Institute on Lake Superior Geology Proceedings, 68th Annual Meeting,
Sudbury, Ontario, Part 1 - Abstracts and Proceedings. v.68, part 1, p.44-45.

U-Pb zircon ages and Lu-Hf isotopes from Precambrian basement along the Trans-Hudson Foldbelt/Superior Craton Boundary Zone, central North Dakota

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Two Precambrian basement cores were recently cut from Oliver County of central North Dakota, along the proposed Trans-Hudson foldbelt and Superior craton boundary zone (Fig. 1) (Klasner and King, 1986; Sims et al., 1991). Intersecting basement at 2969.7 m (9,743 ft) and 3132.9 m (10,278.5 ft) depths respectively, the J-ROC1 1 and J-LOC 1 cores offer new opportunities to evaluate this region's buried crystalline basement and to determine potential affinity with the ~1.6-1.8 Ga Trans-Hudson foldbelt and/or ~2.7 Ga Superior craton.

The cores were logged and representative samples were analyzed at Washington State University for major and trace elements, REEs, U-Pb zircon age dates, and Hf zircon analyses.

The top two meters of J-ROC1 1 is composed of heavily weathered amphibolite or granitic gneiss intruded by an approximately 10 cm wide granitic dike. Unweathered foliated amphibolite dominates the lithology to 2976.5 m (9765.5 ft), which is composed of hornblende, plagioclase, and biotite. Granitic dikes varying from 2 - 3 cm to 14 cm in width occur sporadically.

The J-LOC 1 core is primarily foliated hornblende-plagioclase-biotite amphibolite of varying fine to coarse grain size. Accessory minerals include opaque minerals (magnetite and pyrite), zircon, and apatite. It contains thin ptygmatic quartz veins, calcite veins, high angle altered fractures, and intrusions of medium grained to pegmatitic granite which range from a few cm to 60 cm in width. The unweathered granitic samples have characteristic SiO_2 values (71.7-73.3 wt.%), and normalized REE ratios (La/Lu)N of 78-80. Amphibolite samples range widely in SiO_2, Al_2O_3, and trace element contents.

The J-ROC1 1 foliated amphibolite/granitic gneiss samples (37672-1 and 37672-3) yielded ~2.68 Ga Archean zircons while the intrusive granite sample (37672-2) contained zircons of both Archean and younger, Paleoproterozoic 1.78 Ga ages. The foliated amphibolite of J-LOC 1 (37380-2) contained 1.83 Ga zircons while the intrusive granitic samples yielded either slightly younger Paleoproterozoic ages of 1.75 Ga (37380-4), or mixed Paleoproterozoic-Archean zircons (37380-1 and 37380-3).

The two J-ROC1 1 Archean samples (37672-1 and 37672-3) and the Archean component of 37672-2 have positive initial epsilon Hf values spanning a narrow isotopic range ($\varepsilon Hf(i) = +3.6 \pm 1.3$, $+3.7 \pm 1.9$, and $+4.1 \pm 1.7$) indicating derivations from a relatively homogeneous depleted mantle at their crystallization age. There is no evidence of older (pre-2.68 Ga) crust in their genesis. The Paleoproterozoic samples of the J-LOC 1, on the other hand, represent either a depleted mantle component (e.g., 37380-2, ($\varepsilon Hf(i) = +6.6 \pm 1.1$) or a mixture of depleted mantle and older (Neoarchean) crustal components (e.g., 37380-4, $\varepsilon Hf(i) = +2.2 \pm 4.3$; 37380-1, $\varepsilon Hf(i) = -1.7 \pm 3.0$) consistent with the existence of mixed ~2.68 Ga and ~1.78 Ga components present in these samples.

The basement at J-ROC1 1 appears to be Archean foliated amphibolite/granitic gneiss intruded by Paleoproterozoic granitoids, while that at J-LOC1 1 consists of Paleoproterozoic foliated amphibolite intruded by slightly younger Paleoproterozoic granitoids. All intrusive

Paleoproterozoic granitoids appear to comprise a mixture of depleted mantle and older (Archean) crustal components. Overall, both cores contain a mix of Paleoproterozoic and Archean crustal components, consistent with the regional interpretation that both cores are from the Superior/Trans-Hudson boundary zone (Klasner and King, 1986; Sims et al., 1991).

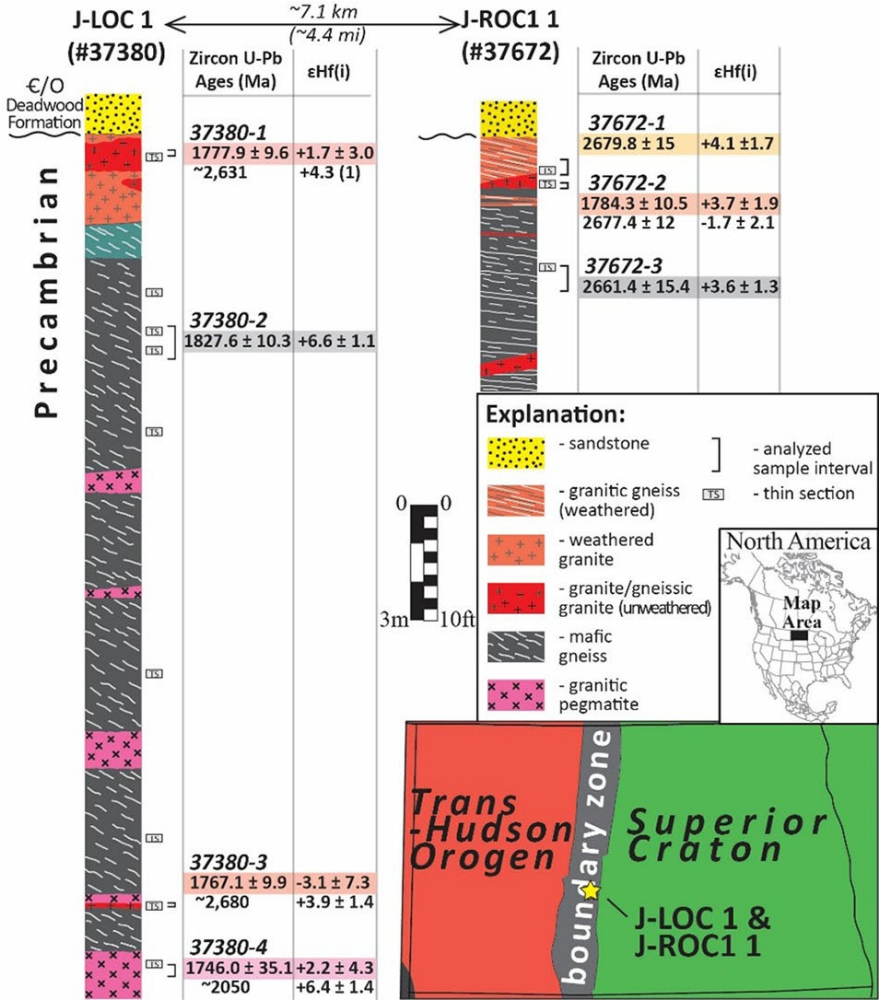

Figure 1: Core lithology illustrations with U-Pb and εHf data from analyzed samples. NDIC (North Dakota Industrial Commission File No: 37380 = J LOC 1, and 37672 = J ROC1 1). Regional geologic basement map modified from Sims et al. (1991).

Acknowledgments: We appreciate funding by the North Dakota Geological Survey.

References

Klasner, J.S. and King, E.R. 1986. Precambrian basement geology of North and South Dakota, Can. J. Earth Sci., 23, 1083-1102.

Sims, P.K., Peterman, Z.E., Hildenbrand, T.G. and Mahan, S. 1991. Precambrian Basement Map of the Trans-Hudson Orogen and adjacent terranes, northern Great Plains, U.S.A.: USGS Miscellaneous Investigations Series Map, I-2214.