Mississippian Stratigraphy in Southeastern Iowa

Mary C. Parker

Iowa Geological Survey

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Mississippian Stratigraphy in Southeastern Iowa

MARY C. PARKER


SYNOPSIS: All foraminiferous units of the Kinderhook, Osage and Meramec Series are represented in Iowa. No rock units of the Chester Series are present in the state. The Mississippian sequence of rocks is dominated by cherty marine carbonates, but thin fossiliferous shale units occur in the Osage and Meramec. Sandstone and sandy carbonate are dominant within the Meramec in the northwestern portion of southeast Iowa and occur locally within the basal Osage. Siltstone occurs within the lower portion of Kinderhook strata. The maximum thickness of the Mississippian System across south-central Iowa represents the main axis of Mississippian deposition.

INDEX DESCRIPTORS: Stratigraphy, Mississippian, Iowa, Meramec Series, Osage Series, Kinderhook Series.

Mississippian formations constitute the bedrock in a diagonal belt twenty to forty miles wide from Lee and Des Moines Counties in the southeast corner of the state northward to southern Cerro Gordo and Hancock Counties in north-central Iowa.

The standard sections of Mississippian age rock units are along the Mississippi Valley from southeastern Iowa into southern Illinois and southeastern Missouri. All foraminiferous units of the Kinderhook, Osage and Meramec Series are represented in Iowa. Because the Kinderhook varies lithologically from place to place and many of the formations originally correlated as Mississippian are now placed in the Devonian, no standard section has been established for the Kinderhook. The type sections of the Burlington and Keokuk Formations are located near those cities in southeast Iowa. The Warsaw Formation derives its name from exposures at Warsaw, Illinois, nearly opposite Keokuk, Iowa. The Spergen, St. Louis, and St. Genevieve Formations are represented in Iowa by marginal facies of formations which are thicker and more uniform in composition farther south in the Mississippi Valley.

None of the Chester Formations are represented in the state and it is probable that the Chester seas never extended this far north.

The Mississippian-Devonian boundary is placed at the base of the North Hill Group by the Iowa Geological Survey. A discussion of the Mississippian-Devonian boundary in Iowa has been presented by Dorheim, Koch, and Parker (1969).

Along the eastern and northeastern edge of the outcrop belt, Kinderhook strata occur above formations of the Yellow Spring Group (uppermost Devonian). Along the northern boundary in Hancock and Kossuth Counties, Kinderhook strata occur above the Lime Creek Formation (lower Upper Devonian). In western Iowa and eastern Nebraska, Kinderhook strata occur above Middle Devonian rocks. For the most part, the boundary is a transgressive, nonconformable contact.

The Mississippian System is unconformably overlain by Lower Pennsylvanian (Cherokee Group) sediments in most of southeastern Iowa. Jurassic (?) (Fort Dodge Beds) and Lower Cretaceous units were deposited upon the eroded Mississippian surface in north-central and northwestern Iowa. Pleistocene deposits mantle the Mississippian rocks along the outermost edge in eastern Iowa. The general thinning to the northwest reflects the transgressive conditions present in the early Mississippian.

The stratigraphic succession of the Mississippian rocks in southeastern Iowa is shown in Table 1. The thickness of the Mississippian sequence and the thickness of each series in southeastern Iowa is shown in Figure 1.

Table 1. Stratigraphic succession of the Mississippian rocks in southeastern Iowa.

<table>
<thead>
<tr>
<th>SERIES</th>
<th>GROUP</th>
<th>FORMATION</th>
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<td>Kinderhook</td>
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<td>Prospect Hill</td>
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1 Iowa Geological Survey, 18 West Jefferson Street, Iowa City, Iowa 52242.
Hill contains fish teeth, brachiopods, and pelecypods. The Starrs Cave Formation is a very pale orange to pale gray, oolitic limestone which contains fragmented brachiopods, corals, and crinoids.

The Wassonville Limestone Member is the only representative of the Hampton Formation (Laudon, 1931) in southeastern Iowa. The Wassonville consists of pale to dark yellowish-orange, dolomitic limestone and pale yellowish-brown dolomite. Over most of the area of its occurrence, the Wassonville contains appreciable amounts of light gray, fossiliferous limestone.
erous chert. In the extreme southeastern counties the Was­
sonville is relatively chert free and is dominantly a dolomitic 
limestone. To the west and northwest the Wassonville be­
comes more dolomitic and contains more chert.

Little formational facies variation occurs in the Kinder­
hook other than an increase of dolomite toward the west 
and northwest in the carbonate units and an increase in shale 
to the south in the Prospect Hill Siltstone.

The thickness of the Kinderhook in southeastern Iowa 
ranges from less than 50 feet near the outcrop area to over 
150 feet in parts of Van Buren, Davis, and Wapello Counties. 
The variations in thickness and areal distribution of the 
North Hill Group formations is more marked than that of the 
Wassonville Member of the Hampton Formation. The thick­
ess of the Wassonville averages 30 feet and varies from 8 
feet near Burlington to over 50 feet at Centerville in Appa­
noose County. In contrast, the North Hill Group varies from 
approximately 25 feet at the type section near Burlington 
to over 100 feet in Davis County. The McCraney Lime­
stone attains a thickness of 70 feet near Keokuk and 60 
feet at Ottumwa. It thins to the north and northwest from 
the Burlington area and appears to be absent west of Davis 
County. South of Burlington the Prospect Hill Siltstone at­
tains a thickness of 30 to 40 feet. West of the Burlington 
area the Prospect Hill becomes thinner and finer grained 
and appears to be absent in Monroe and Appanoose Coun­
ties. In the Burlington area the Starrs Cave Limestone is 3 
and 5 feet thick. West of the Burlington area it increases in 
thickness to approximately 65 feet at Albia in Monroe Coun­
ty and 75 feet at Cincinnati in Appanoose County.

An unconformity at the top of the Kinderhook in south­
eastern Iowa has been described by Landon (1937) and 
Harris and Parker (1964). Basal Burlington (Osage) rests 
on units as old as the Starrs Cave Formation. Regional dis­
tribution and thicknesses suggest the possibility of facies 
equivalency between the Eagle City-Iowa Falls and the Gil­
more City Formations (Kinderhook) in north-central Iowa 
with the lower Burlington in southeastern Iowa. Detailed 
faunal studies are needed to clarify these Kinderhook-Osage 
boundary relationships.

Osage Series

The Osage Series in southeastern Iowa includes the Bur­
lington Limestone (Hall, 1857), Keokuk Limestone (Owen, 
1852), and Warsaw Formation (Hall, 1857). The Osage is 
composed dominantly of cherty carbonate rocks interstrati­
fied with minor amounts of fissiliferous shale. Quartz sand­
stone occurs only locally at the base of the Burlington Lime­
stone and has been noted in parts of Washington, Keokuk, 
and Louisa Counties. The detailed stratigraphy of and con­
formable relationships between the Burlington and Keokuk 
and the Keokuk and Warsaw in southeastern Iowa were de­
scribed by Harris and Parker (1964).

The members of the Burlington Limestone are: Dolbee 
Creek, Haight Creek and Cedar Fork. In general, the Dolbee 
Creek Member (Laudon's Cactocrinus zone in the type area, 
but including his underlying zones where the member is thick) 
is relatively pure, coarsely crystalline, fissiliferous lime­
stone with a small amount of chert. Spirifer grimesii and frag­
ments of bryozoans are prevalent in this member. It rests un­
conformably on rocks which are more susceptible to weath­
ering. This unit is thickest (17 feet) in the south near Keo­
kuk. To the north and west it decreases in thickness and is 
absent north of a line across southern Washington and Keo­
kuk Counties and west of a line from Hedrick to Centerville. 
In Washington, Keokuk, and Louisa Counties a sandstone 
occurs at the base of the Burlington which probably repre­
sents a shoreline deposit equivalent to the calcarenites of the 
Dolbee Creek. The Haight Creek Member (Laudon's Phys­
etcrinus zone) is highly cherty and contains dolomite as 
well as limestone beds. The base of the Haight Creek is 
marked by a glauconitic dolomite. The glauconite occurs as 
greenish-black grains or pellets with rounded or polished 
surfaces. This zone extends beyond the limits of the under­
lying Dolbee Creek Member and rests on rocks of Kinder­
hook age to the north and west. The Haight Creek has a 
rather uniform thickness ranging from 40 to 50 feet. The Cedar Fork (Laudon's Dizygocrinus and Pentremites zones) 
is relatively pure crystalline limestone. The Dizygocrinus 
zone commonly contains abundant soft flakes of glauconite 
which gives the limestone a green color, and the Pentre­
mites zone is cherty. The Cedar Fork ranges from 10 to 30 
feet in thickness.

The Burlington Limestone exhibits gradational changes in 
 lithology from the southeast to the north and west where dolomite content increases and both carbonates and cherts 
decome darker in color.

The Keokuk Limestone consists of cherty limestone at the 
base, called "Montrose Cherts" by Keyes (1893), overlain 
by fissiliferous limestones with interbedded fissiliferous 
shales. The "Montrose Cherts" are easily separated from the 
relatively noncherty Cedar Fork Member of the Burlington 
Limestone. The top of the Keokuk cannot always be identi­
fied as readily. The upper portion of the Keokuk is com­
posed of gray fissiliferous calcarenites with interbedded fissiliferous, calcareous shales. The shale beds increase in 
number and thickness upward grading into the gray Warsaw 
shales, and dolomite beds replace the limestone. In subsur­
face usage, the upper boundary of the Keokuk generally is 
placed at the top of the calcarenite.

In the extreme southeastern counties the thickness of the 
Keokuk averages about 75 feet. To the west it thins to an 
average of 50 feet and to the north in Story and Marshall 
Counties it averages 25 feet.

The two units of the Keokuk are typified by light gray, 
medium to coarsely crystalline limestone grading into calcare­
inite. Fossil fragments, especially of brachiopods and cri­
noids, are common in well cuttings. Light gray to light olive­
gray, fine to medium crystalline dolomite beds constitute about 50 percent of the carbonates of the lower "Montrose" 
unit. Chert that is typically light gray and off-white, mottled 
and specked with black, gray, or brown is the dominant 
lithology in well cuttings through the upper portion of the 
Montrose unit. Spicular fragments of fossils are abundant in 
the chert and serve to distinguish the Keokuk from the domi­
nantly chertaceous of the Burlington. The shales in the upper portion of the Keokuk generally are gray, fissiliferous, 
and calcareous. Glauconite, as scattered soft green spots, is 
associated with the Keokuk sediments, but no concentration 
has been noted at a single horizon over a broad area, as it 
has in the Burlington. To the west the Keokuk is typically 
brown—dark in the upper portion and lighter below. The 
most striking lithology is the brownish-gray chert which is 
mottled white and contains white spicules. The carbonate in 
the western portion is chiefly dolomite rather than limestone 
and is characteristically brown, finely crystalline, argillaceous
and highly siliceous. Brown, blocky, dolomitic shale is typi-
cal in the western counties. The lower part of the Keokuk
contains a large amount of secondary siliceous material in
the form of crystalline quartz and chalcedony, probably of
geoidal origin.

The Warsaw Formation is characterized by shale, argilla-
ceous dolomite and chalcedonic chert. Shale is dominant in
the upper portion whereas chalcedony tends to be concen-
trated in the lower portion.

In the southeastern counties the shale of the Warsaw is
primarily very light gray to medium gray, chunky, and dolo-
mitic. Fenestrate bryozoans are common. Very light-gray to
light medium-gray, finely crystalline, argillaceous dolomites
accompany the shales. To the west and north both the shales
and dolomites are darker. The chalcedony is associated with
crystalline quartz and typically the color is light bluish-gray
and bluish-white, but some is moderate reddish-orange or
moderate pink.

The carbonate rocks interstratified with shale are more
numerous in the lower portion of the formation. In the out-
crop area, these are calcarenites that are somewhat dolomitic.
However, in most of southeastern Iowa they have been al-
tered to finely crystalline dolomite. Argillaceous dolomites
are the dominant lithology toward the west, probably be-
cause the shaley upper Warsaw has been removed by post-
Osage erosion. The average thickness is 50 feet. It thins to
25 feet to the northwest. The Warsaw is unconformably over­
lain by the Spergen and St. Louis Formations.

**MERAMEC SERIES**

The Meramec Series contains the youngest Mississippian
present in Iowa: Spergen (Salem) Limestone (Ulrich, 1905),
St. Louis Limestone (Engelmann, 1847), and Ste. Genev-
ieve Limestone (Shumard, 1860). The lithologies of the
Meramec units are more varied and complex than those of
the Kinderhook and Osage. The Meramec overlies older
Mississippian strata unconformably and overlaps formations
as old as the North Hill Group (Kinderhook). The upper
boundary constitutes a post-Mississippian erosional surface.
This interval is unconformably overlain by the Cherokee
Group of Pennsylvanian age and by Pleistocene deposits.
The northward thinning is the result of truncation and over-
lap at the base of the St. Louis.

The Spergen (Salem) Limestone is a brownish-gray, mi-
caceous dolomitic limestone with a minor quartz sand
fraction. It is restricted to southern Iowa by the pre-St. Louis
unconformity. The Spergen often has been confused with the
basal St. Louis. The average thickness is 20 feet, al-
though as much as 35 feet has been recorded in wells in
Appanoose County.

The St. Louis Limestone in southeastern Iowa is domi-
nantly a pale yellowish-brown limestone, often sublitho-
igraphic, with a lower zone of brown arenaceous dolomite.
It contains an upper shaley zone and a lower zone with a
high percentage of anhydrite and gypsum. The absence of
evaporites in the outcrop area may be due to solution,
which would account for the brecciated nature of the carbo-
nates. The shale content increases across southern Iowa
with a sandy facies becoming prominent toward the north.

The average thickness is 50 feet, although thicknesses of over
125 feet have been recorded in the evaporite areas.

The Ste. Genevieve is a pale yellowish-gray limestone
with a high percentage of quartz sand in southern Iowa and
is represented mainly by greenish-gray and pale red shales
in central Iowa. The Ste. Genevieve is conformable upon the
St. Louis, but varies greatly in thickness and distribution
because of post-Mississippian erosion.

**SUMMARY**

The beginning of Mississippian time was a period of gen-
eral emergence with no evidence of localized uplift. The
region was a broad plain, modified somewhat by differen-
tial erosion. Shallow, restricted seas are evidenced by the
distribution of the formations of the North Hill Group. Nor-
mal marine seas during deposition of the Hampton are indi-
cated by fossiliferous carbonate rocks. The nearly pure bio-
clastic carbonate rocks of the Osage are the result of a
shallow shelf environment. The shales of the Warsaw are
the terminations of a clastic wedge from the east. Carbonate
deposition continued into the lower Meramec. However, an
evaporite facies is present in the lower St. Louis. The nor-
mal marine carbonate rocks of the upper St. Louis and the
Ste. Genevieve contain an increase in sand and shale north-
ward culminating in a shale facies of the Ste. Genevieve in
northern Iowa. No evidence of Chester deposition has been
recognized. At the end of Mississippian time this region was
a land mass of low relief undergoing erosion and karst de-
velopment. The Mississippian surface was further modified
by uplift which continued into Pennsylvanian time.

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