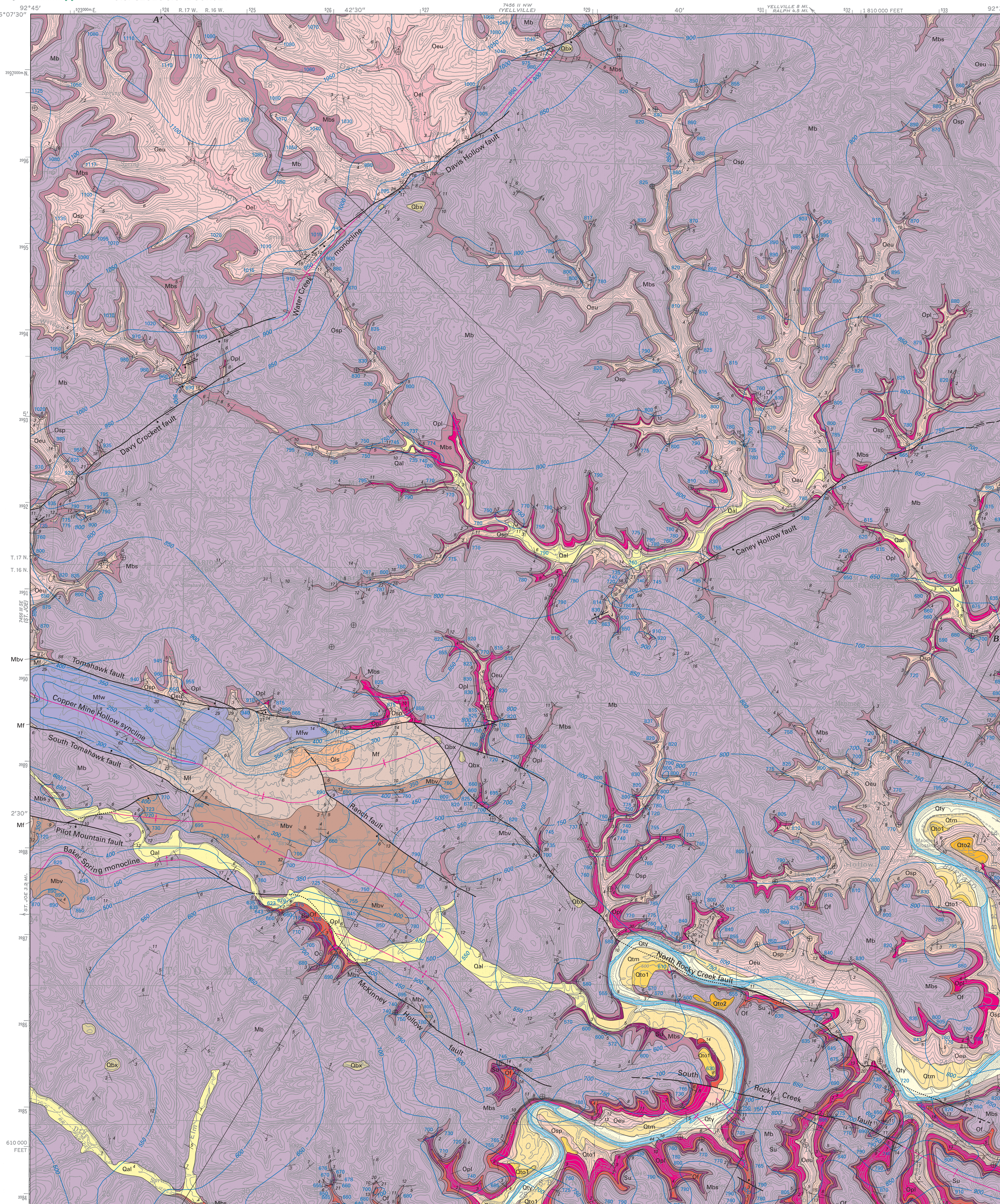


Base from U.S. Geological Survey, 1966
Projection and 10,000-foot grid ticks: Arkansas coodinate system, north zone
1000-meter Universal Transverse Mercator grid ticks, zone 15
1927 North American Datum

APPROXIMATE MEAN DECLINATION, 1966

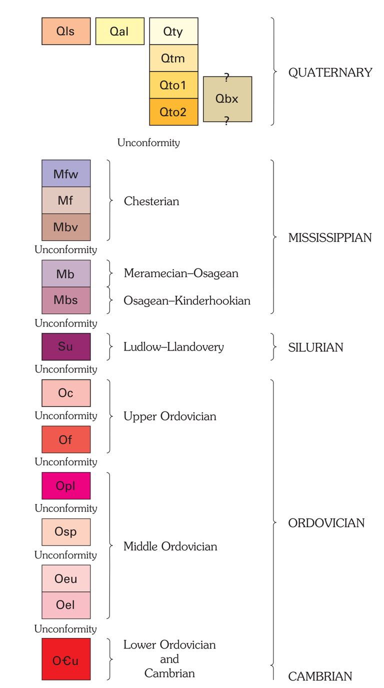
SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

Geology mapped by K.J. Turner and M.R. Hudson, 2007–2009
Digital map database prepared by Kenzie J. Turner
Editing and digital cartography by Gayle M. Dumonceaux, Denver Publishing Service Center
Manuscript approved for publication September 1, 2010

CORRELATION OF MAP UNITS



INTRODUCTION

This map summarizes the geology of the Maumee 7.5-minute quadrangle (fig. 1) in northern Arkansas. The map area is in the Ozark plateaus region on the southern flank of the Ozark dome (fig. 1). The Springfield Plateau, composed of Mississippian cherty limestone, overlies the Salem Plateau, composed of Ordovician carbonate and clastic rocks, with areas of Silurian rocks in between. Erosion related to the Buffalo River and its tributaries, Tomahawk, Water, and Dry Creeks, has exposed a 1,200-ft-thick section of Mississippian, Silurian, and Ordovician rocks (fig. 2) mildly deformed by faults and folds. An approximately 130-mile-long corridor along the Buffalo River forms the Buffalo National River that is administered by the National Park Service.

McKnight (1935) mapped the geology of the Maumee quadrangle as part of a larger 1:125,000-scale map focused on understanding the lead and zinc deposits common in the area. Detailed new mapping for this study was compiled using a Geographic Information System (GIS) at 1:24,000 scale. Site location and elevation were obtained by using a Global Positioning Satellite (GPS) receiver in conjunction with a U.S. Geological Survey 7.5-minute topographic map and barometric altimeter. U.S. Geological Survey 10-m digital elevation model data were used to derive a hill-shade-relief map used along with digital orthophotographs to map ledge-forming units between field sites. Bedding attitudes were measured in drainage bottoms and on well-exposed ledges. Bedding measured at less than 2° dip is indicated as horizontal. Structure contours constructed for the base of the Boone Formation are constrained by field-determined elevations on both upper and lower formation contacts.

DESCRIPTION OF MAP UNITS

Qal **Alluvial and active channel deposits of tributary drainages (Quaternary)**—Tributaries to the Buffalo River include Tomahawk, Dry, and Water Creeks. Active-channel deposits include gravel deposits, composed of subangular to rounded Paleozoic rock clasts of predominantly chert and sandstone, and sandy point bar deposits composed mostly of rounded fine sand. Low terraces and active flood plain composed of light-brown, fine sand are locally present adjacent to creeks and extend up to about 20 ft above creek level. Unmapped bedrock exposures are interspersed along channels. As thick as 10 ft

Qty **Young terrace and active channel alluvial deposits (Quaternary)**—Active channel deposits consist of gravel bar and sandy point bar deposits of the Buffalo River. Gravel bar deposits composed of rounded to subrounded pebble- to cobble-sized clasts of Paleozoic chert, dolostone, and sandstone, and sandy point bar deposits composed of fine to medium, rounded to well-rounded sand grains. Terrace deposits are principally light-brown, fine sand with lesser interspersed silt and have smooth upper surfaces that are about 20–40 ft above the base-flow level of river. Unmapped bedrock exposures are located along channel. Deposits are as thick as 20 ft

Qls **Landslide deposits (Quaternary)**—Slump block of shale from main body of Fayetteville Shale (Mf) and minor sandstone blocks derived from Wedington Sandstone Member (Mfw) of Fayetteville Shale in west central part of map. Generally back-tilted into hillside and forms hummocky terrain. Probably no more that 60–80 ft thick

Qtm **Medial terrace and alluvial deposits (Quaternary)**—Unconsolidated sand deposits adjacent to Buffalo River. Deposits are poorly exposed and are principally brown-weathered, fine sand. Terrace surfaces are flat to gently sloping as high as 60 ft above base-flow level of river. Thickness uncertain but probably as much as 20 ft

Qto1 **Old terrace and alluvial deposits (Quaternary)**—Unconsolidated gravel and sand deposits adjacent to Buffalo River. Deposits are poorly exposed and are principally lag gravel of brown-weathered, subrounded to rounded, pebble- to cobble-sized clasts of Paleozoic rocks in a sandy matrix. Clasts are primarily composed of very fine grained tan sandstone and chert. Terrace surface generally rounded 80–120 ft above base-flow level of river. Thickness about 5–10 ft

Qbx **Remnant block deposits (Quaternary)**—Remnant erosional blocks of Batesville Sandstone (Mbv) in sinkholes and along faults within the underlying main body of the Boone Formation (Mb). Deposits are characterized by tabular sandstone blocks with moderately rounded edges 1 to 4 ft in diameter and interspersed with chert. Deposits interpreted to be related to more recent, late-stage karst development because blocks are not encased in paleokarst features such as calcified collapse breccia. Relationship to faults is unknown

Qto2 **Very old terrace and alluvial deposits (Quaternary)**—Poorly exposed, unconsolidated gravel and sand deposits adjacent to Buffalo River. Deposits are principally a lag of weathered, rounded to well-rounded Paleozoic clasts of very fine grained tan sandstone and chert in a sandy matrix 230–260 ft above base-flow level of river. Thickness about 5–10 ft

Fayetteville Shale (Upper Mississippian, Chesterian)—Fine-grained sandstone and siltstone of Wedington Sandstone Member (Mfw) that grades downward into main body of black, slope-forming shale. Thickness 125–170 ft

Mfw **Wedington Sandstone Member**—Brown to light-gray, well-indurated, calcite-cemented, very fine grained sandstone and siltstone; thin to thick bedded and has parallel laminations and locally developed low-angle crossbeds. Sandstone grades downward into siltstone beds that are ripple cross-laminated and bioturbated. Unit gradational with underlying main body and caps steep slopes of the main body to form a topographic bench. Thickness 25–50 ft

Mf **Main body**—Fissile black shale that locally contains thin beds of ripple-marked olive-brown siltstone near its top. Lower part of Fayetteville exposed along stream gullies and may contain medium- to light-gray, fetid septarian concretions as large as 2 ft in diameter. Unit is susceptible to landslides and is conformable with underlying Batesville Sandstone. Thickness 100–120 ft

Mbv **Batesville Sandstone (Upper Mississippian, Chesterian)**—Light- to medium-brown, fine-grained to very fine grained, calcite-cemented sandstone with sparse interbedded limestone. Sandstone is thin to medium bedded with parallel laminations and occasional low-angle crossbeds in upper part of unit. Commonly contains burrows on bedding-plane surfaces and weathers to form thin flat blocks or tabular blocks. Fetid, fossiliferous limestone in discontinuous 1- to 3-ft-thick beds. Unit contains oxidized pyrite framboids 0.1–0.5 in. in diameter; framboids weather to reddish-brown spheres. Batesville caps topographic flats where Fayetteville Shale is eroded and contains sinkholes resulting from collapse in underlying Boone Formation. Unconformable with underlying Boone Formation. Thickness 40–60 ft

Boone Formation (Upper to Lower Mississippian)—Limestone and cherty limestone of main body that grade into basal St. Joe Limestone Member (Mbs). The Boone Formation is a common host of caves and sinkholes. Total thickness 365–375 ft

Mb **Main body (Upper to Lower Mississippian, Meramecian to Osagean)**—Light- to medium-gray, coarsely crystalline, bioclastic limestone and interbedded chert; thin- to thick-bedded with parallel planar and wavy beds of limestone. Crinoid ossicles are common throughout and a 1- to 3-ft-thick bed of oolitic limestone is common in upper part of unit. Chert content is highly variable both laterally and vertically; horizons with abundant chert are typically poorly exposed and only chert lag is observed. Brachiopod and crinoid ossicle molds are observed in chert in upper part of unit. Most chert is white but blue, orange, or reddish chert become more common approaching gradational contact with St. Joe Limestone Member (Mbs). Thickness 300–350 ft

Mbs **St. Joe Limestone Member (Lower Mississippian, Osagean to Kinderhookian)**—Limestone is red to pink on fresh surface due to hematite content in the matrix, but color varies and gray or white is not uncommon. Matrix varies from muddy to finely to coarsely crystalline supporting abundant crinoid fragments in thin to medium, parallel wavy beds. Chert-poor except in upper part where red to pink lenticular chert becomes more persistent as it grades upward into main body of Boone Formation (Mb). Middle and lower parts of unit contain greenish-gray, tan, and yellow interbedded shale. Base of St. Joe is a 1- to 10-ft-thick, fine-grained, moderately sorted sandstone containing phosphate pebbles; sandstone has discontinuous conglomerate beds with clasts from underlying units. Unit unconformable with underlying Silurian and Ordovician rocks, amount of missing section beneath unconformity increases to northwest. Thickness 30–60 ft

Su **Silurian rocks, undivided**—Includes parts of units discussed below. Cumulative thickness 0–95 ft although no more than 60 ft exposed in any one location

Lafferty Limestone (upper to middle Silurian, Ludlow)—Light-gray, purple, and red dense micrite that breaks with conchoidal fracture; white to light-gray on weathered surface. Medium bedded and forms rounded outcrop. Contact with St. Clair Limestone sharp and described as unconformable by Wise and Chaplin (1979) and Smart and Hutto (2008) but Craig and others (1984) and Craig (1993) interpreted as conformable. Thickness 0–5 ft

St. Clair Limestone (middle to lower Silurian, Ludlow to upper Llandovery)—Light-pink, tan, and light-gray fossiliferous limestone; contains crinoid and brachiopod fragments. Limestone is micritic to coarsely crystalline and massive bedded. Unit contains pyrite framboids and irregular vugs filled with white or colorless sparry calcite crystals. Basal contact with Brassfield Limestone is unconformable. Thickness 0–60 ft

Brassfield Limestone (lower Silurian, Llandovery)—Light-gray to light-pink, micritic to coarsely crystalline, thin- to massive-bedded limestone mottled red and gray. Contains crinoid ossicles, pyrite framboids, and irregular vugs filled with colorless to white sparry calcite; alteration around calcite-filled vugs produces red to maroon color that contributes to mottled appearance. Unit underlain unconformably by the Cason Shale (Oc). Thickness 0–30 ft

Oc **Cason Shale (Upper Ordovician)**—Green, tan, black, and blue-green, poorly exposed, fissile shale and siltstone that is occasionally dolomitic. Contains phosphate-replaced fossils and abundant, polished phosphate nodules from sand to pebble size and oxidized pyrite framboids. At type section to the east near Batesville, Ark., Cason Shale extends into the Silurian (Craig and others, 1984; Craig, 1993). Unit unconformably overlies Fernvale Limestone (Of). Thickness 0–15 ft

Of **Fernvale Limestone (Upper Ordovician)**—Light-pink, red, and light-gray coarse-grained fossiliferous limestone; massive to thick bedded and crossbedded with distinctive stylolitic partings 2–3 in. thick that enhance dissolution giving the appearance of thinner bedding. Crinoid fragments are common including distinctive barrel-shaped crinoid ossicles and phosphate nodules are present. Unit unconformably overlies Plattin Limestone (Opl). Thickness 0–60 ft

Opl **Plattin Limestone (Middle Ordovician)**—Light-gray to tan, medium- to thin-planar-bedded micrite with discontinuous calcarenite beds. Micrite is dense and breaks with conchoidal fracture and locally contains, fine-grained, well-rounded quartz grains. Calcarenite is tan, yellow, and light-brown, medium bedded, slightly fetid, and contains poikilitic calcite growth. Unit unconformably overlies St. Peter Sandstone (Osp). Thickness 0–120 ft

Osp **St. Peter Sandstone (Middle Ordovician)**—Tan, white, and lesser blue calcite-cemented quartz arenite with minor interbedded dolomite and blue-green shale and siltstone. Sandstone is medium to massive bedded, often crossbedded, with well-rounded, fine-grained quartz grains; friable where calcite cement has been leached out. Upper part of unit rarely preserved but as thick as 15 ft when present and forms a ledge above middle slope-forming part. Middle part of unit is poorly exposed slope former and consists of interbedded sandstone, dolomitic layers, and blue-green shale and siltstone. Basal part is best preserved and forms a 5 to 30 ft ledge with an undulatory unconformable contact with the Everton Formation. Sandstone beds often bioturbated and characteristically contain cylindrical *Skolithos* burrows perpendicular to bedding. Thickness 0–120 ft

Everton Formation (Middle Ordovician)—Interbedded dolostone, dolomitic sandstone, and limestone, divided into upper and lower parts. Base not exposed in quadrangle. Total thickness 320 ft

Oeu **Upper part**—Jasper Member (Glick and Frezon, 1953) forms up to 80 ft of upper part of Everton Formation and is light-gray, finely crystalline to micritic, medium-bedded limestone and sandy limestone. Below Jasper Member, upper part of Everton Formation consists of dark- to light-gray, micritic to finely crystalline dolostone, limey dolostone, and carbonate cemented sandstone. Dolostone and limey dolostones are planar-laminated to medium-bedded and commonly contain rounded to well-rounded quartz grains. Sandstone is well-sorted, rounded to well-rounded, fine- to medium-grained quartz arenite that is dolomite or limey-dolomite cemented. Unit contains dolomitic stromatolite mounds. Farther west base of upper part of Everton Formation is marked by base of Newton Sandstone Member (McKnight, 1935) but is absent in this quadrangle; therefore, basal contact is placed above the first consistent limestone beds. Thickest exposed section is in northwestern part of quadrangle, 140–160 ft, where Jasper is mostly removed. Cumulative thickness 220–240 ft

Oel **Lower part**—Interbedded finely crystalline to micritic dark- to light-gray limestone, limey sandstone, and sandy limestone. Medium to thick bedded with planar to wavy laminations. Near upper contact stromatolite mounds are present. Upper beds also contain collapse breccia with clasts of overlying dolomitic rocks of upper part of Everton. Only about 60 ft exposed in quadrangle

O€u **Lower Ordovician and Cambrian rocks, undivided**—Sedimentary rocks shown on cross section only

STRATIGRAPHY

The 1200-ft-thick stratigraphic section of Paleozoic rocks (fig. 2) records deposition in a continental shelf environment during the Ordovician, Silurian, and Mississippian Periods. Provincial series terms determined for Mississippian and Silurian units are from McFarland (1988) and Craig (1993), respectively, and are based mostly on conodont biostratigraphy. The Buffalo River and its major tributaries have exposed the Paleozoic units and have recorded Quaternary deposition in the preserved terrace levels.

Limestone in the lower part of the Everton Formation (Oel) is restricted to the northwest portion of the quadrangle where it has been exposed by erosion of a structural high. The limestones host a karst aquifer that discharges groundwater from an artesian spring along Water Creek. Dolomitic rocks in the upper part of the Everton Formation (Oeu) grade upward into the basal sandy limestone of the Jasper Member (Glick and Frezon, 1953; Suhm, 1974), which reaches a maximum thickness of 80 ft on the eastern edge of the quadrangle. The Jasper Member thins and pinches out to the north and west in the quadrangle. The St. Peter Sandstone (Osp), Plattin Limestone (Opl), and Fernvale Limestone (Of) all reach maximum thicknesses in the southeast corner of the quadrangle but are mostly absent in the northwest part. We observed the Cason Shale (Oc) at three localities in the quadrangle, although McKnight (1935) documented additional exposures within the quadrangle. At the type-section east of the map area near Batesville, Ark., the upper part of the Cason Shale is Silurian because it overlies the Silurian Brassfield Limestone and contains Silurian fauna (Craig and others, 1984; Craig, 1993), but Craig (1975) demonstrated that in its western outcrops, including this quadrangle, only the Ordovician part of the Cason Shale is present.

Silurian rocks (Su) are restricted to the southern half of the quadrangle and continue into the Marshall quadrangle to the south (McKnight, 1935; Maher and Lantz, 1953; Hutto and Smart, 2008). Silurian rocks are generally preserved in pre-Mississippian structural lows; their limited extent resulted from multiple episodes of erosion prior to deposition of the Boone Formation (Mb) (McKnight, 1935; Craig, 1993). Differentiation of Silurian rocks from Fernvale Limestone (Of) is difficult but Fernvale outcrops are typically moss covered, friable, lack micritic facies, and contain characteristic stylolitic partings.

Although the Mississippian Boone Formation (Mb) overlies Silurian rocks (Su) in the southern part of the quadrangle, the major unconformity at the base of the Boone Formation progressively truncates underlying rocks north and west across the quadrangle, eventually placing basal St. Joe Limestone Member (Mbs) above the eroded upper part of the Middle Ordovician Everton Formation (Oeu) (cross section *A–A'*). The basal contact of the Boone Formation is often marked by the presence of phosphate nodules in the sandstone or shaley horizons. Horner and Craig (1984) suggest this sandstone was deposited as a transgressive lag during Late Devonian time.

The Batesville Sandstone (Mbv) marks a change to dominantly clastic sedimentation from mostly carbonate sedimentation in the underlying Boone Formation (Mb). Sandstone blocks are commonly found in sinkholes developed from the karstification of the Boone Formation. Sandstone blocks found around some larger sinkholes and faults in the quadrangle are interpreted as remnant block deposits (Qbx) and not indicative of the basal contact. Thicknesses for the Boone Formation of 365 ft and 375 ft are documented in wells from the towns of St. Joe, Ark., to the west (well records from Arkansas Geological Survey, Little Rock, Ark.) and Marshall, Ark., to the southeast (Maher and Lantz, 1952; 1953), respectively. In the areas mapped as Qbx however, numerous sandstone blocks are present that cannot be in situ without a greatly reduced thickness of the Boone Formation. We interpret the blocks to have been trapped in closed depressions created by sinkholes and as the underlying limestone was dissolved, reducing the total thickness of the Boone Formation, the erosion resistant sandstone blocks remain. The relation between remnant blocks and faults is unknown. Fayetteville Shale (Mf) overlies the Batesville Sandstone but is only preserved in the Tomahawk graben system. The Fayetteville Shale hosts the only mappable landslide deposit (Qls).

Four levels of terrace deposits are preserved along the Buffalo River. Relative age is indicated by elevation above river level with the oldest at the highest elevation. Dating of archeological materials and analysis of soil characteristics by Guccione and Guendling (1988) suggest an age of Holocene and late Pleistocene for young terrace deposits (Qty) and medial terrace deposits (Qtm) are likely late Pleistocene. Old terrace deposits (Qto1) are Quaternary (< 2.6 Ma; Head and others, 2008; Walker and Geissman, 2009) but have not been studied in detail. Old terrace deposits correlate to similar terrace deposits about 80–120 ft above base-flow level of the Buffalo River on the Western Grove (Hudson and others, 2006), Hasty (Hudson and Murray, 2004), Jasper (Hudson and others, 2001) and Ponca quadrangles (Hudson and Murray, 2003) to the west (fig. 1). Very old terrace deposits (Qto2) are significantly higher than any other terrace deposit at 230–260 ft above base-flow level. These deposits are located on narrow point bars and are suspected to be correlative with a similar mapped terrace on the Western Grove quadrangle (Hudson and others, 2006) (fig. 1).

STRUCTURAL GEOLOGY

Rocks within the map area were deformed by faults and folds, and structure contours on the base of the Boone Formation illustrate the location and relative offset of these structures. The structure contours conform to elevations at 565 control points located at both lower and upper contacts of the Boone Formation, as well as other information limiting maximum or minimum elevations of these contacts. A 370-ft average thickness for the Boone Formation (Mb), including the St. Joe Limestone Member (Mbs), was used to project the elevation of the basal contact from points on the upper contact. This average thickness is constrained by well data documenting approximately 375 ft of Boone Formation southeast in the town of Marshall (Maher and Lantz, 1952; 1953) and a well that penetrated about 365 ft in the town of St. Joe to the west (well records from the Arkansas Geological Survey, Little Rock, Ark.). The average thickness determined for the Boone Formation in this quadrangle is 20 ft less than a 390-ft average thickness determined from surface stratigraphic sections of the Boone Formation farther to the west in the Buffalo River watershed (Hudson, 1998) that was used in construction of structure contours for published geologic maps farther to the west (fig. 1).

Several regionally extensive faults and folds are present within the Maumee quadrangle. The Tomahawk, South Tomahawk, and Pilot Mountain faults correspond to faults previously named by McKnight (1935) in the western part of the quadrangle and the North Rocky Creek and South Rocky Creek in the southeastern part of the quadrangle. As a result of our new detailed geologic mapping, we have revised fault traces from those of McKnight (1935). We mapped several newly recognized faults, including the Ranch, McKinney Hollow, and Caney Hollow faults.

Some structural features mapped as folds by McKnight (1935) are reinterpreted as combined fault and fold zones. A N 50° E-trending structural zone with a down-to-southeast throw of about 200 ft extends across the northwestern part of the quadrangle and was named the Water Creek monocline by McKnight (1935). This zone contains several left-stepping en echelon faults of N 55° E to N 68° E strike, the longest of which is the northeastern extension of the Davy Crockett fault from the adjacent St. Joe quadrangle (Hudson and Turner, 2009). In the center of the zone, the Davis Hollow fault elevated the lower part of the Ordovician Everton Formation, the lowest stratigraphic level in the quadrangle, to the surface in its footwall. At its southwestern end the Davis Hollow fault loses throw but is interpreted to continue across Water Creek on the basis of an abrupt start of a dolostone and sandstone cliff of upper part of Everton Formation (Oeu) to the south and a silicified zone holding up a bedrock knob southwest of the creek. However, dips as great as 25° southeast of this fault accommodate most of the throw and mark the limb of the Water Creek monocline. The Caney Hollow fault is a NE-striking fault and associated fold located at the intersection of Water Creek and White Oak Hollow in the east-central part of the quadrangle. This is named for exposures in the Caney Hollow drainage just to the east of the quadrangle boundary (S. Ausbrooks, Arkansas Geological Survey, oral commun., 2010). Beds dip as steeply as 40° SE adjacent to the fault, and folding contributes significantly to the overall down-to-southeast throw across the structure. A small dome southwest of the Caney Hollow fault (Sec. 3, T. 16 N., R. 16 W.) may have formed as a result of flexure related to termination of a right-lateral component of the Caney Hollow fault.

The Tomahawk graben of McKnight (1935) is a system of west-northwest- to northwest-trending faults and associated folds that form a broad down-dropped zone across the southern part of the quadrangle (fig. 3). The northern margin of this zone is formed by the Tomahawk and North Rocky Creek faults. Although a portion of the North Rocky Creek fault is concealed beneath the Buffalo River and alluvium, we interpret it to be continuous from the Rocky Creek area, northwest to its intersection with the Tomahawk fault. The southern margin of the graben system is defined by down-to-north faults and monoclines. The South Rocky Creek fault dies into a monocline at its eastern end and is discontinuous with the McKinney Hollow fault that dies into the Baker Spring monocline at its western end. The graben system is internally deformed by the South Tomahawk, Pilot Mountain, and Ranch faults and several folds including the Copper Mine Hollow syncline marking the lowest structural axis.

Fault data collected at numerous sites within the quadrangle (fig. 3) indicate the typical orientations and slip senses for faults (fig. 4*A*) and give insight into the causative stresses responsible for deformation. Many of these faults are small displacement cataclastic faults, deformation bands (Aydin and Johnson, 1978), preferentially developed in well-sorted Ordovician sandstones of the St. Peter Sandstone (Osp). Frequency maxima demonstrate common orientations of faults that dip moderate to steeply either to the south to south-southeast or to the north to northeast. A subset of faults whose slip senses could be determined are predominantly normal or strike slip (fig. 4*B*). Dips of normal faults vary from north to north-northeast or south to southwest. Among strike-slip faults, those with right-lateral sense mostly strike east-northeast and dip southeast, whereas those with left-lateral sense mostly strike southeast and dip northeast or southwest. Paleostress inversions for these normal and strike-slip faults, using the method of Angelier (1990), mostly fit stress regimes with a least principal stress axis oriented south-southwest and near horizontal, and with intermediate and maximum principal stress axes flipping between near vertical and east-southeast and near horizontal (fig. 4*B*). From these data we interpret that northeast-striking fault zones in the quadrangle have right-lateral slip as well as down-to-the-southeast throw, whereas east-southeast to southeast-striking faults have dominantly normal slip but may also have components of left-lateral slip. Similar coordinated movements among normal and strike-slip faults have been documented elsewhere in the southern Ozark dome, and their dominantly north-south extension accommodated late Paleozoic flexure of the southern continental margin as it was loaded by the adjacent Ouachita orogenic belt (Hudson, 2001).

Whereas most of the faulting in the quadrangle is probably late Paleozoic in age, the outcrop distribution of pre-Mississippian rocks suggests effects of older deformation. The progressive truncation of Silurian rocks (Su), Upper Ordovician Fernvale Limestone (Of), and Middle Ordovician Plattin Limestone (Opl) and St. Peter Sandstone (Osp) beneath the Mississippian unconformity suggests the presence of a broad pre-Mississippian uplift centered northwest of the quadrangle. McKnight (1935) suggested that this progressive truncation might be linked to uplift across the Water Creek monoclinal zone, but detailed mapping in this and adjacent quadrangles (Hudson and others, 2006; Hudson and Turner, 2009) demonstrates a more regionally extensive east-northeast trend of these stratigraphic truncations, distinct from the N 50° E Water Creek monoclinal zone. In a second example, the northern margin of the Tomahawk graben system probably was active before Mississippian deposition. Silurian rocks (Su) and Upper Ordovician Fernvale Limestone (Of) are thickest in the hanging wall of the North Rocky Creek fault but are thin to absent in footwall exposures (cross section *B–B'*), suggesting that this west-northwest-trending zone had pre-Mississippian activity (McKnight, 1935). Northeast of North Rocky Creek fault, thickening, thinning, and removal of the Plattin Limestone (Opl) indicate this paleohigh area was an irregular surface with localized domes and basins and one small steep-limbed syncline (SE ¼, Sec. 15, T. 16 N., R. 16 W.) prior to being planed off during pre-Mississippian erosion.

Joints measured within the map area (918 total) are near vertical and distributed in several sets (fig. 4*C*). The dominant set strikes north. Less prominent joint sets strike west-northwest and northeast. Joint planes within limestone and dolostone formations, such as the Boone (Mb) and Everton Formations (Oeu and Oel), are commonly enlarged due to dissolution.

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MAP EXPLANATION

- **Contact**
- **Normal fault**—Dashed where approximately located, dotted where concealed, bar and ball on downthrown block
- **Normal, right-lateral, strike-slip fault**—Dashed where approximately located, bar and ball on downthrown block, arrows show relative motion
- **Normal, left-lateral, strike-slip fault**—Dashed where approximately located, bar and ball on downthrown block, arrows show relative motion
- **Fault movement**—Away from viewer (left), toward viewer (right), shown in cross sections only
- **Anticline**
- **Syncline**
- **Monocline**
- **Strike and dip of bedding**
  - **Inclined**
  - **Horizontal**
- **Line of equal elevation showing base of Boone Formation, contour interval 50 ft**
- **Control point showing elevation in feet on base or top of Boone Formation**

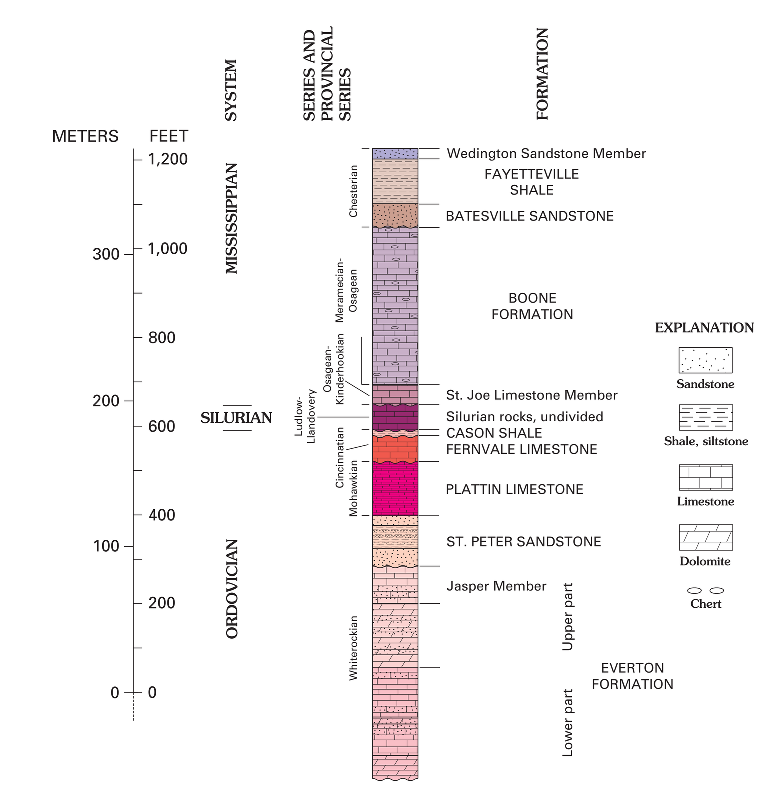


Figure 2. Stratigraphic column for Paleozoic rocks within the quadrangle. Provincial series are from Purdue and Miser (1916), Craig (1993), and McFarland (1988).

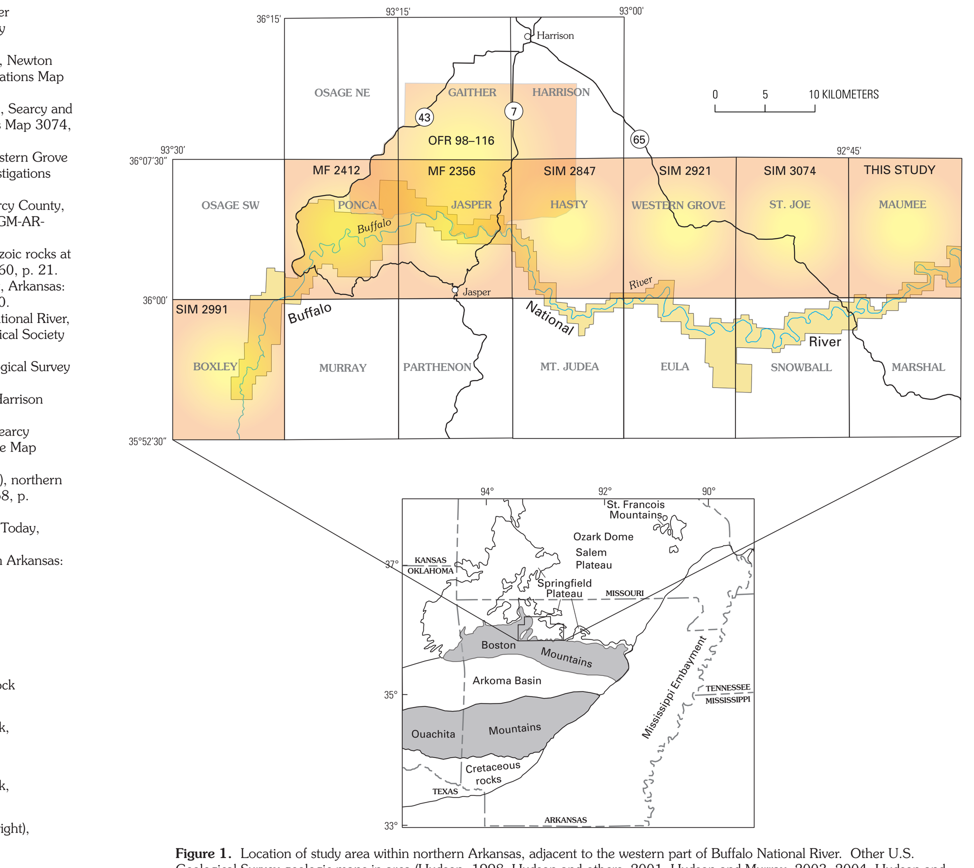


Figure 1. Location of study area within northern Arkansas, adjacent to the western part of Buffalo National River. Other U.S. Geological Survey geologic maps in area (Hudson, 1998; Hudson and others, 2001; Hudson and Murray, 2003, 2004; Hudson and others, 2006; Hudson and Turner, 2007, 2009) are listed by publication number. U.S. Geological Survey publication series abbreviations are: Open-File Report (OFR), Miscellaneous Field Studies Map (MF), and Scientific Investigations Map (SIM). Lower regional map illustrates geological and selected physiographic provinces of Arkansas and adjacent areas.

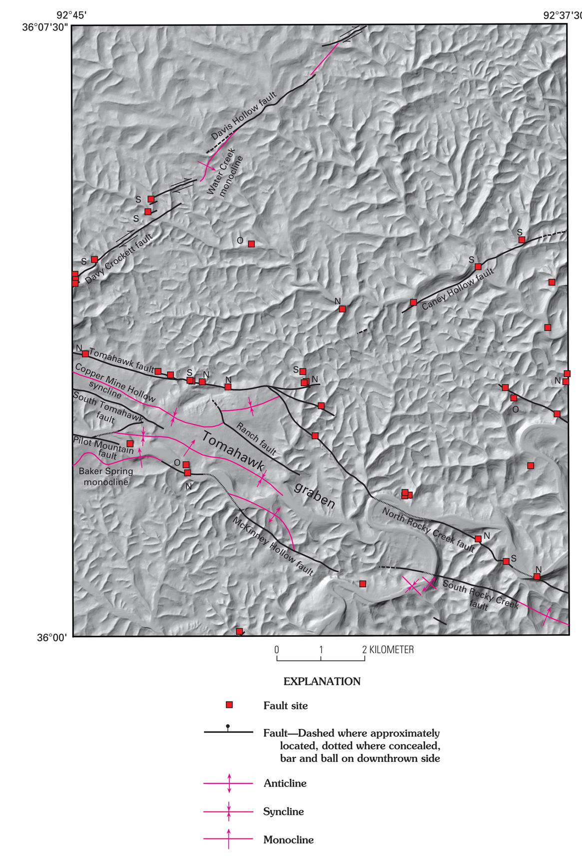


Figure 3. Shaded-relief digital elevation map of quadrangle with structural features and sites where faults (squares) were observed. Where determined, slip senses for faults at sites are indicated as normal, N (rake 90° to 60°); oblique, O (rake 59° to 30°); and strike-slip, S (rake 29° to 0°).

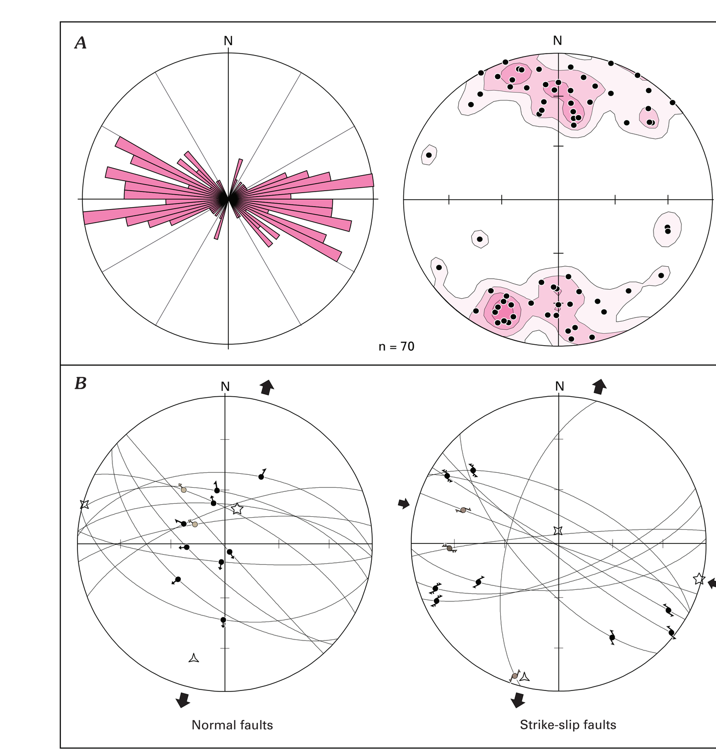
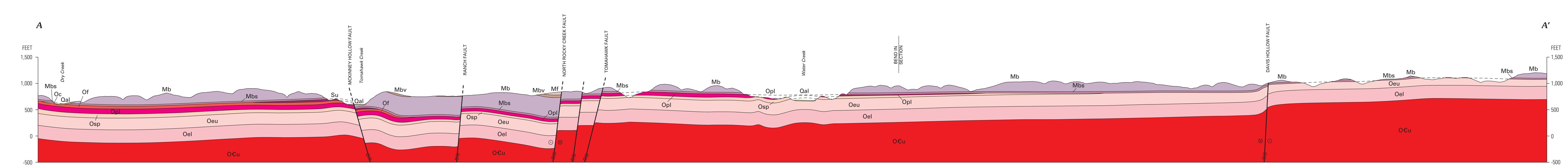
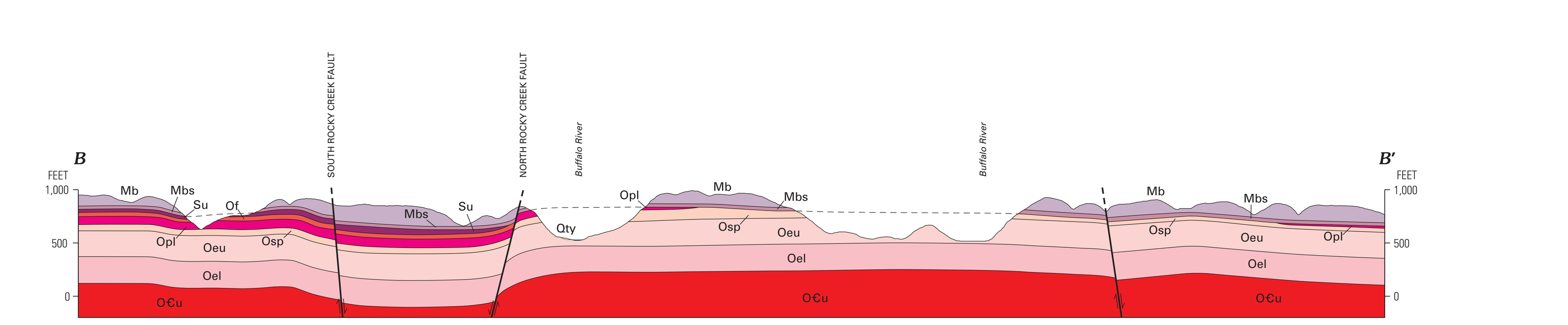


Figure 4. Structural data from the Maumee quadrangle. Number of data are "n". (*A*) Rose diagram of strike frequency (left) and stereoplot of poles and orientation density contours (right) for fault planes measured in outcrop within quadrangle. Contour levels are multiples of standard deviations. (*B*) Striated faults with slip sense that are compatible with normal (left) and strike-slip (right) paleostress regimes. Arcs and dots are lower hemisphere projections of fault planes and their slip lines, respectively. Small arrows show movement sense of hanging-wall block. Open five-, four-, and three-pointed stars represent orientation of maximum, intermediate, and least principal paleostress axes, respectively, from analysis of Angelier (1990). Gray slip symbols are faults excluded from calculation due to slip misfits > 45°. Large black arrows show azimuth of least horizontal compression. (*C*) Rose diagram of strike frequency of joints recorded within the map area.





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CONVERSION FACTORS

Multiply	By	To obtain
inches (in.)	2.54	centimeters (cm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)

GEOLOGIC MAP OF THE MAUMEE QUADRANGLE, SEARCY AND MARION COUNTIES, ARKANSAS

By
Kenzie J. Turner and Mark R. Hudson
2010