

2.56 to 1.87 Ga evolution of the Rae cratonic margin: micro- to macro-scale constraints from Boothia Peninsula-Somerset Island, Nunavut

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Summary

Conceived as one of three Geo-Mapping for Energy and Minerals (GEM) projects targeted to fill knowledge gaps in frontier regions of the western Rae craton, mapping of the “Boothia Uplift”, Nunavut, combined with cutting-edge U-Pb zircon-monazite petrochronology has established the **absence** of crust typical of Rae.

Whereas Rae craton is characterized by ca. 2.79 - 2.6 Ga rocks, with lesser ca. 2.97 Ga orthogneiss, Boothia-Somerset exposes a distinctly younger 2.56-2.52 Ga tonalitic-granodioritic terrane, for which Sm-Nd data indicate a 2.89-2.82 Ga pre-history. The extent of this terrane is uncertain, but on the Canadian Shield it may be >1600 km, if exposures of ca. 2.53-2.52 Ga tonalite (Sherman basin; Taltson basement) and 2.51 Ga tonalite (Zemlak domain) are correlative. Counterparts in the north China and/or Yangtze cratons are suspected. Ca. 2.5 Ga erosion and sedimentation, followed by 2.49-2.48 Ga extension marked by Th/Nb \ll 1 intermediate-mafic plutons are correlated with the Queen Maud suite, 300 km to the SW. Penetrative deformation and metamorphism at 2.44 Ga and 2.39-2.37 Ga (2-stage Arrowsmith Orogeny) establish connection with Rae by this time, possibly due to collision of Boothia terrane with its western margin. Flat transposition fabrics axial planar to F₂ recumbent folds reveal horizontal translation was an important component of Arrowsmith deformation. Tightly folded micro-inclusion trails of fibrolite, biotite and monazite within garnet establish deformation prior and synchronous with 2.44 Ga metamorphism at 5-7 kb and 750-850°C, followed at ca. 2.39-2.37 Ga by near-isothermal decompression (P<4 kbar) recorded by spinel-cordierite symplectites on sillimanite and garnet.

Discontinuous occurrences of quartzite-marble on Boothia-Somerset may be an extension of ca. 2.1-2.0 Ga clastic-carbonate rocks of the Ellice River, Mary Frances and Rutledge River groups, considered to mark a >1200 km extensional rift sequence along the Rae/Buffalo Head margin. Thelon arc magmatism is not directly recorded on Boothia-Somerset, however, clastic rocks dominated by ca. 2.01-1.98 Ga detritus record exhumation and erosion of the Thelon arc after 1.97 Ga. Subsequent upright D₃ deformation and multistage metamorphism at UHT conditions (sapphirine-high-Al orthopyroxene-garnet-sillimanite, ~1020°C) initiated at 1.95 Ga, was followed by granulite-facies metamorphism (garnet-prismatic sillimanite, ~850°C) at 1.93-1.91 Ga, and a regional thermal overprint at ca. 1.87 Ga. Collectively, micro- to macro-scale constraints from Boothia-Somerset highlight a polycyclic 700 million year evolutionary history on, or outboard of, thinned Rae cratonic margin from which linkages to the central Canadian Shield (Zemlak) and to the China±Siberian cratons may extend.