BEDROCK GEOLOGY
OF THE
CAPE GIRARDEAU-MCCLURE QUADRANGLES,
SOUTHEASTERN MISSOURI

by

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INTRODUCTION

The area within the Cape Girardeau and McClure Missouri-Illinois 7 1/2-minute Quadrangles is in Cape Girardeau County, southeastern Missouri, on the eastern flank of the Ozark uplift and the southwestern boundary of the Illinois basin. The rock strata have a regional northeast dip of 2 to 4 degrees. There are 14 formally recognized Paleozoic formations in the study area and 12 mappable formations; because of their thinness, the Decorah Formation and Cape Limestone were mapped with the Plattin and Kimmswick Formations, respectively. The outcropping formations comprise approximately 1850 ft of rock strata. Excluding Mississippi River alluvium, 0 to 35 ft of surficial deposits blanket most of the area.

Over 1400 field control points, many field observations, and 65 water-well logs were used in constructing the map. Aerial photographs aided in making field and office compilations at a scale of 1:24,000 resulting in the first published geological map of the area since Shumard (1873). Due to the complexity of the area, field work was done during winter field seasons, except for a small portion of the southwestern part of the Cape Girardeau Quadrangle (delineated on the map). Quality of field control in this mapped area is considered somewhat poorer than that for the rest of the area.

The writer is grateful for the aid of James A. Martin in familiarizing him with units of the Champlainian Series in the study area, and thanks Thomas L. Thompson for his field visitations and comments.

GEOLOGY

Twelve Paleozoic formations were mapped; they range in age from lower Champlainian (Ordovician) to Lower Devonian and comprise approximately 1850 ft of strata. All rocks in the area are of marine sedimentary origin, consisting of shale, limestone, dolomite, quartz sandstone, clay, and chert. In ascending order, the recognizable formations are the Joachim Dolomite, Pecatonica Formation**, Plattin Formation (including the Decorah Formation), Kimmswick Formation (including the Cape Limestone, an unnamed shale unit**, Thebes Sandstone, Orchard Creek Shale, Girardeau Limestone, Sexton Creek Limestone, McClure Limestone**, Moccasin Springs Formation**, and the Bailey Formation. Templeton and Willman's (1963) divisions of the Joachim, Pecatonica**, and Plattin were used in mapping.

Joachim Dolomite: This formation consists of interbedded dolostone and limestone, with a maximum thickness of approximately 275 ft in the Cape Girardeau area. The basal part is generally thick bedded, with occasional thin beds and traces of shale. A yellow to brown, massive quartz-sandstone bed with a thickness of slightly less than 4 ft has been recorded approximately 20 ft above the base. The upper portion of the Joachim is thin bedded, with some shaly beds. Gray to dark-gray laminated lithographic limestone with occasional dome-shaped algal structures is present in the upper 75 to 100 ft. The limestone is very similar to that in the Pecatonica and Plattin Formations. The dolostone beds are usually buff to light brown, porous, and silty, with red iron-oxide stains.

In southeastern Missouri, the Joachim Dolomite is underlain by the Dutchtown Formation. Their approximate contact interval can be observed just north of Highway 74, where the Cape Girardeau and the Gordonville Quadrangles border one another. A contact was not observed, although Templeton and Willman (1963) report a possible diastem between the Dutchtown and Joachim. The contact of the Joachim with the overlying Pecatonica was also not observed, but their similar lithologies above and below the contact zone suggest a conformable relationship.

Exposures of the Joachim can be observed in the bluffs along Highway 74, in the southwestern part of the study area.

Pecatonica Formation**: The Pecatonica consists of dolomitic limestone and limestone, with an approximate maximum thickness of 140 ft. It is thick bedded, light gray to gray, fucoidal, lithographic, partly cherty, platy, and partly fossiliferous, with some wavy argillaceous partings.

Although thick beds are not uncommon, many beds near the base are platy, some with a petroliferous odor. The chert, usually black, is essentially confined to the upper third of the formation, although minor amounts have been observed in the lower part.

The Pecatonica appears to be slightly unconformable with the overlying Plattin Formation. Templeton and Willman (1963) reported a regional diastem between them. At present, the Pecatonica is best exposed in a quarry operated by Southeast Stone Company in the northwest corner of sec. 24 and southwest corner of sec. 13 (projected), T. 30 N., R. 13 E. Another fairly good exposure of the formation can be observed along its outcrop belt in the upper reaches of Ramey Branch.

Plattin Formation: In the study area, the Plattin reaches a maximum thickness of about 440 ft. It is a light-gray to dark-gray, thick- and thin-bedded, slightly dolomitic, fossiliferous limestone. Black chert is not uncommon and appears to be more abundant near the middle and upper thirds of the formation, along with fucoidal structures. Wavy shale partings are moderately common throughout the formation. Oolitic and conglomeratic beds, which occur approximately 20 ft from the base and are overlain by a green shale unit are marker beds for field work. Excellent sections of the Plattin Formation are exposed in the Marquette and Federal Material (Southeast Stone Company) Quarries in sec. 18 (projected), T. 30 N., R. 14 E.

Due to the thinness (approximately 12 to 15 ft) of the Decorah Formation in the Cape Girardeau area, it was mapped with the upper part of the Plattin.

Highly calcareous, green and rust-colored shale, with abundant interbedded, thin, argillaceous limestones characterize the lithology of the Decorah. It is unconformable with the over and underlying formations, as reported by Templeton and Willman (1963).

Kimmswick Formation: The Kimmswick in the Cape Girardeau area is a grayish-white to pinkish, mostly coarsely crystalline fossiliferous, thick-bedded limestone, with a maximum thickness of approximately 150 ft. Some beds have pitted, weathered surfaces. The formation has a "pure" look about it, but there are a few beds that are lithologically similar to the Plattin.

The Cape Limestone, mapped as the top of the Kimmswick, is medium-gray to dark-gray, calcarenitic, fossiliferous, and thick bedded, with a maximum thickness of 8 ft 2 in. It is unconformable with the under- and overlying strata.

The Kimmswick is best observed in the vicinity of the Cape Girardeau Bridge (Highway 146), which crosses the Mississippi River. The Cape Limestone may be observed at its type section on the west side of Main Street, just north of Broadway, in Cape Girardeau. For additional information concerning the Cape Limestone, see Sweet, Thompson, and Satterfield (1975).

Maquoketa Group**: The Maquoketa Group comprises four formations. In ascending order these are, an unnamed shale unit, Thebes Sandstone, Orchard Creek Shale, and the Girardeau Limestone. The group consists of shale, limestone, quartz sandstone, and chert, with a combined maximum thickness of about 200 ft.

Unnamed Shale Unit**: Stratigraphically, this unit is between the underlying Cape Limestone-Kimmswick Formation and the overlying Thebes Sandstone. It consists mostly of green and light-brown calcareous shale, but thin beds and nodules of light-bluish-gray argillaceous limestone are also present. The unit is fossiliferous and has a maximum thickness of about 50 ft. A slight diastem probably exists between it and the overlying Thebes Sandstone. A good exposure of the unit can be seen in the SW 1/4 SW 1/4, sec. 13, T. 31 N., R. 13 E., on the southeast bank of Cape LaCroix Creek.

Thebes Sandstone: The Thebes is a grayish-brown to brown, very fine-grained, slightly calcareous, thick- and thin-bedded, argillaceous quartz sandstone with subangular to subrounded grains. The thick beds appear to be confined mostly to the lower part, whereas the thin slabby beds occur in the upper. The formation has an approximate maximum thickness of 60 ft in the area mapped, although as much as 100 ft was reported by Worthen (1866), at the type section across the Mississippi River, at Thebes, Illinois.

The contact of the Thebes with the overlying formation was not observed in the area mapped, but has been observed across the Mississippi River in Alexander County, Illinois. There appears to be a sedimentary break, although well cuttings in the Cape Girardeau area suggest the Thebes grades into the overlying shales.

The basal 5 ft of the Thebes Sandstone is exposed at the same locality as the underlying shale unit. Another good section is exposed in SE 1/4 sec. 14, T. 31 N., R. 14 E., along the St. Louis-San Francisco Railroad.

Orchard Creek Shale: The Orchard Creek mostly comprises alternating beds of shale and limestone, with an approximate maximum thickness of 60 ft (suggested by water-well data in the area mapped). The shales are olive green to bluish gray, calcareous, slightly fossiliferous, and mostly weather light brown. The limestone is mostly finely crystalline, irregularly thin bedded, and argillaceous; fossils are not uncommon. The shales are more abundant in the lower portion of the formation; limestones dominate the upper part.

Good exposures of the Orchard Creek are not common. Due to its low resistance to erosion there are sparse exposures in the headwaters of Sloan Creek, in NE 1/4 sec. 30 and SE 1/4 sec. 19, T. 31 N., R. 14 E. The Orchard Creek Shale grades into the overlying Girardeau Limestone (Satterfield, 1971).

Girardeau Limestone: This formation, a medium-gray to dark-gray sublithographic to finely crystalline limestone, occurs in discontinuous, thin to medium-thick irregular beds interbedded with 1/8- to 1-in.-thick, yellowish-brown laminated calcareous shale beds. Due to more rapid erosion of the shale beds than of the associated limestone beds, the Girardeau has a unique weathered appearance. A maximum thickness of 33 ft was measured at its type section, in W 1/2 NE 1/4 SE 1/4 sec. 28, T. 31 N., R. 14 E., along the west bank of the Mississippi River, and along the St. Louis-San Francisco Railroad.

In the lower half of the formation, the limestone beds become argillaceous, and the laminated shale layers give way to shale beds very similar to the upper part of the Orchard Creek Shale below. In the upper half, the limestone becomes more finely crystalline, the laminated shale beds become thinner, and there are minor amounts of bluish-black chert.

The best, most accessible section of the formation is at its type section (cited above). The contact of the Girardeau with the overlying strata is everywhere unconformable (Satterfield, 1969, 1971; Thompson and Satterfield, 1975).

Sexton Creek Limestone: The Sexton Creek mostly comprises alternating fossiliferous limestone and chert, with a combined thickness of 54 ft at its type locality, in Alexander County, Illinois. The approximate maximum thickness of the formation in the mapped area is 35 ft. The Sexton Creek can be subdivided into three units. The basal unit, 5 to 15 ft thick, comprises light-brownish-gray, medium-crystalline, thick-bedded limestone, with an occasional trace of glauconite and chert. The limestone in the middle unit is lighter colored, and the beds are generally thinner, usually separated by light-bluish-gray and caramel-colored chert beds; the thickness varies from 10 to 20 ft. Weathering of the limestone and chert beds in the middle unit is quite characteristic in natural exposures. The limestones of the upper unit are lighter gray than those of the other units; there is abundant glauconite, occasional gray-green shale partings are present, and the ratio of limestone to chert is similar to that of the lower unit, or slightly less.

This formation is unconformable with the overlying McClure. An excellent section of the Sexton Creek can be viewed overlying the Girardeau Limestone at the type section of the Girardeau.

Bainbridge Group**: The Bainbridge Group is probably the most easily recognizable unit in the mapped area. Its dominant characteristic is its color: earthy brick-red, usually accompanied by greenish grays and purples.

Because of lithologic differences between the basal and upper portions, the Bainbridge has been mapped as two formations: McClure Limestone and Moccasin Springs Formation. This division of the Bainbridge is basically the same as that made by Lowenstam (1949); the McClure and

Moccasin Springs are correlative with his St. Clair Limestone and Moccasin Springs Formation, respectively. The thickness of the Bainbridge Group is greater northward and eastward; an approximate maximum of 150 ft appears to be present in the mapped area.

McClure Limestone**: This basal unit is a light-gray to pinkish-red, thick-bedded, stylolitic biomicrite and biosparite, with a maximum thickness of 35 ft in the area mapped. Insoluble residues contain an abundance of arenaceous foraminifers, of which Ammodiscus is the most common; Bathysiphon psammosphaera is also present. Phosphatic inarticulate brachiopods (Artiotreta parva and Acrotretella siluriana) also occur (Satterfield and Thompson, 1969).

There is a thin, green and brick-red calcareous shale at the base of this formation; normally it is less than 1 ft thick. This shale, the Seventy-Six Shale of Satterfield and Thompson (1975), is highly glauconitic and contains hematitic "buttons," probably the remains of fossil algae referable to "Girvanella." For additional information concerning this shale, see Satterfield and Thompson (1975).

The contact of the McClure with the overlying Moccasin Springs appears conformable. Complete exposures of the McClure are not common; a partial exposure occurs in SW 1/4 sec. 18, T. 31 N., R. 14 E., along the southeastern bank of Juden Creek.

Moccasin Springs Formation**: The Moccasin Springs is easily distinguished from the underlying McClure, not only by its color (greens and purples in addition to the reds), but also by its abundant shales and argillaceous limestones. The formation is about 100 to 120 ft thick in the mapped area.

Recognizable units can be distinguished within this formation (Satterfield, 1968). Strata of the lower part are almost entirely earthy brick-red and greenish-gray calcareous shales in irregular thin beds, although purple mottling is not uncommon. The middle unit is fossiliferous and is characterized by alternating limestones and shales. The latter somewhat resemble shales in the lower unit, although they are not as argillaceous. The limestones are predominately earthy brick red in color, although a greenish gray is also common. Some limestone beds are thick-bedded and ledge formers. The upper unit is an irregularly bedded greenish-gray calcareous shale, with slight red and purple mottling. At the base of this unit is a 3- to 5 ft-thick black laminated shale containing abundant graptolites (Berry and Satterfield, 1972) and spores. Although abundant, the graptolites (several species of Monograptus, and linograptid fragments) are sparsely distributed throughout the unit.

In southeastern Missouri, there appears to be no sedimentary break between the Moccasin Springs and the overlying Bailey Formation. There are good exposures of the Moccasin Springs along Scism and Juden Creeks in the northeastern part of the map area; an excellent one is in a fault block along Interstate 55, in the extreme northwestern corner of the mapped area.

Bailey Formation: The Bailey Formation in the mapped area is atypical. The limestones that are interbedded with chert beds in most of the formation's outcrop belt are absent; instead there are red clays and shales. The chert is thin to thick bedded, white to grayish white and chalcedonic or tripolitic; red and purple staining is common.

Water well records indicate the Bailey is at least 300 ft thick in the area. Many outcrops are in hills in secs. 8, 9, 16, 17, 21, and 22, T. 31 N., R. 14 E.

Recent Mississippi Valley Alluvium: No attempt was made to differentiate recent Mississippi River alluvium. It is mapped as a single unit (unit zero on map). Fisk (1944, pl. 8), reported Mississippi River alluvial deposits up to 150 ft thick in the Cape Girardeau area.

STRUCTURE

The mapped area is on the eastern flank of the Ozark uplift, north of the Mississippi Embayment and west southwest of the Illinois basin. The regional dip varies from 2 to 4 degrees, except locally, where dips of 90 degrees have been recorded.

Approximately 165 faults have been noted in the map area, most of which are considered normal faults. The author, however, suspects some may have resulted from strike-slip movement. There are several additional faults in the Plattin outcrop belt, but due to thicknesses and similarity of lithologies throughout, they were difficult to establish.

Faulting as recent as Holocene is suggested, but see McCracken (1971) for more information on age of faulting.

**Names not formally recognized by the Missouri Geological Survey.

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