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Extent and character of a Paleoproterozoic cratonic-scale lower crustal domain in Arctic Laurentia: implications for tectonic processes during assembly of Nuna

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New field mapping, thermobarometric and isotopic studies in the northern Canadian Shield reveal that a hitherto unknown cratonic-scale lower crustal domain within the Rae craton stretches for over 2000 kilometres from northern Saskatchewan to Hudson Strait. The domain is characterized by 1.9-1.86 Ga paleopressures of 8-15 kbar affecting both Archean basement and Paleoproterozoic supracrustal rocks. It is bounded on the northwest by major crustal-scale fault zones and on the southeast largely by the Snowbird Tectonic Zone.

A transect of the domain's widest part in the Northwest Territories reveals a shallowly-dipping crustal stack of Neoarchean to Paleoproterozoic ortho- and paragneisses, transected by ductile shear zones and blastomylonites. Archean rocks record ca. 2.5-2.3 Ga MacQuoid and Arrowsmith orogenesis at MPHT conditions. U-Pb zircon and baddeleyite ages on a variety of mafic-intermediate and felsic rocks yield ca. 2.3, 2.1 and 2.0 Ga crystallization ages. These rocks record ca. 1.88-1.9 Ga metamorphic zircon growth associated with high pressure granulite to eclogite Grt-Cpx assemblages. Grt-Hbl assemblages in intermediate orthogneisses are widespread and yield upper amphibolite temperatures at ~10-11 kbar. Abundant new growth of zircon ca. 1.88-1.86 Ga is linked to these assemblages, placing a maximum age for attainment of regional high pressure conditions firmly in the Paleoproterozoic. Similar to other large regional deep crustal domains like the Western Gneiss region of Norway, the Rae high pressure tectonometamorphic record is best preserved in the latest suites of intrusions.

Paleomagnetic constraints for the Hearne craton, along with evidence for extension and exhumation of Archean Rae basement by ca. 2.1 Ga requires renewed loading and major crustal thickening at ca. 1.9-1.86 Ga. The scope and cratonic-scale of the deep crustal domain suggests that such significant thickening was accomplished by collision, most likely related to accretion of microcontinents in the Manikewan ocean during early phases of Nuna assembly.

The Rae lower crustal domain, estimated at approaching 400,000 square kilometres in size, may be the largest lower crustal domain in the world. Its lateral extent is apparently pinned, in a manner analogous to Himalayan extrusion, by the two major syntaxes of the Superior craton collider, the largest single Archean plate involved in Nuna assembly. Uplift of the lower crust was complete by ca. 1.82 Ga when unmetamorphosed supracrustal rocks were deposited in transtensional basins. These basins host the world's largest ultrapotassic volcanic province, in a setting analogous to the Tarim basins of the high Himalaya. The scope, scale and tectonic processes involved in formation and exhumation of the Rae lower crustal domain highlight that assembly of Nuna, the world's first supercontinent, took place under orogenic conditions remarkably similar to those of major Phanerozoic collision-accretion systems.