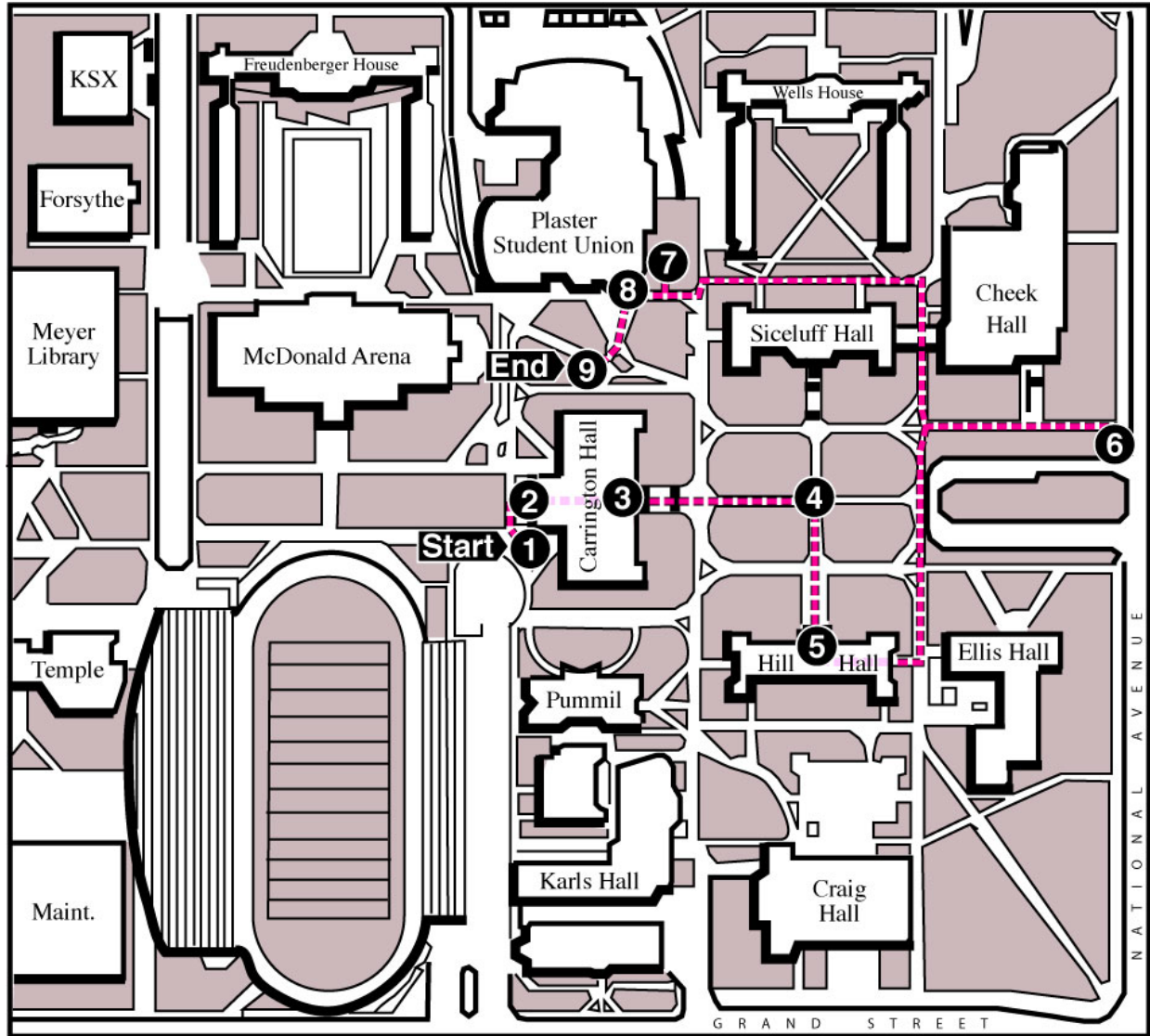




# Missouri State

UNIVERSITY

## FIELD TRIP GUIDE TO THE GEOLOGY OF MSU'S SPRINGFIELD CAMPUS



**This walking tour of the Missouri State University campus highlights rocks and minerals used for construction of historic and more recent buildings. The map above traces a route through the older part of the campus. It begins at the southwest corner of Carrington Hall.**

Distance: Approximately 0.5 miles (0.8 km)

Time: 30-45 minutes

### Stop 1 West Face of Carrington Hall

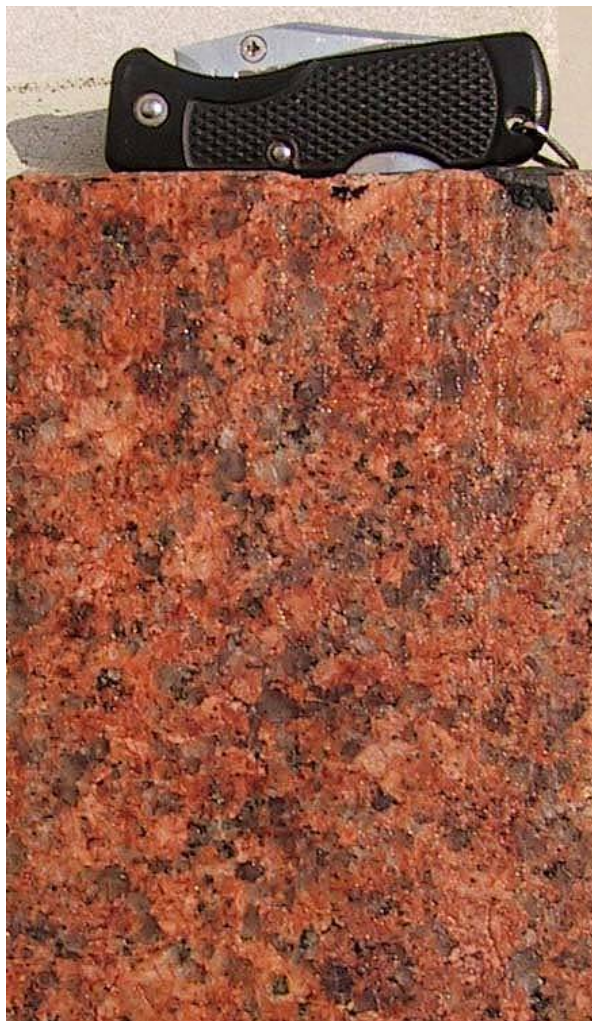
Carrington Hall, constructed in 1908, was the first building on campus. When the University was founded in 1905, classes were held in a building near Cherry Street and Pickwick Avenue, a few blocks northeast from here.

Carrington Hall is mostly constructed with a building stone known as “Carthage Stone” or “Carthage Marble”. This material is sometimes referred to as dimension stone.

The rock type is actually a *limestone* that was quarried near Carthage, Missouri. Limestone is a sedimentary rock made from the mineral *calcite* (chemical formula  $\text{CaCO}_3$ ). This limestone is particularly fine grained (it has very small particles of calcite). If you look carefully at the cut faces of this building stone, you will find fossils in it (you will see some larger fossils at other stops). Carthage Stone is Mississippian in age or about 340 million years old.

The foundation of Carrington Hall is very different. It is made from *granite*, an igneous rock. Builders refer to this stone as “Missouri Red”. Red granites are primarily composed of the minerals *potassium feldspar* ( $\text{KAlSi}_3\text{O}_8$ ) and *quartz* ( $\text{SiO}_2$ ). Missouri Red is particularly red because of the trace amounts of iron in it. This granite is coarsely crystalline; that indicates it formed deep within the Earth, where it cooled very slowly. The feldspar crystals are pink and red, and the quartz, which does not have very well defined crystals, is light gray and translucent. You will also see black flecks of material in it as well. These are called accessory minerals; they may include *hornblende* or *biotite*, a kind of platy mica mineral. At about 1.5 billion years in age, Missouri Red is among the oldest rocks exposed in the state. Large outcrops of this granite are exposed in Elephant Rocks State Park in the St. Francois mountains of southeastern Missouri.

Proceed to the center entrance on the west (back) side of Carrington Hall and enter through the double doors.



“Missouri Red” is quarried in southeastern Missouri near Graniteville.

### Stop 2 Center Entrance West Side of Carrington Hall

Just past the foyer, look carefully at the black border surrounding the floor. Do you notice any strange shapes in this material? The light gray and translucent materials that form coils or spirals are fossil snails (gastropods). This is a sedimentary rock; in fact, it is limestone also. Isn't it amazing that limestone can vary so much in color and texture? We do not know the location from which this limestone was quarried.

Proceed to the front of the building. You will find that many of the floors in Carrington Hall are made of artificial rock. This material contains crushed rock fragments that are bound together by

mortar and resin. It makes a very durable flooring material.

### Stop 3 Front (East) Entrance of Carrington Hall

The steps and decorative spheres on the grand staircase are made of the rock *marble*. Marble is a metamorphic rock that also is composed of the mineral calcite. Marble is formed from limestone that has been changed by heat and pressure. Marble typically is formed near the roots of mountains or near igneous rocks that give off heat as they cool. Extreme heat and pressure can completely recrystallize limestone so that fossils and other sorts of rock textures are unrecognizable. Notice how the marble steps are worn. Marble is not very resistant to wear because the mineral calcite only has a hardness of three on Moh's scale. In contrast, diamond has a hardness of ten on Moh's scale, but the tax-paying citizens of Missouri might object to diamond stairs.

Walk eastward through the main entrance to Carrington Hall. Once outside, find your way to the center of "the quad".

### Stop 4 Cornerstone

This cornerstone was on the original structure that housed the District 4 Normal School, the school that eventually evolved into Missouri State University. The cornerstone is composed of limestone, as are Hill Hall, to the south, and Siceluff Hall, to the north. Notice the hand-sculpted faces, where you can see the rough-cut marks of the stonemasons. On the faces of this rock you will also see many fossils. "Carthage Stone" is the main building stone used for public buildings on campus, but the cornerstone looks similar to another type of limestone quarried in southwest Missouri.

One of the main quarries near Springfield was the Phenix (no, it is not misspelled) Quarry near Walnut Grove. The quarry operates intermittently; some of the limestone quarried there is composed of tiny spherical pellet-like particles known as *oöids* (meaning "egg shaped"). "Phenix Stone" is not common on the SMSU campus, but many of the houses in Springfield use it as a facing stone. Polished Phenix Stone was used to decorate the second floor of the Missouri State Capitol

Building in Jefferson City. "Phenix Stone" is also Mississippian in age. Three different rock units were quarried at Phenix: the Burlington-Keokuk formation (for the adventurous, a block of the Burlington-Keokuk rests on the lawn at the southeast corner of Temple Hall), the Short Creek Oölite, and the Warsaw Formation.



Cornerstone of the building where classes for the District 4 Normal School were first taught.

For the next stop, walk south and enter Hill Hall. By the way, the tree that you are passing on the right is a redwood, a variety that was first described from 30 million year old strata on the West Coast of the United States. Younger fossils were discovered from Japan in 1941, and in 1944 a forester shocked the world by finding a grove of living "dawn redwoods" (*Metasequoia glyptostroboides*) in a remote area of China. Dawn redwoods are cousins of the California coast redwoods (*Sequoia sempervirens*) and the giant sequoias (*Sequoiadendron giganteum*) of the Sierra Nevada. Dawn redwoods were planted on

the SMSU campus to help protect this species from possible extinction.

### Stop 5 Staircase in Hill Hall

Hill Hall was constructed in 1924. The steps and facing on the main staircase are slabs of polished limestone. Limestone commonly accumulates in shallow tropical to subtropical seas. Since these stones were quarried in Missouri, it means that shallow seas once covered Missouri, and at that time, nearly 340 million years ago, Missouri was near the equator. Plate tectonic movements have caused North America and other continents to shift across the face of the Earth through time to higher latitudes.

If you look closely at the polished rock faces, you will see fossils and strange black lines that run across slabs. The lines are called *stylolites*. They indicate that this rock was once buried and some of the material that accumulated as sediment later dissolved, leaving behind a dirty residue as the rock compacted unevenly.

Continuing the tour, walk out the east doors of Hill Hall. Ellis Hall, the building ahead of you, was faced with Carthage Stone. Turn left and walk north then east around the circle drive toward the southeastern corner of Cheek Hall. The next stop is on the curb at the entrance to the circle drive. Watch carefully for traffic at this stop.

### Stop 6 Benchmark

Following World War II, a major effort was initiated to map the entire United States. Several hundred “field men” with the U.S. Geological Survey (USGS) surveyed and mapped the country in extraordinary detail. The round metal tablet mounted on this curb is a USGS benchmark. Benchmarks were placed at locations of precisely known elevations; the elevation at this spot, shown on the Springfield, MO 7.5’ quadrangle, is 1,313 feet (400.2 m). This and other benchmarks have been used to establish second-order elevations at intersections and other features across Springfield.

Return to the walkway between Cheek Hall and Siceluff Hall. Siceluff Hall was completed in 1927. It was the original science building on campus. Cheek Hall was the University Library

until the late 1970’s. Continue on between Siceluff Hall and Wells House. On the south end of the west wing of Wells House, notice the material that was used for facing stone. It’s made of concrete slabs and Carthage Stone. Concrete commonly contains brown quartz sand grains that give it a rougher finish than cut Carthage Stone. Carthage Stone, of course, has fossils in it.

Concrete is an artificial rock. It is made with Portland or masonry cement (a product made from the heating of limestone), clays (made from shale, a sedimentary rock), sand (mostly from riverbeds), and aggregate (made of gravel or crushed rock, including limestone). Because of its use in building, aggregate is the number one mineral resource both monetarily and volumetrically in the world.

Continue west on this walkway toward Plaster Student Union.

### Stop 7 Memorial Garden

Two quite different rock types can be seen in the Memorial Garden.

The large black disk is a rock that builders refer to as “black granite” (see photo on back page). The geological term for this rock is *gabbro* (pronounced GAB-bro). Like granite, gabbro is an igneous rock that formed deep within the Earth, where it cooled very slowly. Note the large crystals. In contrast to granite, gabbro contains dark silicate minerals such as *plagioclase feldspar* ( $(\text{Na,Ca})\text{Al}_{1-2}\text{Si}_{3-2}\text{O}_8$ ) and *pyroxene* ( $\text{Ca}(\text{Mg,Fe})\text{Si}_2\text{O}_6$ ). The variety of plagioclase feldspar in this stone is known as *labradorite* (named after the Canadian territory famous for water retriever dogs). Labradorite has a sort of iridescent color.

Gabbro is one of the main rocks that forms ocean crust. Gabbro commonly is emplaced deep within the crust at mid-ocean ridges. Granite is much more common in continental crust. The nearest gabbro exposures are in southwestern Oklahoma, an area that was near the edge of the North American continent between 300-500 million years ago.

The stones that form the ramp that leads to the gabbro monument are *sandstone*. Sandstone is a sedimentary rock; that is, it consists of tiny particles (sand grains) that were deposited as sediment and then cemented together. This

sandstone is yellow-brown in color, but sandstones can be red, white, green, gray, and black. The coloration of this sandstone is due to the oxidized iron in it. It looks like rust, but it is known as the mineral *limonite*. The dominant grains in this sandstone are *quartz* sand particles.

This sandstone is Pennsylvanian in age, about 300 million years old. Quarries in northwestern Arkansas ship this material into southwestern Missouri because it is fairly inexpensive and needs little preparation before it is set in rustic landscaping like on the south end of Plaster Sports Complex or in lodge-like buildings like Bass Pro Shops Outdoor World.

To continue the tour, walk over to the southeastern doors on Plaster Student Union.

### Stop 8 Fossil Hash and Crystal Mash

Notice the shelf-like slab on the right side of this entrance. Many students may dine in Plaster Student Union, but when the rocks were deposited, animals fed on plankton. In this slab you can see several fossils, including *Archimedes*, a bryozoan that is shaped like a long corkscrew, and a pecten, a single valve of the bivalve mollusk. The pecten is the symbol that Shell Oil uses on their signs.

Fossils are one of the key ways that we can determine the ages of rocks. Because of evolution, the forms of animals that are preserved in rock commonly go extinct or give rise to new species. The successions of fossil fauna preserved in sedimentary rocks, together with other key principles of geology, allow paleontologists and geologists to determine relative ages of strata.

The steps leading into this southeastern entrance to Plaster Student Union look similar to the granite we saw earlier in the foundation of Carrington Hall. In fact, it is a type of granite known as *granite porphyry*. The only difference between this and regular granite is that this rock has a mixture of large and small crystals, a sort of hodge-podge crystal mash. This distribution of different crystal sizes indicates that it had two phases of cooling and crystallization.



*Pecten bivalve in Carthage Stone.*

Proceed to the double doors at the southwest entrance of Plaster Student Union.

### Stop 9 Dolomite Rocks

As you approach the sandstone embankments along this walkway, you will also see some large gnarly rocks that are placed on some of the hillocks. This is a rock known as *dolomite*, composed of the mineral *dolomite* ( $\text{CaMg}(\text{CO}_3)_2$ ). Dolomite is similar to limestone, except that it contains magnesium. This makes it slightly harder, but a particularly ugly rock. This dolomite is Ordovician in age, about 450 million years old. It crops out over parts of southwestern and southeastern Missouri, where it is a rock unit known as the Jefferson City-Cotter Dolomite. This marks the end of the field trip.

### Summary

Geology is the study of the Earth. It focuses on the 4.6 billion-year old history of Earth and on the formative processes that affect life on the planet. Geologists address societal concerns, such as geologic hazards (i.e. earthquakes, volcanoes, mass wasting, and surface and ground-water contamination), as well as natural resources, like the ones that have been used in building the MSU Springfield campus. We depend on natural resources for construction projects. Rocks and minerals are also essential for the development of soils and enrichment of the inorganic nutrients

that plants need. If products can't be grown, then they must be mined, quarried, or extracted from the Earth. Consequently, we are stewards of these natural resources and the decisions we make will affect the lives and livelihood of our children and our children's children. Let us strive to be wise stewards of these resources.

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*Written by*  
Dr. Kevin R. Evans  
*Department of Geography, Geology & Planning*  
*Missouri State University*

*Edited by*  
Dr. James F. Miller  
*Department of Geography, Geology & Planning*  
*Missouri State University*

Dr. Thomas G. Plymate  
*Department of Geography, Geology & Planning*  
*Missouri State University*



*Gabbro monument in the MSU Memorial Garden.*

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*Missouri State University*



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