.77 - 3.81 Ga) and the Akilia association (3.65 - 3.85 Ga), both in Greenland, which also preserve widespread volcano-sedimentary enclaves. As with all pre-3.7 Ga terranes, the NSB has been thermally metamorphosed and multiply deformed. In a combined approach to exploring the thermal history of the NSB, conventional geothermometry was coupled with zircon U-Th-Pb depth profiles (Fig. 1), REE partitioning and Ti-in-zircon thermometry to show that metamorphism culminated at upper amphibolite facies conditions (~640°C, at ≥3 kbars) in the late Archean (ca. 2.7 Ga). This event resulted in some thick neoform zircon overgrowths on older cores and corresponds to the amalgamation of the Minto Block in the Northeast Superior Province and the initiation of widespread igneous activity. An earlier metamorphic episode (3.67 Ga) probably corresponds to the intrusion of the granitoids which envelope the NSB.

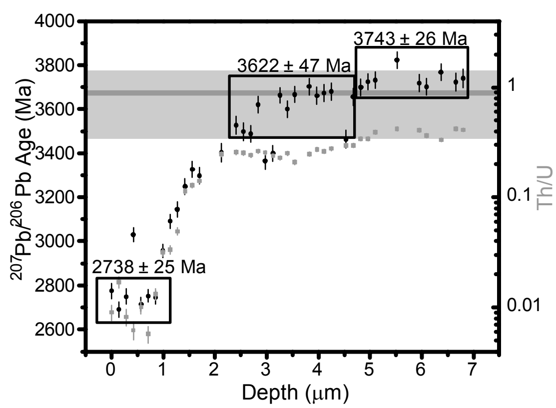

Figure 1: U/Pb age vs. depth-profile and Th/U of a NSB zircon. Shaded area is predicted zircon Th/U based on host rock.

U-Pb zircon geochronology and Ti-in zircon thermometry of large-volume low $\delta^{18}O$ magmas of the Miocene Yellowstone hotspot

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U-Th-Pb isotopic compositions as well as Ti concentrations in cores and/or rims of ~320 zircon crystals from the multiple units of the Cougar Point Tuff of the Bruneau-Jarbidge eruptive center of the Yellowstone hotspot track in southern Idaho, USA were measured by LA-ICPMS. Crystallization ages of zircon determined using ^{208}Pb-based common Pb-corrected $^{206}Pb/^{238}U$ ages from the collective suite of tuffs range from 12.4 Ma in the oldest unit to 10.5 Ma in the youngest, with an average uncertainty of 0.2 Ma (2σ) and are consistent with eruption ages as determined by Ar/Ar geochronology and tephrochronology. Average analytical precision on single grain analyses is 0.4 Ma (1σ) with a spot size of 32 μm. Eruptive ages for the oldest and youngest units are 12.67±0.08 and 10.5±0.1 Ma respectively. Ti-in-zircon thermometry results yield crystallization temperatures of ~835±60 °C using a titania activity of 0.5, which are significantly lower than those calculated from pyroxene and Ti-in-quartz thermometry (900-1000°C). Approximately one third of the grains analyzed for U-Th-Pb were previously analyzed for oxygen isotopes by ion microprobe, and spots for analysis by LA-ICPMS were centered over the 10 μm diameter pits produced by the ion microprobe. The total range of $\delta^{18}O_{VSMOW}$ in zircon cores and rims is from -3.1 to 6.4 ‰, and the vast majority (96 %) of analyses indicate that CPT zircons grew in low $\delta^{18}O$ crustal melts, with 60% of these zircons displaying core-rim zonation of 0.5 to 7.4 ‰. The oxygen isotopic data indicate that multiple discrete low $\delta^{18}O$ sources were involved in magma generation for most CPT units, and the new U-Pb ages provide no evidence for oxygen depletion events of source materials that significantly predate hotspot-related silicic magmatism in the region. However, approximately 15% of zircons provide evidence for subtle inheritance.