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## SHRIMP study of zircons from Early Archean rocks in the Minnesota River Valley: Implications for the tectonic history of the Superior Province

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### Abstract

Interest in Paleoproterozoic to early Meso-proterozoic crust in North America has been sparked by the recent identification of ca. 3800–3500 Ma rocks on the northern margin of the Superior craton in the Assiniboine Lake region of northern Manitoba and the Porpoise Cove terrane in northern Quebec. It has long been known that similarly ancient gneisses are exposed on the southern margin of the Superior craton in the Minnesota River Valley and in northern Michigan, but the ages of these rocks have been poorly constrained, because methods applied in the 1960s through late 1970s were inadequate to unravel the complexities of their thermotectonic history. Rocks exposed in the Minnesota River Valley include a complex of migmatitic granitic gneisses, schistose to gneissic amphibolite, metagabbro, and paragneisses. The best-known units are the Morton Gneiss and the Montevideo Gneiss. The complex of ancient gneisses is intruded by a major younger, weakly deformed granite body, the Sacred Heart granite. Regional geophysical anomalies that extend across the Minnesota River Valley have been interpreted as defining boundaries between distinct blocks containing the various gneissic units.

New sensitive high-resolution ion micro-probe (SHRIMP) U–Pb data from complex zircons yielded the following ages: Montevideo Gneiss near Montevideo,  $3485 \pm 10$  Ma, granodiorite intrusion,  $3385 \pm 8$  Ma; Montevideo Gneiss at Granite Falls,  $3497 \pm 9$  Ma, metamorphic event, 3300–3350 Ma, mafic intrusion,  $3141 \pm 2$  Ma, metamorphic overprint (rims),  $2606 \pm 4$  Ma; Morton Gneiss:  $3524 \pm 9$  Ma, granodiorite intrusion,  $3370 \pm 8$  Ma, metamorphic overprints (growth of rims),  $3140 \pm 2$  Ma and  $2595 \pm 4$  Ma; biotite–garnet paragneiss,  $2619 \pm 20$  Ma; and Sacred Heart granite,  $2604 \pm 4$  Ma. Zircons from a cordierite-bearing feldspar–biotite schist overlying the Morton Gneiss yielded well-defined age peaks at 3520, 3480, 3380, and 3140 Ma, showing detrital input from most of the older rock units; 2600 Ma rims on these zircons indicate metamorphism at this time. Zircons from a hypersthene-bearing biotite–garnet paragneiss, overlying the Montevideo Gneiss near Granite Falls, yielded ca. 2600 Ma ages, indicating zircon growth during high-grade metamorphism at this time. Despite some differences in the intensity of the 2600 Ma event between the Morton and Montevideo blocks, both blocks display similar thermochronologic relationships and ages, suggesting that their boundary is not a fundamental suture between two distinct Paleoproterozoic terranes.

Previously obtained zircon age data from the tonalitic gneiss at Watersmeet Dome in northern Michigan indicated formation at ca. 3500 Ma, whereas a granite body near Thayer was dated at  $2745 \pm 65$  Ma and leucogranite dikes are ca. 2600 Ma. Thus, these rocks and those in the Minnesota River Valley were formed in the late Paleoproterozoic and show a history of igneous activity and metamorphism in the Meso-proterozoic and Neoproterozoic. The occurrence of ancient crustal rocks on both the northern and southern margins of the ca. 2900–2700 Superior craton suggests that they are remnants of once more-extensive Paleoproterozoic crust that existed prior to formation of the Neoproterozoic Superior craton.

Minnesota River Valley Archean zircons SHRIMP geochronology U–Pb

### Footnotes

USGS Data Repository Item 2006011, SHRIMP analytical data, is available on the Web at <http://www.geosociety.org/pubs/ft2006.htm>. Requests may also be sent to [editing@geosociety.org](mailto:editing@geosociety.org).

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