

Proterozoic Sedimentology, Great Lakes Regions, Southern Canadian Shield – Richard W. Ojakangas
(Email: rojakang@d.umn.edu)

Paleoproterozoic

Erosion of Neoproterozoic mountains resulted in deposition of the Huronian Supergroup (SG) in Ontario between 2450 and 2100 Ma. This sequence, as thick as 10,000 m, includes a basal quartz-pebble conglomerate on Archean basement rocks. The conglomerate contains pyrite and uraninite, and overlies a paleosol. Also present are three glaciomarine units, feldspathic sandstones, orthoquartzites and carbonates. Diabase intrusions with an age of 2219±4 Ma cross-cut the SG.

The Marquette Range SG in Michigan and the Animikie Group in Minnesota, Wisconsin, and Ontario are located ~200 km to the west of the Huronian SG, and unconformably overlie Archean greenstones and granitoids. They include Lake Superior-type iron-formations on quartzose sandstones and overlain by greywacke/mudstone units. The SG contains glaciogenic units that correlate with the Huronian SG.

The correlative Animikie Group to the west of the Marquette Range SG was deposited during a marine transgression in

a northward-migrating foreland basin north of the fold-and-thrust belt of the Penokean (Hudsonian) Orogeny (an accretionary orogen) along the southern edge of the Archean Superior Province at ~1850 Ma. Volcanic arcs and microcontinents collided from the south with northward-directed thrusting over a southward-dipping subduction zone. Lake Superior-type granular (GIF) iron-formation, including stromatolites formed in a tidally influenced shelf environment on the peripheral bulge along the north side of the basin.

A large impact structure containing Ni deposits at Sudbury, Ontario, is dated at ~1850 Ma. Deposits of seismic- and tsunami-generated breccias of iron-formation and airfall components of the Sudbury event have been discovered as far as 900 km to the west and provide evidence for the synchronicity of the Lake Superior iron-formations.

There are striking similarities with the Fennoscandian Shield. The Archean and Paleoproterozoic rocks comprised part of Kenorland, a supercontinent that broke apart

~2100 Ma, with one part moving 1800 km westward to Wyoming, the main part remaining in Ontario as the Huronian SG, and another part moving eastward to the Fennoscandian Shield as the Karelian SG of Finland and adjacent Karelia, Russia.

Mesoproterozoic

The Midcontinent Rift System, 2200 km long and as wide as 100 km, formed at 1100 Ma, the product of a mantle plume. Spreading may have ceased due to collision of the Grenville Province in eastern North America. The rift rocks are well-exposed in the Lake Superior region. Seismic profiling beneath Lake Superior shows 20,000 m of dominantly subaerial mafic volcanic rocks deposited between 1108 and 1094 Ma, overlain by 10,000 m of continental red beds. A black muddy unit, the Nonesuch Formation, contains Cu and rare petroleum. Native copper formed in the porous tops of basalt flows and in intercalated conglomerates. Cu, Ni, and PGEs occur in the gabbroic Duluth Complex, and may soon be exploited.

Abstract of the Special Lecture delivered at the Geological Society of India on 25 February 2011