## A Collection of

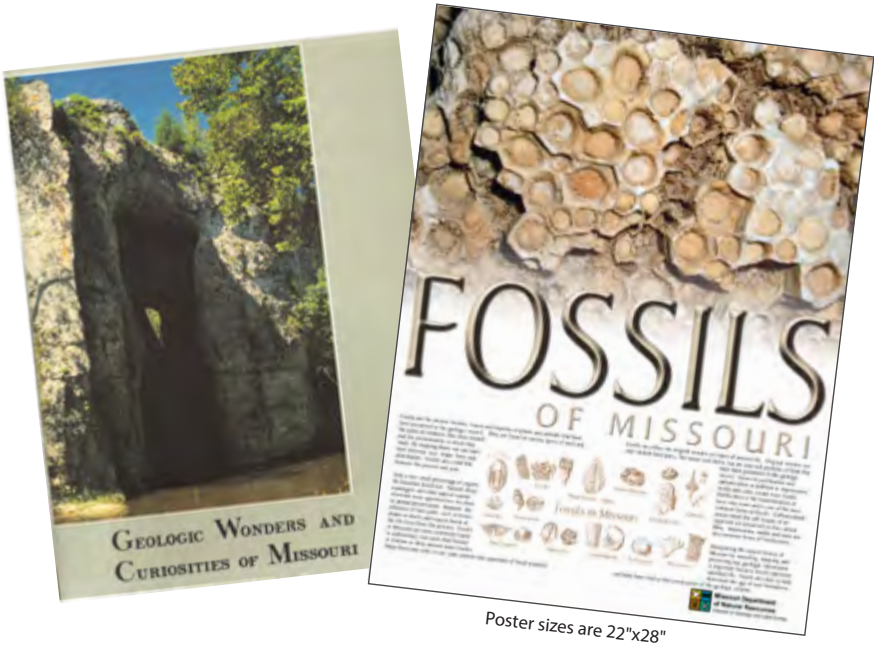
# Missouri Rocks and Minerals

Mozarkite, Missouri State Rock

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES
Missouri Geological Survey

# Ed Clark Museum of Missouri Geology

The Ed Clark Museum of Missouri Geology showcases the diverse geology and related history of the state. The museum is named for Edward L. Clark, State Geologist from 1944 to 1955. The museum is open to the public for self-guided tours from 8 a.m. to 5 p.m. weekdays, and is co-located with the Missouri Geological Survey, 111 Fairgrounds Road in Rolla.




Poster sizes are 22"x28"

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Samples of some of Missouri's more common rocks and minerals have been assembled as a set for use as a teaching aid and as a service to those interested in the fascinating geology of the state. Be sure to visit online for more information about Missouri geology and your rock set.
dnr.mo.gov/geology

Joe Gillman
State Geologist and Director
Missouri Geological Survey

**Parental Advisory:** WARNING: CHOKING HAZARD — This item contains small parts. Not recommended for children younger than 5 years. Do not put any rock or mineral in mouth. Always wash hands after handling rocks and minerals.

*Photo Courtesy of Fred Weber Inc.*

# Importance of Missouri's Rock and Mineral Industry

Rocks and minerals are important to everyone, every day. We see rocks everywhere – both as a part of the Earth, and utilized by society in construction and manufacturing. All of the raw materials we use to make things are either grown (plants and animals) or mined (rocks and minerals).

All metals are smelted from mineral ores; nearly all construction materials (except wood) are made from rocks and minerals; much of our energy is derived from mineral fuels; some plastics and textiles are manufactured from mineral resources; and the most important seasoning for our food (salt) is a mineral. Even items that are grown are harvested using equipment made from materials that have been mined. In addition, this equipment is powered mostly by mineral fuels that have been extracted from the Earth. Therefore, our homes, schools, factories, offices, shopping centers, streets, roads, bridges, parking lots, automobiles, airplanes, trains, bicycles, appliances, electricity, plastics, fuels, clothes, jewelry and even the flavoring for our food have a tie to mineral resources.

Even renewable energy resources depend on mineral resources to utilize them. Solar cells, wind turbines, hydroelectric dams, electric transmission lines and substations are all made from mineral resources. Crops used to produce ethanol and biodiesel are harvested by machines made from mineral resources and are powered mostly by mineral fuels.

Higgins iron mine cart

This set contains twenty common rocks and minerals that are found in Missouri.

## What are Minerals?

A mineral is a naturally-occurring, inorganic, solid substance, with distinctive physical properties, a definite chemical composition, and a characteristic geometric or crystal structure.

Materials referred to as economic minerals include true minerals (as defined above), rocks (see below) and mineral fuels. Economic minerals are classified as metallic (such as galena, chalcopyrite and hematite), nonmetallic (such as barite, limestone, fireclay, granite and sandstone), or fuels (coal, petroleum and natural gas).

## What are Rocks?

A rock is a naturally occurring substance, composed of one or more minerals. Rocks have a degree of chemical and mineralogical constancy, but their properties and compositions are variable. They owe their distinctive properties to the rock-forming minerals present (such as quartz, feldspar or calcite). Rocks are classified into three categories – igneous, sedimentary and metamorphic.

## Igneous Rocks

Igneous rocks are formed by the melting of pre-existing rocks (igneous, metamorphic or sedimentary) into molten rock or magma. The subsequent cooling of magma forms new rock. The magma is either forced into older surrounding rocks (intrusive) or is discharged onto the Earth's surface by volcanic eruption (extrusive).

Granite (intrusive) and rhyolite (extrusive) are examples of igneous rocks, which are common in the St. Francois Mountains of southeast Missouri.

## Sedimentary Rocks

Sedimentary rocks are formed from eroded pieces of rock that have been deposited in layers by wind or water. The sediments are then lithified (compacted and cemented) to form rock. The sediments may be derived from any rock type (igneous, metamorphic or sedimentary).

Most of the rocks exposed in Missouri are sedimentary rocks that were formed on the floors of ancient oceans that once covered virtually the entire state. Other sedimentary rocks were accumulated as stream or lake sediments or were wind-blown deposits.

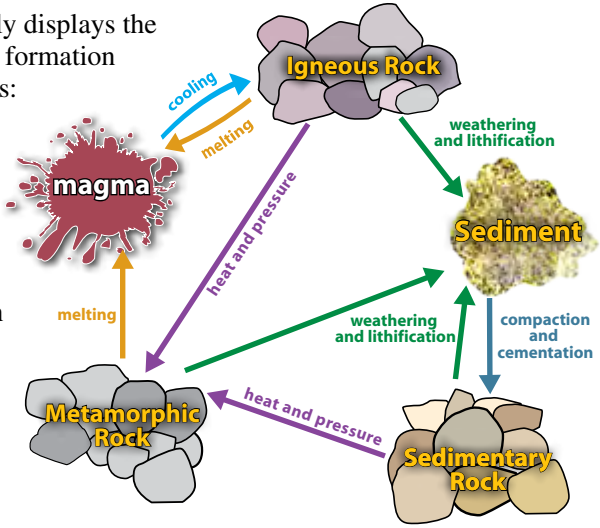
Sandstone, shale, limestone, dolomite, chert, fireclay, coal and conglomerate are examples of Missouri sedimentary rocks.

## Metamorphic Rocks

Metamorphic rocks are formed from pre-existing rocks by extreme heat and pressure that cause changes in the rock's mineralogical, chemical and structural properties. Metamorphic rocks do not occur in Missouri in their original environment. Ice age glaciers moving south from the Arctic deposited metamorphic rocks from the Minnesota, Wisconsin, Michigan, South Dakota and Canada in northern Missouri. These rocks can be found as glacial erratics and are usually composed of igneous and metamorphic rock types most resistant to weathering. Quartzite and gneiss are the most common metamorphic glacial erratics in Missouri.

## Rock Cycle

The rock cycle graphically displays the processes involved in the formation of the three types of rocks: igneous rocks form from melting and cooling, metamorphic rocks by heat and pressure, and sedimentary rocks by weathering, transportation, deposition and lithification. Each type may be formed from either one of the other two rock types or from the same rock type.




This set contains 20 of Missouri's common rocks and minerals.

| Minerals | Sedimentary | Metamorphic | Igneous |
|---|---|---|---|
| Barite | Coal | Glacial Erratic (quartzite) | Granite |
| Calcite | Conglomerate | | Rhyolite |
| Galena | Dolomite | | |
| Hematite | Fireclay | | |
| Limonite | Limestone | | |
| Magnetite | Mozarkite | | |
| Pyrite | Sandstone | | |
| Quartz | Shale | | |
| | Chert | | |

# Minerals:

## **Barite** (barium sulfate, $BaSO_4$)

*A heavy non-metallic mineral*

Barite is a white, gray, or bluish-gray non-metallic mineral that is heavy and brittle. Missouri was once the nation's leading barite producer. Most production came from the Washington County district where barite occurs as masses in residual red clay. Some barite was also produced from small deposits in the Central district (in the Lake of the Ozarks region).

Because barite is heavy (specific gravity of 4.5), it is used in drilling mud for high-pressure oil wells and in the medical field. It is also a source of barium for chemicals, and is used as ballast in the tires of heavy construction equipment. Historically, barite was used as a paint pigment and extender, and as filler in rubber, paper, oil cloth, textiles, linoleum, plastic and leather.

Collectors may find the bladed opaque variety of barite in the open-pit workings of Washington County near Potosi and Old Mines. Small transparent to translucent crystals have been collected from abandoned filled-sink workings in Morgan and Moniteau counties.

## **Calcite** (calcium carbonate, $CaCO_3$)

*A common rock-forming mineral*

Calcite is the principal mineral in limestone and also occurs as distinct crystals within cavities of limestone and dolomite. It is indurated (hardened or consolidated by pressure, heat or cementation) in marble, loose and earthy in chalk, spongy in tufa, and as various forms of travertine in caves. Calcite is commonly found as a gangue mineral in ore deposits, as the cementing medium in sandstones and conglomerates, or as a minor constituent in igneous rocks. Even the "lime" deposit in the bottom of a teakettle, water heater or boiler is calcite (or a similar mineral, aragonite).

Crystals of calcite vary in size from microscopic to several feet in length and may weigh as much as several hundred pounds each. Some of the largest calcite crystals ever found in Missouri came from the crystal caves near Joplin where they are called "glass tiff." These crystal caves were encountered in mining the zinc-lead deposits of that area.

Calcite crystals occur in a variety of shapes, but in Missouri they are usually sharply pyramidal (called "dog-tooth" crystals). Most calcite is colorless, white or pale amber. It is easily scratched with a knife and breaks readily into perfect rhombohedral-shaped fragments. Transparent fragments exhibit the interesting

optical property of double refraction (a pencil line viewed through the fragment will appear double!). Calcite effervesces (bubbles) vigorously in dilute acid.

In addition to its many uses when in the form of limestone, large calcite crystals are sold as specimens. The finest comes from the lead-zinc mines of southeast and southwest Missouri, but good crystals have been found in cavities in limestones and dolomites throughout the state.

## **Galena** (lead sulfide, PbS)

*A metallic mineral and principal ore of lead*

Galena, the principal ore of lead, is bluish-gray with a metallic luster when freshly broken, and dull gray when weathered. It is heavy (specific gravity of 7.5), soft and brittle; crystal masses break into perfect cubic fragments. Galena contains 87 percent metallic lead and 13 percent sulfur when pure.

Galena is mined extensively in the Southeast Missouri Lead District, the world's most productive lead mining region. The mineral occurs as cavity and fracture fillings and as disseminated particles within specific beds of the Bonneterre Formation, and in other carbonate rocks in lesser quantities. It is often associated with sphalerite (a zinc ore), and chalcopyrite (a copper ore). Minor amount of silver are also recovered during the smelting and refining process from ore mined in the Viburnum Trend of the Southeast Missouri Lead District.

Galena was at one time easily collected in the zinc-lead mines of the Joplin-Webb City area of southwest Missouri. These mines have long been closed and specimens for collecting are difficult to find.

Because of its importance to the economy and historical development of our state, galena was designated the official state mineral of Missouri by the 74th General Assembly in 1967.

## **Hematite** (iron oxide, $Fe_2O_3$)

*A common iron ore mineral*

Hematite is a heavy, red or bluish-black mineral that contains 70 percent metallic iron when pure. It is found in many kinds of rocks, both as a primary constituent and as an alteration product.

The most common variety of hematite is red to reddish-brown, and occurs as hard dense masses or soft clay-like material. It occurs in filled-sink and residual deposits over a large area including Crawford, Dent, Franklin, Phelps, Shannon, Oregon and neighboring counties. The specular variety of hematite, which is hard and bluish-black with a bright metallic luster, occurs in the Iron

Mountain and Pilot Knob deposits in St. Francois and Iron counties, and at the Pea Ridge Mine in Washington County. It also occurs in association with red hematite in the sinkhole mines or pits of south-central Missouri. Both varieties of hematite make a distinctive vermillion-red streak.

Hematite is used as a red pigment, a polishing agent, and, of course, as an iron ore. Hematite was once the most important iron ore in Missouri, but it is not commercially mined here today. It may be collected from mine dumps or abandoned open-pit mines. Hematite is closely related to limonite, and red hematite specimens often contain limonite.

## **Limonite** (hydrous iron oxide, $FeO(OH)\cdot nH_2O$)

*A common iron oxide mineral*

Limonite is a heavy, yellowish-brown to dark brown iron oxide mineral of variable composition. It commonly forms as a weathering product of other minerals containing iron. Limonite usually has a dull luster and may vary in hardness from chalky or clay-like to almost that of steel. It has a distinctive yellowish-brown streak.

Limonite was once mined as iron ore in south-central Missouri where large boulders, discontinuous beds, nodules and clay-like masses of the mineral are associated with cherty residual clay. Much of the limonite found in Missouri originally formed as pyrite or marcasite, then was chemically changed (by weathering) to limonite; such limonite specimens often contain small remnants of the original pyrite or marcasite.

Limonite specimens may be collected from abandoned workings in Phelps, Crawford, Dent, Howell, Oregon, Wayne and Carter counties. The mineral is common throughout the Ozarks, where it occurs as scattered lumps and boulders in stream gravels and on hillsides.

## **Magnetite** (iron oxide, $Fe_3O_4$)

*A magnetic iron ore mineral*

Magnetite is a widely distributed accessory mineral in igneous and metamorphic rocks. It is strongly attracted to a magnet.

Hard, and black with a metallic luster; magnetite makes a black streak. It is most commonly granular or massive, but also occurs as octahedral crystals.

Magnetite contains 72 percent iron when pure, and is an important ore. Magnetite's magnetic property sets it apart from other iron ores; prospectors can locate ore deposits with instruments that measure magnetic intensity. This process led to the discovery of the large magnetite

deposit at Pea Ridge in Washington County. Magnetite also occurs at Iron Mountain in St. Francois County and at Pilot Knob in Iron County.

## **Pyrite** (iron disulfide, $FeS_2$)

*A common accessory mineral in rocks and ore deposits*

Pyrite is a common, pale-bronze or brass-yellow mineral. It has the same chemical formula as the mineral marcasite, and it often contains small amounts of other metals. The diagnostic physical properties of pyrite are brilliant metallic luster, nonmagnetic, black streak, an absence of cleavage, brittle fracture, and hardness greater than that of a knife blade or nail. It has often been mistaken for gold, which is softer, malleable and much heavier, and so is also known as "Fool's Gold." It commonly crystallizes in cubes (whose faces are sometimes striated), octahedrons, or pyritohedrons, and it also occurs in nodules or in shapeless masses.

Pyrite is the most widespread and abundant of the sulfide minerals and it may occur in almost any kind of rock. Also, it is a common vein mineral that occurs in association with many economically important metallic ore minerals, such as galena, sphalerite, chalcopyrite, gold, silver, etc. Pyrite is an important ore of sulfur, less so of iron, which is used to make sulfur dioxide and sulfuric acid. Pyrite weathers relatively rapidly in the surface environment, reacting chemically with water and atmospheric oxygen to form rust and sulfuric acid. Due to its weathering properties, it is the chief cause of acid mine drainage.

## **Quartz** (silicon dioxide, $SiO_2$)

*A common rock-forming mineral*

Quartz, a common and abundant mineral, is an important constituent of many different rock types. It appears as individual grains in sandstone, as microscopically fine grains in chert, as small crystals in sedimentary rocks, as lustrous, angular grains in granite and rhyolite, and as distinct crystals lining the hollow, spherical bodies of geodes.

Quartz is usually colorless, transparent or translucent, and is harder than glass or steel. Ordinary acids do not attack quartz, and it is relatively unaffected by chemical weathering in Missouri.

Pure quartz sandstone is used in the manufacture of glass. Quartziferous river sand and gravel is used in concrete aggregate and a road material. Quartz occurring as drusy coatings on chert and in large masses is used for rock gardens or as ornamental stone.

Drusy and banded quartz (agate) may be collected in the extensive barite mining area of Washington County, near the towns of Potosi, Mineral Point and Old Mines. The geodes found in extreme northeastern Missouri are almost always lined with quartz crystals.

# IGNEOUS ROCKS

## Granite

*An intrusive igneous rock composed chiefly of quartz and feldspar*

Granite, one of the oldest rocks exposed in the state, is an intrusive igneous rock; it solidified from a large body of hot liquid magma beneath or surrounded by pre-existing rocks. Because they cooled and solidified slowly, most Missouri granites are coarse-grained; the constituent mineral grains – quartz, feldspar, and (less frequently) mica or hornblende – are easily recognized.

Granite may range in color from white, gray, tan or brown to pink or red, but pink and red granites predominate in Missouri. Fine-quality granite is abundant in the southeastern part of the state, particularly in Iron, St. Francois, Madison and neighboring counties. It has long been quarried for building, structural, and monument purposes, as well as for riprap, ballast, aggregate, paving blocks, crushed chicken gravel and other specialized uses.

Collectors may obtain specimens from abandoned quarries in Iron or St. Francois counties, or on the Current River near Van Buren. Weathering and erosion of a massive, fractured granite at Graniteville (Iron County) has produced a group of giant boulders preserved in Elephant Rocks State Park.

## Rhyolite

*An extrusive igneous rock composed chiefly of quartz and feldspar*

Rhyolite, the oldest igneous rock exposed in Missouri, has about the same chemical and mineral compositions as granite, but is extremely fine-grained. It is a compact, hard, brittle rock that breaks with a conchoidal fracture. Missouri rhyolite varies in color from light gray through pink and red to dark purplish-red and almost black; it often has a distinct banded pattern.

Rhyolite exposed in the St. Francois Mountains of southeast Missouri was erupted from ancient volcanoes. It solidified very rapidly, creating a dense, extremely fine-grained rock. Some examples contain scattered larger crystals (phenocrysts) of pink/red feldspar or glassy quartz.

Missouri rhyolite is quarried at Iron Mountain (St. Francois County) for high-quality aggregate. Rhyolite is also quarried at both Annapolis (Iron County) and Piedmont (Wayne County) for making granules for roofing shingles.

# SEDIMENTARY ROCKS

## **Chert** (silicon dioxide, $SiO_2$)

*A sedimentary rock composed microscopic quartz*

Chert, a granular micro crystalline form of quartz, is harder than glass, brittle, and breaks with a smooth, rounded or clam-like (conchoidal) fracture and sharp edges. The term "flint" is essentially synonymous with chert, although flint is more properly used for the darker varieties, while chert is employed for the white, gray or lighter colored varieties. Colors may range from buff, green, gray or blue to red, pink, yellow, brown or black. Although a banded mixture of several colors is very common.

Because it is highly resistant to weathering, chert is the chief constituent of natural stream gravels in Missouri. The loose rock fragments blanketing hillsides in many parts of the state, particularly in the Ozarks, are mostly chert.

Chert was one of the major rock materials used by Native Americans for making arrowheads and other stone tools.

# Coal

*A readily combustible sedimentary rock composed of carbonaceous material*

Coal, a sedimentary rock that will burn, is formed by compaction of altered and decomposed fossil plant material, usually accumulated in ancient swamp-like areas. It is black, often has a glossy luster, and may be either firm and compact or soft and granular. Most Missouri coal is bituminous, but some cannel coal is also present. Bituminous coal occurs in horizontal beds or seams in the northern and western parts of the state and breaks with a blocky fracture. It is commonly layered and commonly contains impurities such as calcite, gypsum, pyrite, marcasite, clay minerals and quartz.

Cannel coal is found chiefly in old sinkhole deposits in central Missouri. It is composed almost entirely of plant spores, fractures conchoidally and has a more massive structure than bituminous coal. Cannel coal burns to a very hot, rather quick fire because of its high volatile content.

Coal mining in Missouri is currently conducted entirely by surface mining methods but was mined historically by underground methods as well. After the coal has been removed, regulations require reclamation of the mined land. Coal is a primary source of energy throughout the world. Missouri's coal is burned at power plants to generate electricity and at limestone kilns to produce cement.

# Conglomerate

*A sedimentary rock consisting of rounded pebbles, cobble, or boulders which are naturally cemented together*

Conglomerate is a coarse-grained, clastic sedimentary rock composed of rounded pebbles, cobbles, or even boulders which are naturally cemented together in a fine-grained matrix of sand, silt, calcium carbonate, iron oxide, silica or clay. Although composition may vary, the pebbles or larger clasts in most conglomerates are composed of chert quartz, or some other hard, resistant rock material.

The Lamotte Sandstone is commonly exposed in the St. Francois Mountains of Missouri and overlies the Precambrian igneous-rock surface. The contact between these units is commonly a conglomerate composed

of pieces of weathered granite or rhyolite and cemented with silica. The Graydon Conglomerate is composed of large rounded cobbles and boulders of Mississippian chert that were redeposited during the Pennsylvanian and cemented with silica.

A similar rock type, breccia, is composed of angular fragments rather than rounded rock or mineral fragments.

## Dolomite

*A sedimentary rock composed mostly of calcium-magnesium carbonate*

Dolomite is a carbonate sedimentary rock that is similar to limestone in occurrence, color, texture and other physical properties, but differs slightly in chemical composition. Limestone is composed mostly of calcium carbonate, whereas dolomite is mostly calcium-magnesium carbonate. The term "dolomite" also applies to a mineral of definite chemical composition, $CaMg(CO_3)_2$. Dolomite (the rock) consists predominantly of the mineral dolomite, but may contain impurities. Dolomite is readily differentiated from limestone by chemical testing. Dolomite effervesces in dilute acid, but only slightly; limestone effervesces vigorously.

"Cotton rock" dolomite is so named because of its light color and chalky or cotton-like appearance. Its crystals or grains are not readily visible because it has such a fine texture. "Cotton rock" is usually an impure dolomite containing abundant clay or fine silt. It effervesces slightly in dilute acid, but the bubbles may be difficult to see because the rock is porous and the acid is mostly absorbed.

Dolomite is one of the most common and abundant rocks in the Ozarks region of Missouri. It is quarried extensively for use as crushed stone and agricultural lime in the southern half of our state. Historically, the Quarry Ledge of the Jefferson City Dolomite formation was used to make dimension stones for buildings in the Ozarks.

## Fireclay

*A heat-resistant, clay-rich sedimentary rock containing a high percentage of aluminum oxide*

Fireclay is a clay-rich sedimentary rock that contains a high percentage of aluminum oxide, which makes it very resistant to the effects of high temperatures. It is usually massive (not

laminated or layered) and fractures into blocky or irregular fragments. Common colors include buff, yellow, red, green or brown. However, good, useable fireclay is usually white, cream-colored, gray, or almost black.

The four types of fireclay (each progressively higher in aluminum oxide or alumina content) are:

***Plastic clay*** is soft and, when wet, has the characteristics of a modeling clay.

***Flint clay*** is compact, smooth, and usually gray, tan or white in color. It will not slake or "dissolve" in water like plastic clay. Most samples in rock sets are flint clay.

***Burley clay*** is similar to flint clay but contains many small, hard, pod-like "burls" which are concentrations of alumina.These burls are hard enough to scratch glass.

***Diaspore clay***, the richest in alumina, is commonly buff colored, earthy and coarse, with burls concentrated in a porous matrix. It is very rough to the touch.

East-central Missouri possesses one of the largest reserves of high-quality fireclay in the world. Most Missouri clays can withstand being heated to temperatures greater than 3000° Fahrenheit without melting. Refractory products made from fireclay are of vital importance to the steel industry as linings in blast furnaces, and to the space program for missile platforms or launching pads. Fireclay is also used as an additive in the manufacture of cement. It reacts with calcium hydroxide as concrete hardens and forms compounds that have the properties of cement.

# Limestone

*A sedimentary rock composed mostly of calcium carbonate (calcite)*

Limestone, a carbonate sedimentary rock, may be relatively pure (composed almost wholly of calcite) or it may have impurities such as clay (argillaceous limestone), sand (sandy limestone) or organic matter. Fossils of marine animals are often preserved in Missouri limestone and are sometimes so abundant that the rock appears to be just a mass of shells or organic fragments. In some limestones, the individual grains are relatively large, while in others the grains are too small to be seen with the naked eye. The color of limestone, which depends on the impurities it contains, may be gray, white, pink, green, bluish-black, black, tan or brown. Because it is composed predominantly of calcite, limestone is easily identified by its vigorous effervescence in dilute acid.

Limestone crops out over large areas of eastern, central and southwestern Missouri. It is quarried for crushed stone to be used as agricultural lime, road-surfacing material, concrete aggregate, and for use as building stone. It is also used for making lime and cement, as a flux in smelting metals from ores, in the manufacture of glass, and as decorative or ornamental stone. The production of limestone contributes about one billion dollars annually to Missouri's economy.

In the building trade, any limestone capable of taking a good polish as well as possessing a pleasing color and texture is called "marble." There are several varieties of limestone in Missouri that are utilized as "marble" for dimension stone.

Because limestone and marble are softer than granite, they can be cut and polished at lower cost. They are, however, susceptible to deterioration from water and abrasion and, for this reason, are most often used for interior decoration rather than as exterior stone. The corridors of the Missouri State Capitol in Jefferson City are paneled with polished slabs of Carthage marble and the historic columns on the campus of the University of Missouri-Columbia are made of this marble.

## Mozarkite

*A red, pink, and/or purple variety of chert with gray and black colors*

Mozarkite is a special variety of chert that is typically red, pink, and/or purple in color and exhibits a banded or mottled pattern. It has won acceptance as a distinctive chert variety by lapidaries throughout the nation because of its unique varied colors and its ability to take a high polish. The name MOZARKITE is a contraction of "MO," for Missouri; "ZARK," for Ozarks; and "ITE," meaning rock.

Mozarkite is most abundantly found as residual masses in soils on hillslopes, along ditches and in roadcuts or excavations. It commonly occurs as nodular masses in the Cotter Dolomite, a sedimentary rock of Ordovician age. Many of the best occurrences are in Benton County in west-central Missouri.

In 1967 the 74th General Assembly designated Mozarkite as the official state rock of Missouri.

## Sandstone

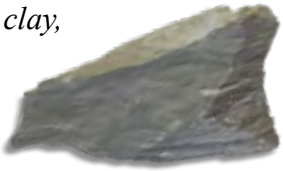
*A sedimentary rock composed of sand-size particles, usually of the mineral quartz*

Sandstone is a sedimentary rock composed of angular or rounded sand grains that are cemented together with silica, clay, iron oxides or calcite. The grains are composed predominantly of the mineral quartz, but any rock or mineral grains of sand size (usually less than 1/16 inch in diameter) may be present. The grains may sparkle from reflections of light from their crystal faces, or they may have dull, frosted surfaces. Sandstones cemented with silica, calcite or clay are generally white or gray, while those cemented with iron oxide are red, brown or yellow. The cements are usually softer and weaker than the particles they hold, and are the first to break when the rock is scratched or crushed, freeing the harder quartz particles.

Sandstone bedrock crops out abundantly throughout Missouri. Commercial uses of sandstone include building stone, flagstone, furnace linings, common aggregate and glass manufacture. Historically, sandstone was used to make circular grinding stone used in mills. In western Missouri, various layers of Pennsylvanian sandstones serve as reservoirs for oil and natural gas.

## Shale

*A sedimentary rock composed of compacted clay, fine silt, or mud*



Shale is a fine-grained sedimentary rock composed of clay, fine silt or mud that has been compacted into solid rock by burial beneath other sedimentary rocks. It is generally smooth to the touch and soft enough to be easily scratched by a copper penny. Shale is usually thin-bedded, layered or laminated, and tends to break along parallel bedding planes. Color varies from gray, green and red to dark brown and black.

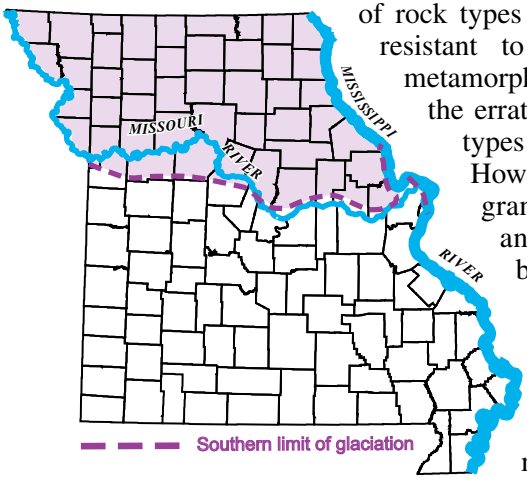
Black shale is commonly associated with coal beds in northern and western Missouri. The black color is due to the presence of carbonaceous material. The Chattanooga Shale crops out in southwestern Missouri. It is a black shale containing kerogen, an organic material that may be processed to produce oil. The kerogen in the Chattanooga Shale occasionally forms oil seeps where the shale is exposed.

Shale is much less abundant in the Ozarks than limestone, dolomite or sandstone. Its chief uses are in the manufacture of Portland cement, brick, tile and ceramics.

# METAMORPHIC ROCK

## Glacial erratic (quartzite)

Northern Missouri is generally void of rock outcrops. This is partially due to a layer of glacial till that has been deposited, sometimes more than 300 feet thick. Before the last glaciers retreated during the ice age, they pushed rocks and soil into Missouri from South Dakota, Iowa, Minnesota, Wisconsin, Michigan and Canada. When the glaciers melted, the rocks and soil remained in deposits of till. The rocks left by the glaciers are called erratics and are found within the till. The size of erratics can range from sand sized particles to boulders the size of cars. The erratics are dominantly composed of rock types that are relatively hard and resistant to weathering. Igneous and metamorphic rocks are common among the erratics. The most common rock types are granite and quartzite. However, erratics composed of granodiorite, diorite, syenite, anorthosite, gabbro, andesite, basalt, greenstone, gneiss, schist and slate may also be found. Occasionally pieces of native copper from Michigan or banded iron formations from Minnesota may be found as erratics.




The sample in this set is an erratic of quartzite. This quartzite is believed to have originated in South Dakota and is known as Sioux Quartzite. It is commonly red to purple and is metamorphosed sandstone.

While the erratics were trapped within glacial ice, they were rubbed against each other, as well as the bedrock they moved over during their journey south. Often, erratics may be found with flattened sides and grooves etched into them from this abrasion.

Photo by Jerry D. Vineyard

The Bairdstown Church Erratic, near Milan, is the largest and most perfectly preserved of any in northern Missouri.

# Notes

**Booklet –** dnr.mo.gov/pubs/pub2815.pdf

**e-Pubs –** share.mo.gov/nr/mgs

**MoDNR Twitter Feed –** twitter.com/modnr

**Geology Website –** dnr.mo.gov/geology

# Missouri Geological Survey

The Buehler Building in Rolla is home to the Missouri Geological Survey, a division of the Missouri Department of Natural Resources. The building is faced with Carthage Marble, a limestone quarried near Carthage, in southwestern Missouri.


**Missouri Departmentof Natural Resources**

**Missouri Geological Survey**

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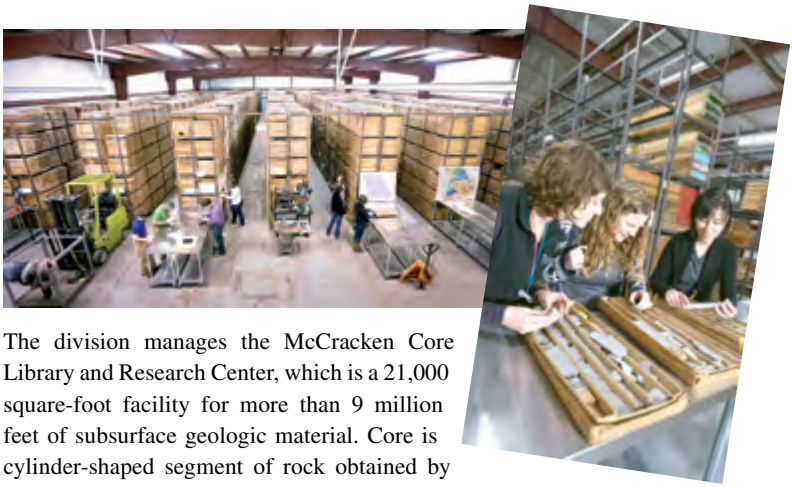
573-368-2100


# McCracken Core Library and Research Center



The division manages the McCracken Core Library and Research Center, which is a 21,000 square-foot facility for more than 9 million feet of subsurface geologic material. Core is cylinder-shaped segment of rock obtained by using a hollow-core drill. Core research and examination preserves geological history, leads to a better understanding of Missouri geology and hydrology, and yields data useful in solving environmental, industrial and engineering problems.


MISSOURI DEPARTMENT OF NATURAL RESOURCES

Missouri Geological Survey

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