STATE OF ARKANSAS

ARKANSAS GEOLOGICAL SURVEY
BEKKI WHITE, DIRECTOR AND STATE GEOLOGIST

INFORMATION CIRCULAR 41

GEOLOGY OF THE PEA RIDGE AND GARFIELD QUADRANGLES, BENTON COUNTY, ARKANSAS

by
Angela Chandler and Scott Ausbrooks

Little Rock, Arkansas
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2009

Introduction

This report is one in a series of companion reports to Digital Geological Quadrangle Maps published by the Arkansas Geological Survey. Its purpose is to: 1) provide a more detailed discussion of the stratigraphy in the quadrangles, 2) provide surface and subsurface geologic interpretations and 3) provide information pertaining to economic natural resources in the area.

The Pea Ridge and Garfield quadrangles are located northeast of Rogers, Arkansas in the northwestern part of the state, Missouri being the northern border (Fig. 1). The area is rural with the largest town being Pea Ridge with a population of 2,346. Smaller communities within the area with a population of less than 500 include Avoca, Garfield and Gateway. One small town (Lost Bridge Village) is located on Beaver Lake. Pea Ridge National Military Park is located on the Pea Ridge quadrangle and encompasses approximately seven square miles. Portions of Beaver Lake including Indian Creek Public Use Area and Lost Bridge Public Use Area are present on the Garfield quadrangle. The area is easily accessed by state and county road systems. A section of the Burlington Northern and Sante Fe Railway system extends from north of Gateway on the Garfield quadrangle southwest to the Pea Ridge quadrangle following Highway 62 to the Rogers Municipal Airport.

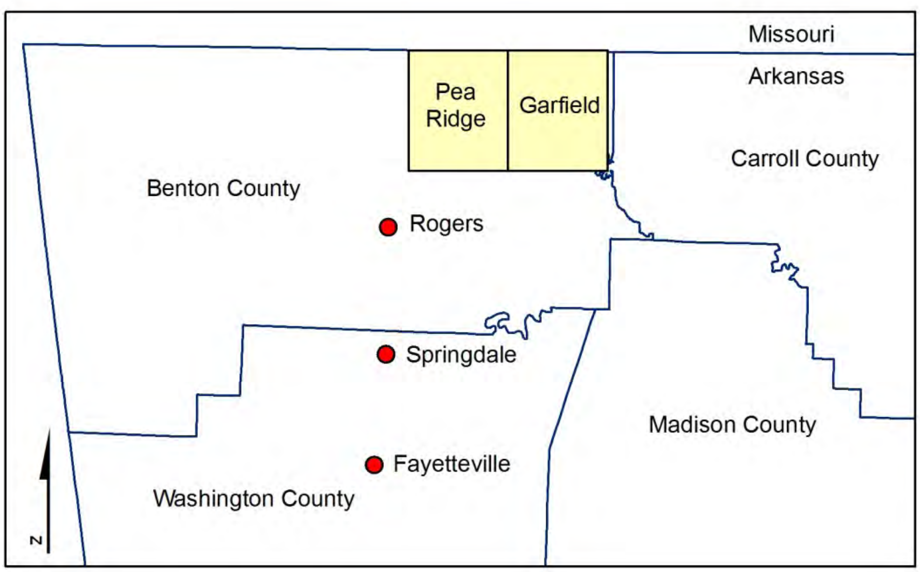


Figure 1. Location map of Pea Ridge and Garfield Quadrangles.

The Pea Ridge and Garfield Quadrangles are located in the Ozark Plateaus Region of north Arkansas. Specifically, the majority of the quadrangles are located on the Springfield Plateau surface, consisting mostly of a fairly flat or gently rolling topography which is capped by the Mississippian Boone Limestone. The escarpment between the Springfield and Salem Plateaus is present on the Garfield Quadrangle near Beaver Lake. In this area tributaries to the lake have dissected the plateau surface creating fairly steep hollows that expose older Devonian and Ordovician formations. Several hills of small areal extent rise above the Springfield Plateau surface and are capped by the Mississippian Wedington Sandstone Member of the Fayetteville Shale.

Previous research in this area is limited to a couple of publications in the late 1800's and early 1900's. Simonds and Hopkins (1894) discuss the geology of Benton County with historic descriptions of the prairies and economic geology of the area. A good stratigraphic synthesis had yet to be developed. The Pea Ridge quadrangle was mapped in the Fayetteville Folio by Adams and Ulrich in 1905. This folio contains detailed descriptions of formations but covers such a large area that a comprehensive geologic map of Pea Ridge is lacking.

Geologic worksheets for both quadrangles were developed for the Geologic Map of Arkansas, 1976. The Pea Ridge geology for the Geologic Map of Arkansas, 1976, was based loosely upon work done in the Fayetteville Folio. The Garfield Geologic Worksheet produced by E.E. Glick in 1970 was based on work by Purdue and Miser, (1916).

Stratigraphy

Approximately 400 to 700 feet (121-213 m) of Lower Ordovician, Middle to Upper Devonian, Lower and Upper Mississippian and Quaternary age strata are present on these quadrangles (Fig. 2). The Lower Mississippian Boone Limestone comprises the surface rock over the majority of the quadrangles and forms the surface of the Springfield Plateau. The Springfield Plateau surface is fairly flat on the Pea Ridge quadrangle, however on the Garfield quadrangle near Beaver Lake the plateau surface is heavily dissected creating steep drainages and a hilly topography. These steep drainages also form the escarpment between the Springfield and the Salem Plateau surfaces. Upper Ordovician and Devonian strata crop out around Beaver Lake and its tributaries on the Garfield quadrangle and form the surface of the Salem Plateau. Upper Mississippian age strata are present on the higher hills that are capped by resistant sandstone of the Wedington Member of the Fayetteville Shale. Quaternary terrace and alluvium deposits are present within the larger creek drainages in the area.

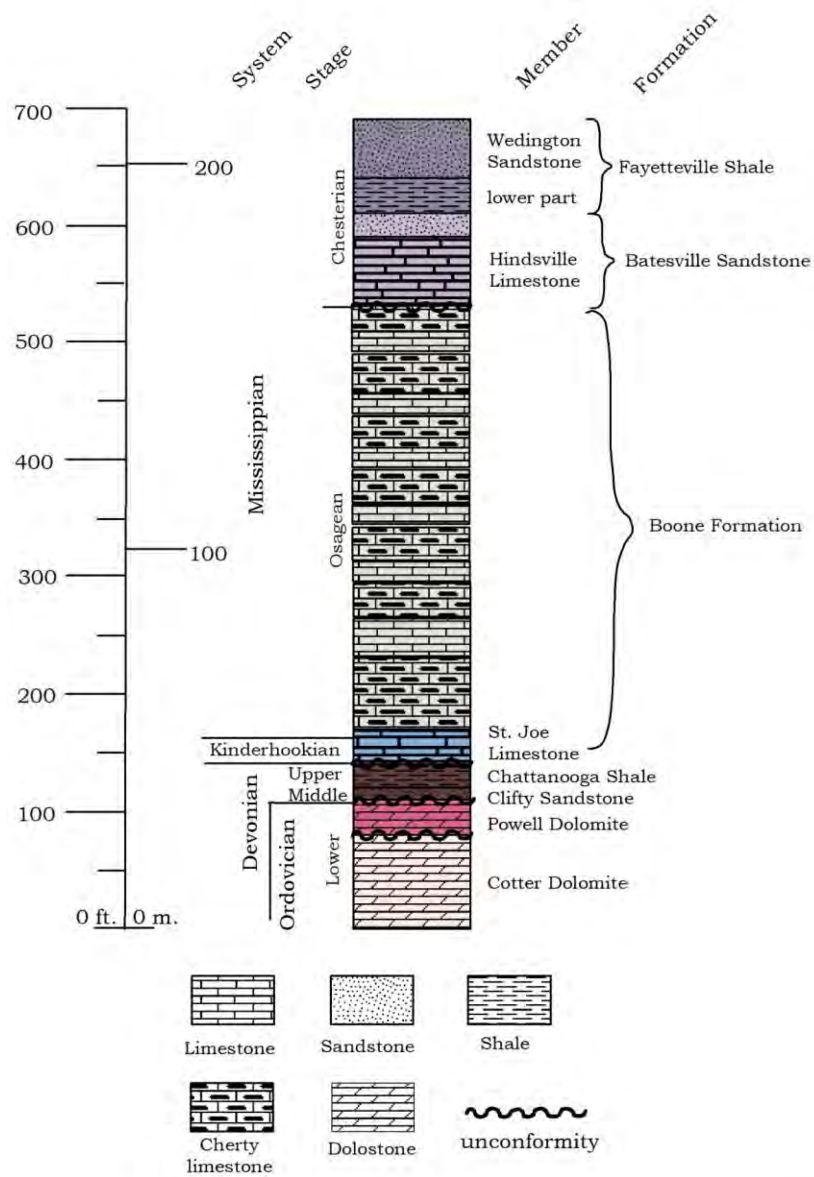


Figure 2. Stratigraphic column for Pea Ridge and Garfield Quadrangles.

Lower Ordovician
Cotter Dolomite

The Cotter Dolomite was named by E.O. Ulrich for the town of Cotter, Arkansas where it is well exposed (Purdue and Miser, 1916). A type section at the Cotter Bridge was designated by Cullison in 1944. The Cotter ranges up to 400 feet (121 m) in thickness, however only the upper 60-100 feet (18-30 m) of this formation is exposed on the Garfield Quadrangle. Dolostones in this unit are exposed along Beaver Lake and in tributaries to the lake. The Cotter Dolomite is overlain unconformably by the Powell Dolomite or the Clifty Sandstone in the Garfield quadrangle.

This formation consists of fine-to medium-grained gray dolostone that is thin- to thick-bedded. The dolostone usually contains chert fragments or nodules, especially near the upper contact with the Powell Dolomite. Stromatolites, oolitic chert and drusy quartz fragments are present in the dolostone in this area. Stromatolites are present as small crinkle bands or as large heads up to 3 feet (.9 m) in diameter. Large stromatolites create an undulatory surface that gives the appearance of disturbed strata. At a few localities greenish clay shale and white coarse-grained sandstone are present in the upper portion of the unit. The base of the sandstone is not a planar bed. Instead it fills in lows and drapes over the irregular dolostone surface. Small vugs containing pink dolomite are present in the dolostone in the Indian Creek area.

(A) (B)

Figure 3. (A) Chert fragments in the Cotter Dolomite. (B) Weathered stromatolitic surface in the Cotter Dolomite. Stromatolites are 2-3 inches across.

Lower Ordovician
Powell Dolomite

The Powell Dolomite was named by E.O. Ulrich for Powell Station, Arkansas where it is well exposed on the White River branch of the St. Louis, Iron Mountain & Southern Railway (Purdue and Miser, 1916). The Powell ranges up to 300 feet (91 m) thick. Where present, this unit ranges up to 30 feet (9 m) thick around Beaver Lake and its tributaries on the Garfield quadrangle. Middle and Upper Ordovician, Silurian and Lower Devonian formations are not present at the surface in this area so that the Powell is unconformably overlain by the Middle Devonian Clifty Sandstone.

This formation consists of very fine- to fine-grained gray to white dolostone that is very thin- to medium-bedded. The very thin- to thin-bedded dolostone is argillaceous and weathers to small blocky pieces. Calcite nodules are present near the contact with the overlying Clifty Sandstone. Gastropods are present in a thin bed of mottled dolostone at one locality near the upper part of the unit. The Powell also contains laminated flat crinkle stromatolites. At a few localities, very thin bedded gray-green to reddish shales are interbedded with the dolostone. Sandstone is present in the upper portion of the Powell in paleokarst features. The basal contact with the Cotter Dolomite is placed at the appearance of banded chert and/or chert nodules or breccia. The Powell Dolomite is relatively chert free which along with the argillaceous fine- grained character helps to distinguish it from the Cotter Dolomite.


(A)


(B)

Figure 4. (A) Weathered Powell Dolomite. (B) Interbedded shale in the Powell Dolomite.

Middle Devonian
Clifty Limestone

The Clifty was originally named the Clifty Limestone for exposures in the East Fork of Little Clifty Creek, Arkansas where it consists of a 2 ½ foot (0.7 m) bed of sandy limestone (Purdue and Miser, 1916). In 1967 Wise and Caplan state that the Clifty Limestone is actually a lens in a sandstone unit that is approximately 20 feet (6 m) thick and unconformable with the overlying and underlying formations. Subsequent stratigraphic analysis by Hall (1978), and Hall and Manger (1978) documents the Clifty as primarily a sandstone unit that appears to be confined to the area surrounding Beaver Lake, Benton and Carroll Counties, Arkansas. The Clifty is subsequently referred to as the Clifty Sandstone by workers in Arkansas and for purposes of this publication. The Clifty Sandstone ranges from 2-10 feet (0.6-3 m) on the Garfield quadrangle.

This formation consists of fine-grained thin-to thick-bedded, silica cemented sandstone that is white on fresh surfaces and gray to orange on weathered surfaces. At some localities the sand is friable, but more commonly is silica-cemented. Usually two sandstone beds can be distinguished by a bedding plane surface within the sandstone ledge; however at a few localities several sandstone beds can be differentiated. The Sylamore Sandstone, which is the basal member of the Chattanooga Shale, may be present in the upper portion of this sandstone as it is at Beaver Dam (Manger, 1985).

The Clifty Sandstone contains chert fragments and pebble clasts/molds on the basal portion of bedding planes.

At one locality on the Garfield quadrangle, mostly bedded chert is present instead of sandstone. Vertical trace fossils are also present in the sandstone interval. A lycopod (plant) fossil was found at one locality. This sandstone forms a small ledge underneath the gentle slope of the Chattanooga Shale. The top of the underlying Powell Dolomite usually forms a re-entrant beneath the sandstone ledge allowing a small overhang with waterfalls. The Clifty Sandstone is unconformable with the underlying Powell or Cotter Dolomites. Locally this unconformity is angular.


(A)


(B)

Figure 5. (A) Clifty sandstone contact with Powell (top of rock hammer). (B) Clifty sandstone ledge above the Cotter Dolomite.

Upper Devonian
Chattanooga Shale

The Chattanooga Shale was named for exposures in Chattanooga Tennessee where it is well developed (Hays, 1891). This terminology was applied to Arkansas in 1905 in the Fayetteville quadrangle by Adams and Ulrich. They described it as a persistent black shale generally underlain by a basal sandstone member known as the Sylamore Sandstone.

The Chattanooga Shale is thickest in northwestern Arkansas averaging approximately 40 feet (12 m) thick. On the Garfield quadrangle, the shale ranges from 10-40 feet (3-12 m) thick.

This formation consists of clay shale that is black on both fresh and weathered surfaces. It contains very small iron concretions and pyritemarcasite concretions that vary in size from one to three inches (25-76 mm) in diameter. At many localities the upper contact of the Chattanooga with the basal portion of the St. Joe will consist of greenish-gray shale which is Lower Mississippian (Manger et al., 1988) on black Chattanooga Shale. Many of the homes along Beaver Lake are built upon the Chattanooga Shale because of the favorable change in slope from the steep St. Joe Limestone to the fairly flat Clifty Sandstone. As a result, several cracks in foundations and walls of new homes have developed due to expansive clays in the weathered shale. The Chattanooga Shale forms a gentle slope between the St. Joe Limestone and the underlying Clifty Formation.

(A)

(B)

Figure 6. (A) Green Mississippian shale overlying black Devonian Chattanooga Shale. (B) Chattanooga Shale slope along Indian Creek with St. Joe above.

Lower Mississippian
St. Joe Limestone Member

The St. Joe Limestone was named for the village of St. Joe, Arkansas by J.C. Branner, where it was first studied by the Arkansas Geological Survey (Hopkins, 1893). Girty (1915) states that it is likely that the type locality is beside the railroad grade along Mill Creek, a short distance northwest of St. Joe. The St. Joe Limestone Member ranges from absent to approximately 40 feet (12 m) thick throughout north Arkansas and appears to be the thickest and most persistent in northwest Arkansas. Approximately 20-40 feet (6-12 m) of St. Joe is present on the Garfield quadrangle.

This member consists of shale, fine- medium grained thin-bedded limestone, argillaceous limestone and fine-to coarse-crystalline limestone. Four separate units that are recognized as formations in Missouri are as follows: Bachelor, Compton, Northview and Pierson, respectively from oldest to youngest. These same units can be recognized in the St. Joe Limestone Member in northwest Arkansas, however they are too thin to map at a 1:24,000 scale.

Pierson – A fine-to coarsely-crystalline, thin-to thick-planar-bedded crinoidal limestone that is gray to white on weathered surfaces and gray to reddish gray on fresh surfaces. This unit forms the upper 10-15 feet (3-4 m) of the St. Joe bluff above the Northview re-entrant.

Northview – A fine-grained argillaceous limestone that is red to gray green on fresh and weathered surfaces. This unit forms 2-3 feet (0.6-0.9 m) re-entrant between the Compton and Pierson Limestones.

Compton – A fine-to medium-grained crinoidal limestone with wavy or nodular thin bedding. It is gray to reddish gray on fresh surfaces but weathers light-gray to white and contains brown to reddish chert with white crinoid fragments and horizontal trace fossils. This unit ranges from 12-15 feet (3-4 m) thick.

Bachelor – gray green clay shale. The contact with underlying Chattanooga Shale is sharp and unconformable. This basal unit ranges from 0-1 foot (0-0.3 m) thick.

The St. Joe Limestone forms a small bluff on top of the gentle slope of the underlying unconformable Chattanooga Shale. The St. Joe is unconformable with the underlying Chattanooga Shale in the Garfield Quadrangle.

(A)

(B)

Figure 7. (A) Contact of St. Joe Limestone with Chattanooga Shale. (B) St. Joe Limestone along tributary to Indian Creek.

Lower Mississippian
Boone Formation

The Boone Limestone was named by J.C. Branner for Boone County, Arkansas where cherts and cherty limestones form the predominate rock type in the region (Penrose, 1891). The Boone Formation (including the St. Joe Member) can range up to 400 feet (121 m) thick. Approximately 220 feet (67 m) is exposed on the Pea Ridge quadrangle and a complete section of 340-400 feet (103-121 m) is exposed on the Garfield quadrangle.

The Boone Limestone consists of coarse-grained fossiliferous and fine-grained gray limestones interbedded with anastomosing and bedded chert. The chert varies in color from white to light gray in the upper portion to dark-gray or blue-gray in the lower portion. The lower dark cherts are probably equivalent to the Reeds Springs Formation in southwestern Missouri. Fairly chert-free sections are petroliferous and contain brachiopods, corals and crinoids. A white oolitic limestone, possibly equivalent to the Short Creek Oolite in southwestern Missouri, is present in the upper part of the Boone at a few localities. Springs and sinkholes are abundant throughout the formation.

A regolith of unconsolidated rock material forms a mantle over the Boone at various localities on the quadrangles. This regolith is comprised of a sequence of thin to thick intervals of chert and cherty beds of clay. The clay is typically red to red-orange in color, while the chert is predominately white in color. Most of the weathered clay of the regolith exhibits relict bedding interbedded with beds of white chert and cherty fragments. The regolith varies from 0 to 40 feet (0-12 m) thick across the quadrangles. The Boone appears to be conformable with the underlying St. Joe Member.

(A) (B)

Figure 8. (A) Boone Formation with 40 feet of overlying regolith. (B) Contact of cherty Boone with underlying St. Joe Limestone Member.

Upper Mississippian
Batesville Sandstone
Hindsville Limestone Member

The Batesville Sandstone was named by J.C. Branner for the town of Batesville, Arkansas where it is well developed (Penrose, 1891). The Batesville Sandstone consists of sandstone in the north-eastern and north-central portion of Arkansas that ranges from 60- 160 feet (18-48 m) thick. The formation consists of sandstone and a basal limestone member, the Hindsville Limestone, in northwestern Arkansas. The Hindsville Limestone is named by Purdue and Miser (1916) for the town of Hindsville where it is well developed. The limestone is absent to thin in north-central Arkansas but thickens to approximately 80 feet (24 m) in northwest Arkansas. The Hindsville Limestone Member ranges from 40 - 70 feet (12-21 m) thick on the Pea Ridge quadrangle with no Batesville Sandstone. Approximately 60 - 80 feet (18-24 m) of Hindsville Limestone is present on the Garfield quadrangle with 5 -15 feet (1-4 m) of Batesville Sandstone.

The Batesville Sandstone consists of very fine-grained thin-bedded micaceous sandstone. The sandstone is light-brown to gray on fresh surfaces but weathers orange-buff to light-gray. It contains pyrite and green shale partings which give the sandstone a greenish color at a few localities. The sandstone also contains trace fossils, crinoid molds, laminae and cross-bedding. The Batesville Sandstone is conformable with the Hindsville Limestone Member.

The Hindsville Limestone Member consists of thin-bedded, fine-to coarsely crystalline limestone. The limestone is light to dark gray on fresh surfaces, but generally weathers to light gray or brown. It usually has a strong petroliferous odor on freshly broken surfaces. The limestones are fossiliferous and/or oolitic, contain pyrite and at various localities are interbedded with thin layers of clay shale and thin beds of siltstone to fine-grained sandstone. A breccia containing angular chert and limestone fragments at the base of this interval is present locally in each quadrangle.


(A)


(B)

Figure 9. (A) Batesville Sandstone, Garfield quadrangle. (B) Hindsville Limestone at Pea Ridge National Park.

Upper Mississippian
Fayetteville Shale
Lower part

The Fayetteville Shale was named by J.C. Branner for its extensive exposure near the town of Fayetteville, Arkansas (Penrose, 1891). In northwest Arkansas the Wedington Sandstone Member of the Fayetteville Shale is present and the Fayetteville is divided into lower and upper parts separated by the middle sandstone unit. Only the lower part and the Wedington Sandstone Member are present on the Pea Ridge and Garfield quadrangles. The lower part of the Fayetteville Shale ranges from 20-50 feet (6-15 m) beneath the Wedington Sandstone Member on both quadrangles.

The lower part consists of black clay shale that contains ironstone concretions at a few localities. The Fayetteville is unconformable with the underlying Hindsville Limestone Member of the Batesville Sandstone.

(A)

(B)

Figure 10. (A) Lower Fayetteville near Bentonville Pea Ridge Fault. (B) Lower Fayetteville, Garfield quadrangle.

Upper Mississippian
Wedington Sandstone Member

The Wedington Sandstone was named for Wedington Mountain, Benton and Washington Counties, Arkansas, which is the type locality (Adams and Ulrich, 1905). The sandstone ranges from 20-80 feet (6-24 m) and is a small bluff former that caps the highest hills on both the Pea Ridge and Garfield quadrangles.

The Wedington consists of fine- to medium-grained sandstone that contains thin to very thin, ripple- bedded siltstones at the base. The sandstone is thin- to medium-bedded and contains cross-beds, liesegang banding and pock-marks or honeycomb weathering. Plant fossils, bryozoans and brachiopods are also present. The sandstone is yellowish to reddish or white on fresh surfaces but weathers gray. Sandstone concretions are present in this member near the Bentonville-Pea Ridge fault in the northwest corner of the Pea Ridge quadrangle. The contact with the underlying lower part is rarely seen, but at one location consists of shale interbedded with very thin-bedded ripple-bedded silt to very fine-grained sandstone.

(A)

(B)

Figure 11. (A) Thin bedded Wedington near lower contact. (B) Wedington sandstone bluff in Pea Ridge National Park.

Quaternary
Alluvium and terrace deposits

Alluvium and terrace deposits consist of unconsolidated clay, silt, sand and gravel including deposits on one or more terrace levels. The gravel consists of mostly rounded to angular chert from the Boone Formation. Approximately 5 -10 feet (1-3 m) of these deposits are exposed in the streams on both of the quadrangles.

Figure 12. Alluvium and terrace deposits, Big Sugar Creek, Pea Ridge

Quaternary
Landslide deposits

The Fayetteville Shale and the Chattanooga Shale are susceptible to landslide events however; none were mapped on these quadrangles. The landslide deposit depicted on the Pea Ridge quadrangle is a rock fall event that occurred in January 2008. Large blocks of the Wedington Sandstone Member are detached from the main bluff line at the East Overlook in Pea Ridge National Military Park. One of these leaning blocks broke into smaller blocks which fell and slid down the slope below the overlook.


(A)


(B)

Figure 13. (A) Large fractured block that broke apart. (B) Blocks of sandstone down slope from rock fall, January 2008.

Structure

The two quadrangles are located on the southern flank of the Ozark Dome, an area of uplift, centered in southeast Missouri. Rock strata in northern Arkansas have a regional dip of one to two degrees to the south; however faulting can produce localized dips upward to 20 degrees. A series of northeast-southwest trending faults in the area were recognized by early workers (Adams and Ulrich, 1905, and Croneis, 1930) and compiled on the Geologic Map of Arkansas (Haley et. al., 1993). Two previously undocumented lineament-monoclines have been found to parallel this fault system. Newly discovered faults have been named on the geologic quadrangles and used in this publication.

Lineaments

Linear features are often visibly located on satellite imagery to be used as a guide when mapping rocks at the surface. Lineaments are linear topographic features of regional extent that probably represent fracture traces in the subsurface or buried faults. It is not uncommon for some lineaments to actually be the surface trace of a fault. For this mapping project, lineaments were located on digital ortho-photographs and 3-D topographic maps to assist in finding faults or other structures. Lineaments and faults characteristic of northwest Arkansas are present in these quadrangles (Fig. 15). The majority of lineaments show no displacement of rock formations at the surface; however two minor offsets in Upper Mississippian units are present along the Chambers and the Clantonville Lineaments (Fig. 14).

The Chambers Lineament-Monocline is a northeast to southwest trending structural feature that extends from the headwaters of Brushy Creek to Roller Ridge. The location of this feature was determined from the 1:24,000 digital ortho-photograph. It is named from the Chambers Spring Syncline (Adams and Ulrich, 1905), which appears to be on trend with the structure found on the Pea Ridge quadrangle. The trend of this lineament is approximately N 50^{o} E. Other lineaments trend N 45^{o} E, E-W and N 25-40^{o} W. The structure causes the Hindsville Limestone through the Wedington Sandstone sequence to crop out approximately 40 feet (12 m) higher in elevation on the southeast side of Elkhorn Mountain than on the northwest side.

The Clantonville Lineament – Monocline is a northeast to southwest trending structural feature that extends from north of Clantonville to Ventris Hollow. The location of this feature was determined from the 1:24,000 3-D topographic quadrangle and from structural disparities in the Lower Mississippian rock units. Lead-zinc mineralization in an old prospect pit near Clantonville may be related to the presence of this structural feature. The trend of this lineament-monocline is N 30-40^{o}E. This structure causes the Hindsville Limestone Member to thin and crop out 30-40 feet (10-12 m) higher in elevation across two small hills southwest of Clantonville. Smaller monoclines are present in the southern portion of the quadrangle and correlate with faults from the War Eagle quadrangle. The trend of these opposing structural features are N 45-50^{o} W. Paleokarst features in the top of the Powell Dolomite are present around Beaver Lake and coincident with a lineament in Limekiln Hollow. This supports the theory that lineaments delineate zones of more intense solutioning and fracturing of the bedrock in the subsurface (Lattman and Parizek, 1964).

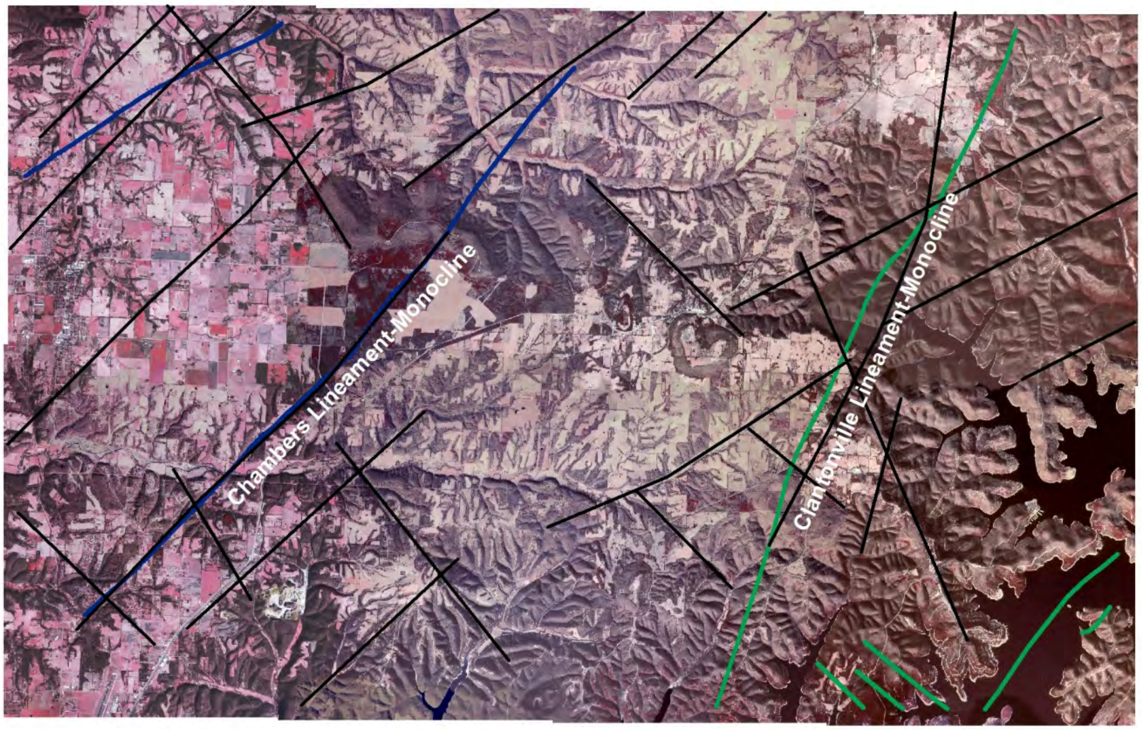


Figure 14. Map showing lineaments (black lines) on Pea Ridge and Garfield Quadrangles. Blue and green lines represent monoclines and faults.

Faults

The Bentonville-Pea Ridge Fault is present in the northwest part of the Pea Ridge quadrangle and trends N 60-70^0 E. There is approximately 200 feet (60 m) of displacement along this fault. It is an off-shoot of a much longer fault that extends to Bentonville and southwest to Siloam Springs. This fault has a trend similar to the Fayetteville and Drakes Creek Faults to the east. Wedington Sandstone beds at the fault are almost vertical and silica cemented. Small folds in the interbedded siltstone and shale of the lower part of the Fayetteville are also present near the fault.

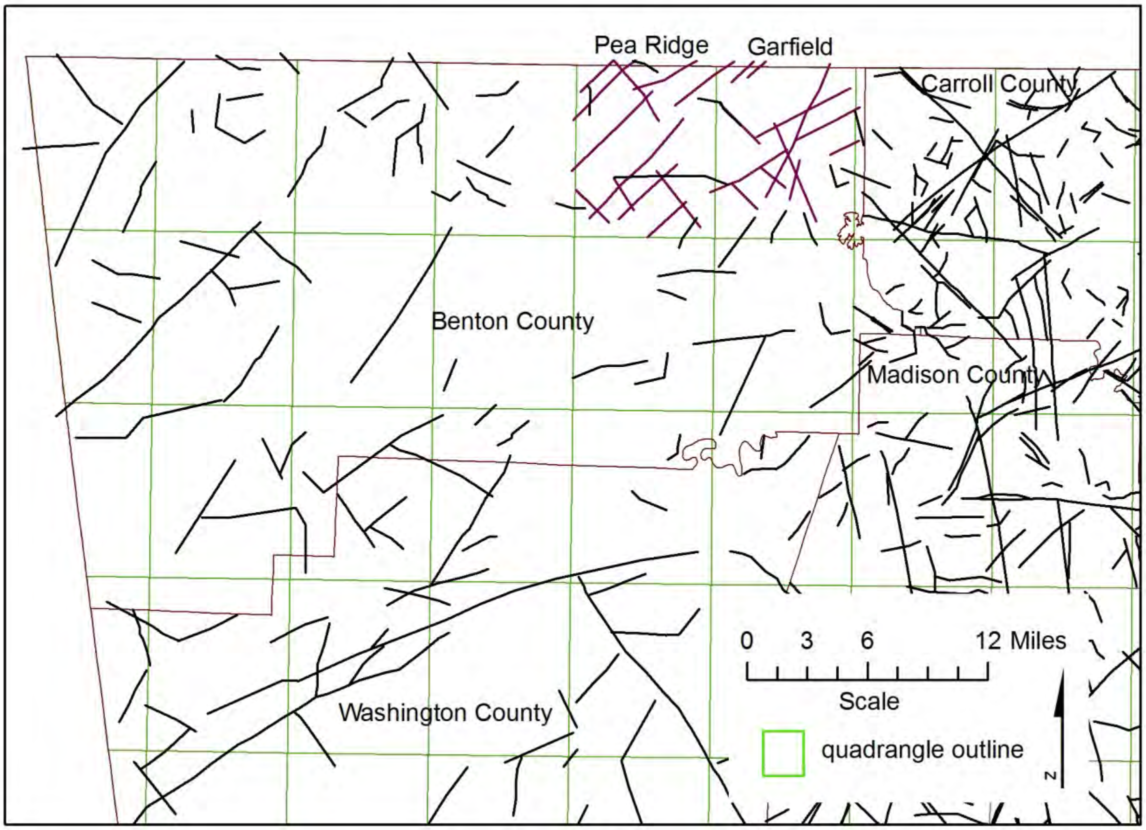


Figure 15. Lineament map showing correlation of lineaments from this report to others in northwest Arkansas (modified from MacDonald et. al., 1977). Maroon colored lineaments traces are those of the authors, present report.

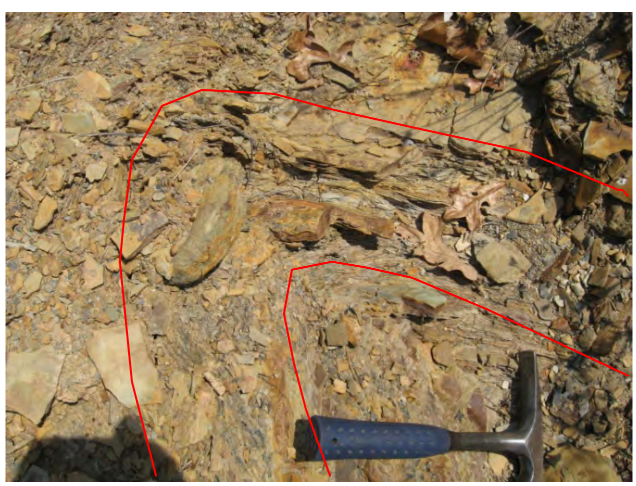
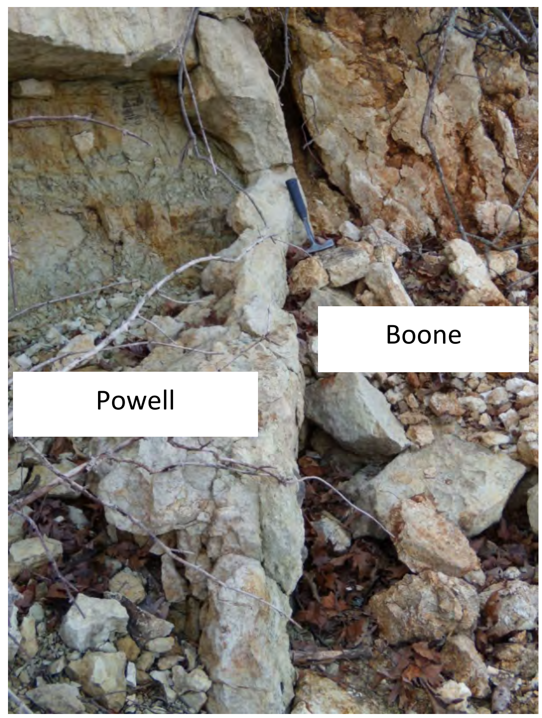


Figure 16. Small fold in lower part of Fayetteville Shale near Bentonville-Pea Ridge Fault.

The Fayetteville Fault is concealed by Beaver Lake in the southeastern part of the Garfield quadrangle but can be seen to the southwest on the War Eagle quadrangle, Sullivan (1999). On the northwest side of the fault the top of the St. Joe Limestone crops out at 1300 feet (396 m) in elevation. Across the fault on a small island near the Starkey Public Use Area the Boone Formation crops out at 1100 feet (335 m) in elevation. According to these elevations there is at least 200 feet (60 m) of offset along the Fayetteville Fault at this location. This fault is the west side of a graben that has down-dropped the Boone Formation to lake level. The Starkey Fault bounds the east side of the graben. Both faults trend approximately N 45^0E. One section of the Starkey fault trends N 60-70^0E and dips 68^0 N. Sandstone dikes, calcite veins, deformation bands, and slickensides are present near the Starkey Fault System. The fault also contains a breccia zone of approximately 40-80 feet (3-24 m).


(A)



(B)

Figure 17. (A) Boone island on southeast side of Fayetteville Fault. (B) Starkey Fault plane showing Powell against Boone.

Karst

Karst is a type of topography that develops on limestone, dolostone, gypsum and other rocks by solution. This process involves the dissolving of calcium carbonate, the main ingredient in limestone, dolostone and other carbonate rocks, by carbonic acid derived from rainwater during its passage through the atmosphere and soil. Once the dissolved calcium carbonate is removed by groundwater, open spaces are left within the rock formation and eventually these open spaces can become interconnected to form karst related features such as springs, caves, disappearing streams and sinkholes.

All of the limestone and dolostone formations in this area are susceptible to karstification. The majority of the rock covering the surface of the two quadrangles is the Boone Formation which consists of varying thicknesses of limestone interbedded with chert. The rock is fractured and a majority of these fractures are enlarged by solutioning, creating passageways for water flow. Ten springs and twenty one sinkholes were found on the Pea Ridge quadrangle. One pit cave is also present on the Pea Ridge quadrangle. The St. Joe Limestone is also highly fractured and contains enlarged solution fractures. The St. Joe contains four known caves forming tunnels along joints and fracture systems on the Garfield quadrangle.

(A) (B)

Figure 18. (A) Avoca Spring in the Boone Formation, Pea Ridge quadrangle. (B) Solutionally enlarged joint in St. Joe Limestone, Garfield quadrangle.

Paleokarst

Paleokarst is rock that has been subjected to karstification in the past and subsequently buried under sediments. Paleokarst features can be microscopic to megascopic and are often oriented perpendicular or oblique to bedding and usually are of a different rock type than the host rock. For this publication we are concerned with megascopic paleokarst features only. Most of the paleokarst features are present on the Garfield quadrangle in the Cotter and Powell Dolomites.

All of the paleokarst infillings consist of sandstone of either Ordovician or Devonian age. At one locality along Beaver Lake paleokarst occurs below the contact with the

Clifty Formation in the Powell Dolomite with no apparent connectivity by a dike. It is assumed the sandstone has an Ordovician source. Several other paleokarst features appear as irregular sandstone bodies are present along Beaver Lake just below or at the contact of the Devonian Clifty Formation with the Powell Dolomite. It is believed the source for these paleokarst features is the Devonian Clifty Formation. Other features include joints and fractures in the Powell Dolomite in-filled with sandstone from the overlying Clifty Formation. Similar features have been observed where sandstone from the basal Mississippian has filled enlarged joints in Silurian limestones along the Buffalo River on the Marshall quadrangle. Several sandstone filled dikes were seen near the Starkey Public Use Area. The dike features are located near the Starkey Fault system which could have contributed to their formation. Sweeting (1972) points out that fault zones are commonly areas of selective dissolution in karst terranes.


(A)


(B)

Figure 19. (A) Sandstone paleokarst in Powell Dolomite. (B) Possible Devonian sandstone paleokarst on Beaver Lake.

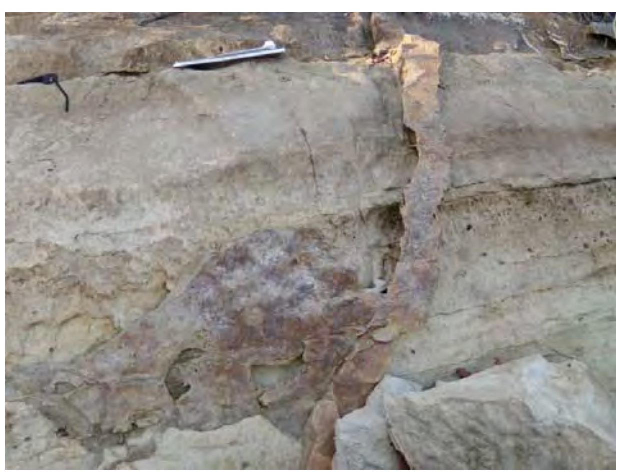


Figure 20. In-filled fractures in Powell Dolomite near the Starkey Fault.

Economic Geology

The economic resources of Benton County were first reported by Simonds and Hopkins in 1892. They discuss building stone, lime, clay, soil, lead and zinc and oil and gas possibilities in a few specific locations within the two quadrangles. Few mineral resources in these quadrangles have been developed since that time. Current mineral resources of the area consist of crushed stone, building stone and sand and gravel.

Crushed Stone

Stone that is crushed and suitable for use as aggregate or used as a base for paved and unpaved roads, is present in the Boone Formation and Hindsville Limestone Member of the Batesville Sandstone. The upper portion of the Boone Formation is currently quarried at the Avoca Quarry in Avoca Arkansas which is located in the south-central portion of the Pea Ridge quadrangle. One inactive quarry in the Hindsville Limestone is present in Pea Ridge National Military Park. Another inactive Hindsville Limestone quarry is located near Highway 62 in the SW ¼ Sec 22, T 21 N, R 28 W.

Dimension Stone

Stone suitable for use as building stone may be in the St. Joe Limestone Member of the Boone Formation, the Batesville Sandstone or the Cotter Dolomite. Several small inactive quarries in the Batesville Sandstone are present near Pond Mountain on the Garfield quadrangle. One small inactive quarry in the St. Joe Limestone is present in the SW ¼ Sec 18 T 20 N, R 27 W. No quarries are present in the Cotter Dolomite; however it is used as dimension stone from a quarry in the community of Beaver, Arkansas on the Beaver quadrangle which borders the Garfield quadrangle on the east side.

Sand and Gravel

The alluvium and terrace deposits from the larger streams on the quadrangles contain sand and gravel. Presently there is only one sand and gravel operator located on the northeast portion of the Pea Ridge quadrangle. Two inactive gravel pits are present in these deposits in the southern portion of the Pea Ridge quadrangle.

Regolith from the Boone Formation is also used as fill. The regolith is rich in clay and when added to chert and limestone compacts more easily.

Lime

Limestone from the Boone Formation was quarried and burned in the late 1800's near Sugar Creek northwest of Garfield (Simonds and Hopkins, 1894). Lime produced was used in the manufacture of cement and concrete. The quarry has not been in operation since 1888.

Lead and Zinc

Low grade deposits of galena and sphalerite have been found in Benton County (McKnight, 1935). In 1929 a fifty foot shaft was constructed in the Boone Formation in Sec. 13, T 21 N, R 28 W. The shaft has been filled in since that time.

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