Arkansas River Valley

Overview

This physiographic region lies between the Boston Mountains Plateau on the north and the Ouachita Mountains to the south. The Valley extends from the Oklahoma border on the west to the Mississippi River Alluvial Plain on the east, a distance of approximately 150 miles. The north to south width is approximately 30 miles along Scenic 7 (Fig.1).

The types of landforms present in the region, crossed by Scenic 7, range from broad floodplains and stream valleys to erosion-produced, mesa-like mountains (Crow Mountain, Mount Nebo) to ridges either narrow (Dardanelle Rock) or broad and rolling (Russellville Skyline Drive) (Fig. 25 and 26). The mountains and ridges are capped by erosion-resistant sandstone (Hartshorne Sandstone and sandstone of the Atoka Formation), while valleys are floored by softer shale and stream-deposited sediments (gravel, sand, silt, and clay). Almost all of the rocks are of sedimentary origin and are Pennsylvanian in age (approximately 300 million years ago). However, there are a few scattered, small igneous intrusions (Cretaceous Period, approximately 100 million years ago) in the Arkansas River Valley Province near the towns of Morrilton, Oppelo, Perry, and Blue Ball.

Rock Types Exposed Along Scenic 7 in the Arkansas River Valley

(Based on McFarland, 2004)

(Rock types are listed from youngest to oldest, map symbols follow the formation name.)

Alluvium (Qal)

Age: Quaternary, Holocene Epoch (Present to 11,700 years ago))

Description: These are unconsolidated sediments consisting of gravel, sand, silt, and clay. Fossils are rare and of modern life forms. Thicknesses are variable being dependent on the size of the stream or river.

Environment of deposition: alluvial deposits of streams and rivers.

Terrace Deposits (Qt)

Age: Quaternary, Pleistocene Epoch (11,700 years to 2.6 million years ago)

Description: These unconsolidated sediments are parts of former floodplains of major river systems. The sediments consist of gravel, sand, silt, and clay deposits that vary in thickness, are usually discontinuous and sometimes lens-shaped. Fossils are rare. Generally, terraces are several tens of feet above the level of the modern floodplain.

Environment of deposition: alluvial deposits of river systems.

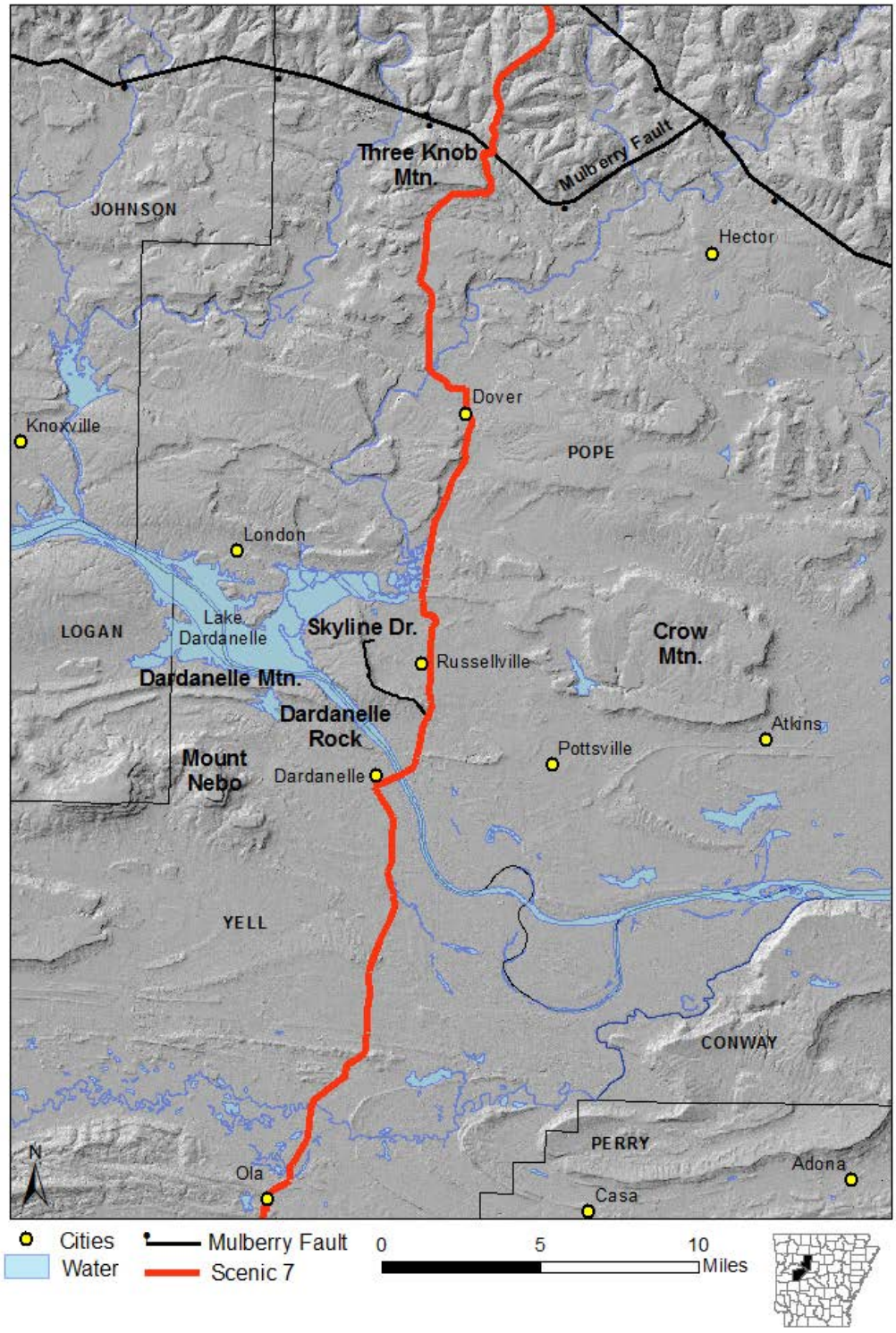

Figure 25. Shaded topographic relief map of the Arkansas River Valley (Ozark Mountains are located to the north of the Mulberry Fault and the Ouachita Mountains are located just to the south of Ola).

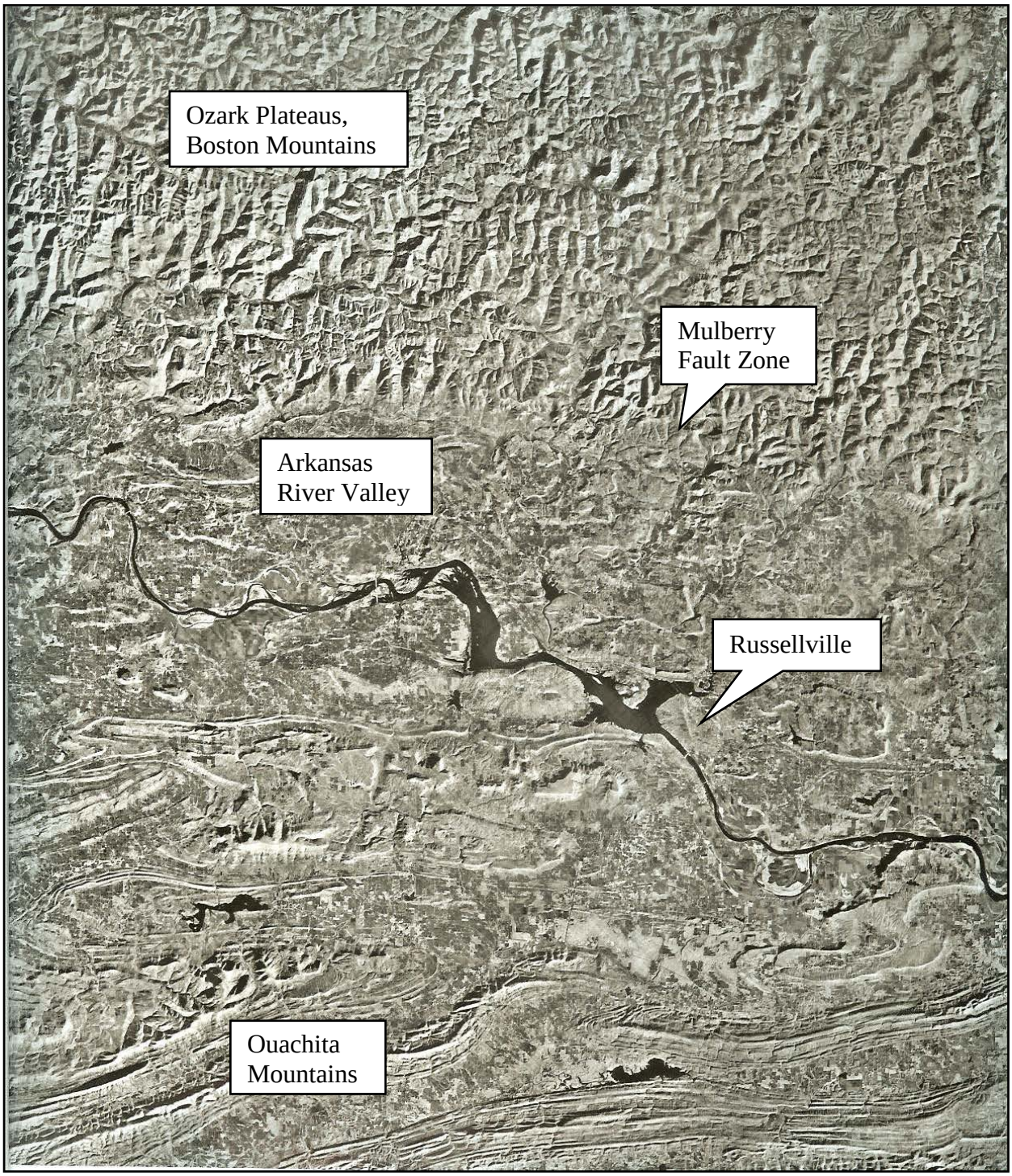

Figure 26. High altitude radar mosaic across the Arkansas River Valley
(source U.S. Geological Survey**)**

McAlester Formation (ℙma)
Age: Pennsylvanian (299 to 318 million years ago)
Description: The McAlester consists of shale, thin sandstones, and coal. The Lower Hartshorne Coal lies approximately 20 feet above the Hartshorne Sandstone in this region. The coal bed, which was mined extensively in the Russellville area, attained a maximum thickness of approximately 3 feet. The McAlester lies conformably above the Hartshorne Sandstone and ranges from approximately 500 to 800 feet thick in the local area. Between SH 7T junction (Bernice Avenue in Russellville) and the ridge approximately 0.6 mile north of the Arkansas River Bridge, the McAlester is exposed at the surface for a distance of approximately 1.1 miles along the axis of the Shinn Basin (syncline).
Environment of deposition: black shale and coal beds were deposited in marine coastal swamps and deltas, while the thicker shale and sandstone was formed in a deeper marine setting.

Hartshorne Sandstone (ℙhs)
Age**:** Pennsylvanian (299 to 318 million years ago)
Description: The Hartshorne is an erosion-resistant, brown to light-gray, massive to cross-bedded, sandstone that forms ridges (Russellville's Skyline Drive and Dardanelle Rock) and caps the flat-topped mountains (Crow Mountain and Mount Nebo) in the region. The Hartshorne ranges from approximately 10 to 300 feet in thickness in various parts of the Arkansas River Valley.
Environment of deposition: meandering stream channels, as indicted by cross-bedding of the sand layers and the exposure of channel-form deposits observed in road cuts and stream valleys.

Atoka Formation (ℙa)
Age: Pennsylvanian (299 to 318 million years ago)
Description: As you may recall (see page 7), the Atoka consists of gray to tan, silty sandstone and silty shale that is gray to black in color. It also contains irregularly distributed coal beds and black, organic-rich shale. The Atoka may be divided into lower (ℙal), middle (ℙam), and upper (ℙau) subdivisions in some areas.
Environment of deposition: shallow fresh to brackish water, coastal environment for some parts of the Atoka, while other parts, especially in the Ouachita Mountains were deposited in a deep-marine, continental slope setting, where turbidity current deposits formed submarine fans.

Rock and Mineral Resources

Pope County

Pope County has produced a number of mineral commodities including: coal, natural gas, dimension stone, crushed rock, sand, and gravel (Fig. 27). Coal mining began in 1873 west of Russellville and was a thriving industry by 1883. Initially, mining was of the down-dip type. Entry was at the surface outcrop of the coal and mining proceeded underground, as far as was commercially feasible. The deepest underground coal mine in the state (480 feet) was in the Shinn Basin south of Russellville.

Surface strip mining began in 1957 and continued until 1962 in the Shiloh Creek area north of Russellville. The mined area was reclaimed and developed into a public fishing area and softball park.

Sandstone has been quarried at a number of locations in the region, especially to produce crushed stone for construction of Interstate 40 and Dardanelle Dam on the Arkansas River. Also, sand and gravel are dredged from the Arkansas River to be used in the production of concrete and for general use.

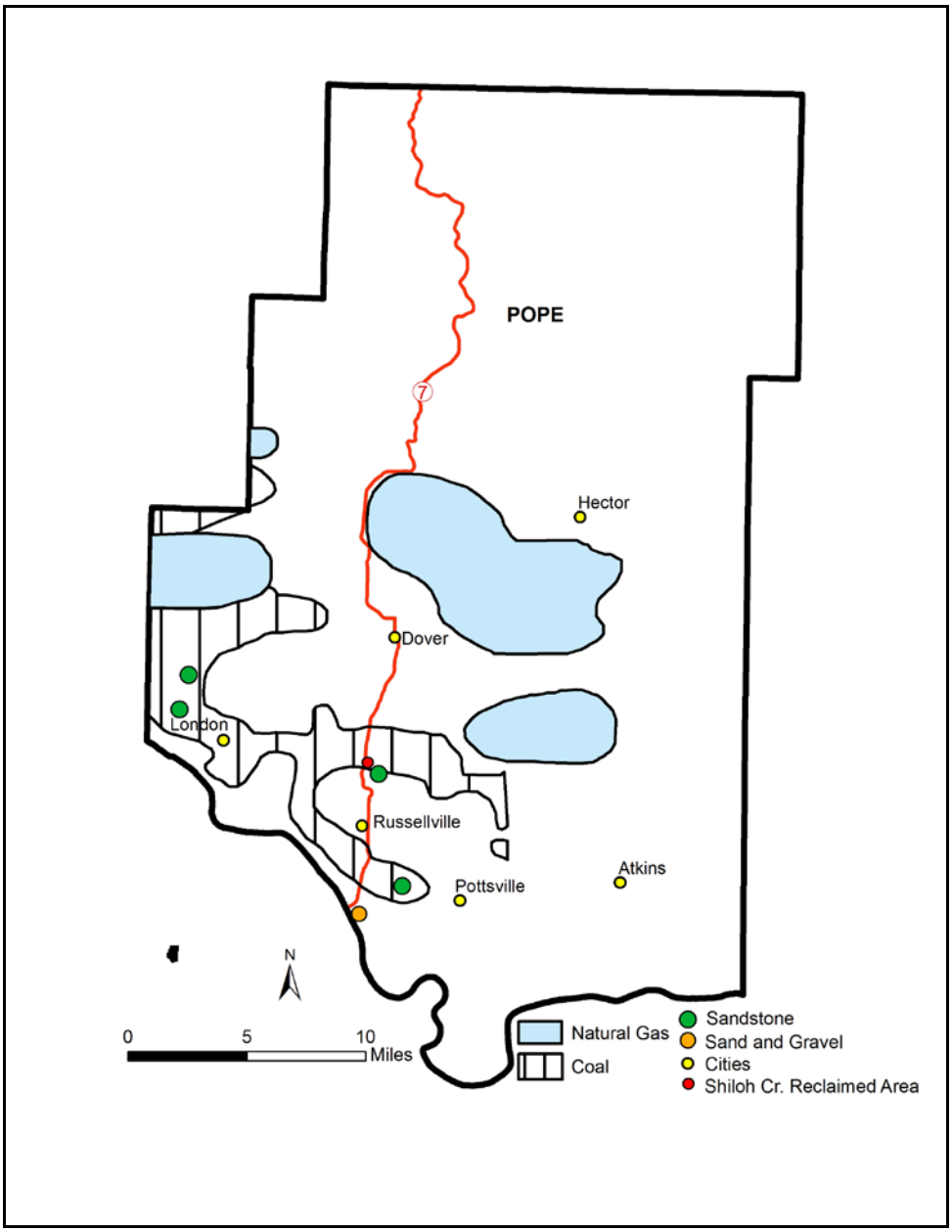

Figure 27. Mineral Resource Map of Pope County

(Natural gas and coal information, Arkansas Geological Commission, 2001; sandstone and sand/gravel information, U.S. Bureau of Mines, Bulletin 645, 1969)

Structural Geology and Natural Gas Production

As stated previously, the geologic boundary between the Boston Mountains Plateau and the Arkansas River Valley is the Mulberry Fault. Additionally, there are numerous parallel, east-west to southeast-northwest trending, normal faults present south of the Mulberry Fault (Fig. 24). Also, there are structural folds in the rock strata. These folds generally trend in an east-west direction with their limbs dipping from just a few degrees to nearly vertical. Many of the faults and folds are responsible for the accumulation (trapping) of natural gas several thousand feet below the surface.

Oil and gas exploration geologists refer to this region as part of the Arkoma Basin. A majority of the gas produced in the Arkoma Basin comes from sandstones in the Atoka Formation. The following gas fields are crossed by Scenic 7 before reaching Russellville: Dover, New Hope, and Furgeson (Fig. 28). In 2011 the wells in these fields produced 188,808,894 thousand cubic feet of gas from the Atoka Formation. At an average price of $4.00 per thousand cubic feet (forecastchart.com) gas production in the county was worth approximately $ 755 million.

Arkansas was ranked 8th in the U.S. among gas-producing states in 2011. Natural gas production, including that produced from the Fayetteville Shale and the central part of the Arkoma Basin, was 1,073,295,953 thousand cubic feet worth approximately $4.29 billion.

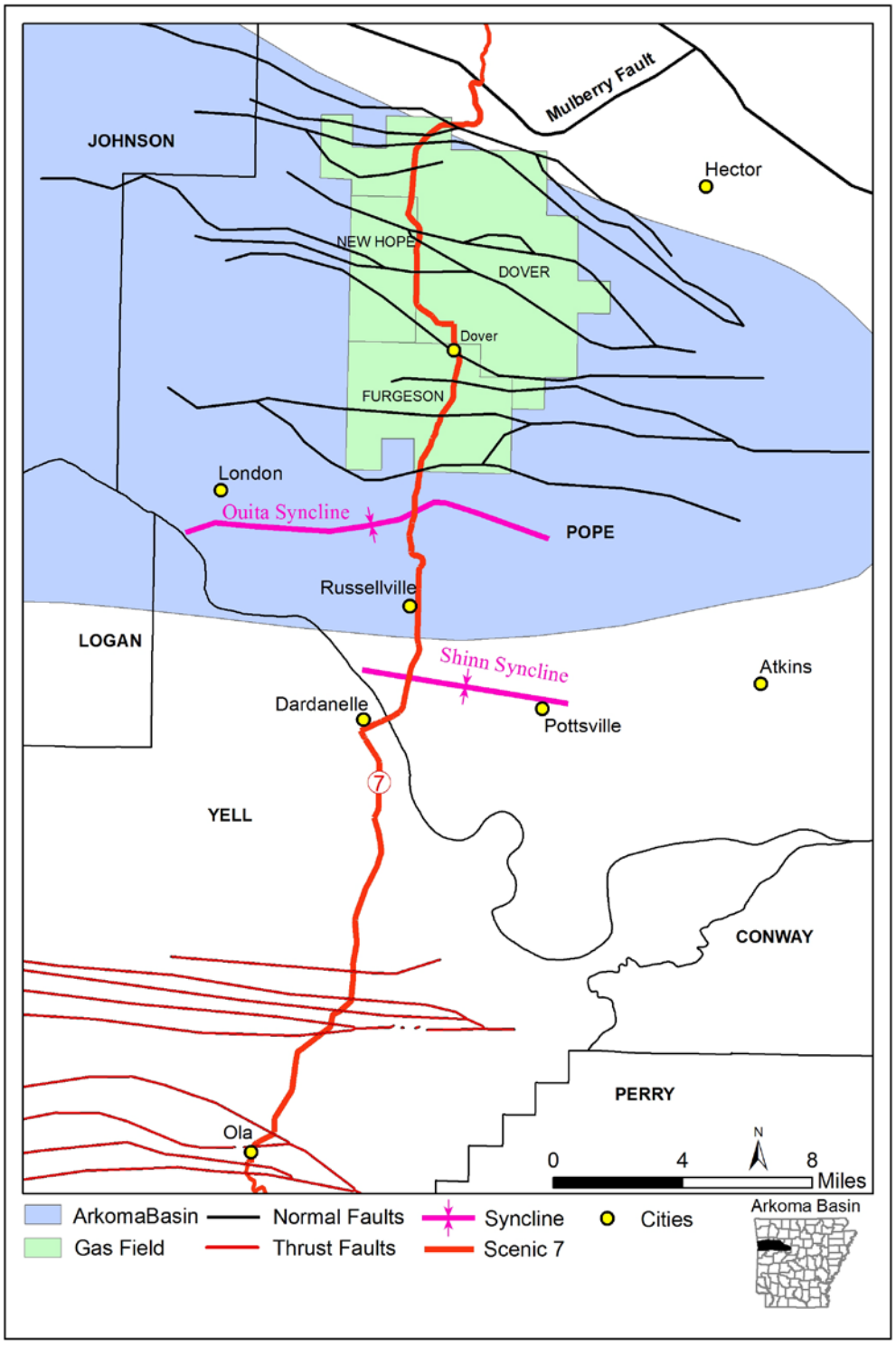

Figure 28. Arkoma Basin, gas fields, faults, and folds in portions of Pope and Yell Counties
(source, Arkansas Geological Survey)

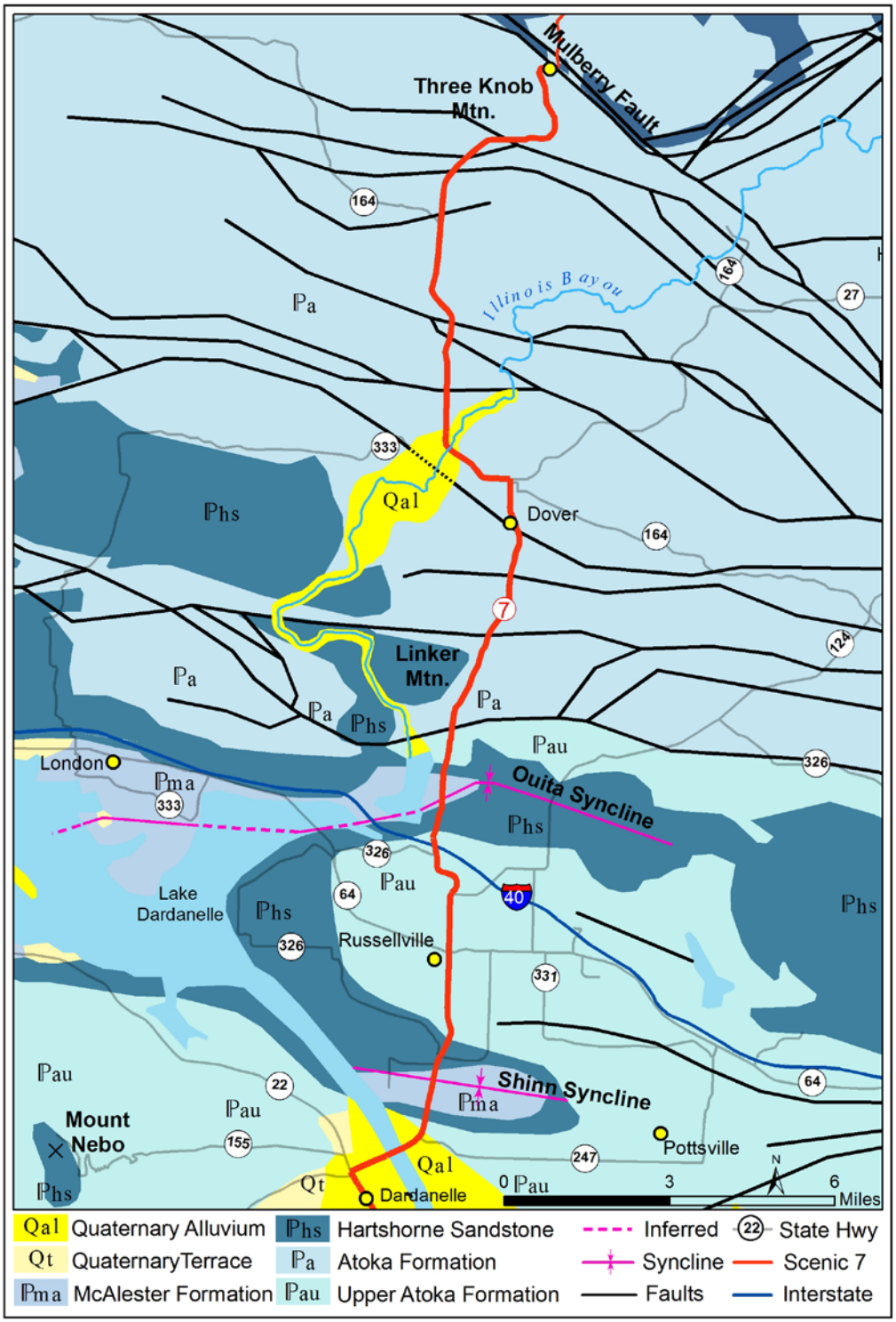

Figure 29. Geologic map Mulberry Fault to Dardanelle
(from Geologic Map of Arkansas, 1:500,000 scale).

Road Log – Mulberry Fault to Dardanelle

As Scenic 7 turns from south to west around Three Knob Mountain and then toward the south at the bottom of the hill, the elevation drops from 980 feet to 680 feet over a distance of 2.4 miles. The 300 foot drop in elevation across the Mulberry Fault marks the edge of the Boston Mountains Plateau and the beginning of the Arkansas River Valley Province. Between Three Knob Mountain and the town of Dover we cross seven normal faults that are not apparent in road cuts (Fig. 29). However, they were mapped by reference to aerial photographs and by geologic surface mapping methods. These structures are also detected during gas well drilling.

The Illinois Bayou is crossed approximately 0.8 mile north of Dover. Just before crossing the Bayou, SH 333 intersects Scenic 7 and heads west. Shale of the Atoka Formation is exposed in a cliff on the north side of SH 333. From the bridge toward Dover we are crossing alluvial deposits of the Illinois Bayou for approximately 0.5 mile.

From Dover to Russellville, four more normal faults are crossed. The rocks exposed adjacent to Scenic 7 are shale of the Atoka Formation. The Hartshorne Sandstone forms the caprock of Linker Mountain on the west (right) side of the road. Just south of the Russellville Golf and Country Club a portion of, nearly black, Atoka shale is exposed on the east (left) side of the road. Further south at Pleasant View and Shiloh Parks, on the west (right) side of the road, we can see reclaimed land where coal strip mining occurred (1957 to 1962) in the Lower Hartshorne Coal of the McAlester Formation. The McAlester is present in the Ouita syncline that plunges to the west under Dardanelle Reservoir.

The City of Russellville is located on the Atoka Formation (downtown area), the Hartshorne Sandstone (Skyline Drive area), and the McAlester Formation (Fig. 30). As we travel south on Scenic 7, the Hartshorne is crossed between West 21st Street and the intersection with SH 7T (Bernice Avenue). Beyond this intersection, the McAlester Formation is at the surface due to the presence of the Shinn Basin (syncline). Underground coal mines were operated in the Basin from 1887 until 1953, and as mentioned previously, this is the area where the deepest underground coal mine in Arkansas was located.

Approximately 1.1 miles south of Bernice Avenue, the south limb of the Shinn Basin is crossed. The McAlester Formation – Lower Hartshorne Coal, Hartshorne Sandstone, and the Atoka Formation are exposed in road cuts on both sides of the road (Fig. 31). The asymmetry of the Basin is displayed by the nearly vertical (89 degrees) north-dipping rock strata exposed in the southern limb, as compared to the 5 to 8 degrees south-dipping strata visible in the north limb.

Alluvial sediment begins approximately 0.4 mile after crossing the south limb of the Shinn Basin. As you cross the Arkansas River Bridge into Dardanelle, Dardanelle Dam can be seen to the northwest (right side of the bridge). Dardanelle Mountain and the famous Arkansas River landmark, Dardanelle Rock (Hartshorne Sandstone) (Fig. 32), also lie to the northwest. Excellent exposures of the Hartshorne are present in a quarry located southwest (left side) of the road to the dam overlook area.

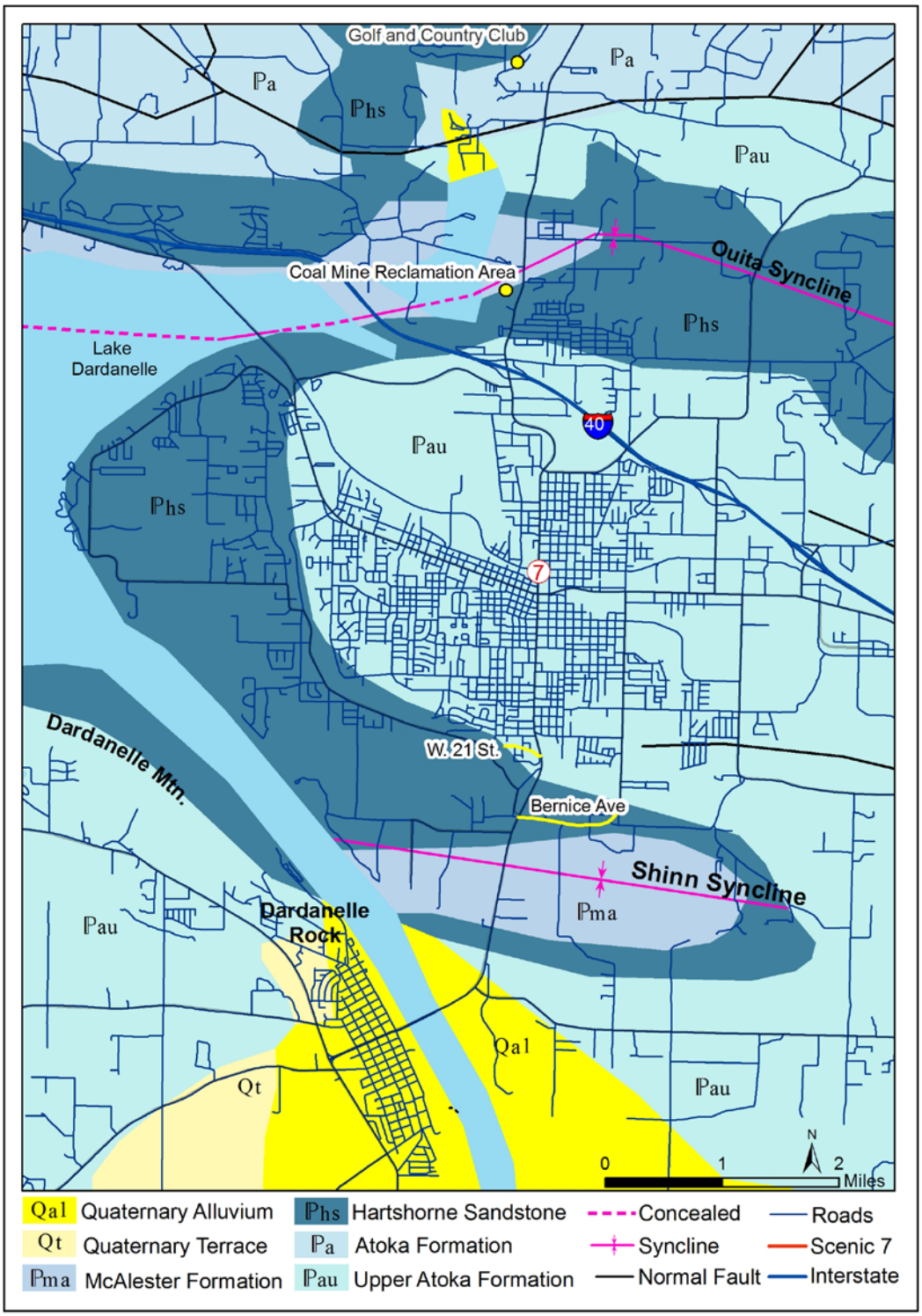

Figure 30. Geologic map of Russellville and Dardanelle
(from Geologic map of Arkansas, 1:500,000 scale)

Figure 31. Hartshorne Sandstone – Atoka Formation
(South Limb of Shinn Basin, 35°14′08″ N 93°08′26″W)

Figure 32. Dardanelle Rock, Hartshorne Sandstone
(Arkansas River at Dardanelle, 35°14′10″ N 93°09′43″ W)

Dardanelle is located on Arkansas River alluvial (river) deposits. These deposits range in age from the Quaternary Period, Holocene Epoch (approximately 11,000 years ago) to the present time. The deposits narrow toward the northwest and widen southeast to approximately 6 miles in the Holla Bend National Wildlife Refuge. The sediment of the floodplain consists of gravel, sand, silt, and clay. The "bottomland" of this region is productive of soybeans, corn, cotton, and other row crops.

Figure 33. Mount Nebo
(West of Dardanelle 35°11′53″ N 93°09′18″ W)

Mount Nebo State Park lies due west of Dardanelle approximately 4.2 miles, "as the crow flies." Road distance to the summit is approximately 7 miles from the junction of Scenic 7 and SH 22. A side trip to the top of Nebo is well worth your time. At the intersection of Scenic 7 with SH 22 turn right and follow the signs to the State Park. The views are spectacular!

Mount Nebo is a prime example of the type of mesa-like, flat-topped mountains typical of the Arkansas River Valley Province (Fig. 33). Other prominent mountains of this "erosional-remnant" type include: Petit Jean, Spring, and Magazine. Each of these structures is capped by sandstone folded into shallow-dipping synclines. These sandstones are more resistant to erosion because compression of the rock, along the fold axis, closed most fractures and promoted recrystallization of the mineral grains. All of these mountains were part of a regional plateau that was eroded by the ancestral Arkansas River and its tributaries.

Road Trip Log -- Dardanelle to Ola

As you leave Dardanelle on Scenic 7, the agriculturally rich soil of the floodplain and terraces of the Arkansas River are seen. Also, excellent views of Mount Nebo and Jones Mountain are seen to the right (west) of Scenic 7 (Fig. 34). The road continues to cross alluvium for approximately 2 miles. At Smiley Bayou bridge we leave the alluvium behind and once again encounter the upper Atoka Formation. The Atoka sandstone and shale have dips generally less than 10 degrees in this area.

Approximately 0.3 mile south of the town of Centerville, the middle Atoka is exposed with dips up to 85 degrees, indicating the close proximity of a frontal thrust fault of the Ouachita Mountains. The fault is crossed by the highway about 0.9 miles south of Centerville. Over the next mile, four additional thrust faults in the middle and lower Atoka are crossed. However, there is little easily seen surface expression of these faults that were mapped through the use of aerial photographs and detailed field study. The road continues to cross the Atoka Formation for another 4 miles to the town of Ola where two more thrust faults are mapped, but which are not readily visible due to a lack of bedrock exposures near Scenic 7.

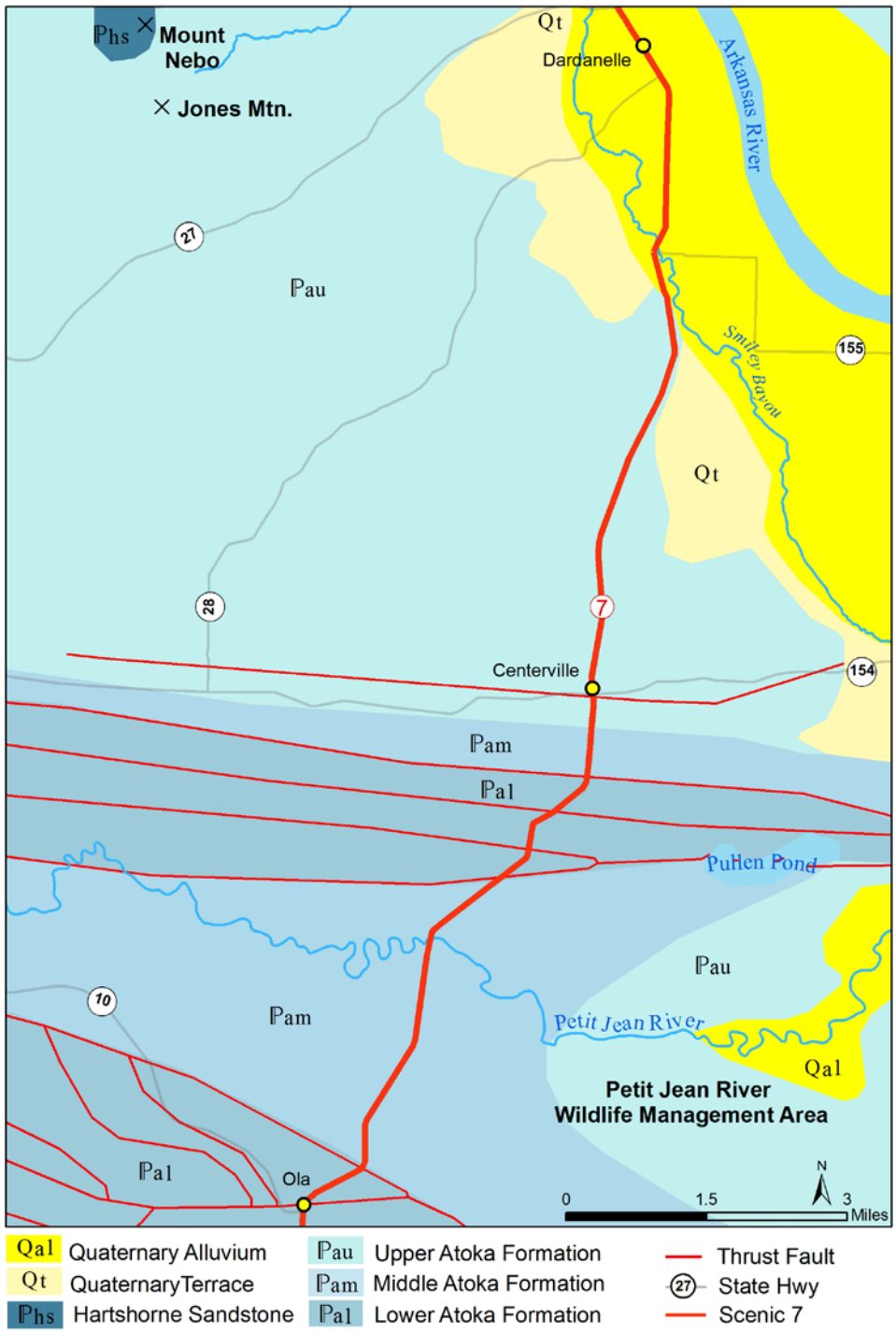

Figure 34. Geologic map from Dardanelle to Ola
(from Geologic Map of Arkansas 1:500,000)