

## *Minnesota's Geology*

**By Harvey Thorleifson, PhD**

Professor and Director

University of Minnesota, Minnesota Geological Survey

Minnesota geology is diverse and complex, and the striking and varied stone that is produced by our thriving stone industry is prized around the world.

The stones being carved by the Symposium sculptors represent three broad segments of geologic time: granite and gneiss -- more than 2.4 billion years old; iron formation, gabbro, and quartzite rocks -- 1 to 2.4 billion years old; and limestone and dolomite -- much younger sedimentary rocks.

Minnesota's *granites* and the banded rocks known as *gneiss* form the foundation of the entire State. They consist of both *igneous* rocks that crystallized from molten material and *metamorphic* rocks that were 'cooked' by high temperature and pressure deep in the Earth's crust. These rocks were complexly deformed during the multiple episodes of continental drift, mountain-building, volcanic activity, faulting, and folding that occurred during the earliest assembly of the North American continent. The resulting intricate array of rocks is arranged in belts aligned southwest-northeast through the state.

Igneous rocks such as *gabbro* and *basalt* are found along the North Shore; metamorphic rocks, such as the *Sioux Quartzite*, are found in the southwest. The North Shore rocks are related to development of the Midcontinent Rift -- a feature about a billion years old that is comparable to the rift valley of east Africa, and that formed the Lake Superior basin.

The youngest rocks in Minnesota are near-horizontal, little-disturbed layers such as the half-billion-year old limestone and sandstone in the southeast, as well as patches of mudstone and sandstone that date to the time of the dinosaurs -- the Cretaceous Period that occurred over 65 million years ago. These are all sedimentary rocks that were deposited on the surface of the earth as water and wind moved about material derived from the decomposition of older rocks.

Ice Age glaciers did the final shaping of our landscape and covered most of our bedrock with a layer of soil materials. These glacial sediments were deposited during multiple cycles of glacial expansion out of Canada, from over a million years ago until little more than ten thousand years ago. These include silt-laden sediments derived from the Red River Valley, sediments rich in granite and other northerly-derived debris in north-central Minnesota, and sediments from the Lake Superior basin that include our well-known agates. Glacial meltwater washed these sediments, leaving sand and gravel in some areas, and carrying the silt and clay into glacial lake basins, such as the Lake Agassiz clay deposits of the Red River Valley. Large boulders that were carried by the ice and that now are scattered over our landscape are known as *glacial erratics*.

You can learn more about Minnesota geology by consulting the experts and publications of the Minnesota Geological Survey: <http://www.geo.umn.edu/mgs/>.