The effects of metamorphism on the preservation of crystallization and detrital ages: a case study from the Archean Rae craton (Canada)

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Deformed and metamorphosed mafic to ultramafic intrusive rocks are common along and adjacent to the Snowbird Tectonic Zone, a major Paleoproterozoic structure separating the Rae and Hearne cratons. On the Rae side of this major lithospheric structure, we investigated a series of mafic bodies that intrude high-grade paragneiss and are associated with Ni-Cu±PGE mineralization. By linking field observations, geochronology and metamorphic petrology, our results indicate Archean (~2.6 Ga) crystallization ages for these mafic intrusions over a minimum along-strike extent of ~500 km and a later high-temperature (850°C and 7.5 kbar) metamorphic overprint during the Proterozoic at t < 1.94 Ga. The youngest reproducible ages of detrital zircon from the host paragneiss indicate a maximum depositional age of ~2.73 Ga. In two of the studied localities (Thye and Yotin-Shagory lakes, in Northwest Territories and northern Saskatchewan), zircon from both the mafic and pelitic samples exhibit an unusual within-run fluctuation in the lead isotope signal during SHRIMP analysis, suggesting inhomogeneous redistribution of radiogenic Pb within the crystal lattice. Redistribution is interpreted to have occurred during the ~1.94–1.90 Ga tectonometamorphic event. This behaviour, documented only in ~10 (Ultra)High-Temperature localities worldwide, has not been observed in the other two studied localities (Currie and Axis lakes in northern Saskatchewan), suggesting either i) a different metamorphic history (2.5 vs 1.9 Ga metamorphism) or ii) different re-crystallization processes occurring during the Paleoproterozoic high-temperature evolution (or a combination of the two). Our data indicate that (U)HT metamorphism and the absence of fluids are not a requirement for lead redistribution in zircon.