Each grain of sand could tell
a long geological story.

The Sands of Time

They're Put to Work in Minnesota

George A. Thiel

The poet Wordsworth once said, "Wisdom is ofttimes nearer when we stoop than when we soar." Such a statement contains good geological advice and therefore let us stoop and take an excursion among the sand grains. Each grain of sand—and there are billions of them on even a small beach—could tell a long geological story. Such a biographical tale would include the events leading up the formation of the crystals and grains of minerals in the ingneous rocks long before the individual crystals became grains of sand.

Minnesota's Mineral Heritage
• • •
Number Seven

Most sands are composed mainly of grains or pieces of quartz (SiO_2) but many contain varying amounts of such minerals as feldspar, hornblende, magnetite, mica, garnet, tourmaline, apatite, zircon, and other minerals. All of these minerals were once constituents of massive rock formation such as granites, diorites, and others, that were subjected to decomposition and disintegration under the ever-active processes of weathering and erosion. These processes liberate and sort the unaltered mineral grains and the unconsolidated aggregates of such grains are called sand.

Sands may be classified in many different ways—by origin, chemical or mineralogical composition, geological or geographical distribution, grain size uses, or combinations of two or more of these methods. The principal types of deposits based on the manner of deposition are (1) river sands, (2) lake-bed sands, (3) beach sands, (4) glacial sands, and (5) eolian (wind blown) sands.

All of the above types of sand deposits are found in Minnesota. Furthermore most of the sands are very complex mineralogically. The reason for this complexity is that most of the sands in the state are of glacial origin. In other words, great, slowly-moving ice sheets crushed and ground millions of granite and other types of boulders to particles the size of sand grains. As the glaciers melted, the water derived from the ice tended to sort the sand from the coarser pebbles of gravel size, and much of the fine clay was carried in suspension to more distant basins of accumulation by the

glacial outwash streams. In many deposits, however, the sand and gravel occur as an intimate mixture.

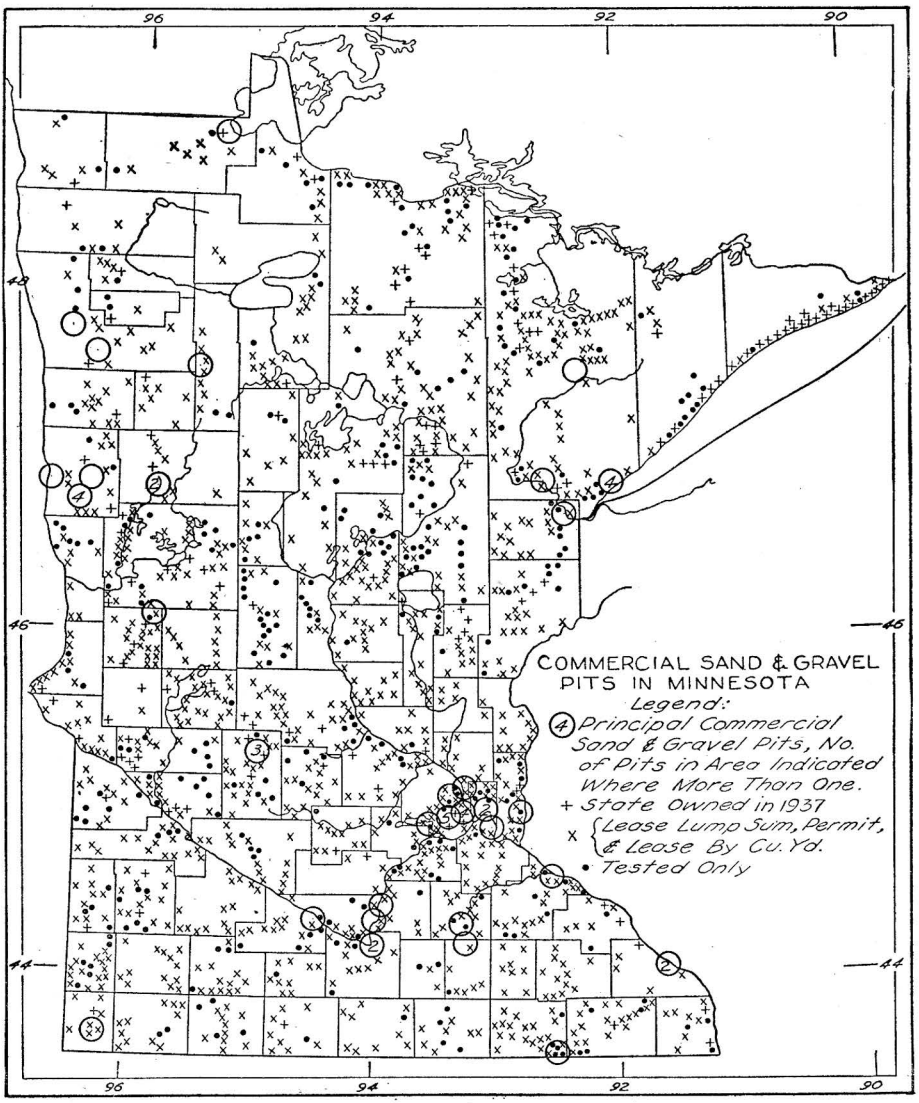
Some sands are nearly pure quartz (silica sand). One of the purest quartz-sand formations in the world (99% SiO_2) is the white sandstone formation that crops out in the walls of the Mississippi River valley, in the Twin Cities area. The sands of this formation, called the St. Peter Sandstone, have had a long and varied history. From the fact that only quartz grains are present in the formation, one concludes that all the other less resistant minerals were removed by decomposition and disintegration prior to the deposition of the quartz sand. Since the formation contains marine fossils, it undoubtedly accumulated in an ancient epi-continental area. Its geographic distribution indicates that similar sands were deposited over an area from eastern Colorado to central Kentucky and from Minnesota southward into Oklahoma and Texas. Because of the high silica content of this formation, it is mined at many places and used as the chief raw material in the manufacture of plate glass. A typical installation is the glass plant of the Ford Motor Company in St. Paul, where the sand is mined by underground methods on the land at the plant.

GEORGE A. THIEL is professor of geology and mineralogy at the University of Minnesota.

The Jordan sandstone that is exposed in the walls of the St. Croix valley at Stillwater, and at several points in the valley of the Minnesota River, near Jordan, contains nearly as much silica as the St. Peter formation. The upper part of the Jordan, which has a total thickness of about 100 feet, is composed of sands with many reconstructed quartz crystals. The crystals are hexagonal with short, sharp pyramids on both ends. Since quartz is very hard (it will cut glass) such crystal sands are used for sandblasting. When the sand grains are forced through the nozzle of a blasting hose under high air pressure, the sharp edges and points of the crystals carve inscriptions or other designs on granite in a few minutes. It is used also quite extensively for cleaning metal castings and for redressing the exterior of stone buildings. Sands for such purposes are mined at Red Wing, Eggleston, and near the city of Jordan.

Sands from both the St. Peter and the Jordan sandstone formations are used for many other purposes, and consequently they may be shipped and sold under several names. A high-grade silica sand is glass sand to a glassmaker, steel sand to a steel molder, grinding sand to a stonecutter, asphalt sand to a pavement contractor, facing sand to a concrete-block maker, and furnace sand to a foundryman.

Because of their many variations



Outline map of Minnesota showing commercial sand and gravel pits and state-owned pits. Courtesy University of Minnesota Press.

both physically and mineralogically, the sands of Minnesota are adaptable to many industrial uses. The foundries require sands that vary from loamy clay to clean silica sand or gravel, the character of the material used depending on the kind of metal to be poured, the size of the casting, the surface desired and the place in the mold where the sand is to be used. For core work a quartz sand free from clay is preferred. Some organic bonding material is added to the clean sand. Greater permeability is obtained in this manner than is possible where clayey or loamy sands are used. A molding sand is a silicious sand having a clay content just sufficient to bind the sand grains together, but not enough to fill the voids between the sand grains. When such a mixture is moistened slightly, the mass may be molded into any form desired, retaining this form when dry.

The Hinckley sandstone, which is quarried extensively along the Kettle River near the city of Sandstone, contains strata that crumble somewhat during quarry operations. The screenings from such layers are composed of subangular, rough grains which offer good attachment for bonding material and are consequently used for refractory purposes in foundry practice. The Galesville member of the Dresbach sandstone, the Jordan, and the St. Peter sandstones, are used also in many of the foundries in the southeastern part of the state.

Grinding and polishing sands are sharp, tough, hard sands free from clay or foreign material and sized for use in sawing, cutting and polishing stone and for grinding and etching glass. The size of the sand varies with the character of the material to be worked and the kind of work to be done. A plant for processing such sands is operated at Mendota.

Burnishing sand is a fine-grained, clean, tough, silica sand with grains as nearly round as possible used in rolling down and burnishing gold decorations on chinaware and porcelain. The sand should be very uniform in size with the grains about seven-thousandths of an inch in diameter (80 mesh). The quartz grains of the St. Peter sandstone are exceptionally well rounded and much of the sand is of the size indicated.

By far the greatest tonnage of sand and gravel is used for constructional purposes. These sands are all of glacial origin and were deposited as alluvial sediments in the major valleys or as products of glacial outwash at the margin of the retreating ice sheet. Some deposits occur as alluvial cones known as kames and others are serpent-shaped ridges or eskers that represent deposits made on the floor of subglacial or superglacial streams. In most glacial streams the sands were washed free of clay before they were deposited.

Pits and plants producing sand

and gravel are so numerous throughout the state that a complete coverage of the industry would be impossible without an extensive survey. The locations of the principal plants are shown on the map.

The accompanying table shows the amount and value of the sand and gravel produced in Minnesota in 1944.

Table showing the amount and value of the sand and gravel produced in Minnesota in 1944*.

Use	Short tons	Value
SAND		
Molding sand	18,502	$ 21,107
Building purposes		
Commercial	442,453	401,477
Gov't contracts	2,786	1,017
Paving		
Commercial	223,740	97,720
Gov't contracts	42,217	14,101
Grinding and polishing	1,603	1,509
Furnace	103	103
Engine	31,081	7,254
Filter	664	2,158
Railroad ballast	171,949	37,928
Other uses	26,399	5,358
GRAVEL		
Building		
Commercial	684,369	304,114
Gov't contracts	41,578	21,155
Paving		
Commercial	426,423	201,534
Gov't contracts	5,287,990	363,129
Railroad ballast	2,128,350	584,914
Other uses	173,945	42,226

*U. S. Geological Survey, Mineral Yearbook, 1945.

OVERCROWDING STUNTS FISH

Contrary to popular belief, the most common cause of stunted fish in Minnesota lakes is overcrowding—not heavy fishing pressure.

Dr. Lloyd L. Smith, Jr., fisheries research supervisor for the Minnesota Department of Conservation, points out that when fish are over-abundant, competition between individuals is strong and the growth rate is slow.

WILD RICE FOR FOWLS AND HUMANS

Minnesota contains more than 15,000 acres of wild rice growing in shallow lakes and along streams in the northern and central parts of the states.

The crop, in addition to having value for waterfowl, provides an average annual harvest of about 500,000 pounds of processed rice. As many as 2,500 persons, about one-third of Indian blood, engage annually in the harvesting and the grain usually has an annual value of $100,000 to $400,000.