

Geology, Geochemistry, and Geochronology of Southern Indian Lake, Manitoba: a unique glimpse into and under the Trans-Hudson Orogen

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Recent investigations in the Southern Indian Lake area of Manitoba have provided unique insights into the tectonostratigraphic framework of this portion of the Trans-Hudson Orogen. Rocks exposed in the area record the development and closure of the Paleoproterozoic Manikewan Ocean between the Archean Hearne, Superior and Sask cratons, the development and accretion of intraoceanic volcanic arc complexes and associated basinal sedimentary sequences to the southern margin of the Hearne craton, continental arc magmatism, orogenic sedimentation, and intrusion of late- to post-orogenic plutonic rocks. We present results from new geological mapping in the Southern Indian Lake area by the Manitoba Geological Survey in collaboration with the Geological Survey of Canada's Targeted Geoscience Initiative 3 (TGI 3), including updated whole rock and trace element geochemical, isotopic, and geochronological data.

An isolated window of previously unrecognized *ca.* 2.5 Ga orthogneiss has been identified in the west central portion of Southern Indian Lake and marks the first known exposures of Sask craton-aged rocks in the area. It is possible that this corresponds to a relatively small, tectonically interleaved wedge of Archean to earliest Proterozoic crust. Alternatively, these exposures could represent part of an isolated fragment of Sask craton-aged crust within the Manikewan oceanic basin; zircons of similar age to the orthogneiss consistently occur as inherited components in intrusive rocks and as detrital components in sedimentary rocks throughout the area. The gneissic rocks are in fault contact with an ocean floor succession consisting of juvenile (epsilon Nd between +1.0 and +4.7 at 1.9 Ga), pillowed to massive mafic volcanic flows with trace and rare earth element geochemical profiles similar to modern MORB. Detrital zircon profiles from rare interflow pelitic to psammitic sedimentary rocks within the ocean floor succession show two dominant zircon modes at *ca.* 2.63 and 2.66 Ga, and suggest erosion of the southern margin of the Hearne craton into the basin. The volcanic and sedimentary rocks of the ocean floor succession stand in distinct contrast to mafic to felsic volcanic and volcanoclastic rocks and associated turbiditic sedimentary rocks which occur to the east. These volcanic rocks have trace and rare earth element contents which indicate an affinity to modern arc magmas, epsilon Nd value of -3.2 (at 1.9 Ga), and a depleted mantle Nd model age of 2.58 Ga, which indicates interaction with and/or recycling of an older crustal component, likely in a subduction zone setting. Sedimentary and reworked volcanoclastic rocks associated with arc volcanism show a bimodal distribution of detrital zircon, with peaks *ca.* 1.86-1.90 Ga (arc-derived), and *ca.* 2.3-2.5 Ga (consistent with derivation from Sask craton-aged rocks). Thus, Archean crustal fragments adrift within the Manikewan Ocean may play an important role in controlling the location of intraoceanic arc complexes. The arc volcanic sequences are

overlain by massive polymictic conglomerate and crudely- to well-bedded quartz and feldspathic arenite. A sample of quartz arenite contains a dominant zircon population centred at 1.832 Ga with a subordinate mode at *ca.* 2.3 Ga. This data is consistent with the interpretation that these fluvial-alluvial rocks unconformably overlie the arc volcanic sequences. A crystallization age of 1.829 ± 1 Ga for an intrusive monzonitic granite (Rayner and Corrigan 2004) provides a precise constraint on the minimum age of sedimentation. This tight time bracket between the dominant detrital mode, and cross-cutting monzogranite indicate rapid burial, lithification and folding of the supracrustal sequence (~ 5 Ma) during orogenesis.

References

Rayner, N. and Corrigan, D., 2004, Uranium-lead geochronological results from the Churchill River – southern Indian Lake transect, northern Manitoba; Geological survey of Canada, Current Research 2004-F1, 14 p.