

THE CHOUTEAU FORMATION OF ILLINOIS*

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The Chouteau formation of Illinois is a distinctive limestone of early Mississippian age which underlies most of the southern half of the state. It is commonly 10 to 30 feet thick. The formation crops out along the western edge of Illinois in Jersey and Calhoun counties; from there it dips to 4500 feet below sea level in the center of the Illinois basin. Stratigraphic variations, criteria for subsurface recognition, distribution of silt and dolomite, and lateral changes in color are described in this study.

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PREVIOUS STUDIES

Swallow (1854, pp. 101-102) named the formation for Chouteau Springs, Cooper County, Mo. Near this town he described a 70-foot section of 40 feet of brownish-gray earthy thick-bedded dolomitic limestone which grades downward into 30 feet of fine-grained compact thin-bedded fossiliferous limestone. Meek and Worthen (1861, p. 167) called an eastern exposure of this limestone the "Rockford goniatite bed" after an outcrop near Rockford, Jackson County, Ind. They reported

several species of fossils from this bed to be identical to those found in the Chouteau formation of Illinois and Missouri. Kindle (1899) modified "Rockford goniatite bed" to Rockford limestone. Moore (1928, p. 33) suggested restricting the term Chouteau to the lower portion of Swallow's section. He proposed the named Sedalia for the upper magnesian portion. Workman and Gillette (1947) drew an isopachous map and showed by cross sections that the Chouteau and Rockford are the same formation. Branson (1944, pp. 189-208) did not recognize Moore's subdivision of the Chouteau. He considered the Sedalia and Weller's (1909, p. 265) Fern Glen formation to be members of the Chouteau formation. In Illinois the Chouteau limestone is considered the uppermost formation in the Kinderhook group.

SOURCES OF DATA

In the present study, microscopic examinations of sample cuttings of the Chouteau from approximately 500 wells which penetrate the formation in Illinois were made to determine thickness, depth, and lithology. Electric logs, drilling-time logs, or radioactivity logs are available for many wells, and these were compared to determine accurate thicknesses and depths of the Chouteau limestone.

Twenty outcrops in Jersey, Calhoun, and Pike counties of southwestern Illinois and in Pike, Lincoln, and St. Charles counties of

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eastern Missouri were visited, and 138 representative samples were studied in the laboratory. Insoluble residues of all the samples were also studied.

The thickest exposure of Chouteau in Illinois crops out in Jerseyville Hollow, Jersey Co., NE $\frac{1}{4}$ sec. 10, T. 6 N., R. 12 W., where 55 feet of Chouteau is exposed. There it is overlain by Burlington limestone and underlain by Hannibal siltstone and shale.

In the bluffs of the Mississippi River, near Chautauqua, Jersey Co., Ill., NE $\frac{1}{4}$ sec. 13, T. 6 N., R. 12 W., a 20-foot exposure of the Chouteau was studied. The Chouteau is overlain unconformably by approximately 15 feet of massive crinoidal dolomitic limestone similar to that called Sedalia by Moore at Frenchman's Bluff, six miles northeast of Troy, Lincoln Co., Mo. Overlying this limestone with apparent conformity are approximately 20 feet of red and green Fern Glen shales, and they are overlain by the Burlington limestone.

At an outcrop near Castlewood, Mo., 18 miles southeast of St. Louis, Branson (1944, p. 199) described approximately 50 feet of "Chouteau" with the Fern Glen shales included as a facies near the base of the formation. The lower 10 feet of Branson's "Chouteau" is lithologically similar to the Sedalia as defined by Moore (1928, p. 33). Overlying conformably are the red and green Fern Glen shales which grade upward into the Burlington limestone. The Chouteau is absent, and a marked unconformity exists between the Sedalia and the underlying Bushberg formation.

The outcrops of Chouteau in Calhoun and Jersey counties of Illinois and in nearby Missouri show a decided thinning to the north.

LITHOLOGY

Bedding and texture.—In outcrops in Illinois the Chouteau formation is composed of irregular beds of limestone which normally range from a few inches to slightly less than a foot thick. Dark gray or black chert nodules form continuous bands 3 to 6 inches thick or disconnected lenticular masses. Geodes 1 to 8 inches in diameter and filled with calcite occur at various intervals. The texture of the Chouteau ranges from sublithographic to very fine-grained with scattered coarse crinoid fragments. Where this formation is a dolomite or dolomitic limestone, the fossils are generally absent and the texture is very fine-grained and saccharoidal rather than sublithographic.

Color.—The Chouteau formation

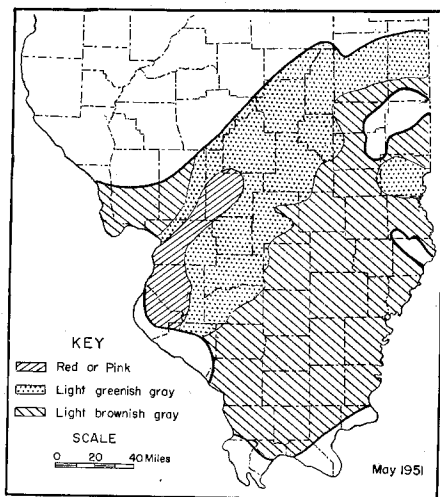


FIG. 1.—Distinctive colors of the Chouteau limestone.

is generally light brownish gray throughout southeastern Illinois and in the outcrop area of Jersey and Calhoun counties of western Illinois (fig. 1). In Wayne and Hamilton counties, the deepest part of the present Illinois basin, the limestone is dark brown. Between the areas of brownish limestone the Chouteau section is normally light greenish gray. In a narrow strip extending northeastward from the Ozark region, well cuttings show part or all of the Chouteau section to be red or

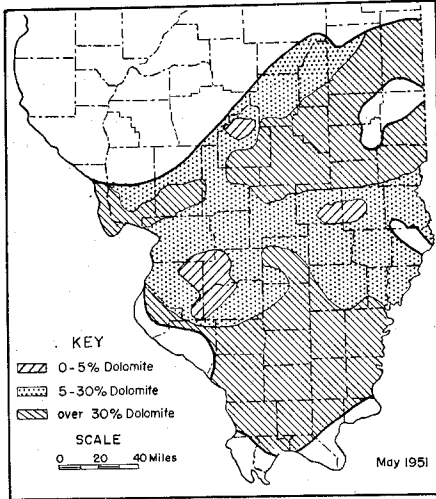


FIG. 2.—Dolomite content of the Chouteau limestone.

pink. The colors are primarily in the groundmass, although some of the crinoid stems also display the red and green tints. Locally some beds of the Chouteau are nearly white. The dolomitie layers become rusty brown when exposed to weathering, while the dense limestone retains its original grayish-brown color.

Dolomite.—The Chouteau formation contains some dolomite almost throughout it (fig. 2). Where ob-

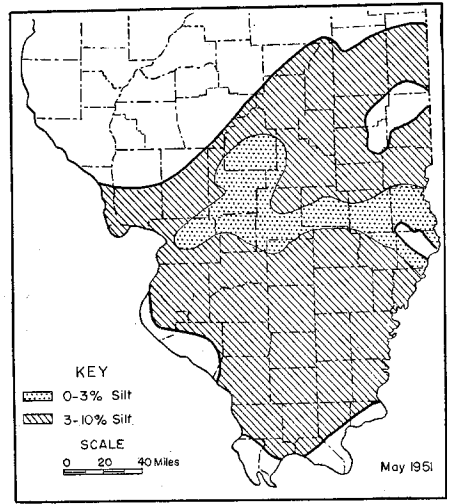


FIG. 3.—Silt content of the Chouteau limestone.

served in outcrops, the dolomite is concentrated in layers seldom over a few inches thick. Silt-size dolomite crystals, however, are present throughout the dense limestone and are occasionally found in the chert nodules. Fossils are not abundant in the dolomitie layers.

Silt.—In Illinois the insoluble silt content of the Chouteau limestone has remarkably even distribution (fig. 3). Although silt-size particles are present nearly everywhere in the formation, they are not known to exceed 10 percent. Insoluble residues of outcrop samples indicate an increase of silt toward the base of the Chouteau.

Chert nodules.—Chert in the Chouteau coincides with the thickest deposits of the formation. The limestone sections in Illinois and Missouri which contain nodular chert vary in thickness from 30 to 100 feet. Throughout most of Illinois, where the average thickness is 20 feet, no chert has been found.



FIG. 4.—Geologic cross section of the Chouteau limestone across Illinois.

The chert is nodular, black to gray and flinty. It encloses dolomite crystals and numerous small fossils. Normally the nodules comprise continuous bands from 3 to 6 inches thick. The chert zones are several feet apart and tend to be more abundant at the base of the sections. As the Chouteau thins northward in Illinois, the chert loses its zoned characteristics and finally disappears.

Electrical and radioactive characteristics.—The normal position of the Chouteau limestone below the shaly siltstones of the Osage group and above the silty shales of the Kinderhook group causes its elec-

trical character to be quite distinct (figs. 4, 5). On electric logs the thin Chouteau formation generally appears with a moderate to extreme increase in resistivity while the spontaneous potential becomes slightly more negative. Radioactivity logs record the same type of curve as do the electric logs. The neutron radiation curve increases to the right when the limestone is reached; at the same time the gamma radiation curve decreases to the left. This causes a fairly symmetrical deviation away from the center by both lines.

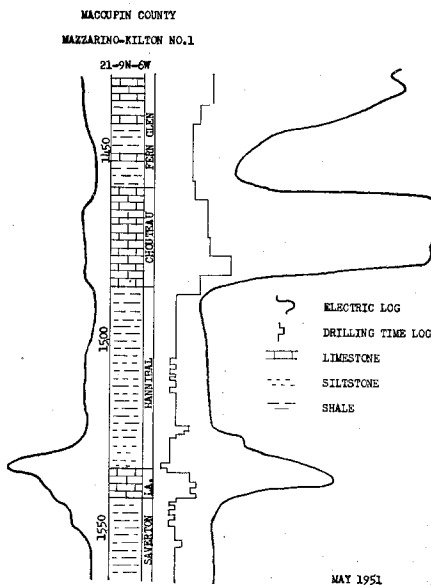


FIG. 5.—Relationship of Chouteau and Louisiana limestones.

STRATIGRAPHIC RELATIONS AND CORRELATION

The Chouteau limestone normally overlies the Hannibal formation with apparent conformity, but in some areas in southwestern Illinois and eastern Missouri it overlaps the Hannibal and lies with unconformity on

the Grassy Creek shale or some member of the Devonian, Silurian, or Ordovician systems. The Chouteau is overlain by several formations of the Osage group. In central and eastern Illinois the Carper sand or the glauconitic Osage siltstone overlies the Chouteau. In western Illinois the massive Burlington limestone takes the place of the siltstone, while in southwestern Illinois the Sedalia and Fern Glen formations overlie the Chouteau. An unconformity at the top of the Chouteau, between the Chouteau and Sedalia formations, was observed near Chautauqua (figs. 6 and 7).

The Chouteau is the uppermost formation of the Kinderhook group of early Mississippian age in Illinois. It is equivalent or approximately equivalent to the *Schellwienella* limestone of Iowa and the lower part of the Waverly formation of Ohio.

Some geologists consider the Chouteau to be equivalent to the Louisiana limestone. The Louisiana limestone, which has limited distribution in Illinois, is separated stratigraphically from the Chouteau formation by the Hannibal shales. Although the Chouteau and Louisiana are not known to

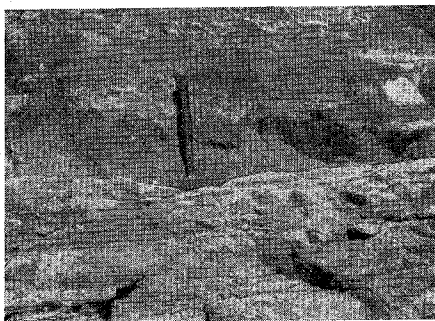


FIG. 6.—Close-up of Chouteau-Sedalia contact at Chautauqua.



FIG. 7.—Chouteau limestone overlying Hannibal shale at Jerseyville Hollow, Jersey Co., sec. 10, T. 6 N., R. 12 W.

occur in the same outcrop, they are both present in several wells in western Illinois, one of which is the well illustrated in figure 5. In southern Calhoun County, subsurface records show that the Hannibal shales pinch out and the Chouteau directly overlies the Louisiana limestone. The Louisiana differs from the Chouteau by being less silty, less cherty, denser, and less fossiliferous. Most of the fossils of the Louisiana are in shaly beds at the base of the formation.

The Rockford formation of Indiana is equivalent to the Chouteau limestone. Since the formation is much thicker and better exposed in western Illinois and Missouri than in Indiana, the long-established name Chouteau is accepted. Although Chouteau is the older name, the name Rockford was the first given to the formational unit as now recognized.

THICKNESS AND DISTRIBUTION

The isopachous map (fig. 8) of the Chouteau limestone was prepared both from well records and outcrop data. The maximum thickness of the Chouteau in Illinois is 74 feet in southern Calhoun County. Normally the formation ranges from 10 to 30

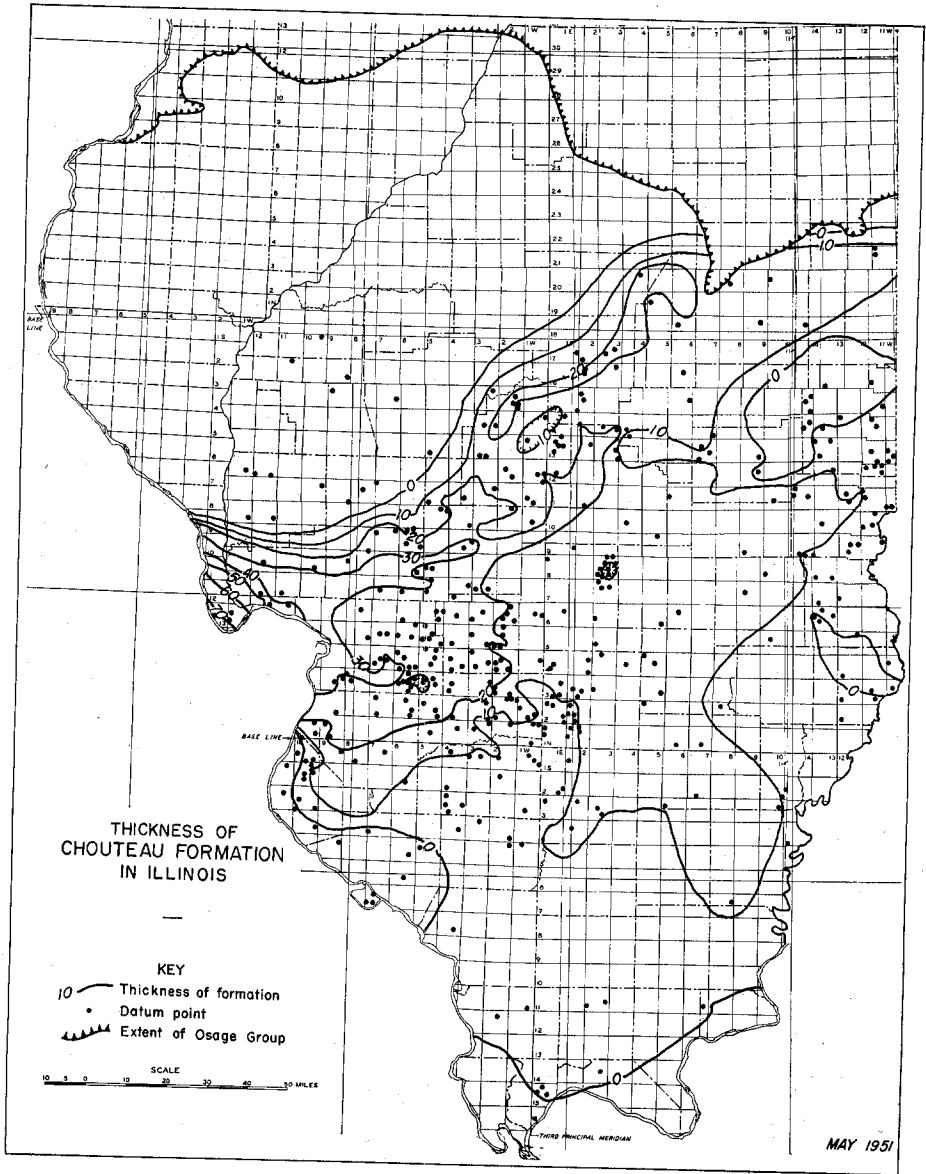


FIG. 8.

feet in Illinois and has an average thickness of approximately 20 feet.

The isopachous map shows no decided thinning of the Chouteau at the crest of the LaSalle anticline,

and it does not indicate any thickening of the formation in the Illinois Basin. At the edge of the Ozark region of southwestern Illinois the Chouteau is thin or absent.

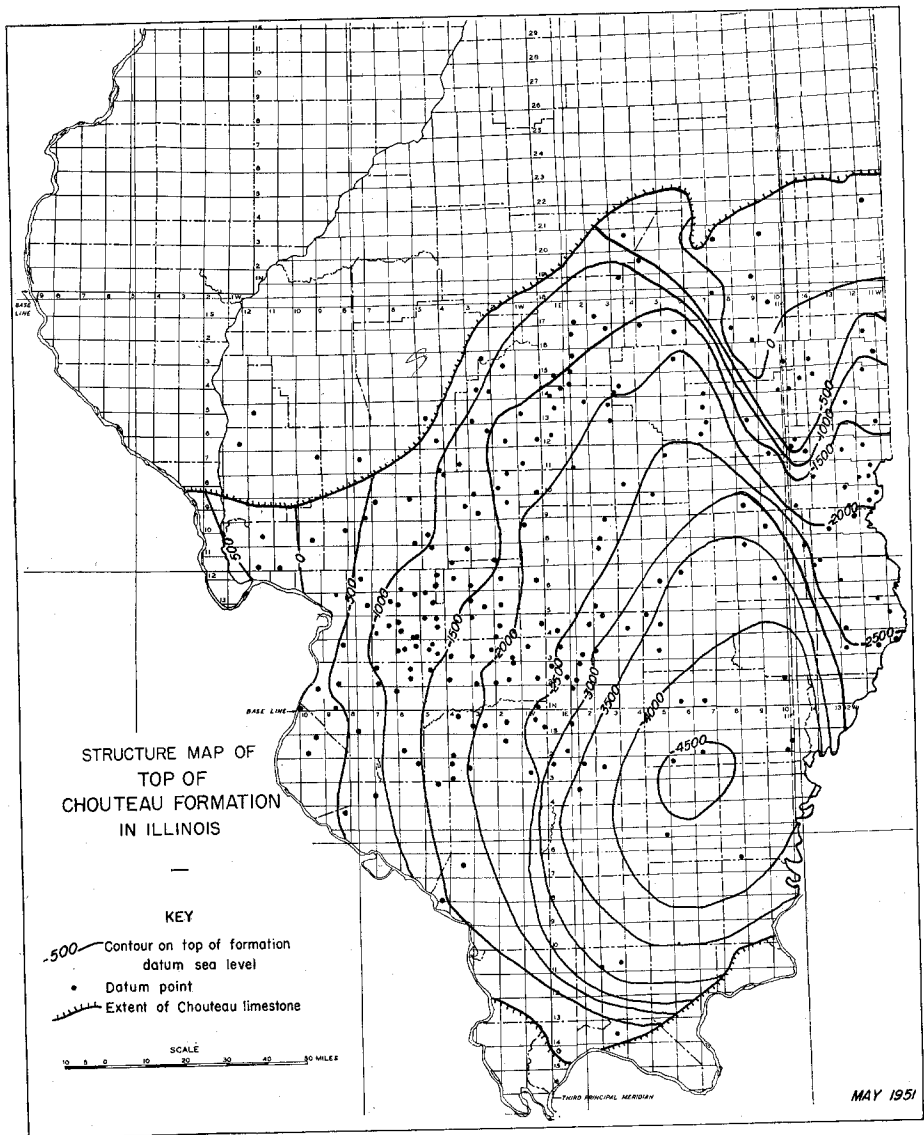


FIG. 9.

Some proved Silurian reef areas are represented on the isopachous map by a thinning of the Chouteau formation, especially in Madison Co., T. 3 N., R. 6 W., and T. 4 N., R. 6 W.; Fayette Co., T. 8 N., R. 3 E.; and in Clark Co., T. 11 N., R. 10 W.

Post-Mississippian — pre-Pennsylvanian erosion had little effect on the distribution of the Chouteau limestone except at its northeastern boundary in northern Champaign and Vermilion counties. There the isopachs are cut by the line rep-

resenting the northerly limit of the Osage group, indicating that erosion cut through the Osage strata and removed the Chouteau.

STRUCTURE

A structure map of the Chouteau limestone (fig. 9) shows the maximum difference in elevation of the top of the Chouteau to be over 5000 feet. The highest occurrence in Illinois is in the outcrop area where the Chouteau is 600 feet above sea level, and the lowest is in the center of the Illinois Basin in Wayne and Hamilton counties, where it is 4500 feet below sea level. The closely spaced contour lines near the eastern edge of the state show the steep western limb of the LaSalle anticline.

ENVIRONMENTAL CONDITIONS

The irregular bedding of the Chouteau limestone is probably a result of disturbance of the calcareous muds by currents. Free circulation in the sea is indicated by the even distribution of silt.

The dolomite of this formation is believed to be primary or diagenetic because it is widespread and tends to be concentrated in layers. The scarcity of fossils in the dolomitic layers suggests that there was a change in salinity unfavorable to normal marine animals.

Bands of nodular chert, which are parallel to the beds of limestone, appear to represent a distinct environmental condition during the deposition of the Chouteau formation and not a secondary deposit after lithification. The chert was precipitated in a local area of downward warping near the Ozark uplift, from which silt and silica could be contributed to the basin. The chert is generally in the thicker portion of the formation in Missouri and Iowa and is absent from the thinner portion of the formation in Illinois.

The tongue of red limestone extending from the Ozark region suggests that this positive area furnished clastics rich in iron into an oxidizing environment. The greenish limestone surrounding the reddish limestone probably outlines an area in which the environmental conditions were favorable for the biological reduction of ferric iron to ferrous iron.

The boundary between the Chouteau and the overlying Osage formations is distinct, but there is only local evidence of an unconformity. The extensiveness and regularity in thickness of the Chouteau limestone indicate that any erosional interval following deposition of the Chouteau was of minor importance.

REFERENCES

- BRANSON, E. B. (1944) The geology of Missouri: Univ. Missouri Studies, vol. 19.
- KINDLE, E. M. (1899) The Devonian and lower Carboniferous faunas of southern Indiana and central Kentucky: Bull. Am. Paleont., no. 12.
- MEEK, F. B., and WORTHEN, A. H. (1861) Age of the Goniatic limestone at Rockford, Indiana: Am. Jour. Sci., vol. 32, pp. 167-177.
- MOORE, R. C. (1928) Early Mississippian formations in Missouri: Missouri Bur. Geol. and Mines, vol. 21.
- SWALLOW, G. C. (1854) Geology of Missouri, 1st and 2nd Ann. Repts., Geol. Survey of Missouri, pp. 59-207.
- WELLER, STUART (1909) Kinderhook faunal studies—5, The fauna of the Fern Glen formation: Geol. Soc. Am. Bull., vol. 20, pp. 265-332.
- WORKMAN, L. E. and GILLETTE, TRACY (1947) Subsurface stratigraphy of the Kinderhook-New Albany strata: Manuscript, Illinois Geol. Survey.