Paleoproterozoic tectonometamorphic evolution of the southeastern Rae craton margin

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One of the largest and least studied tectonic boundaries in North America is the Snowbird Tectonic Zone (STZ), which separates the Rae and Hearne cratons. Significant tectonothermal reworking of the STZ occurred at 2.55 Ga and at 1.9 Ga, however, substantial uncertainty persists on the nature and extent of that metamorphism. This thesis focuses on a poorly studied portion of the STZ and adjacent crustal domains within Northwest Territories in order to better understand the nature of 1.9 Ga tectonometamorphism.

New mapping revealed a 300 km long and up to 20 km wide crustal scale shear zone, the Wholdaia Lake shear zone (WLsz), which separates distinct crustal domains. Analysis of hanging wall metasedimentary units returned a new depositional age between 1.98-1.94 Ga. These metasedimentary units, and much of the STZ in the south Rae, were buried and partially melted by ca. 1.92 Ga and began to exhume 7-10 kbar, granulite-facies rocks between 1.92 and 1.90 Ga. Continued amphibolite-facies exhumation of crustal domains was accommodated by the WLsz and other localized extensional shear zones between 1.90 and 1.86 Ga. Much of this high-grade margin was at the surface by 1.83 Ga when new volcanic supracrustal material was deposited.

Petrological investigation and Lu-Hf garnet dating of multiple metamorphic assemblages in a mafic granulite from the WLsz has revealed high-grade age components at 2.11 and 1.87 Ga, whereas zircon U-Pb age components are 2.6 and 1.89 Ga. These results highlight a high-grade event at 2.11 Ga not recorded by U-Pb zircon analysis during a poorly understood time of possible extension in the Rae craton.

Mapping, U-Pb zircon and titanite geochronology along the STZ at Kasba Lake demonstrates continuity of rock types and isotopic ages over 200 km of strike length. Pervasive high-strain occurred between 1.9-1.84 Ga within a panel between the Rae and Hearne cratons without obvious coeval metamorphism, however, Archean metamorphism and deformation are preserved in this region. This panel may be a sliver of Rae crust that was highly-strained but never reached high-grade conditions at 1.9-1.8 Ga but likely contributed to exhumation of the STZ region.

Keywords: Snowbird Tectonic Zone; Canadian Shield; Lower crust; Shear zone; Petrochronology; Granulite