OFFICE OF THE STATE GEOLOGIST

Digital Geologic Quadrangle Map
Marcella Quadrangle, Arkansas
DGM-AR-00527

Geologic Map of the Marcella Quadrangle, Stone County, Arkansas

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2024
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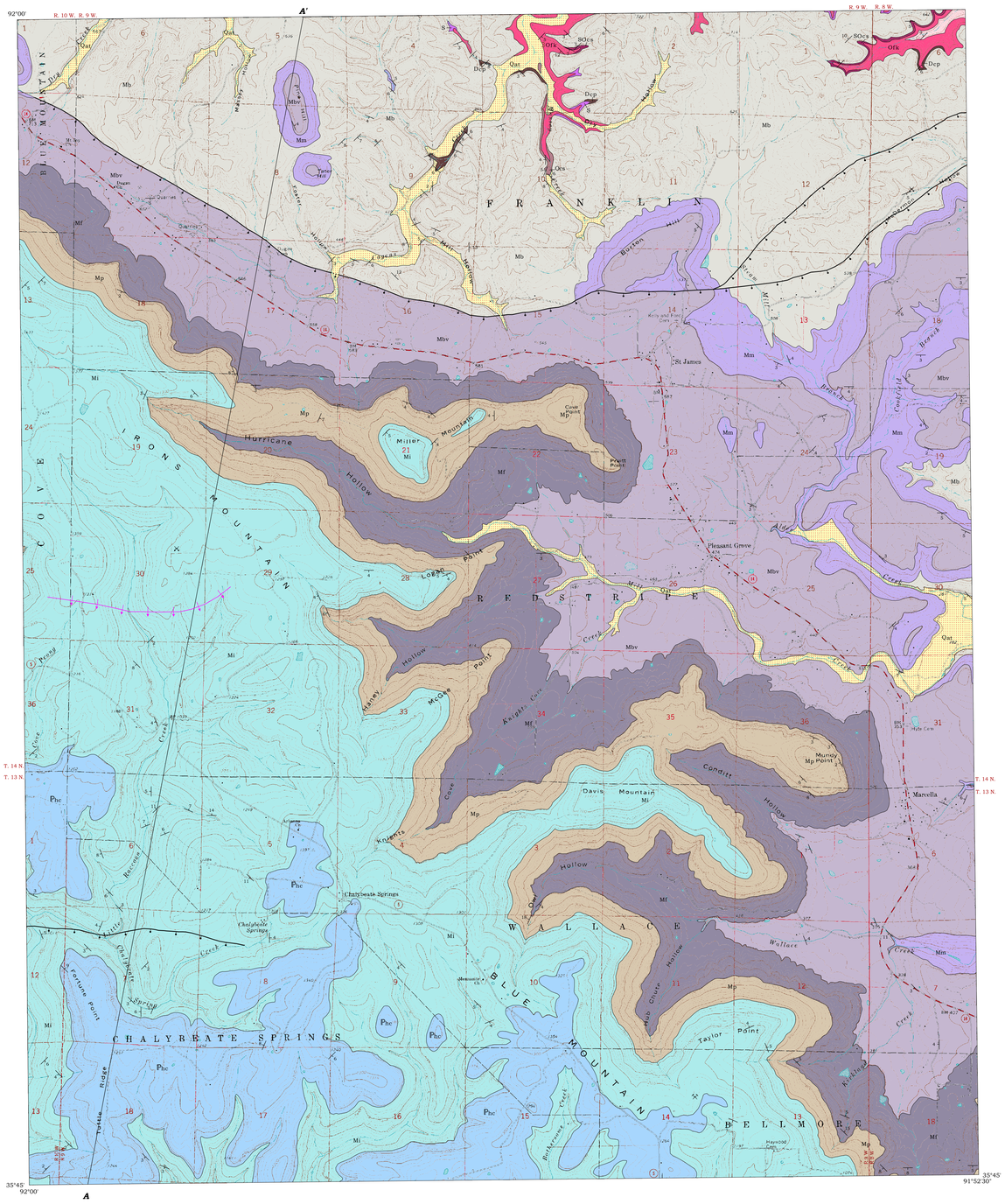


The topographic base is a collarless Digital Raster Graphic (DRG). The DRG is a scanned image of a U.S. Geological Survey 7.5-minute series topographic map published in 1969.

Polyconic projection, 1927 North American Datum.

Fine red dashed lines indicate selected fence and field lines where generally visible on aerial photographs.

Approximate mean declination 2024

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

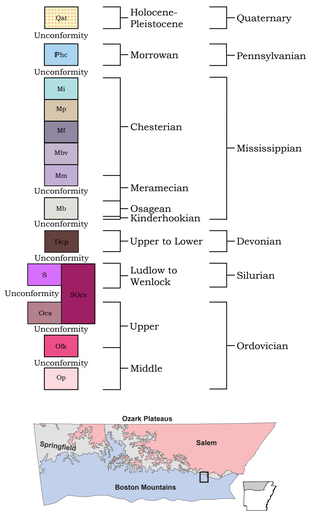
Quadrangle Location

Adjoining Quadrangles

ROAD CLASSIFICATION
- Secondary highway
- Light duty road
- Unimproved road

Scale:
Horizontal: 1 Inch = 2000 Feet
Vertical: 1 Inch = 500 Feet
(Exaggeration: 4x)

Correlation of Map Units



Location of the Marcella quadrangle on the Springfield and Boston Mountains Plateaus in the Ozark Plateaus physiographic province.

Introduction

This map illustrates the surface geology of the Marcella 7.5-minute series topographic quadrangle in Stone County, Arkansas. The mapping for this project was partially funded through a grant from the National Cooperative Geologic Mapping Program (NCGMP).

The map area spans the Springfield and Boston Mountains Plateaus within the Ozark Plateaus province of the Interior Highlands region. Regionally, the rocks dip very gently to the south with local interruptions caused by various structural features including normal faults and monoclinal folds. Approximately 1725 ft. (530 m) of Middle Ordovician to Early Pennsylvanian sedimentary rocks crop out at the surface. Typically, larger valleys are filled with alluvium and the hillsides covered by colluvium. The Springfield Plateau occupies the northern portion of the map and is formed on limestone and chert of the Boone Formation. A chert and red clay regolith has developed on the surface leading to a characteristic topography of rounded hills and joint controlled drainages. In the north part of the map, erosion has cut through the base of the Boone exposing Ordovician, Silurian, and Devonian limestones and clastic rocks. Since these units are less than 20 ft. (6 m) thick, they are mapped as composite units. The prominent escarpment between the Springfield and Boston Mountains plateaus exhibits bench and bluff topography that results from the differential weathering of the Upper Mississippian rocks. The Batesville Sandstone and Moorefield Formation typically form a narrow plateau surface at the base of the escarpment. It is overlain by the slope-forming Fayetteville Shale, which in turn, is overlain by the bluff-forming Pitkin Limestone. At the top of the escarpment and on the edge of the Boston Mountains Plateau is the Imo Interval, a series of sandstone and shale units with lesser amounts of limestone and conglomerate. Farther back from the edge is the sandstone and shale of the Cane Hill Member of the Hale Formation.

The map covers an area of 60.46 sq. mi. (156.5 sq. km). The highest elevation encountered is 1520 ft. (463 m) on Irons Mountain near the west edge of the map and the lowest elevation is less than 280 ft. (85 m) on Mill Creek on the east edge. Approximately 75% of the area is situated in the White River watershed and the remainder is drained by tributaries of the Little Red River via Greers Ferry Lake. Limited prospecting for manganese and phosphate in the Cason Shale and St. Joe Limestone Member has historically occurred in the north-central and northeastern portions of the map. Several small pits in the Boone Formation have been used locally for road material and the Batesville Sandstone has been quarried for building stone in the northwest portion of the map. Caves, springs, and sinkholes are common in areas underlain by limestone.

The geology of the Marcella quadrangle was previously mapped at a 1:125,000 scale by Branner (1892) during the survey of north Arkansas and by Glick (1973) in preparation for the 1:500,000-scale Geologic Map of Arkansas. This map builds on the previous work and depicts the structure and stratigraphy in greater detail. Data for this map was collected between August 2023 and April 2024. Several samples were collected and processed to make thin sections for petrographic studies and to conduct detrital zircon analysis. Field station locations and descriptions were recorded on a portable GPS data collector and integrated into a geodatabase.

Ordovician to Mississippian units exposed along Massey Creek.

Symbols

- Contact
- A — A' Line of cross-section
- Normal fault - ball and bar on downthrown side. Dotted where concealed.
- Monocline
- Strike and dip of bedding
- Mine or quarry
- Pit
- Abandoned mine or quarry

Description of Map Units

Alluvium and Terrace Deposits (Quaternary) - Unconsolidated clay, silt, sand, and gravel including deposits on one or more terrace levels along larger streams. Approximately 10-15 ft. (3-5 m) thick.

Hale Formation (Lower Pennsylvanian, Morrowan) - The Hale Formation consists of two members: the Prairie Grove and the underlying Cane Hill. Only the Cane Hill Member is present on the Marcella quadrangle.

Cane Hill Member - Sequence of interbedded very thin- to thin-ripple-bedded, micaceous, very fine- to fine-grained sandstone and fissile clay to silty shale and siltstone. Shale intervals commonly contain iron nodules and limonitic box-work fragments. Commonly has a 20-40 ft. (6-12 m) bluff-forming sandstone interval at the base. Unconformable with the underlying Imo Interval. Thickness varies from 40-260 ft. (12-80 m).

Imo Interval (Chesterian) - Primarily consists of sandstone with lesser amounts of clay shale interbedded with siltstone, limestone, and conglomerate. The sandstone is brown to gray, fine to medium grained, thin to medium bedded, stylolitic, lenticular to platy, and locally exhibits flaser, ripple, or cross bedding and quartz pebbles. Bedding is also irregular to convoluted in places. The limestone is dark gray to red, fine to coarse grained, thin to medium bedded and fossiliferous. Conglomeratic zones are red to gray, fine to coarse grained and fossiliferous, with limonitic or limestone-pebble intervals up to 6 ft. (2 m) thick. Fossiliferous zones commonly preserve a wide variety of organisms as well as plant material. The contact with the Cane Hill is placed at the base of a thin- to ripple-bedded silty to micaceous sandstone. Commonly forms a series of benches and bluffs resulting in a distinct topography. Conformable with the underlying Pitkin Limestone. Thickness ranges from 200-420 ft. (60-128 m).

Pitkin Limestone (Chesterian) - Thin- to massive- bedded, locally cross-bedded, finely to coarsely crystalline, oolitic, bioclastic limestone. Commonly gray to dark gray with abundant fossils. Black chert was observed near the upper and lower contacts at a few locations. Locally, a black, fissile calcareous shale with interbedded limestone concretions is present near the top. Commonly fossiliferous with crinoids, brachiopods, corals, and bryozoans being the main constituents. Karst features including caves, sinkholes, and springs are common. Bluff forming unit. Conformable with the underlying Fayetteville Shale. Thickness ranges from 140-400 ft. (42-121 m) but generally is 260-300 ft. (80-90 m).

Fayetteville Shale (Chesterian) - Predominately black, fissile, clay shale that is locally fossiliferous. Interbedded dark gray to black micritic beds with chert are interbedded with the shale near the top. Septarian concretions and concretionary beds are present in the lower part. Locally, a medium-bedded or nodular concretionary siltstone is present. Locally, a 20-40 ft (6-12 m) thick, dark gray, fine-grained to micritic limestone unit with abundant brachiopods was observed near the middle of the formation. Locally, a well-indurated black shale was observed near the top. The lower part of the unit forms steep slopes at the base of the escarpment. Conformable with the underlying Batesville Sandstone. Thickness ranges from 200-400 ft. (60-121 m).

Batesville Sandstone (Chesterian) - Fine- to medium-grained, thin- to thick-bedded, locally cross-bedded sandstone. Calcareous intervals are common. Commonly forms bluffs and small plateau surfaces at and away from the base of the escarpment. Bedrock underlying much of the route of AR-14 across the map. Conformable with the underlying Moorefield Shale. Thickness ranges from 50-160 ft. (15-48 m) but is typically 20-80 ft. (6-24 m).

Moorefield Formation (Chesterian and Meramecian) - Silty to clay shale containing limonitic concretions and interbedded dark gray to black calcareous siltstone in the lower portion. Slope forming unit. Unconformable with the underlying Boone Limestone. Up to 100 ft. (30 m) thick.

Boone Formation (Meramecian and Osagean) - Fine- to coarse-grained or crystalline fossiliferous limestone with anastomosing or discontinuous chert intervals. Limestone is light to dark gray. Chert is white to tan and dark gray to black and locally red. Upper part of the interval is commonly coarse grained with white to buff chert. A red-brown regolith composed of residual clay and angular chert covers the surface of the Boone and underlying formations. Contains abundant karst features including springs, caves, and sinkholes. Conformable with the basal St. Joe Limestone but unconformable with older units. Thickness ranges from 300-400 ft. (91-122 m).

St. Joe Limestone (Osagean and Kinderhookian) - fine- to medium-grained, thin-bedded bioclastic and crinoidal limestone. Commonly dark gray or red. Phosphate pebbles, pyrite nodules, and manganese zones are locally common. Generally chert free with small flattened green clay spheres at the top. Commonly, a shale or sandstone unit is present at the base. Unconformable with older units. Thickness generally ranges from 2-8 ft. (0.5-2.5 m) with a maximum thickness of 12 ft. (3.5 m).

Chattanooga Shale (Upper Devonian) - Fissile clay shale with thin, lenticular sand bodies containing abundant trace fossils interbedded locally. Only seen in a few places on the northern portion of the map. Brachiopods were observed at one location. Unconformable with the underlying Penters Chert or older units. Thickness ranges from 0-20 ft. (0-6 m).

Sylamore Sandstone - Medium-grained, moderately to well-sorted, sub-angular to sub-rounded, friable, iron- or calcite-cemented sandstone. Weathers to light tan but commonly has a salt-and-pepper appearance on a fresh surface. Unconformable with the underlying Penters Chert or older units. Thickness ranges from 0-3 ft. (0-1 m).

Penters Chert (Lower to Middle Devonian) - Medium- to thick-bedded chert. Gray and white banding is common. Commonly brecciated and highly fractured. Contains drusy quartz and manganese oxide coatings. Unconformable with the underlying older units. Ranges from 0-20 ft. (0-6 m) thick.

Silurian (undivided) (Ludlow to Wenlock) - Discontinuous limestone units that crop out across the northern part of the map. Locally the Upper Ordovician Cason Formation has been mapped with the Silurian due to its diminutive or negligible thickness. Each formation is unconformable with underlying units. (Wise and Caplan, 1967) Thickness ranges from 0-20 ft. (0-6 m).

Lafferty Limestone - Thin- to thick-bedded, finely crystalline to micritic, stylolitic limestone. Light to medium gray with small red to dark pink blebs. Most persistent and thickest Silurian unit exposed. Thickness ranges from 0-20 ft. (0-6 m).

St. Clair Limestone - Thick-bedded, coarsely crystalline fossiliferous limestone. Color ranges from light gray to light pink gray. Up to 3 ft. (1 m) thick.

Cason Formation (Upper Ordovician) - Lithology is variable, however, it is most commonly composed of light-brown siltstone or fine- to very fine-grained sandstone with minor, dark-brown silty shale. Locally contains dark-brown to black, irregularly rounded phosphate pebbles and silty or nodular limestone. Unconformable with the underlying Fernvale Limestone. Thickness ranges from 0-15 ft. (0-4.5 m) but is generally less than 6 ft. (1.8 m).

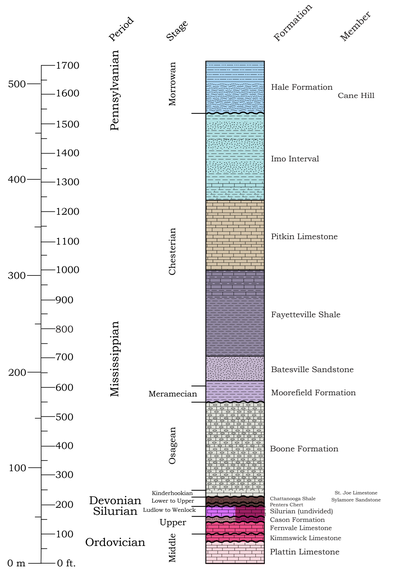
Fernvale Limestone (Upper Ordovician) - Medium- to massive-bedded, medium- to coarsely crystalline, locally cross-bedded, gray to white limestone. Outcrops form rounded friable masses covered with lichen or moss. Unconformable with the underlying Kimmswick or older strata. Thickness ranges from 20-80 ft. (6-24 m).

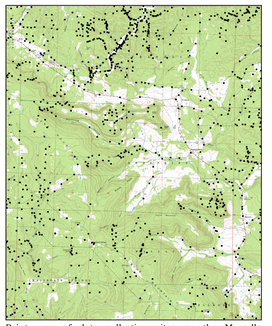
Kimmswick Limestone (Middle Ordovician) - Fine- to medium-grained bioclastic limestone with minor micritic zones that are locally stylolitic. Fresh surfaces are typically light gray to white, but weather medium or dark gray. Weathers into rounded masses but remains well indurated. Karst features are rare. Unconformable with the underlying Plattin Limestone. Only present in the northeast corner of the map. Very thin unit mapped with the Fernvale Limestone. Up to 10 ft. (3 m) thick.

Plattin Limestone (Middle Ordovician) - Very thin- to thick-flat-bedded, dense, gray to light-gray micritic limestone. Calcite veins and pyrite clusters are common. Karst features such as disappearing streams, caves, springs, sinkholes, and scalloped beds are common. Only the upper 100 ft. (30 m) is exposed in the northeast corner of the map.

View to the southeast from the top of the escarpment on Miller Mountain across Knights Cove to Davis Mountain.

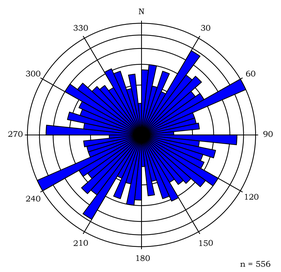
Stratigraphic Column





Point map of data collection sites on the Marcella quadrangle.

Joint Frequency



n = 556

Rose diagram of the strike frequency of joints recorded on the Marcella quadrangle.

References

Branner, J.C., 1892, Geologic Map of north Arkansas, Arkansas Geological Survey, Annual Report for 1892, Vol. 5, 8 sheets. 1:125,000.

Glick, E.E., 1973, Geologic map of the Marcella quadrangle, Stone County, Arkansas: Arkansas Geological Commission, 1 sheet, 1:24,000.

Wise, O.A. and Caplan, W.M., 1967, Silurian and Devonian rocks of northern Arkansas: Tulsa Geological Society Digest, Vol. 35, Symposium Volume, 11p.

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Limitations: This map, like all geologic maps, is based on interpretations which were made from the data available at the time it was created. As new information is collected, the features depicted on this map may be changed.

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Map and cross section digitized by Brian Kehner.