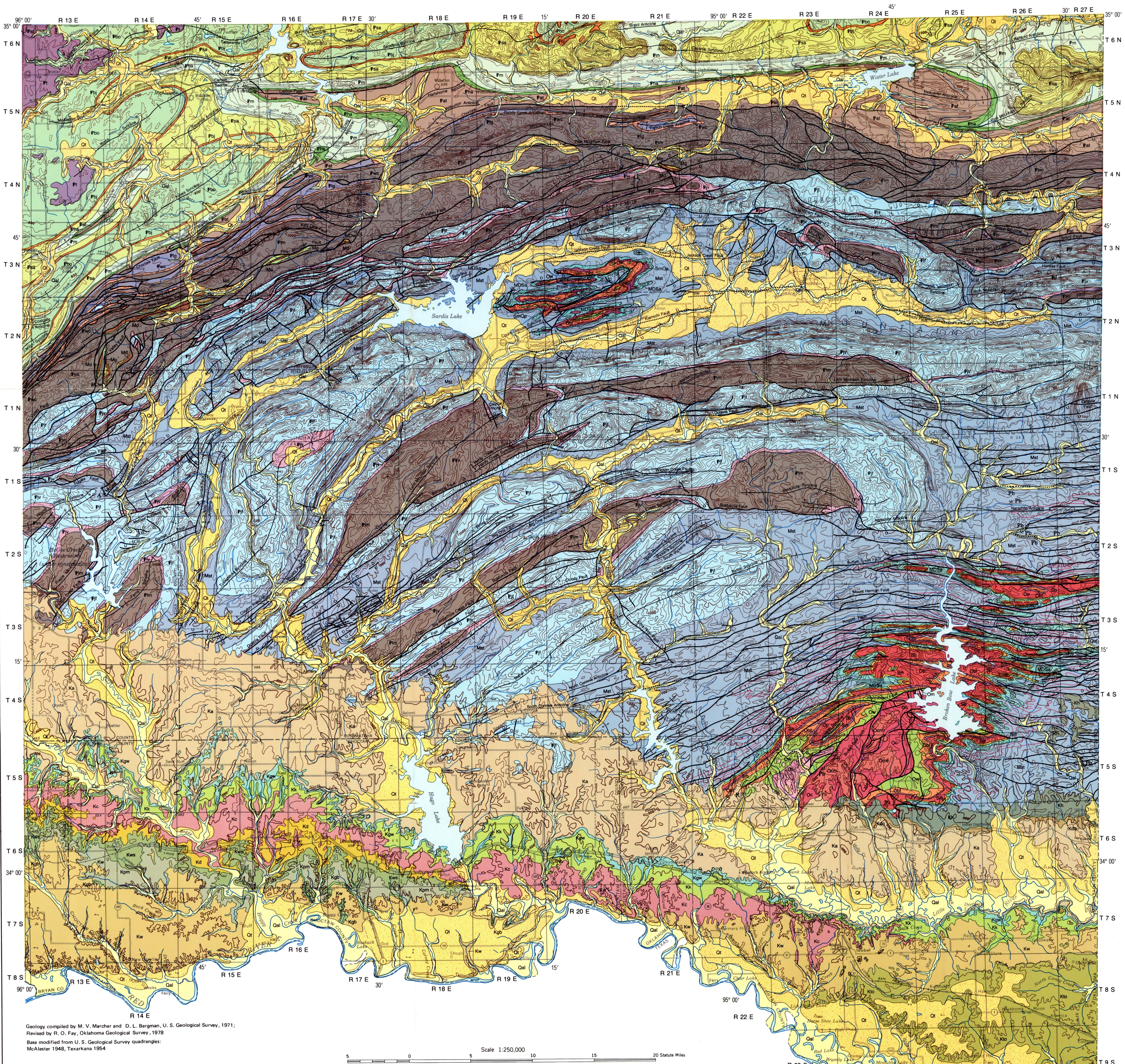
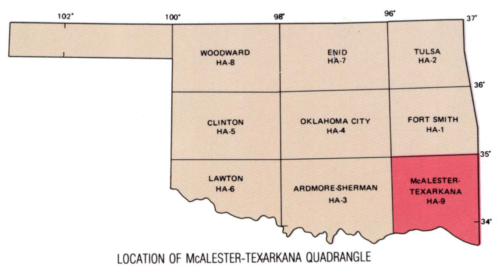


Figure 1: Geologic Map.



LOCATION OF McALESTER-TEXARKANA QUADRANGLE

EXPLANATION

The stratigraphic nomenclature and age determinations used herein are those accepted by the Oklahoma Geological Survey and do not necessarily agree with those of the U.S. Geological Survey.

QUATERNARY: ALLUVIUM (Qal); TERRACE DEPOSITS (Qt)

CRETACEOUS: OZAN FORMATION (Ko); BROWNSTOWN MARL (Kbr); TOKIO FORMATION (Kto); WOODBINE FORMATION (Kw); GRAYSON MARL AND BENNINGTON LIMESTONE (Kgb); PAWPAW SANDSTONE AND McNUTT LIMESTONE (Kpm); WENO CLAY AND SOPER LIMESTONE (Kws); DENTON CLAY (Kd); CADDO FORMATION (Kc); KIAMICHI FORMATION (Kk); GOODLAND LIMESTONE AND WALNUT CLAY (Kgw); ANTLERS SANDSTONE (Ka); DeQUEEN LIMESTONE (Kdq); HOLLY CREEK FORMATION (Kh)

PENNSYLVANIAN: STUART SHALE (Pst); THURMAN SANDSTONE (Pt); BOGGY FORMATION (Pbo); BLUEJACKET SANDSTONE (Pbj); SAVANNA FORMATION (Psa); McALESTER FORMATION (Pm); HARTSHORNE SANDSTONE (Pha); ATOKA FORMATION (Pa); LYNN MOUNTAIN FORMATION (Plm)

Exposures north of Ti Valley Fault: WAPANUCKA LIMESTONE AND CHICKACHOC CHERT (Pwc); LIMESTONE GAP (Plg); GODDARD SHALE (Mg); DELAWARE CREEK SHALE (Md); WOODFORD SHALE (MDw); PINE TOP CHERT (Dp)

Exposures south of Ti Valley Fault: JOHNS VALLEY SHALE (Pjv); JACKFORK GROUP (Pjf); STANLEY GROUP (Ms); ARKANSAS NOVACULITE (MDSa)

The underlying units described occur only in the Potato Hills and Broken Bow Uplift and adjacent smaller uplifts in the southeastern part of the Ouachita Mountains:

SILURIAN: MISSOURI MOUNTAIN SHALE (Sm); BLAYLOCK SANDSTONE (Sb)

ORDOVICIAN: POLK CREEK SHALE (Op); BIGFORK CHERT (Obf); WOMBLE FORMATION (Ow); BLAKELY SANDSTONE (Ob); MAZARN SHALE (Om); CRYSTAL MOUNTAIN SANDSTONE (Ocm); COLLIER SHALE (Oc)

Igneous Rocks of Unknown Age: DIORITE SILL

Contact

Fault, approximately located; dotted where concealed; U, upthrown side; D, downthrown side

Anticline, approximately located; dotted where concealed

Syncline, approximately located; dotted where concealed

Prospect areas
A Asphaltite
Pb Galena, sphalerite, chalcopyrite, and quartz
R Rhodochrosite
Zn Zinc

INTRODUCTION

Urbanization, economic growth, and improved standards of living in rural areas of Oklahoma have resulted in ever-increasing demands for water. To fill the requirements for this vital resource, planners and individual consumers need basic information on the availability and suitability of water in all parts of the State. To provide this information, the U.S. Geological Survey and the Oklahoma Geological Survey have conducted a cooperative program of reconnaissance appraisals on a regional basis of the water resources throughout the State, with special emphasis on ground water.

The present report covers an area of approximately 7,200 square miles in the southeastern part of Oklahoma that includes the McAlester Quadrangle and the part of the Texarkana Quadrangle that lies in Oklahoma (hereinafter referred to as the McAlester-Texarkana Quadrangle). This is the ninth and final region to be considered.

Maps contained in the report offer information on the geology (sheet 1), the distribution and hydrologic characteristics of the various aquifers (sheet 2), the chemical quality of ground water (sheet 3), and the availability, chemical quality, and usage of surface water (sheet 4).

Data used to appraise the water resources of the McAlester-Texarkana quadrangle were obtained in the field, taken from the U.S. Geological Survey reports and files, or obtained from other Federal agencies and from private industries. The U.S. Public Health Service, the Farmers Home Administration, the U.S. Soil Conservation Service, city officials, and many individuals provided useful information on the area's water resources.

NEED FOR ADDITIONAL STUDIES

Because of its potential as a source of large amounts of water, additional studies are needed to determine the capabilities of the Antlers Formation in McCurtain, Choctaw, and Bryan Counties in the southern part of the quadrangle. Locally in southeastern McCurtain County, naturally occurring saline water in the Antlers Formation may be moving upward through abandoned oil- and water-well test holes, thus contaminating the overlying aquifers, particularly the alluvium along the Red River. The amount and extent of such contamination should be determined.

The alluvium along the Red River is a potentially important aquifer and should be studied in detail to provide information to guide future development of this aquifer. The Bigfork Chert and Arkansas Novaculite in the Potato Hills area and in central McCurtain County also may be sources of large amounts of ground water. Although the areas where these formations crop out are remote from any present use, they should be studied in anticipation of future needs and to make a more complete assessment of the State's ground-water resources.

HYDROLOGIC SETTING

The flow characteristics of streams, the occurrence of ground water, and the chemical quality of both ground and surface waters in the McAlester-Texarkana Quadrangle are controlled largely by geology, topography, and climate. Because of profound differences in geology and topography, the quadrangle is naturally separated into two hydrologically dissimilar parts. The northern part, about 70 percent of the total area, includes a small part of the Arkoma Basin and the major part of the Ouachita Mountains in Oklahoma.

The Ouachita Mountains have the most rugged topography in the State, with an average relief of several hundred feet and local relief that exceeds 1,700 feet. With some exceptions, ridges are held up by hard, resistant sandstones, and valleys are carved into soft, easily eroded shale. Upon weathering, these rocks provide only thin, stony soils that have little ability to soak up and store precipitation or to release it gradually to streams and underlying rock. The capability of the bedrock to store and transmit water depends almost entirely on fractures formed by folding and faulting.

The southern part of the quadrangle, in Choctaw County and parts of McCurtain, Pushmataha, Atoka, and Bryan Counties, lies entirely within the Gulf Coastal Plain and includes about 30 percent of the total area. In this area, relief is low, rarely exceeding 100 feet, and the topography is gently rolling to hilly. Soils in much of the area are thick and permeable and can intercept considerable amounts of precipitation. The bedrock consists mostly of sand, clay, and shale that is extensively veneered with sandy terrace deposits. Although the clay and shale units have low permeability, the sand units, which underlie about one-half the area, are capable of storing and transmitting large amounts of water.

Climate plays an important role in the hydrology of the McAlester-Texarkana Quadrangle, which includes the region of greatest precipitation in Oklahoma. Annual precipitation ranges from 42 to 56 inches and for the entire quadrangle averages about 48 inches; therefore, about 18.4 million acre-feet of water falls on the area each year. Because of the rugged topography and thin soils in most of the area, an average of nearly one-third of the total precipitation, approximately 6 million acre-feet, flows off within a short time as surface runoff. Of the remaining portion, part is lost almost immediately by evaporation and part percolates into the soil.

Precipitation entering the soil first replaces previously depleted soil moisture and then is evaporated or transpired by plants. Water entering the soil in excess of that needed to replace depleted soil moisture percolates downward through the soil and enters the zone of saturation, where it recharges the ground-water reservoir. The amount of ground-water recharge in the McAlester-Texarkana Quadrangle is unknown, but it probably does not exceed 1 percent of total precipitation in the northern part where slopes are steep, soils thin, and the bedrock has limited permeability. In the southern part, where slopes are gentle, soils thick, and the bedrock permeable, recharge may be as much as 5 percent.

During periods of no rainfall, streams in the quadrangle are maintained entirely by springs and seepage from the ground-water reservoir. In the northern part of the area, where the rocks have limited storage capacity, streams frequently go dry. In the southern part of the area, where the rocks can store large amounts of water, streams that have cut their channels below the water table are fed by ground-water seepage during dry periods. Evidence of ground-water seepage is shown by the many small springs flowing from the contact of terrace deposits with the underlying bedrock.

Rocks in the McAlester-Texarkana Quadrangle consist mainly of quartz and clay minerals. These minerals have low solubility and do not contain elements that cause undesirable mineralization to the ground water. Thus, in most of the quadrangle, water is of good quality and is suitable for most uses. North of the Choctaw Fault, however, sulfide and sulfate minerals associated with coal beds contribute undesirable mineralization to the ground water. Ground water from deeper formations in the southeastern corner of the quadrangle, in McCurtain County, has a high chloride content, derived from natural brines, that prevents its usage for most purposes. Because of the rather sparse population and low level of industrialization, man's activities have had only local, temporary effects on the quality of both ground and surface waters.

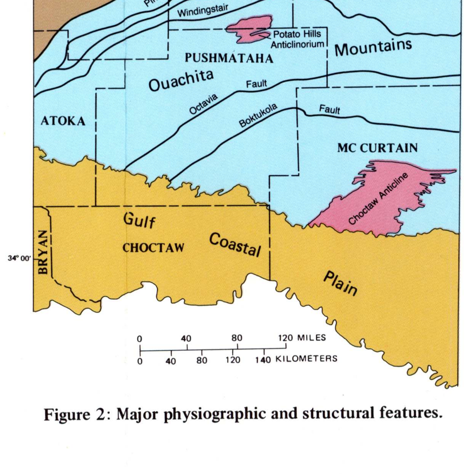


Figure 2: Major physiographic and structural features.

GEOLOGIC SETTING

The McAlester-Texarkana Quadrangle includes parts of three geologic provinces: the Gulf Coastal Plain, the Arkoma Basin, and the Ouachita Mountains (fig. 2). The following summary description of these provinces is abstracted from various published and unpublished reports.

The Gulf Coastal Plain, which covers about 2,000 square miles in the quadrangle, is underlain by sand, clay, shale, and limestone of Cretaceous age and widespread terrace deposits of Quaternary age. From a featheredge at the line of overlap onto Paleozoic rocks, the Cretaceous formations thicken southward and southeastward to as much as 3,500 feet in southeastern McCurtain County. Regional dip of the Cretaceous rocks is southward at about 50 feet per mile in Bryan County, increasing to about 125 feet per mile in McCurtain County.

The part of the quadrangle north of the Choctaw Fault, about 1,000 square miles, is in the Arkoma Basin. Subsidence of the basin, which began in Late Mississippian time, resulted in the accumulation of a sequence of shale, sandstone, and coal having a maximum aggregate thickness of 18,500 feet. Some of the rocks within the basin have been folded into a series of long, relatively tight anticlines separated by broad synclines. A few of the anticlinal crests have been broken by thrust faults of small displacement, with south limbs pushed northward. The folds and faults trend east-northeast and are more or less parallel to the front of the Ouachita Mountains.

The Ouachita Mountains province, lying between the Choctaw Fault on the north and the Gulf Coastal Plain on the south, covers about 4,200 square miles and is an area of considerable structural and stratigraphic complexity. Many investigators have described the geology of various parts of the region, and their reports are cited in the extensive bibliography by Flawn and others (1961, p. 197-210).

The part of the Ouachita Mountains between the Choctaw Fault and the Ti Valley Fault is characterized by a sequence of shale and sandstone, mainly of Early Pennsylvanian age, 7,000 feet thick, broken by numerous arcuate thrust faults that dip steeply toward the south. The major fault blocks and the few large synclines are cut by small tear and reverse faults or are interrupted by small plunging anticlines and synclines.

South of the Ti Valley Fault, the Ouachita Mountains are characterized by strata assigned to the Stanley and Jackfork Groups and the Johns Valley Formation of Late Mississippian to Early Pennsylvanian age. These strata thicken rapidly southeastward from a few thousand feet at the Ti Valley Fault to about 17,000 feet in southwestern Pushmataha County. The Stanley-Jackfork sequence is almost entirely clastic, with shale constituting about 75 percent of the Stanley and sandstone making up 50 to 70 percent of the Jackfork. Because of their incompetence, the shale units typically are much deformed and show widespread incipient to low-grade dynamic metamorphism. Similar deformation is shown by the sandstone units in some areas although, as a general rule, they are less distorted.

Structurally, the central Ouachitas south of the Ti Valley Fault are characterized by broad synclines and narrow anticlines that are separated by steep, southward-dipping thrust faults and broken by many small reverse, normal, and tear faults. Small, steeply plunging anticlines and synclines occur on the flanks of the large synclines and adjacent to thrust faults. A structural feature of particular interest is the Potato Hills Anticlinorium, which straddles the Latimer-Pushmataha County line. Miser (1929, p. 18) interpreted the structure as a tectonic window cut through the Windingstair thrust block and exposing the intricately folded rocks of the anticlinorium below. Alternate explanations for the origin of the Potato Hills are summarized by Pitt (1971).

The Choctaw Anticline is the western end of the Broken Bow-Benton Uplift, which extends in a broad arc, about 150 miles long, from near Benton, Arkansas, westward into McCurtain County, where it is covered by Cretaceous rocks of the Gulf Coastal Plain. Rocks involved in this structure range in age from Cambrian (?) to, and including, Devonian and have an aggregate thickness of 4,200 feet. All these strata have been intensely folded and faulted with accompanying widespread weak to low-grade dynamic metamorphism. Numerous hydrothermal quartz veins fill faults and fractures and are present along bedding planes in all formations.

Most faults are thrusts and high-angle reverse faults, although normal faults are not uncommon. Folds range from simple and open through tightly compressed to compound fan folds, both normal and inverted. Rocks in the core of the uplift are not as intensely folded, nor do they reflect the structure of the surrounding younger rocks. To explain this discrepancy, Miser (1929, p. 22) postulated a window in the thrust sheet of the Boktukola Fault, whose trace crops out north and northwest of the core area. Pitt (1955) mapped the area as a simple anticlinorium.

REFERENCES CITED

Flawn, P. T., Goldstein, August, Jr., King, P. B., and Weaver, C. E., 1961, The Ouachita System: The University of Texas at Austin, Publication No. 6120, 401 p.

Miser, H. D., 1929, Structure of the Ouachita Mountains of Oklahoma and Arkansas: Oklahoma Geological Survey Bulletin 50, 30 p.

Pitt, W. D., 1955, Geology of the core of the Ouachita Mountains of Oklahoma: Oklahoma Geological Survey Circular 34, 34 p.

______1971, Potato Hills problem area: Oklahoma Geological Survey, Oklahoma Geology Notes, vol. 31, no. 5, p. 99-107.

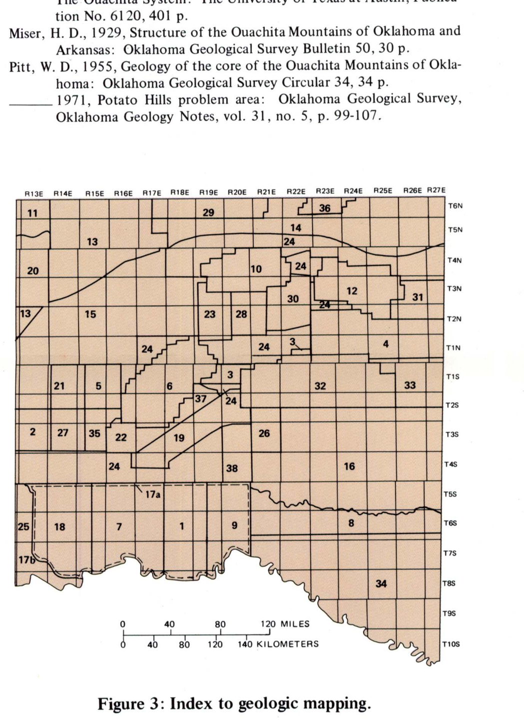


Figure 3: Index to geologic mapping.

SOURCES OF GEOLOGIC INFORMATION

1. Alfonsi, P. P., 1968, Lithostratigraphy and areal geology of east-central Choctaw County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 57 p.
2. Boone, R. L., 1961, Areal geology of Bruno and Lane quadrangles, Atoka County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 99 p.
3. Bradshaw, D. D., 1962, Areal geology of the Stanley Group (Mississippian) in northeastern Pushmataha County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 56 p.
4. Briggs, Garrett, 1973, Geology of the eastern part of the Lynn Mountain syncline, Le Flore County, Oklahoma: Oklahoma Geological Survey Circular 75, 34 p.
5. Burrough, H. C., 1960, Surface geology of the Jumbo quadrangle, Pushmataha County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 131 p.
6. Cline, L. M., 1960, Stratigraphy of the late Paleozoic rocks of the Ouachita Mountains, Oklahoma: Oklahoma Geological Survey Bulletin 85, 113 p.
7. Dalton, R. C., 1966, Stratigraphy and areal geology of central Choctaw County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 68 p.
8. Davis, L. V., 1960, Geology and ground-water resources of southern McCurtain County, Oklahoma: Oklahoma Geological Survey Bulletin 86, 108 p.
9. Duarte, A. H., 1968, Geology of eastern Choctaw County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 70 p.
10. Fellows, L. D., 1964, Geology of the western part of Winding Stair Range, Latimer and Le Flore Counties, Oklahoma: Oklahoma Geological Survey Circular 65, 102 p.
11. Govett, Ray, 1957, The geology of the Cabaniss-Arpelar area, Pittsburg County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 60 p.
12. Hart, O. D., 1963, Geology of the eastern part of Winding Stair Range, Le Flore County, Oklahoma: Oklahoma Geological Survey Bulletin 103, 87 p.
13. Hendricks, T. A., 1937, The McAlester district, *pt. 1 of* Geology and fuel resources of the southern part of the Oklahoma coal field: U.S. Geological Survey Bulletin 874-A, p. 1-90.
14. ______1939, The Howe-Wilburton district, Latimer and Le Flore Counties, *pt. 4 of* Geology and fuel resources of the southern part of the Oklahoma coal field: U.S. Geological Survey Bulletin 874-D, p. 255-300.
15. Hendricks, T. A., Gardner, L. S., Knechtel, M. M., and Averitt, Paul, 1947, Geology of the western part of the Ouachita Mountains of Oklahoma: U.S. Geological Survey Oil and Gas Investigations Preliminary Map 66, 3 sheets, scale 1:42,240.
16. Honess, C. W., 1923, Stratigraphy, structure, and physiographic history, *pt. 1 of* Geology of the southern Ouachita Mountains of Oklahoma: Oklahoma Geological Survey Bulletin 32, 278 p.
17a. Huffman, G. G., and others, 1975, Geology and mineral resources of Choctaw County, Oklahoma: Oklahoma Geological Survey Bulletin 120, 39 p.
17b. ______, 1978, Geology and mineral resources of Bryan County, Oklahoma: Oklahoma Geological Survey Bulletin 126, 113 p.
18. Jeffries, E. L., 1965, Areal geology of western Choctaw County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 51 p.
19. Johnson, R. H., Jr., 1954, Geology of the Medicine Springs area, Pushmataha County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 59 p.
20. Jones, J. G., 1957, Geology of the Ashland-Kiowa area, Pittsburg County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 126 p.
21. Krivanek, C. M., 1961, Areal geology of Lane NE Quadrangle, Pushmataha and Atoka Counties, Oklahoma: University of Oklahoma unpublished M.S. thesis, 113 p.
22. McCullough, E. L., 1954, The geology of the Finley area, Pushmataha County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 48 p.
23. Miller, B. W., 1955, The geology of the western Potato Hills, Pushmataha and Latimer Counties, Oklahoma: University of Oklahoma unpublished M.S. thesis, 55 p.
24. Miser, H. D., and others, 1954, Geologic map of Oklahoma: Oklahoma Geological Survey and U.S. Geological Survey, scale 1:500,000.
25. Olson, L. J., 1965, Geology of eastern Bryan County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 64 p.
26. Piatt, Larry, 1962, Geology of the Signal Mountain area, southeastern Pushmataha County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 79 p.
27. Ray, G. D., 1960, Areal geology of the Farris Quadrangle, Pushmataha and Atoka Counties, Oklahoma: University of Oklahoma unpublished M.S. thesis, 87 p.
28. Roe, N. C., 1955, Geology of the eastern Potato Hills, Pushmataha County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 63 p.
29. Russell, D. T., 1960, Geology of northern Latimer County, Oklahoma: Oklahoma Geological Survey Circular 50, 56 p.
30. Seely, D. R., 1955, Geology of the Talihina area, Pushmataha, Latimer, and Le Flore Counties, Oklahoma: University of Oklahoma unpublished M.S. thesis, 77 p.
31. ______1963, Structure and stratigraphy of the Rich Mountain area, Oklahoma and Arkansas: Oklahoma Geological Survey Bulletin 101, 173 p.
32. Shelburne, O. B., Jr., 1960, Geology of the Boktukola syncline, southeastern Oklahoma: Oklahoma Geological Survey Bulletin 88, 84 p.
33. Smith, D. L., 1967, Geology of northeast McCurtain and southeast Le Flore Counties, Oklahoma: University of Wisconsin unpublished M.S. thesis, 46 p.
34. The University of Texas Bureau of Economic Geology, 1966, Geologic atlas of Texas, Texarkana sheet - Elias H. Sellards Memorial Edition: Scale 1:250,000. (Includes 7-page accompanying text.)
35. Todd, H. W., 1960, Areal geology of the Moyers Quadrangle, Pushmataha County, Oklahoma: University of Oklahoma unpublished M.G.E. thesis, 71 p.
36. Webb, P. K., 1960, Geology of the Cavanal syncline, Le Flore County, Oklahoma: Oklahoma Geological Survey Circular 51, 65 p.
37. Willis, P. D., 1954, The geology of the Snow area, Pushmataha County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 60 p.
38. Woodson, J. P., 1964, Areal geology of the Southwest Pickens area, Pushmataha County, Oklahoma: University of Oklahoma M.S. thesis, 81 p.

RECONNAISSANCE OF THE WATER RESOURCES OF THE MCALESTER AND TEXARKANA QUADRANGLES, SOUTHEASTERN OKLAHOMA

By
Melvin V. Marcher and DeRoy L. Bergman
U.S. Geological Survey
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