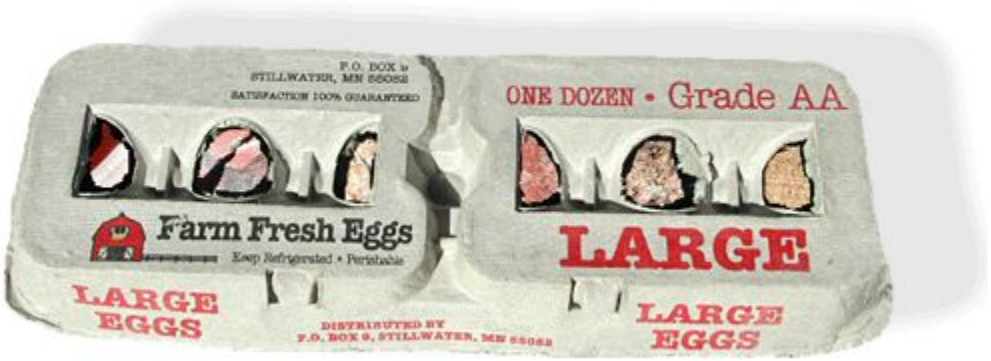
The Virtual Egg Carton



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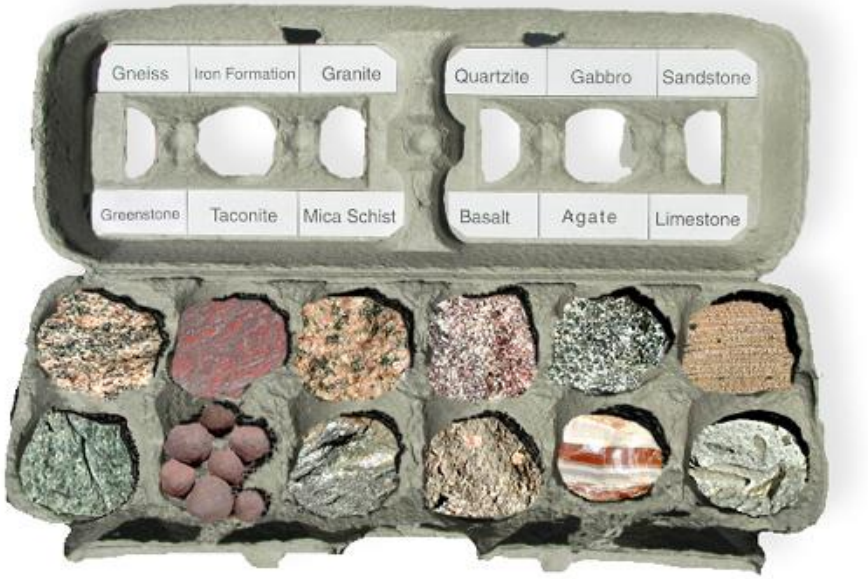
A virtual resource to rock types commonly found in Minnesota

The Virtual Egg Carton



Click on each rock to learn more.

GNEISS

Some of the oldest rocks in the world include the gneiss found in the Minnesota River Valley. The Morton Gneiss, which is 3.6 billion years old, is a coarsely crystalline, foliated metamorphic rock. The texture and mineral assemblage of the Morton Gneiss give clues as to how the rock formed. The fact that it is a crystalline rock with large visible grains indicates that it originated as a granitic igneous rock that cooled slowly beneath the Earth's surface. The foliation, or alignment of the mineral grains, indicates that the original rock was subjected to great heat and pressure deep below the Earth's surface. Gneiss is quarried for use as building stone and monuments. You can find outcrops of gneiss near Morton (the famous “Rainbow Gneiss”), Redwood Falls, Sacred Heart and Ortonville.

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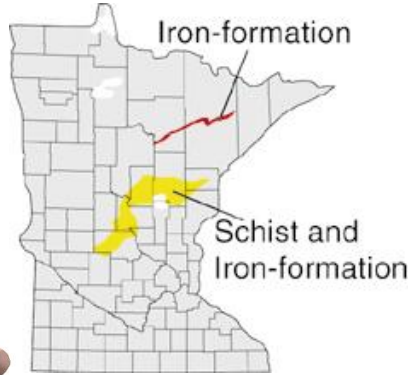
IRON FORMATION and TACONITE

TACONITE ORE

TACONITE PELLETS



Thin layers of iron-formation occur within the approximately 2.7 billion year old greenstone lava of northern Minnesota. The term is a contraction of “iron-bearing formation,” which is precisely what it is--a rock having in places as much as 30 percent iron. Iron-formation formed as iron-rich particles precipitated and settled to the sea floor during quiet periods in volcanic activity. The iron-formation we see today consists of thinly layered red, white, and black minerals. The red layers are jasper; the white--chert (mostly quartz); and the black are iron-bearing minerals--mostly magnetite (magnetic) and hematite (nonmagnetic). A much younger iron-formation (only 1.9 billion years old) occurs along the Mesabi Iron Range that extends from Grand Rapids to Babbitt. This iron-formation (above) formed by the same process, but its deposition also involved interplay among sea water, surface rain water, volcanic activity, and some of the world's oldest life forms (cyanobacteria). When upgraded in iron content by industrial processing, rocks of the Mesabi range yield an important ore called taconite (bottom-left).

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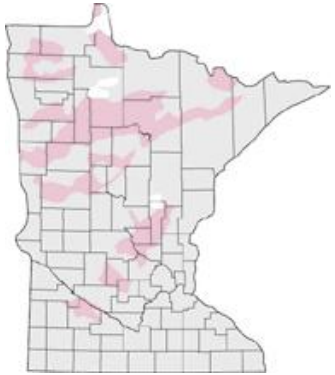
GRANITE



Granite is found throughout northern and central Minnesota. It varies in age from 2.6 billion years in the Minnesota River Valley and northern Minnesota to about 1.7 billion years near St. Cloud. Minnesota granites are composed predominantly of the minerals feldspar, quartz, mica, and hornblende. These rocks formed deep below the surface in the roots of major mountain ranges. These once deeply buried rocks are now exposed at or near the surface due to uplift and erosion. Granite is quarried for use as building stone and monuments. You can find outcrops of granite in Stearns, Pine, and Mille Lacs counties, and also in places in northeastern Minnesota, including the Boundary Waters Canoe Area.

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QUARTZITE

Not long after mountains were uplifted across central Minnesota, sand began to accumulate in braided streams in southwestern Minnesota. These stream deposits of reddish quartz sand grains were eventually consolidated and slightly altered into a very hard rock called quartzite (top-left). The reddish to purple Sioux Quartzite is at the surface near Blue Mound State Park and the Jeffers Petroglyphs in southwestern Minnesota. At the Pipestone National Monument, the soft, red pipestone (catlinite) the Indians favored for carving (bottom-left) is a thin claystone layer that is sandwiched between thick layers of quartzite.

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GABBRO

Gabbro is an intrusive rock formed when molten rock is trapped beneath the land surface and cools into a hard, coarsely crystalline mass. It is the intrusive equivalent to basalt. Minnesota's best examples of gabbro are in the part of the 1.1 billion year old Midcontinent rift exposed in the large hills at Duluth, known as the Duluth Complex. The rock is dense, dark-colored and contains varied percentages of the minerals plagioclase, pyroxene, and olivine. The Duluth Complex contains extensive, but relatively low-grade deposits of copper, nickel, and platinum group elements. None are currently being mined.

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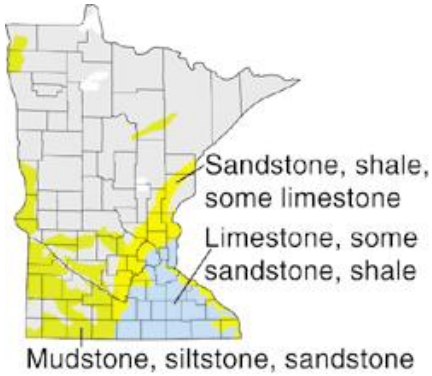
SANDSTONE

(from Mossler, J.H., 1999, Geology of the Root River State Trail Area, southeastern Minnesota, Minnesota Geological Survey, Educational Series-10)



A major time period when sandstone along with other sedimentary rocks in Minnesota were deposited was during the early Paleozoic era (about 500 million years ago). At that time, Minnesota was near the equator, and shallow seas covered most of the state. Sediment eroded from upland areas was transported to the seashore, and the coarser sediment eventually formed the sandstones seen today in southern Minnesota (top-left). Some of these sandstones are so poorly cemented that the grains can be rubbed off with your finger (bottom-left). As the sandstone is eroded, piles of clean quartz sand are formed.

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GREENSTONE

Greenstone in northern Minnesota is somewhat younger than gneiss. Greenstone is a weakly metamorphosed (altered) basalt that is, as its name suggests, greenish to gray. This type of rock formed about 2.7 billion years ago when the area that is now northern Minnesota was part of a volcanic island arc, much like the islands of Japan are today. Greenstone and other associated volcanic and related rocks have in the past been prospected for deposits of economic metals such as gold, copper, zinc, lead, and iron. Iron mines at Ely and Soudan are now closed. As yet, no other significant metal deposits have been found.

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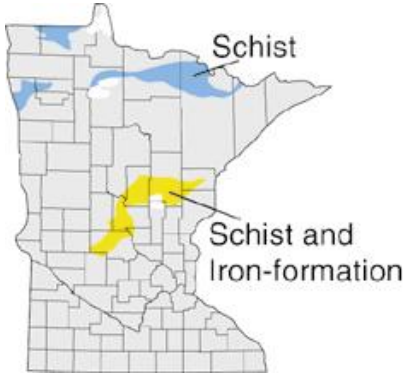
MICA SCHIST



Just as today, the erosion of ancient rocks produced sediment. These sediments, fine-grained sand and mud, were later deformed by the same forces that caused the uplift of mountains in northern Minnesota. The resulting high temperatures and pressures formed metamorphic rocks called schist. Schist is composed predominantly of mica minerals, which impart a platy or layered texture to the rock. Schist is common in central Minnesota and across northern Minnesota.

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BASALT

About 1.1 billion years ago, the continent that had been building for billions of years began to split apart across what is now Minnesota. The “Midcontinent rift,” as it is called, is where the crust began to separate to form a new ocean basin. The same process is currently underway between Africa and Saudi Arabia. The rifting process stopped short of producing a new ocean basin in central North America, but the abundant dark red-brown basaltic rocks now exposed along Lake Superior's north shore are a testament to the massive outpouring of lava through fractures or cracks along the rift. Gooseberry Falls State Park is an ideal place to explore these ancient lava flows.

Shown here is an example of amygdaloidal basalt. The grey-brown basalt is riddled with vesicles, or holes, created when gas was trapped within the lava flow as it cooled. The cavities have since been filled by minerals to form zeolites or agates (light colored nodules in the far-left picture).

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AGATE

Minnesota's state rock is the Lake Superior agate--so named because it is found predominantly along the coast of Lake Superior. Agates form in cavities in basalt. As mineral-rich water circulates through the cavities, silica (SiO_2), or quartz, is deposited in layers along cavity walls. Eventually, the cavities completely fill with this banded variety of quartz. The color variations are due to slight mineral impurities in the water. Iron, for example, causes much of the red and orange color seen in Lake Superior agates.

Although agates originated in the basaltic rocks along the North Shore, some of the best places to hunt for agates are in gravel pits scattered across the state. Specifically, agates are likely to be found where operators are mining glacial sand and gravel deposits associated with glaciers that advanced into Minnesota from the northeast, bringing agate-bearing gravel into the central and southern parts of the state.

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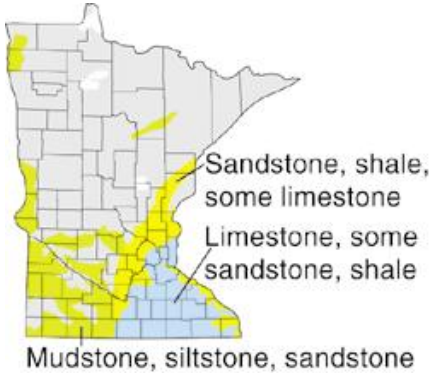
LIMESTONE



Farther offshore away from the beach, finer grained sediment accumulated and chemical sediment precipitated to form limestone and a closely related rock called dolostone. In this environment, marine life was abundant. Shells and skeletons of various clams, snails, corals, etc., are preserved in the limestone of southern Minnesota. Limestone is typically tan to gray. It may be massive or bedded in layers with sandstone and shale. In places fossils may readily be found (see Minnesota at a Glance: Fossil collecting in the Twin Cities area).

Many quarries in southern Minnesota mine and crush limestone for aggregate. Coarsely crushed limestone and dolostone are used for road ballast and making concrete; finer grained aggregate can be used for landscaping; powdered limestone is used on farm fields.

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