STUDIES RELATED TO WILDERNESS

Mineral Resources of the Caney Creek Wilderness, Polk County, Arkansas

GEOLOGICAL SURVEY BULLETIN 1551

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U.S. GEOLOGICAL SURVEY *and by* MAYNARD L. DUNN, JR., *and*
DONALD K. HARRISON, U.S. BUREAU OF MINES

STUDIES RELATED TO WILDERNESS — WILDERNESS AREAS

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An evaluation of the mineral potential of the area

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STUDIES RELATED TO

WILDERNESS AREAS

In accordance with the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Studies and reports of all primitive areas have been completed. Areas officially designated as "wilderness," "wild," or "canoe" when the Act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The Act provided that areas under consideration for Wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. This report discusses the results of a mineral survey of the Caney Creek Wilderness, Arkansas, in the Ouachita National Forest. Caney Creek was established as a wilderness by Public Law 93-622, January 3, 1975.

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MINERAL RESOURCES OF THE CANEY CREEK WILDERNESS, POLK COUNTY, ARKANSAS

By GEORGE E. ERICKSEN and SAM H. PATTERSON,
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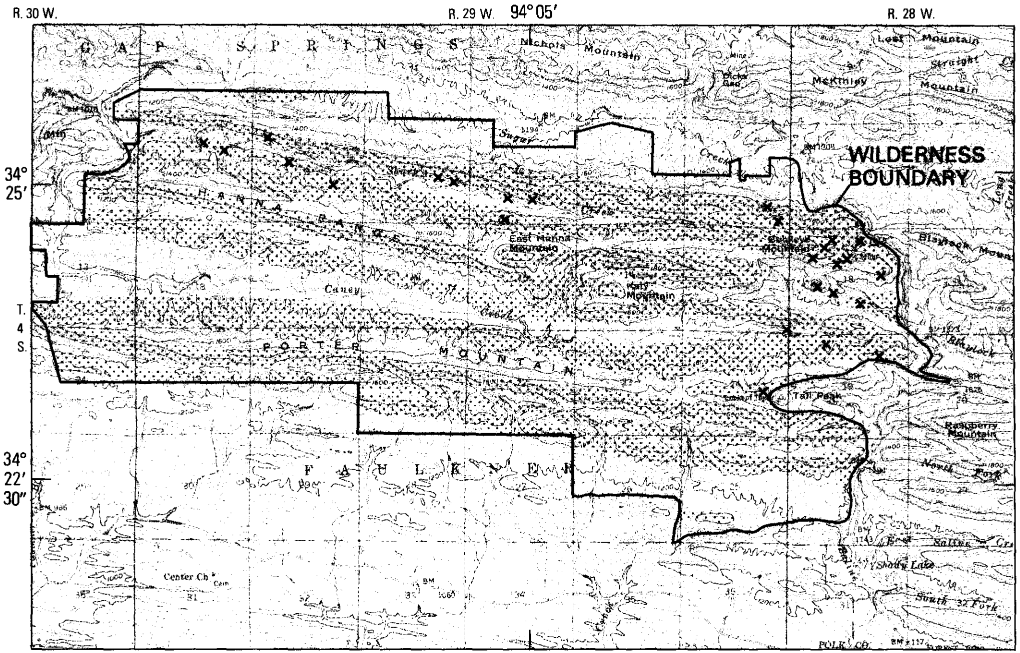
SUMMARY

The Caney Creek Wilderness lies within the west-central Arkansas manganese district of the southern Ouachita Mountains, a region containing many small deposits of metallic minerals and important resources of industrial minerals. Except for a small amount of manganese oxides, no mineral commodities are known to have been produced from the wilderness. Twenty-five manganese prospects (fig. 1), two tripoli prospects, and a manganese mill site were found within the wilderness. Neither these prospects nor other mineral occurrences in the wilderness are covered by patented mining claims.

The wilderness is in a region of deformed Paleozoic sedimentary rocks, and the mineral deposts were either accumulated as part of the original sedimentary sequence or formed by subsequent metamorphism, hydrothermal vein formation, or supergene alteration during weathering. Six formations ranging in age from Ordovician to Mississippian crop out in the wilderness. From oldest to youngest these are Bigfork Chert, Polk Creek Shale, Blaylock Sandstone, Missouri Mountain Shale, Arkansas Novaculite, and Stanley Shale. Deformation at the end of the paleozoic caused intense folding of these rocks and transformed some of the shale to slate and sandstone to quartzite.

Metallic and nonmetalic minerals in the wilderness include manganese and iron oxides, turquoise, novaculite, tripoli, shale, slate, and gravel. Barite, an important mineral commodity in the Ouachita Mountains, has not been found in the wilderness. Field investigations and sampling indicate that manganese oxides are widely distributed through the wilderness, but deposits are too small to be mined profitably under present economic conditions. Undiscovered deposits undoubtedly exist in the Arkansas Novaculite within the wilderness (fig. 1), although it is unlikely that any are larger or higher in grade than those already known. Thin layers and small masses of iron oxides are associated with some of the manganese occurrences, but quantities are too small to be of value as iron ore. A small turquoise deposit, a short distance outside



Base from U.S. Geological Survey, 1:62,500 Umpire, 1959

0 1 2 MILES

EXPLANATION

Arkansas Novaculite—(Contains resources of novaculite and tripoli and scattered small, low-grade occurrences of manganese oxides)

× Manganese prospect

FIGURE 1.—Mineral resource potential map of the Caney Creek Wilderness.

the southwestern boundary of the wilderness, was being mined in 1978. Two turquoise occurrences, significantly smaller and of poorer quality than at the mine, were found in the Caney Creek Wilderness during field investigations. The Arkansas Novaculite contains rock suitable for railroad ballast, road material, building stone, and whetstones; however, the amount of novaculite in the Ouachita Mountains is enormous, and that in the wilderness is of no particular value. Although deposits of tripoli, shale, gravel, and possibly slate occur in the wilderness, they are of little or no value because larger, more accessible deposits of equal or better-grade materials exist outside the area nearer to markets. Thin layers of barite, too small to be mined, have been found in the Stanley Shale near the wilderness. Although similar layers may occur in the area, geochemical sampling indicates that large, potentially exploitable barite deposits are not present.

Nodules and thin layers of phosphate rock have been found in the Stanley Shale near the wilderness and may be present in it. However, the known occurrences of phosphate in the Stanley Shale are far too small to be minable. The wilderness does not contain resources of coal and oil or gas. It does not have any potential for geothermal energy.

INTRODUCTION

This report describes the results of a mineral resource survey of the Caney Creek Wilderness, Polk County, Arkansas. The survey was made jointly by personnel from the U.S. Geological Survey (USGS) and the U.S. Bureau of Mines (USBM) in the spring of 1978. The area, designated as a wilderness by Public Law 93-622, January 3, 1975, comprises 14,433 acres in the Ouachita National Forest in the Cossatot Mountains, which are a southern segment of the Ouachita Mountains of west-central Arkansas (fig. 2). The Caney Creek Wilderness is about 12 airline miles southeast of Mena, Ark., the seat of Polk County (fig. 2). The area is elongate in an east-west direction, being about 8 mi long and 3–3½ mi wide. Topographic map coverage is provided by the Umpire 15′ quadrangle, scale 1:62,500, and by the DeQueen 30′ quadrangle, scale 1:125,000, the base which Miser and Purdue (1929) used for their classic geologic map of the southwestern Ouachita Mountains. The U.S. Forest Service has prepared a user map of the wilderness, scale 1:31,680, that is an enlargement of the Umpire 15′ quadrangle.

The wilderness is accessible by State Route 375 from Mena and by State Route 246 from U.S. Highway 71, south of Mena. Except for the southern half of the western boundary, secondary roads encircle the area. The interior is accessible by a well-maintained trail along Caney Creek and an unmaintained trail that follows a former road up Short Creek for about 5 mi.

The wilderness encompasses three prominent east-west ridges—Porter Mountain, Hanna Range, and Shadow Rock Mountain—and the intervening valleys of Caney and Short Creeks, which drain westward into the Cossatot River (fig. 3). Altitudes range from 940 ft at the confluence of Caney Creek and the Cossatot River to 2,330 ft at

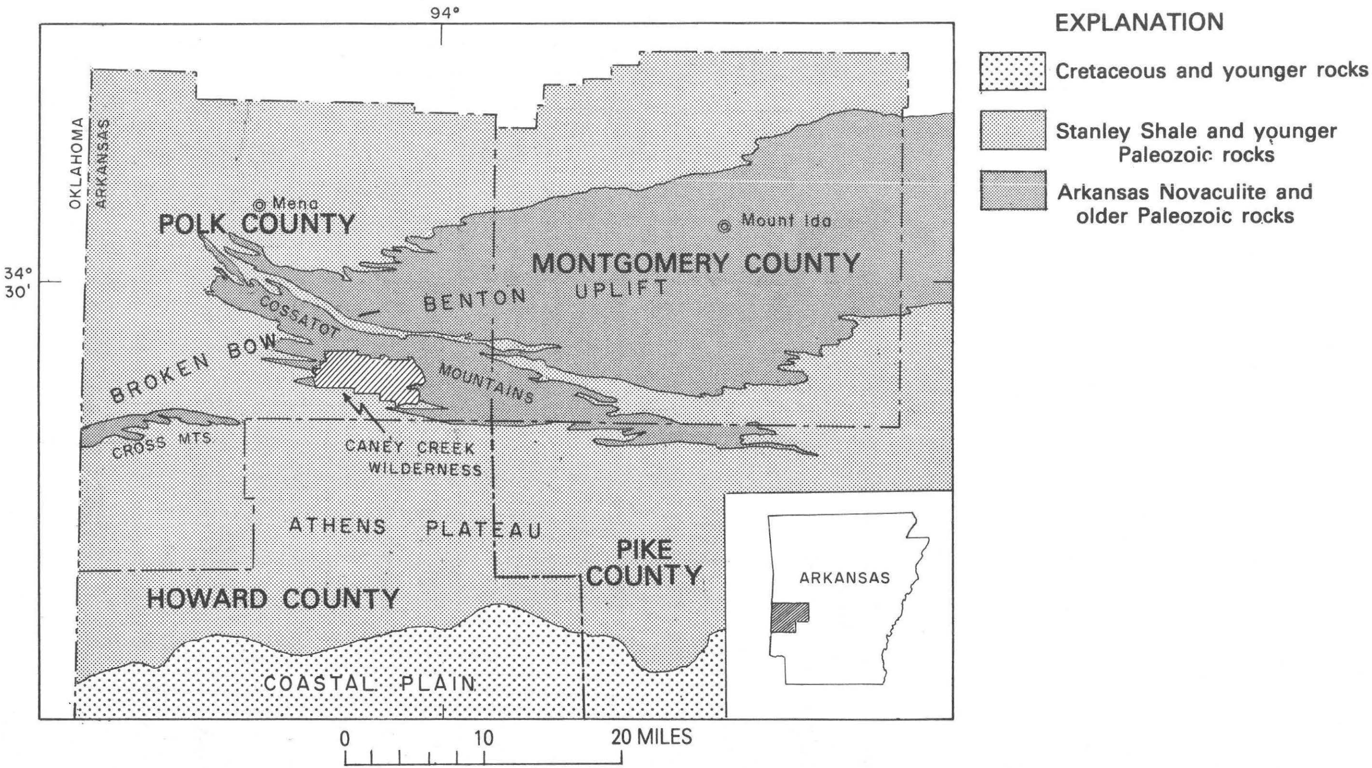


FIGURE 2.—Location of the Caney Creek Wilderness and its relation to regional geologic and geomorphologic features. Modified from Flawn and others (1961, fig. 1).

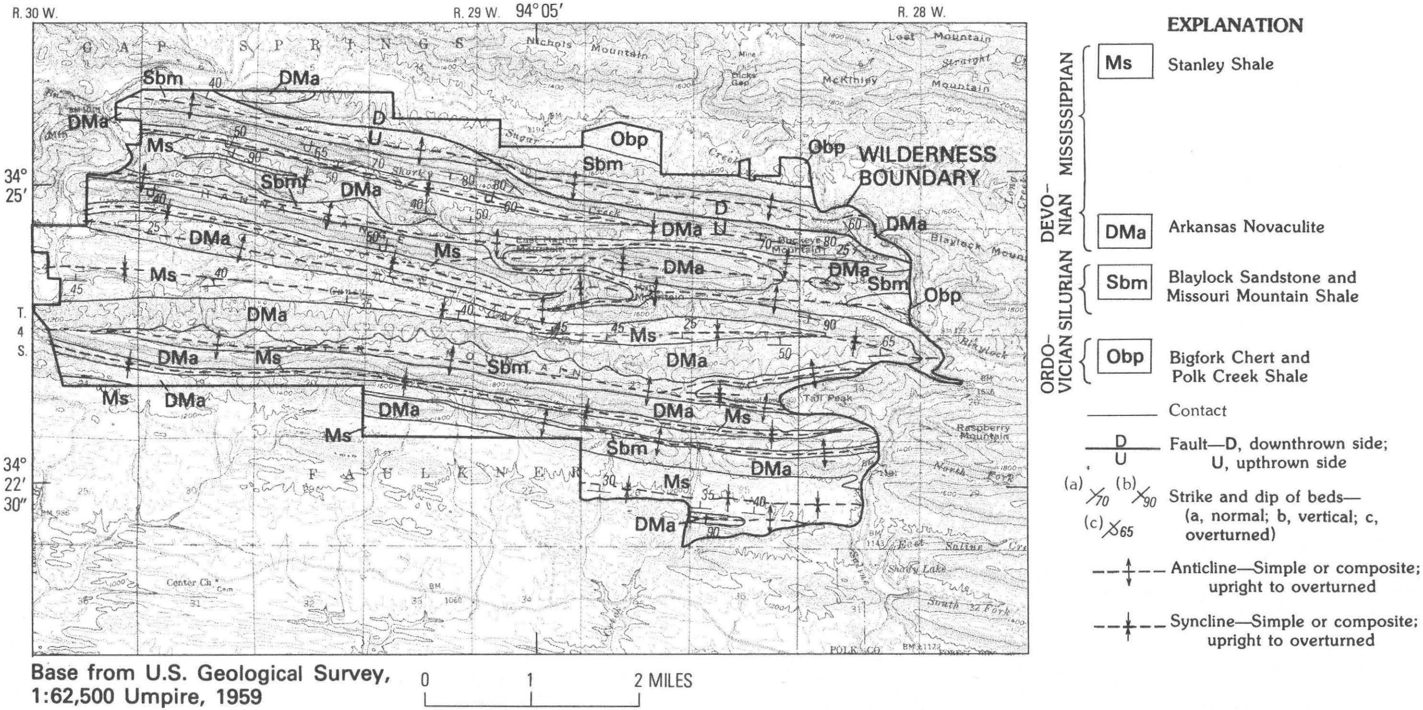


FIGURE 3.—Geologic map of the Caney Creek Wilderness. After Miser and Purdue (1929), modified according to Haley and others (1976) and to photogeologic mapping and field observations of the present study.

Tall Peak just outside the eastern boundary of the area. The crests of the three principal ridges slope gently westward, from elevations of 2,000–2,300 ft in the east to 1,500–1,700 ft in the west. The highest peaks in the wilderness, East Hanna and Buckeye Mountains, are about 2,290 and 2,320 ft in altitude, respectively. Relief between the major streams and ridge crests is generally 500–600 ft.

Topography and drainage are controlled by the westerly trending, ridge-forming fold structures typical of this part of the Ouachita Mountains (fig. 3). The valleys of Caney and Short Creeks have been cut into the relatively unresistant Stanley Shale exposed in the centers of tightly folded synclines. The three major ridges are formed by the resistant Arkansas Novaculite at the syncline margins and in intervening anticlines. Sugar Creek, near the northern boundary, has been cut into relatively unresistant sandstone and shale in the core of an anticline.

Vegetation is typical of an eastern oak-hickory-pine forest. Stands are dominated by either hardwoods or softwoods; hardwoods occur principally on shaded northern slopes. Severe climatic and drainage conditions on ridge crests have limited vegetation to grasses, briars, and shrubby trees.

PREVIOUS INVESTIGATIONS

Many published reports describe the geology and mineral resources of the Ouachita Mountains, but few contain specific information about the area included in the Caney Creek Wilderness. Miser and Purdue (1929) described the geology and presented a geologic map, scale 1:125,000, of the DeQueen and Caddo Gap quadrangles. The wilderness is in the northern part of the DeQueen quadrangle, and the geologic map (fig. 3) is a modified version of the Miser-Purdue map. Owen (1860) first mentioned the geologic features in Polk County. Griswold (1892) reported on the first systematic study of geology in the region and presented the first geologic map of the Ouachita Mountains. His report includes geologic cross sections through East Hanna Mountain and Tall Peak. Comstock (1888) first mentioned manganese in southern Polk county, and Penrose (1891) and Miser (1917) described many manganese deposits of the area, including some of those in the wilderness. Penrose (1892) described the iron deposits. Jones (1948) and Scull (1958) described barite deposits outside but near the wilderness. Griswold (1892) described the distribution and characteristics of the Arkansas Novaculite, which crops out widely in and near the wilderness, and discussed its use in the manufacture of whetstones. Sumary reports about mineral deposits of Polk County (Branner and others, 1940) and of Arkansas (Stroud and other, 1969) include information about deposits in and near the wilderness.

PRESENT STUDY

Field study by personnel of the USGS during a 10-day period in March–April 1978 consisted of a reconnaissance geochemical survey, field checking of previous geologic mapping, and brief inspections of prospects and mineral occurrences in and near the wilderness. A total of 114 geochemical samples of stream sediment, soil, rock, and manganese ore were collected from within and near the area. These samples were analyzed by semiquantitative spectrographic methods in the USGS laboratories in Denver, Colo. Visits to mines and prospects outside the wilderness were made to gain an idea of the general features and habitat of mineral deposits in the southern Ouachita Mountains and to assist in evaluating the geochemical data and the relatively poorly exposed mineral occurrences in the wilderness.

The investigations by personnel of the USBM included a search of courthouse records of mining claims in the wilderness and the location and examination of mines and prospects in and near it. Twenty-five manganese prospects and two tripoli prospects were examined in the wilderness. Workings consist mainly of pits, trenches, and sidehill cuts; five short adits were found. Several other mines and prospects for manganese, tripoli, barite, and turquoise, all within 3 mi of the wilderness, also were examined and sampled. Samples for chemical and spectrographic analyses were collected from most of the manganese deposits. In each case, an effort was made to select the highest-grade material available, excluding visible impurities and wall rock. Samples of shale, tripoli, and barite were collected where exposed in prospects and along roads and streams. All samples believed to contain appreciable quantities of maganese or iron were analyzed for eight elements by atomic absorption. Semiquantitative spectrographic analyses were made of other samples, principally for the detection of detrimental impurities or anomalous elements. These analyses were performed by the USBM, Reno Metallurgy Research Center, Reno, Nev. Ceramic properties of four shale samples were evaluated by the USBM, Tuscaloosa Metallurgy Research Center, Tuscaloosa, Ala.

SURFACE AND MINERAL-RIGHTS OWNERSHIP

The U.S. Forest Service owns all surface and mineral rights in the wilderness. Most of the area, 13,495 acres, is in the public domain; the remaining 938 acres are acquired lands. Distribution of acquired lands is shown in figure 4.

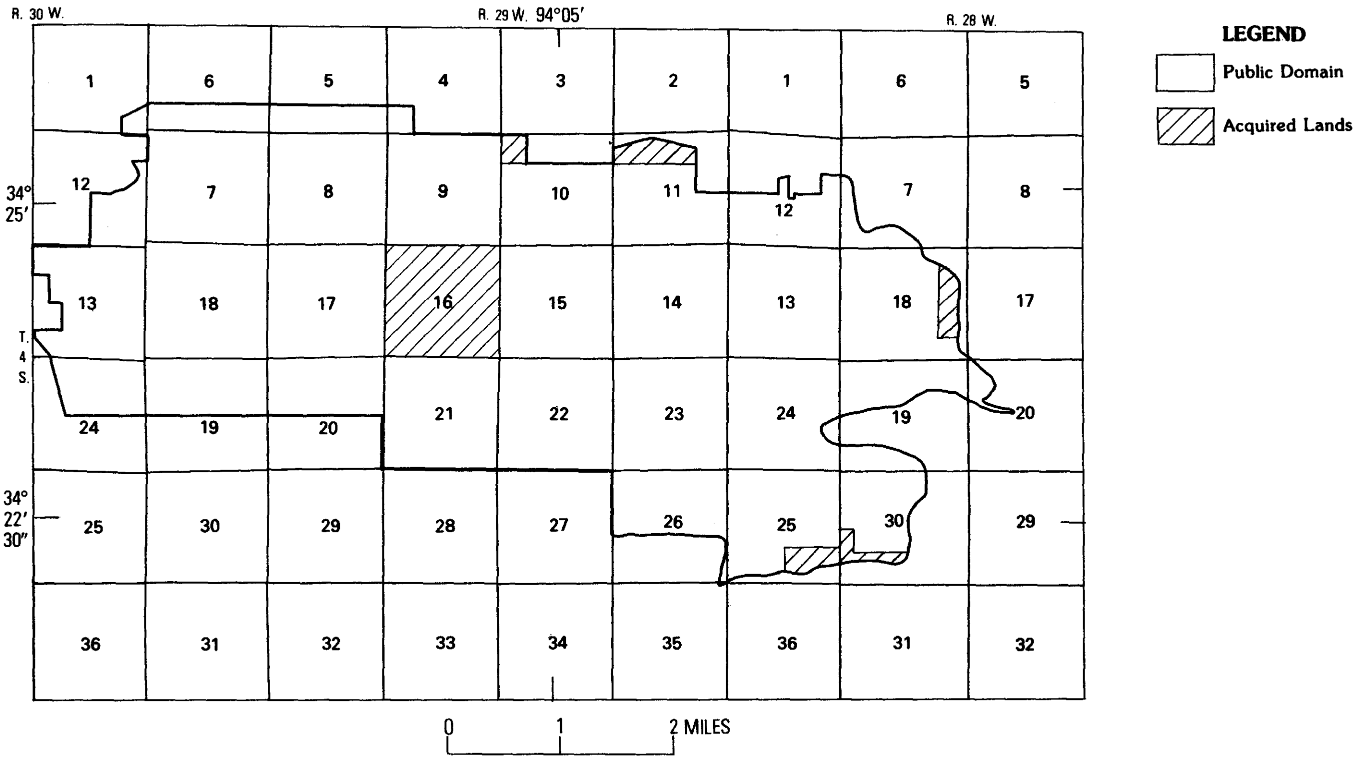


Figure 4.—Land status, Caney Creek Wilderness.

Examination of Polk County records revealed that at least 2,000 claims had been filed in the area of Caney Creek Wilderness as of March 31, 1978. None of these have been patented. Earliest claim records are nonexistent, having been destroyed by courthouse fires in 1878 and 1883. Most descriptions are vague, and many claims apparently overlapped. Statements of assessment work are similarly confusing, and only a few corner monuments were found during the investigation. As of July 1979, only one claim in Polk County had entered final patent procedure and according to the U.S. Forest Service, will probably be patented. The claim is on a tripoli deposit in the NW 1/4, SE 1/4, sec. 26, T. 4 S., R. 29 W., just south of the wilderness.

ACKNOWLEDGMENTS

Appreciation is extended to several people who contributed to the investigation. Terry Grotbo assisted in the USGS field study, and Elwin L. Mosier made the spectrographic analyses of the geochemical samples collected during this study. John F. Lewis furnished information about the small turquoise mine at the southwestern corner of the wilderness. Lynn A. Burton, mining engineer, and Ferryl C. Gale, geologist, Milchem, Inc., guided USGS personnel on a visit to the company-owned barite deposit near Fancy Hill, Ark. Jack Roehm, the former owner and discoverer of the barite deposit, accompanied the group on this visit. Norman F. Williams, State Geologist of Arkansas; Benjamin F. Clardy, Arkansas Geological Survey; and Boyd R. Haley, USGS, furnished information about recent geologic mapping in the vicinity of the wilderness. Barney Sherrer, District Ranger, and Al Tanner, Resource Assistant, U.S. Forest Service, Mena, Ark., furnished maps and information about the area. In addition, the following individuals who provided information and assistance to the USBM personnel are acknowledged: Lenard Aleshire, a local prospector who provided information about mineral deposits and production; Raymond Stroud, former USBM State Liaison Officer; Ronald Konig, Professor, University of Arkansas, Fayetteville; Edward W. Read and Donald Williams, geologists, U.S. Forest Service; and Charles Stone, geologist, Arkansas Geological Survey. Paul T. Behum and Peter C. Mory, geologists, USBM, assisted in the field investigation.

GEOLOGY

REGIONAL SETTING

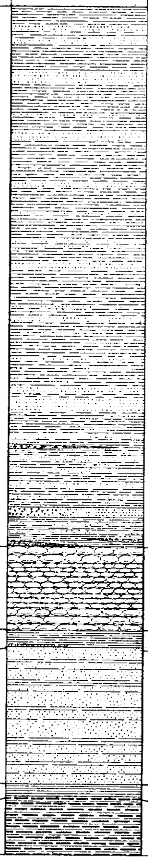
The Cossatot Mountains, in which the Caney Creek Wilderness is located, consist of a complexly folded and faulted sequence of marine sedimentary rocks of Paleozoic age. These mountains are at the southern margin of the Broken Bow-Benton uplift (fig. 2). South of the Cossatot Mountains is the dissected Athens Plateau, a southward-sloping monocline with many minor fold corrugations. The Paleozoic rocks of the region, as mapped by Miser and Purdue (1929), range from Cambrian to Pennsylvanian in age and have an aggregate thickness of 21,720–26,875 ft. In the Cossatot Mountains, the Palezoic rocks have been tightly folded and are steeply inclined to vertical or even overturned.

The investigations of the USGS were directed primarily toward geochemical exploration and secondarily toward confirming previous mapping. Consequently, the discussions of stratigraphy, structure, and metamorphism are, except as noted, excerpted from Miser and Purdue (1929).

STRATIGRAPHY

The Paleozoic sequence exposed in the wilderness comprises six formations of Ordovician to Mississippian age, which from oldest to youngest are Bigfork Chert, Polk Creek Shale, Blaylock Sandstone, Missouri Mountain Shale, Arkansas Novaculite, and Stanley Shale (fig. 5). Miser and Purdue (1929) estimated the aggregate maximum thickness of these formations to be about 9,500 ft in the DeQueen and Caddo Gap quadrangles. In the vicinity of the Caney Creek Wilderness the aggregate thickness is 8,000–9,000 ft (fig. 5). The Arkansas Novaculite and the Stanley Shale were of particular interest in this study of the wilderness because at many places in western Arkansas these formations contain economic mineral deposits, chiefly manganese-oxide and tripoli deposits in the Arkansas Novaculite and bedded barite in the Stanley Shale.

The Bigfork Chert, the oldest formation exposed in the wilderness, is of Ordovician age, and is underlain by the Womble Shale, also of Ordovician age, and overlain by the Polk Creek Shale. On the geologic map (fig. 3), the Bigfork and the Polk Creek are combined as a single map unit. The formations are exposed only in the nose of an anticline in the eastern part of the wilderness between Buckeye Mountain and Tall Peak, and along Sugar Creek near the northern boundary of the area (fig. 3). Miser and Purdue (1929) estimated the Bigfork to be about 700 ft thick, and they described it as consisting of gray to black chert containing small amounts of interbedded black shale and limestone (fig. 5). The chert occurs in even-bedded layers 3–6 in thick but in places is as much as 3 ft thick; some is finely laminated, and some contains finely disseminated grains of calcite and pyrite. The chert is intensely jointed, and quartz veinlets in



System	Formation	Section	Thickness in feet	Character of rocks
Mississippian	Stanley Shale		6,000	Mainly shale, with much sandstone and some tuff and conglomerate. Shale fissile, bluish black and black in fresh exposures along streams, green, yellow, or brown in more weathered exposures along roads. Sandstone hard, tough, compact, quartzitic, fine grained, greenish or bluish gray. Tuff massive, homogeneous, dark gray with a greenish tinge; contains large grains of feldspar. Conglomerate near base is composed of novaculite pebbles in dense siliceous matrix.
	Hatton tuff lentil		30	
	Unconformity			
Devonian	Arkansas Novaculite		900	Massive gray novaculite Thin-bedded dark novaculite and black shale Massive white novaculite
Silurian	Missouri Mountain Shale		200–300	Red and green slate
	Unconformity?			
	Blaylock Sandstone		500–1,000	Hard light to dark gray sandstone and dark shale
	Unconformity?			
Ordovician	Polk Creek Shale		100	Black fissle carbonaceous shale
	Bigfork Chert		700	Gray to black even-bedded, much fractured chert, some black shale, and a little black siliceous limestone.

FIGURE 5.—Generalized section of Paleozoic rocks in the Caney Creek Wilderness. From Miser and Purdue (1929, pl. 4). Thicknesses are for region of the wilderness and are approximate only; estimated from cross sections and formation descriptions in Miser and Purdue (1929).

joints are numerous. According to Miser and Purdue (1929), the interbedded shale, which occurs throughout the formation, is black, carbonaceous, and siliceous; it forms layers ranging from less than an inch to several feet in thickness. Thin lenses and layers of black, siliceous limestone occur in the upper and lower parts of the Bigfork. The formation has been assigned to the Ordovician on the basis of a sparse graptolite fauna (Miser and Purdue, 1929).

Miser and Purdue (1929) reported the Polk Creek Shale as having an average thickness of about 100 ft in the Cossatot Mountains. They found the formation to consist of black, carbonaceous, fissile shale containing a few interbeds of black chert and quartzitic sandstone. A layer of black oolitic limestone as much as 2 ft thick occurs in the formation along Sugar Creek. The formation contains abundant graptolites that show it to be of late Ordovician age.

In the wilderness, the Blaylock Sandstone crops out in the centers of anticlines along Porter Mountain, Hanna Range, and Sugar Creek. On the geologic map (fig. 3), the Blaylock is combined with the overlying Missouri Mountain Shale as a single map unit. Miser and Purdue (1929) reported the Blaylock as being as much as 1,500 ft thick and as consisting of variable amounts of sandstone and shale. Cross sections by Miser and Purdue show the Blaylock to be between 500 and 1,000 ft thick in the wilderness. The shale is described as being buff in color and resembling the overlying Missouri Mountain Shale, whereas the sandstone is light to dark gray, fine grained, laminated, and quartzitic. Sandstone beds are 1–6 in thick but at places are as much as 3 ft thick. Along Sugar Creek, the base of the formation is marked by a 2- to 4-ft layer of conglomerate, which Miser and Purdue (1929) cited as evidence for an unconformity between the Blaylock and the underlying Polk Creek Shale. Sparse graptolites from the Blaylock were dated as Silurian.

The Missouri Mountain Shale, formerly the Missouri Mountain Slate (Miser and Purdue, 1929), also is exposed in the centers of the anticlines along Porter Mountain, Hanna Range, and Sugar Creek (fig.3). Miser and Purdue (1929) reported the Missouri Mountain to be 50–300 ft thick, and to judge from their description of the formation and cross sections, it is 200–300 ft thick in the vicinity of the Caney Creek Wilderness. They described the formation as consisting of red slate marked by green patches and streaks; 3 to 5 in layers of sandstone and quartzite are present near the base and top. At some places, the base was found to be marked by a layer of chert pebble conglomerate as much as 15 in thick or by a few feet of green slate. Miser and Purdue (1929) suggested that this basal conglomerate indicates an unconformity between the Missouri Mountain and the underlying Blaylock. Fossils were not found in the Missouri Mountain, and a Silurian age was assigned on the basis of lithology and stratigraphic position.

The Arkansas Novaculite consists of the following three lithologic units having an aggregate thickness of about 900 ft (Miser and Purdue, 1929): (1) lower unit, generally 150–300 ft thick, the most conspicuous part of the formation, consisting of massive white novaculite in beds 2–10 ft thick, (2) middle unit of dense, dark-gray to black novaculite and interbedded shale, which has a minimum thickness of about 75 ft at East Hanna Mountain in the Caney Creek Wilderness, increasing to 525 ft at West Hanna Mountain about 1 km west of the wilderness, and (3) upper unit of massive, finely laminated, calcareous, gray novaculite 20–125 ft thick. The only fossils that

Miser and Purdue (1929) found in the formation were silicified wood and conodonts. These authors assigned a Devonian age to the formation, but Hass (1951) redefined the age as Devonian and Mississippian, with the boundary between the two systems falling within the middle unit of the formation.

The Stanley Shale crops out in the centers of the major synclines in the wilderness (fig. 3). It is the thickest of the Paleozoic formations in southwestern Arkansas, being about 6,000 ft thick in the Caddo Gap quadrangle (Miser and Purdue, 1929). Only the lower part of the formation is exposed in the wilderness. Miser and Purdue (1929) described the Stanley as consisting chiefly of bluish-gray to black shale with many interbeds of dark, quartzitic sandstone as much as 18 ft thick. The rocks of the formation weather readily, and the dark-colored shale and sandstone, upon weathering, take on hues of green, yellow, and brown. Miser and Purdue (1929) found at places a unit of novaculite pebble conglomerate as much as 15 ft thick at the base of the formation and a similar, though less widespread, conglomerate in the overlying shale 20–75 ft above the base. They reported sporadic layers of volcanic tuff in the lower part of the formation, of which the Hatton Tuff Lentil (fig. 5) is thickest and most persistent. At Gillham Springs, near the southwestern corner of the wilderness, the Hatton is about 30 ft thick (Miser and Purdue, 1929). All the tuff units are reported to consist of dark greenish-gray material resembling a porphyritic igneous rock containing abundant grains of feldspar that weather readily to white kaolin, giving the rock a spotted appearance. Fossils in the Stanley Shale consist of plant fragments, sponge spicules, radiolarians, and conodonts (Flawn and others, 1961). The Stanley has been classified as being of Mississippian age (Miser and Honess, 1927; Miser and Purdue, 1929).

Miser and Purdue (1929) found black phosphate rock in the lower part of the Stanley Shale in the Cross Mountains 10–20 mi west-southwest of the wilderness (fig. 2). This phosphate rock is described as occurring in widely separated layers and lenses as much as 1-1/2 in thick, and as nodules. These authors also reported nodules of phosphate rock at Gillham Springs, near the southwest corner of the wilderness, which they assumed occurred in the middle part of the formation. The quantity of phosphate rock at these localities is apparently too small to be of economic value, and larger quantities of potentially exploitable phosphate rock have not been found elsewhere in the Stanley Shale.

STRUCTURE

The stratfied rocks of the Ouachita Mountains were intensely deformed during late Paleozoic orogeny, which culminated here in

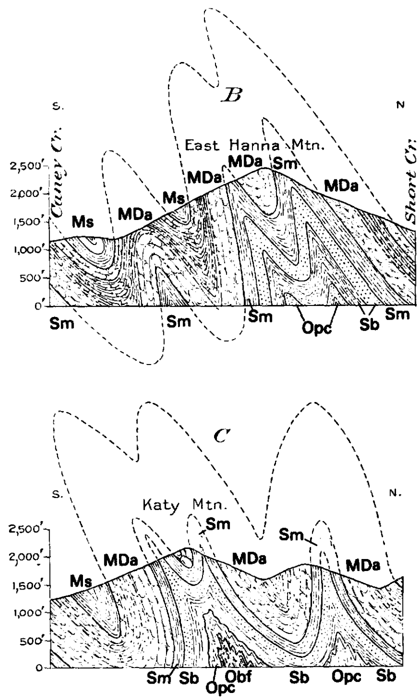


FIGURE 6.—Sections through East Hanna and Katy Mountains. (Obf, Bigfork Chert; Opc, Polk Creek Shale; Sb, Blaylock Sandstone; Sm, Missouri Mountain Shale; MDa, Arkansas Novaculite; and Ms, Stanley Shale). Modified from Miser and Purdue (1929, pl. 16); approximate scale 1:41,000 and altitude above mean sea level in feet.

Middle Pennsylvanian time (Miser and Purdue, 1929). This deformation produced many westward-trending tightly folded anticlines and synclines that make up the compound Ouachita anticline, which is the major structural unit of the Broken Bow-Benton uplift (fig. 2). The Ouachita anticline comprises several subsidiary anticlinoria, of which one, the Cossatot anticline, is the structural unit of the Cossatot Mountain (Miser and Purdue, 1929). The Caney Creek Wilderness is on the southern limb of the Cossatot anticline, of which the axis of greatest uplift is along Sugar Creek near the northern boundary of the wilderness.

The several anticlines and synclines in the wilderness trend approximately east-west and are tight folds having steeply dipping to vertical and overturned strata on their limbs (fig. 3). These folds are all of similar height and generally less than a mile in width. They tend to be asymmetrical and overturned to the south. Major folds may also be composite as shown by the anticlines at East Hanna and Katy Mountains (fig. 6).

Faults are less conspicuous than folds in the Ouachita Mountains, and the importance or incidence of faults in the development of the Ouachita structural pattern is uncertain. Miser and Purdue (1929) mapped relatively few faults and assigned faulting to a subsidiary role. In contrast, the latest geologic map of Arkansas (Haley and others, 1976) shows many faults in the Ouachita Mountains, based on the assumption that thrust faulting played a major role in the deformation. This geologic map shows several faults within the wilderness, all of which are more or less parallel to the folds. The present investigation verified the presence of only one of these faults, the high-angle reverse fault in the ridge north of Short Creek (fig. 3). Other faults might be present, but more detailed mapping would be required to identify them.

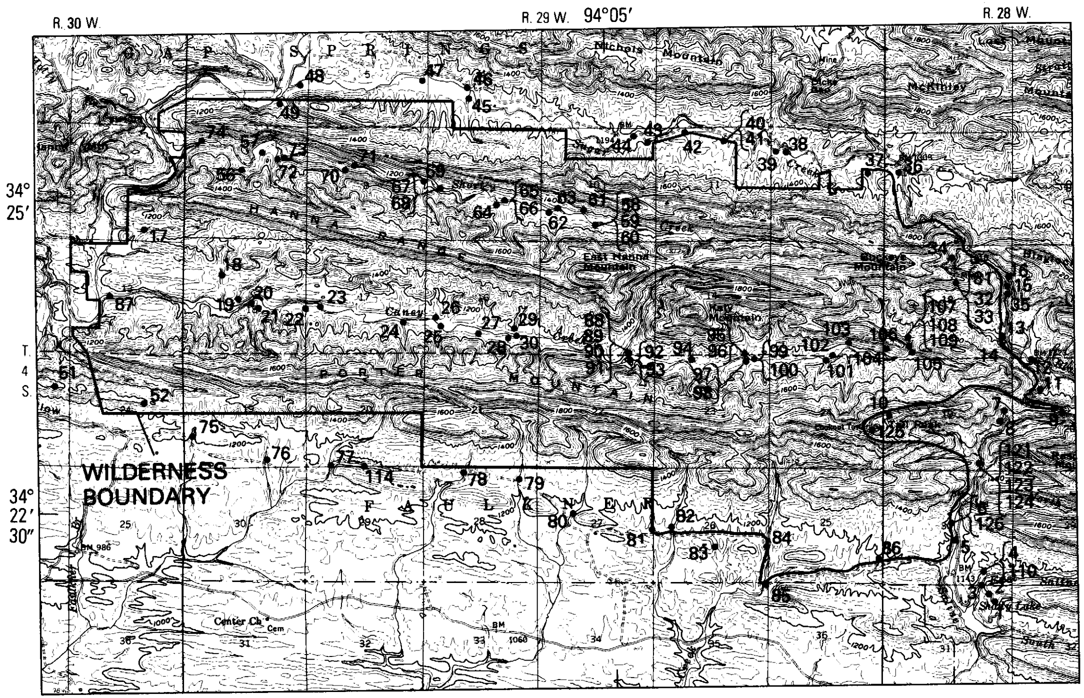
METAMORPHISM

Regional metamorphism during deformation in the Ouachita Mountains caused hardening of shale units and transformation of some shale to slate and sandstone to quartzite. Of the rocks exposed in the wilderness, those most affected were shale units in the Polk Creek, the Missouri Mountain, and the Arkansas Novaculite, which were transformed to slate (Miser and Purdue, 1929). Shale units in the overlying Stanley Shale are reported to have been locally transformed to slate, but in general, the rocks in this formation were less affected by metamorphism than were those in the underlying formations. Flawn and others (1961) suggested that the pre-Stanley Paleozoic formations were more intensely metamorphosed than the Stanley and post-Stanley formations because they were more deeply buried at the time of deformation.

GEOCHEMICAL EXPLORATION

SAMPLING AND ANALYTICAL TECHNIQUES

Geochemical sampling in the Caney Creek Wilderness (fig. 7) was undertaken as a means of determining patterns of anomalous metal values that might indicate heretofore unknown mineral deposits. The sampling and analytical techniques used were designed to obtain the maximum information possible in a reconnaissance survey of this type. The majority of geochemical samples (78) were of stream sediments, which result from the weathering of rocks in the area and therefore reflect the metal content of both the rocks and any mineral deposits in them. Ideally, mineral deposits that are undergoing erosion impart anomalously high metal values to the stream sediments that distinguish them from normal or background values of the erosion products of the enclosing rocks. Stream sediment samples consisted of 68 bulk samples, of which only the minus 80-mesh fraction



EXPLANATION

56 • Sample locality and number

Base from U.S. Geological Survey, 1:62,500 Umpire, 1959

0 1 2 MILES

FIGURE 7.—Geochemical sample localities, Caney Creek Wilderness.

was analyzed, and 10 panned concentrates. Analyses of the fine fractions of the stream sediments (and other unconsolidated materials such as soil) provide information not only about the metals present in mineral and rock fragments, but also about metals dissolved in surface and ground waters that were absorbed by silt- and clay-size particles. Analyses of the panned concentrates provide information about the distribution of metals in the heavy-mineral fraction of the stream sediments. Twenty-one rock samples, eight manganese-ore samples, and a sample of barite also were collected and analyzed to determine background metal values of the various rock units in the area and anomalous metal values of known mineral occurrences within and near the area. Six soil samples were collected and the minus 80-mesh fraction analyzed.

During the geochemical study, attention was focused on the search for manganese and barite deposits, which are the major types of deposits that have been prospected and mined in the west-central Arkansas manganese district. In addition to collecting stream-sediment samples that might show anomalous concentrations of manganese and barium, the stream beds were searched for pebbles and fragments of manganese oxides and barite for the purpose of gaining additional information regarding deposits of these substances.

The geochemical samples were analyzed by six-step semiquantitative spectrographic analysis for the following 31 elements: Fe, Mg, Ca, Ti, Mn, Ag, As, Au, B, Ba, Be, Bi,Cd, Co, Cr, Cu, La, Mo, Nb, Ni, Pb, Sb, Sc, Sn, Sr, Th, V, W, Y, Zn, and Zr. Besides manganese, only Cu, Zn, Co, and Ni, which are known to occur in anomalous amounts in the manganese deposits, show unusual concentrations in the stream sediments (table 1).

EVALUATION OF SAMPLE DATA

Interpretations of the geochemical sample data from the Caney Creek Wilderness in this report differ slightly from those of Wagner and others (1978) for the entire west-central Arkansas manganese district. These authors based their study on 46 samples of stream sediments, from which *aqua regia* extracts of the minus 95-mesh fraction were analyzed. They determined anomalous values for manganese by log-probability plots, a method used by Lepeltier (1969), and established a threshold value or minimum anomalous value of 1,900 ppm Mn. About 75 percent of our samples show values of 2,000 ppm or more Mn, and 44 percent contain 5,000 ppm or more Mn (fig. 8). A minimum anomalous value of 5,000 ppm was found to be more meaningful for interpretation of the sample data. Wagner and others (1978) stated that Fe, Cu, Zn, Co, Ni, and Ba in the stream

TABLE 1.—*Semiquantitative spectrographic analyses for selected elements in geochemical samples from the Caney Creek Wilderness*

[Analyses shown are for samples containing 5,000 ppm or more manganese. Analyses by Elwin L. Mosier, USGS, Denver, Colo.]

Sample No.	Mn (ppm)	Cu (ppm)	Zn[1] (ppm)	Co (ppm)	Ni (ppm)	Ba (ppm)
			Stream sediments (<80-mesh)			
7	>5000	1000	500	700	700	700
17	5000	200	200	70	100	1000
18	5000	200	200	100	100	1000
21	>5000	100	N	50	100	700
22	>5000	100	200	100	150	700
24	>5000	150	200	70	150	700
28	>5000	70	N	100	150	700
35	>5000	100	N	50	70	700
39	>5000	70	300	70	150	700
40	>5000	70	300	50	100	700
43	>5000	70	700	70	150	500
45	5000	50	N	30	100	500
47	5000	50	N	50	100	300
49	>5000	50	N	50	100	500
56	>5000	200	1000	70	300	700
62	>5000	100	200	70	100	500
64	>5000	150	300	100	150	500
69	>5000	100	200	70	150	500
70	>5000	200	300	200	150	700
72	>5000	100	300	70	150	500
73	5000	100	200	30	100	500
88	5000	300	N	100	100	700
92	5000	100	N	100	100	500
94	>5000	100	N	70	100	500
95	>5000	100	200	50	200	500
97	>5000	150	N	70	150	500
101	>5000	500	N	500	200	500
103	5000	200	N	50	100	700
105	>5000	70	N	100	100	300
107	5000	200	N	50	100	500
			Panned concentrates of stream sediments			
68	5000	100	N	50	100	1000
91	>10000	100	N	70	70	1000
93	>10000	200	N	70	150	700
96	7000	70	N	50	100	700
98	10000	100	N	70	100	3000
100	>10000	200	N	100	150	1500
108	5000	70	N	70	100	700
126	10000	100	N	50	100	700
			Selected samples from manganese prospects			
32	>5000	200	300	700	150	1500
33	>5000	200	500	100	200	700
57	>5000	15000	3000	2000	2000	700
61	>5000	300	1500	500	500	1500
121	>5000	15000	5000	>2000	5000	1000

[1]N indicates that the Zn content is below the limit of detectability, which is 500 ppm for panned concentrates and 200 ppm for the other sample types shown.

sediments show a uniform increase with Mn. According to the sample data of the present study, Cu, Zn, Co, and Ni show a general though nonuniform increase with Mn (table 1), but Ba shows little relation to Mn. The analyses show that most of the stream sediments contain 3–5 percent Fe, and that only about half the samples highest in Fe contain 5,000 ppm or more Mn.

The histograms (fig.8) show the problem of attempting to identify by statistical methods minimum anomalous values for Mn, Cu, Co, and Ni in stream sediments collected in this study. A histogram for Zn was not made because most of the Zn values of stream sediments are below the limit of detectability. The normal or background frequency distribution of these elements in unmineralized rocks and stream sediments resulting from erosion of such rocks would be expected to be log-normal, and histograms such as those shown in figure 8, in which the analyses in parts per million are shown on a logarithmic scale, should be symmetrical. A log-probability plot of these same data would be a straight line. In a region where the erosion products of mineral deposits are sufficiently abundant to be detected in the stream sediments, given the limitations of the analytical method, the resulting histogram would be asymmetrical, showing a tailing off of higher values or even a second high value maximum that clearly distinguishes the erosion products of the mineral deposits from those of the enclosing rocks. Similarly, mineral deposits are reflected in log-probability plots by a change in the slope of the straight line that indicates the background value of the country rock. In figure 8, the asymmetrical Mn histogram is due to the widespread manganese oxide occurrences in the Caney Creek Wilderness and to the large number of samples containing more than 5,000 ppm Mn, which is the highest value that could be estimated by the semiquantitative spectographic method used in making these analyses. A minimum anomalous value for Mn cannot be determined by inspection of this histogram or by inspection of a log-probability plot of the same data. Because of the close association of Cu, Co, and Ni with Mn, it is not possible to select meaningful minimum anomalous values for these elements by inspection of the histograms or by inspection of log-probability plots of these same data. Anomalous values selected from figure 8, which are indicated by the tailing off of values at the right sides of the histograms, would give minimum values somewhat higher than those that we have selected.

Anomalous values for Mn, Cu, Zn, Co, and Ni in the stream sediments were selected by trial and error to establish meaningful distributions on the geochemical maps (figs. 9–13) relative to known and potential distribution of manganese oxides in the Arkansas Novaculite. A lower limit for anomalous Mn values in stream sediments (fig. 9) was set at 5,000 ppm because such a value indicates

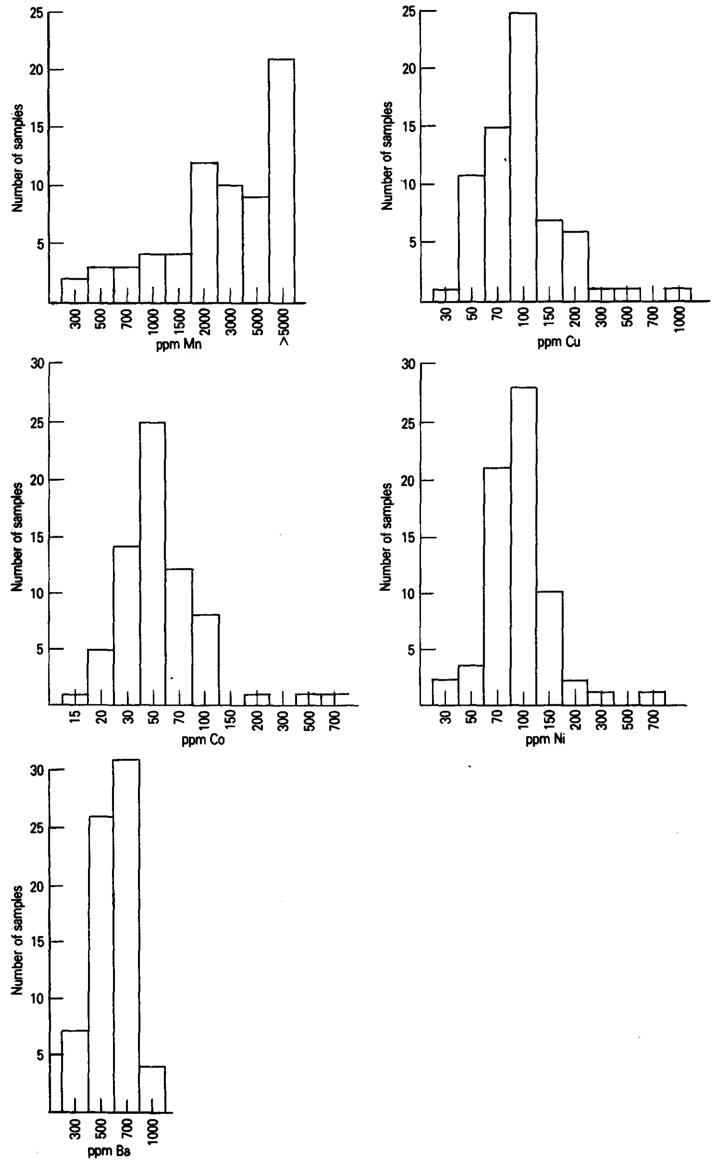


FIGURE 8.—Histograms showing the distribution of Mn, Cu, Co, Ni, and Ba in stream sediments (minus 80-mesh) in and near the Caney Creek Wilderness.

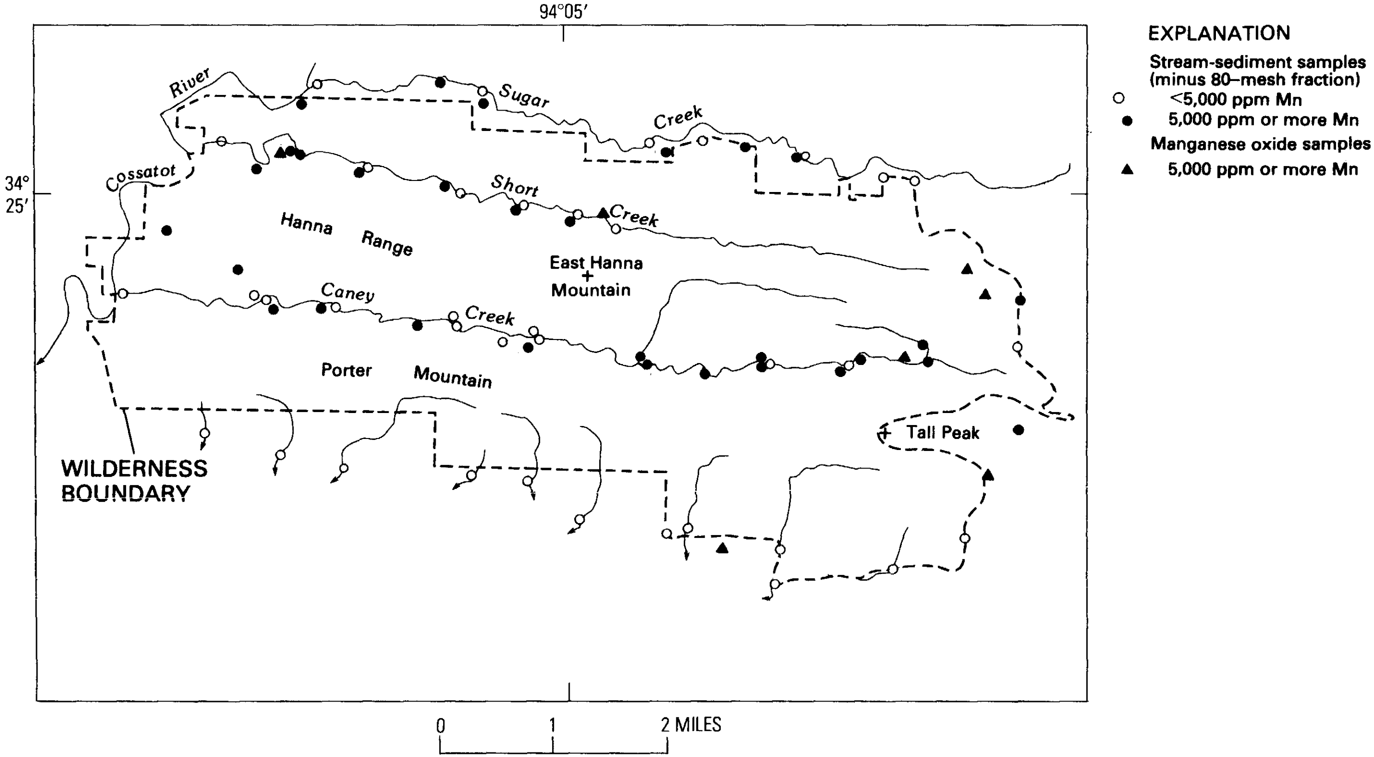


Figure 9.—Distribution of manganese in geochemical samples, Caney Creek Wilderness.

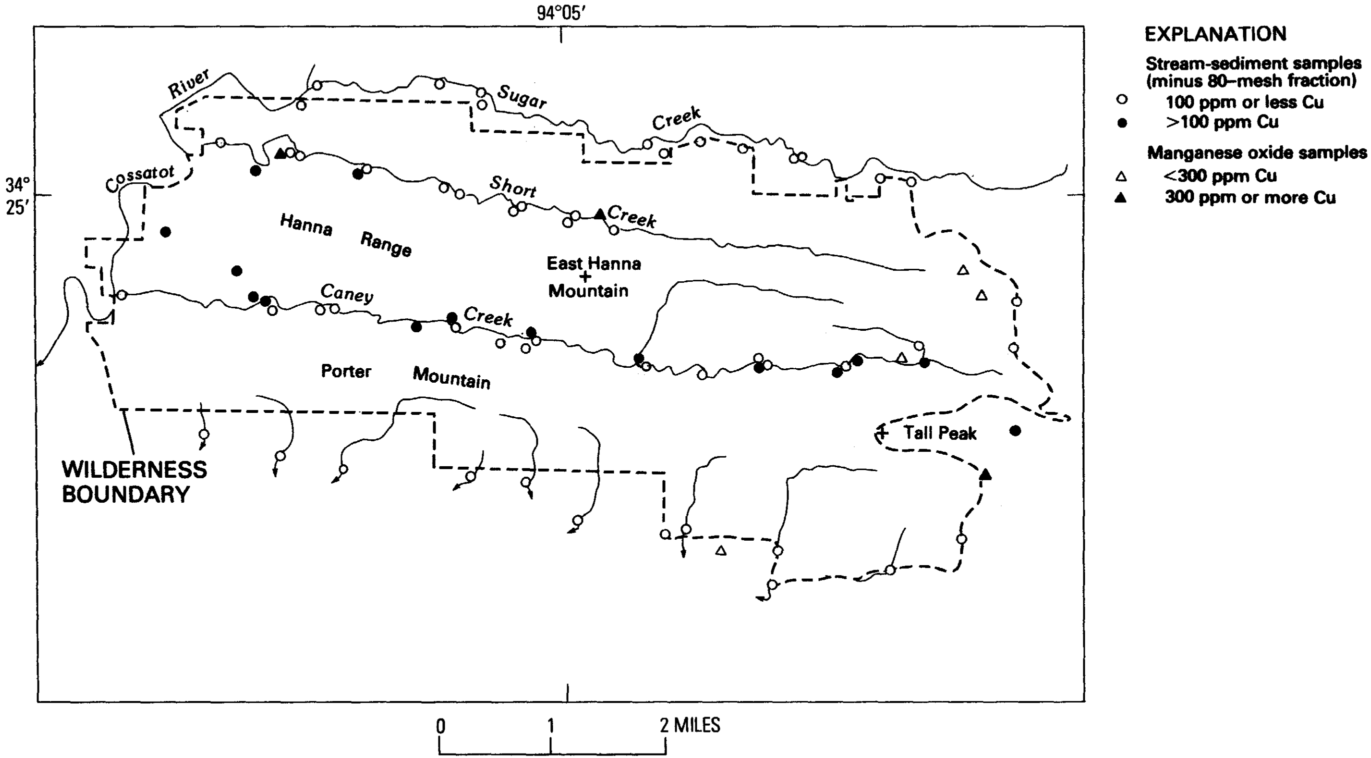


Figure 10.—Distribution of copper in geochemical samples, Caney Creek Wilderness.

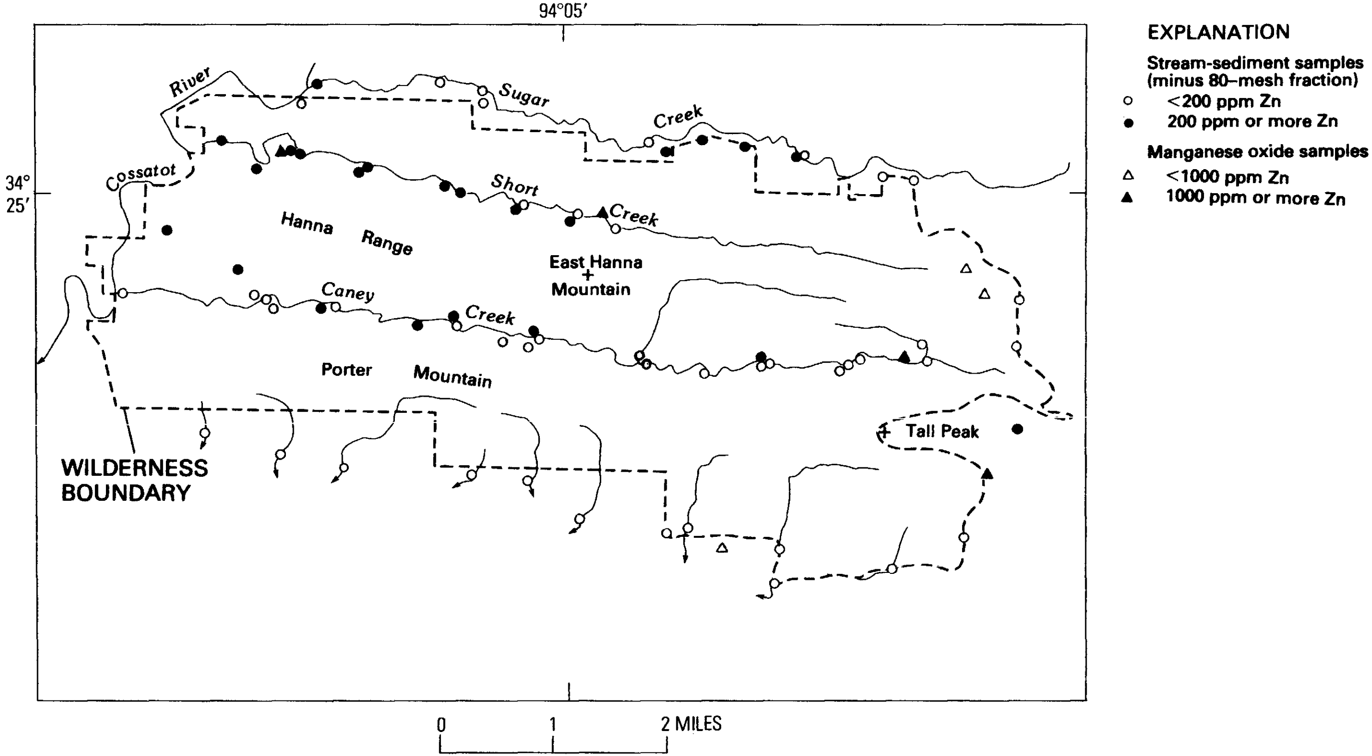


FIGURE 11.—Distribution of zinc in geochemical samples, Caney Creek Wilderness.

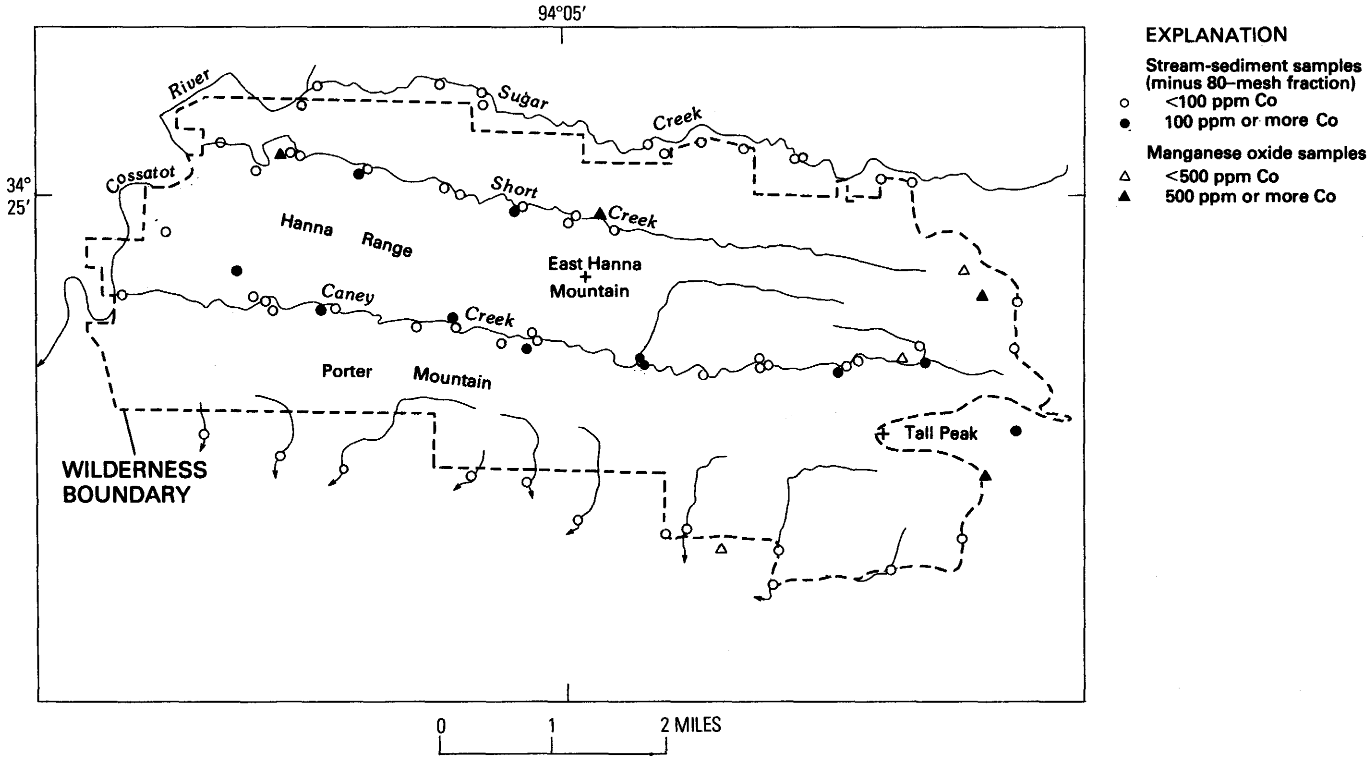


Figure 12.—Distribution of cobalt in geochemical samples, Caney Creek Wilderness.

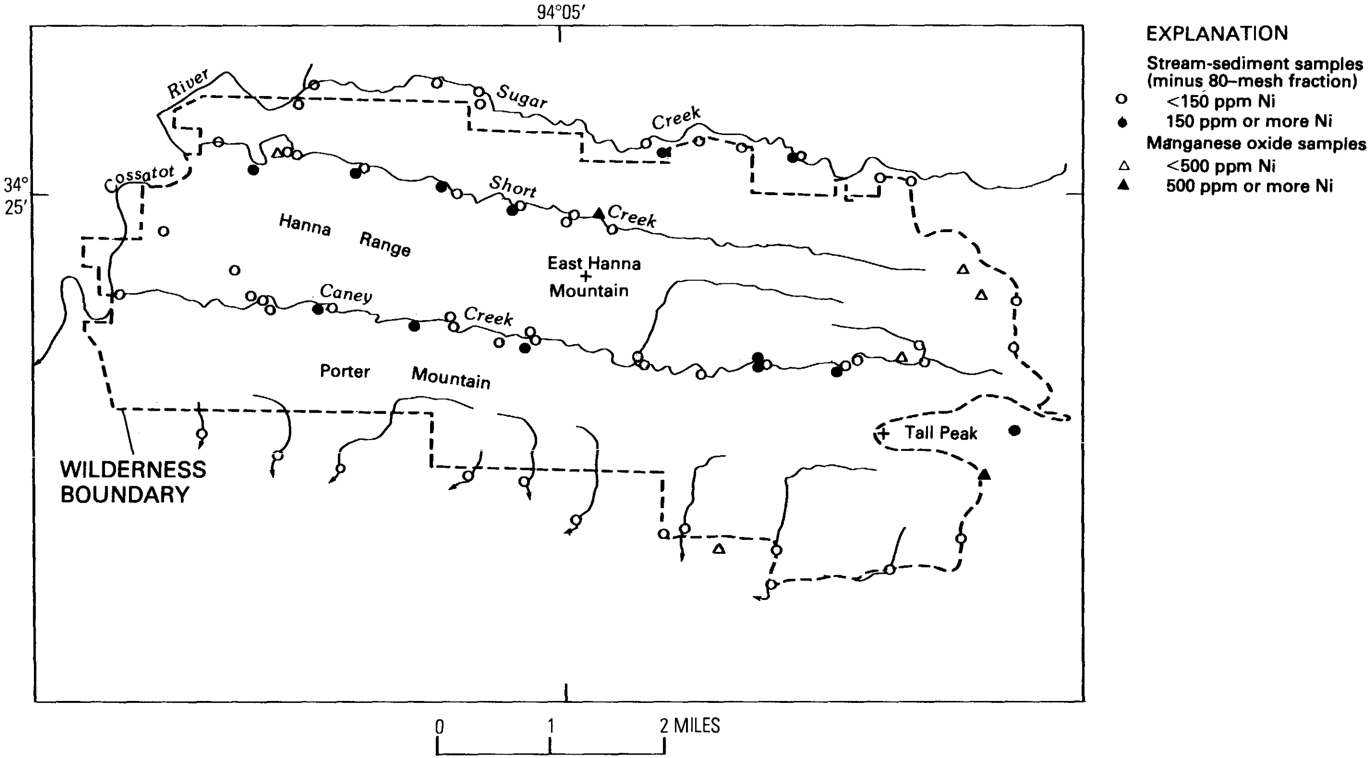


FIGURE 13.—Distribution of nickel in geochemical samples, Caney Creek Wilderness.

the presence of anomalous Mn in small tributaries of the main streams in which erosion products of the Arkansas Novaculite are particualrly abundant. Anomalous values for Cu (150 ppm or more), Zn (200 ppm or more), Co (100 ppm or more), and Ni (>100 ppm) (figs. 10–13) were selected to be compatible with the distribution of anomalous values for Mn. The barium content of the stream sediments shows a narrow range of relatively low values (table 1) which are within range of the background values for the Stanley Shale of the Caddo Gap and DeQueen quadrangles (Brobst and Ward, 1965).

Most of the stream-sediment samples (minus 80-mesh) having anomalous values (5,000 ppm or more) of Mn (fig. 9) were collected at the mouths of small intermittent tributaries of Sugar, Short, and Caney Creeks. These tributaries have been cut into the ridge-forming Arkansas Novaculite and consequently the stream courses contain the erosion products of the novaculite and of the manganese oxide occurrences in the novaculite. Pebbles enriched in manganese oxides were found in several of the tributary streambeds, and a systematic search would probably reveal similar pebbles in many other tributaries as well as in the main streams. The fewer anomalous values for Mn in the main streams are no doubt due to the greater dilution of sediment by the erosion products from formations that do not contain manganese deposits. Panned concentrates of stream sediments were taken at several localities to compare with the minus 80-mesh fraction from the same locality. Significantly greater Mn values are present in the panned concentrates than in the fine fractions, indicating that Mn occurs mainly in oxide grains rather than as absorbed ions on silt and clay particles.

Anomalous values for Cu, Zn, Co, and Ni are associated with stream sediments that contain anomalous amounts of Mn, and they reflect the presence of deposits of manganese oxides in the Arkansas Novaculite, which also tend to be anomalously high in these elements (table 1). The distribution of samples showing anomalous values for these elements are shown in figures 10–13, which may be compared with the distribution of anomalous values for manganese shown in figure 9. As can be observed in these figures and table 1, the relative amounts of Cu, Zn, Co, and Ni are variable, and all are not anomalously high in all samples high in Mn. A few of the stream sediments containing less than 5000 ppm Mn show low anomalous values for either Cu (150) ppm), Zn (200 ppm), Co (100 pm), or Ni (150 ppm). These are random anomalous values that would be expected to occur in a suite of geochemical samples, and do not necessarily indicate an anomalous source such as a mineral deposit.

The stream-sediment samples (minus 80-mesh fraction) from the wilderness show nearly uniform background values for barium, chiefly in the range of 500–700 ppm (table 1), which, as was previously mentioned, are background values for the Stanley Shale as determined by Brobst and Ward (1965). No barite pebbles or fragments were found in streams, but this may not be significant because barite fragments, being softer than other minerals in the sediment, would be rapidly destroyed by stream action. In addition, the density of barite causes fragments, even near a deposit, to work their way down into the streambed rather than remaining at the surface (D. A. Brobst, oral commun., 1980). Two of the panned concentrates from upper Caney Creek (samples 98 and 100, fig. 7, table 1), which are high in Mn, showed the highest values of 3,000 and 1,500 ppm Ba, respectively. These apparently anomalous samples might reflect the presence of local barite beds in the nearby Stanley Shale, but because of their exceptionally high Mn contents, it is believed to be more likely that the high barium reflects the presence of the barium-rich manganese-oxide mineral psilomelane. In contrast, two panned concentrates from a stream in the Fancy Hill barite district, collected during this study, contain 3,000 ppm and >5,000 ppm Ba, respectively, and only 700 ppm Mn. These values are believed to reflect the presence of the nearby barite deposits.

Rock and soil samples from the wilderness do not contain any unusual concentrations of metals, and these materials are not considered further.

MINERAL RESOURCES

The mineral resources of the Caney Creek Wilderness and nearby areas include metallic mineral deposits containing oxides of manganese and iron, sulfides of lead, zinc, copper and antimony, and native copper. Turquoise, a copper phosphate mineral used as a semiprecious gem stone, occurs in and near the area. Industrial mineral resources include barite, novaculite, tripoli, clay and shale, gravel, and slate. Of these mineral commodities, only manganese oxide has been produced from deposits within the wilderness.

EXPLORATION AND MINING IN AND NEAR THE CANEY CREEK WILDERNESS

Exploration for manganese and other minerals in Polk County apparently commenced in the mid-1800's, but the first significant work was done by the Arkansas Development Company in 1888–1889 (Penrose, 1891). The Company opened many manganese prospects in the region, including several in the area now within the Caney Creek Wilderness. Total production apparently was small, and none was recorded in the 19th century for the area now included in the wilderness. The other manganese production recorded for Polk County was during World Wars I and II and the U.S. Government stockpile purchase program in the 1950's. Production during World Wars I and II was small, but during the stockpile purchase program more than 7,000 tons of ore and concentrates valued at nearly $750,000 were produced from Polk County (Stroud and others, 1969).

Mines near the wilderness that produced manganese ore include the following. 1) Sugarstick Mine, about 1/4 mi northwest of the wilderness (locality 2, fig. 14), was worked in 1921, 1942, and 1952, yielding 18 carloads of ore (Stroud and others, 1969), (2) Lost Hatchet Mine, 5 mi east-northeast of the wilderness, produced at least 4,000 tons of concentrates between 1955 and 1959; an estimated 50,000 tons of submarginal ore remained after mining ceased (Brown, 1955; Stroud, 1959), (3) Coon Creek Mine, about 5 mi east of the wilderness, was operated in 1942 and during the period from 1956 to 1959, producing at least 1,500 tons of manganese concentrate; as much as 40,000 tons of submarginal ore containing 5–10 percent manganese is reported to remain on this property (Stroud, 1959).

Several manganese mills, now dismantled, were located near the wilderness; but according to Brown (1955) and Stroud (1959), all the mill feed came from mines outside the area now designated as Caney Creek Wilderness. A mill on Short Creek, within the wilderness, was erected by A. B. Pickell to process ore from prospects[1] 4 and 5 (fig. 14) (C. M. Boos, 1952, unpublished report, U.S. Bureau of Mines). No records concerning the production of this mill were found, and it is not known whether ore from the prospects was actually treated. The records also are unclear as to whether construction of the mill was completed.

Most of the manganese prospects in the Caney Creek Wilderness are between Buckeye Mountain and Tall Peak, and this area has the longest history of activity. The Arkansas Development Company workings on the lower north slope of Tall Peak during the period from 1887 to 1889 were described as consisting of two short adits, of which one, called the Pointed Rock tunnel, was about 100 ft long (Penrose, 1891). Penrose also noted several prospect workings on Buckeye Mountain and a spur locally known as Manganese Mountain. Some work in the Buckeye Mountain and Tall Peak prospects undoubtedly took place during both the World Wars, but most work apparently was in the 1950's in response to the stockpile purchase program.

Penrose (1891) noted several manganese occurrences in the Short Creek valley but did not mention any workings. Aerial photographs

[1]The term "prospect" is used in this report for sites in the wilderness showing evidence of mineral exploration activities regardless of whether there was any actual production.

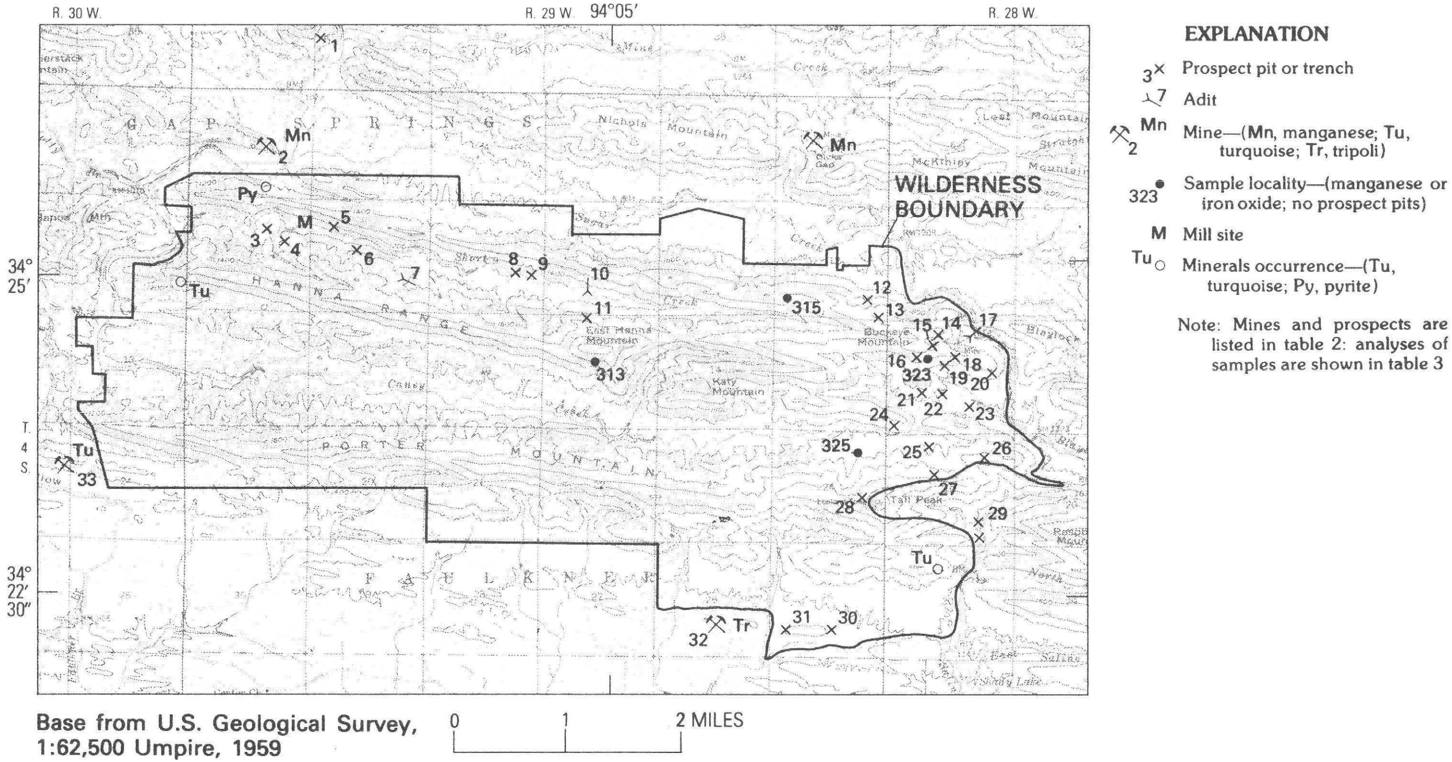


FIGURE 14.—Prospects and mines in and near the Caney Creek Wilderness. Sample numbers shown refer to analyses in tables 2 and 3.

taken in the mid-1950's and courthouse records indicate that most activity along Short Creek was during the stockpile purchase program. Prospecting in this area was chiefly by shallow pits, but a few bulldozed cuts were opened in addition to two short adits (localities 7 and 10, fig. 14 and table 2).

Other manganese prospects were reported by Penrose (1891) and shown on a geologic map by Miser and Purdue (1929) at several other places in the wilderness, and although none of these was found during the fieldwork in 1978, several unreported prospects were located. Two were short adits and the others were small pits. Other prospects are no doubt present in the area but were not found because of dense

TABLE 2.—*Prospects and mines in and near the Caney Creek Wilderness*

Map No. (fig. 14)	Sample no.	Property or prospect name	Description of workings	Deposit description
1	301		Trench in bulldozer cut	8-in vein of crystalline barite in shale
2	302, 303	Sugarstick Mine	Open stope 25 ft wide by 25 ft high by 100 ft long with adits to surface on two levels	
3	307		Several trenches over 0.2 acre area	Mn oxide nodules in residuum
4	308	Pickell[4]	Open cut 25 ft wide by 25 ft high by 60 ft long	
5	309	Pickell[4]	Sidehill cut, 20 ft high by 25 ft long	
6	NS		Two shallow bulldozer cuts	No deposit
7	NS		Two adits 5 ft long and 8 ft long	
8	310	"Moody" Group	Trench 7 ft deep and 20 ft long	
9	NS	"Moody" Group	Sidehill cut 15 ft high by 50 ft long	
10	311	Manganese Corp. of Delaware	Adit 25 ft long	Adit stopped 20 ft short of Mn- and Fe-oxide zone exposed at surface
11	312	Manganese Corp. of Delaware	Sidehill cut 10 ft high by 190 ft long	Fe staining and impure Mn oxides in weathered sandstone
12	316	Taylor and Howell	Open cut 30 ft wide by 25 ft high by 50 ft long	
13	NS		Pit 6 ft deep by 10 ft long	

TABLE 2.—*Prospects and mines in and near the Caney Creek Wilderness*—Continued

Map No. (fig. 14)	Sample no.	Property or prospect name	Description of workings	Deposit description
14----	NS		Pit 3 ft deep by 15 ft long	
15----	NS		Circular pit 3 ft by 1-1/2 ft deep	
16----	NS		Circular pit 5 ft by 2 ft deep	
17----	NS		Adit 22 ft long	
18----	321		Open cut 20 ft wide by 20 ft high by 40 ft long	
19----	322		Trench 7 ft deep by 13 ft long	
20----	NS		Trench 20 ft deep by 55 ft long	
21----	NS		Pit 1 ft deep by 4 ft long	
22----	NS		Pit 1 ft deep by 5 ft long	
23----	NS	Hawkins, Hughes, and Sullivan #2	Pit 7 ft deep by 24 ft long	Fe and Mn oxides filling fractures in shale
24----	326		Trench 6 ft deep by 8 ft long	
25----	NS		Four pits average 3 ft deep by 6 ft long	Mn oxide nodules in soil, shale, and novaculite
26----	NS	William Robinson	Four pits average 2 ft deep by 10 ft long	
27----	NS		Broad pit 30 ft wide by 32 ft long by 4 ft deep	No deposit—apparently a borrow pit for road material
28----	328	Luke Lawrence #4	Trench 2 ft deep by 18 ft long; caved adit	
29----	330		Adit 6 ft long at end of 15 ft trench	
30----	332	Mac #5	Trench 1 ft deep by 9 ft long	Decomposed upper novaculite—"tripoli"
31----	333	Mac #4	Trench 1-1/2 ft deep by 27 ft long	Decomposed upper novaculite—"tripoli"
32----	334	Mac #2	Open cut 75 ft wide (at face) by 120 ft long by 58 ft high	Decomposed upper novaculite—"tripoli"
33----	337	MacBride	Shaft 40 ft deep; adit 110 ft long	Turquoise veins and nodules in novaculite

[1]NS indicates that no sample was taken.
[2]Property names are taken from literature or assessment affidavits filed in Polk County courthouse.
[3]Except as noted, all openings are in fractured Arkansas Novaculite displaying Mn and/or Fe oxides as staining, veinlets, pods, and veins.
[4]There is disputed ownership with Inland Mining Co. (M. Boos, unpublished data, 1952).
[5]Major work may have been performed by S. Christian (Lenard Aleshire, oral commun., 1978).

forest cover and the difficulty of distinguishing old pits from soil disturbed during logging.

The total tonnage of manganese ore produced from the Caney Creek Wilderness is unavailable because no records were kept of the production from individual prospects. In addition, during the stockpile purchase program, manganese ore from the wilderness was mixed with ore from other localities in the west-central Arkansas manganese district. Lenard Aleshire (oral commun., 1978) reported that manganese ore was produced in the 1950's from two prospects on Buckeye Mountain. He and his brother removed about 80 tons of high-grade (>40 percent Mn) manganese oxide from one prospect (locality 18, fig. 14). He mentioned that hand-cobbed ore from another prospect (locality 20, fig. 14) was low in impurities and was used to upgrade ores from mines outside of the wilderness. It is likely that this ore was reported along with ore from those mines. One operator is reported to have produced 35 tons of high-grade ore from a prospect in the Short Creek valley (Brown, 1955). Lenard Aleshire, who at one time was employed at the General Services Adminstration shipping point in Mena, recalled that several truckloads of ore from Short Creek were delivered at Mena where it was mixed with ore from other mines. He stated that such blending was necessary because the copper content of Short Creek ores exceeded stockpile purchase

[1]The USBM (DeHuff, 1965) published the specifications for stockpile pruchase of manganese as follows: National Stockpile Specification P-30-R, Manganese-Metallurgical, January 8, 1953, covered ore, nodules, and sinter "suitable for the manufacture of commercial grades of ferromanganese and special manganese alloys, and for the production of chemicals which do not require ore of high manganese dioxide content." The chemical requirements, for it and for the March 14, 1958 revision, P-30-R1, were essentially as follows:

		Percent by weight (dry basis)			
		P-30-R[1]	P-30-R1[2]	P-30-R[3]	P-30-R1[4]
Manganese	Minimum	46.00	46.00	40.00	44.00
Iron	Maximum	8.00	8.00	16.00	12.00
Silica-plus-alumina	do	12.00	12.00	(5)	15.00
Phosphorus	do	.18	.18	.30	.24
Copper	do	—	—	.25	—
Copper-plus-lead-plus-zinc	do	.10	.20	1.00	.30

[1]Any proposal could be rejected if its guaranteed chemical analysis on the weighted average basis were inferior.
[2]Material purchased "shall conform" on a weighted average basis for each contract.
[3]No proposals considered unless guaranteed chemical analysis on the weighted average basis is equal or better.
[4]Each lot delivered "shall conform", a lot being "any quantity determined by the Government to require a separate chemical analysis report."
[5]"No limit specified for material, which may be offered; however, material over 15 percent will be purchased in exceptional cases only."

specifications[1] and apparently was a major factor leading to the termination of mining on Short Creek.

Barite, which is used mainly in heavy drilling muds vital to the production of petroleum and natural gas, is mined at several places in southwestern Arkansas. The principal barite deposits nearest the wilderness are in the Hatfield and Fancy Hill districts, 9 mi west-northwest and 9 mi east, respectively, of the wilderness. The Hatfield district, long inactive, was explored by about 60 prospects, and an estimated 18 tons of barite was produced (Scull, 1958). The Fancy Hill district was active at the time of the field investigations, and the Baroid Division of NL Industries, Inc., produced a considerable tonnage of barie during the 1970's. Both districts have recently attracted the attention of several other companies. R. B. Stroud (oral commun., 1979) reported that little activity was anticipated in the Hatfield district, but that one of these companies, Milchem, Inc., had outlined three major ore bodies in the Fancy Hill district. Milchem, Inc., plans development of an open-cut mine and construction of a mill.

Tripoli deposits in the upper part of the Arkansas Novaculite have been mined east of the Caney Creek Wilderness in Montgomery, Pike, and Garland Counties (Stroud and others, 1969). Several thousand tons of tripoli have been produced from an open cut 600 ft south of the wilderness (locality 32, fig. 14) (U.S. Forest Service, unpublished data, 1971).

Slate has been produced intermittently from several open pits near the wilderness; the principal production came from deposits in T. 3 S., R. 28 and 29 W., about 4 mi north of the wilderness (Branner and others, 1940). Production of slate from Polk County for a 9-yr period (1931–1939) was reported to be 24,376 tons, having an estimated value of $168,790 (Branner and others, 1940). In the 1950's, a small quarry was operated in T. 4 S., R. 30 W., less than a mile west of the wilderness (Stroud and others, 1969). Quantity or value of production of slate from this deposit is not known.

Clay and shale for brick and tile were mined near Mena, about 12 mi northwest of the wilderness. Production between 1952 and 1955 was an estimated 365,000 tons valued at $375,000 (Stroud and others, 1969). After 1970, no production of clay or shale is recorded for Polk County (U.S. Bureau of Mines, 1971–1977; U.S. Bureau of Mines, unpublished data).

Small quantities of turquoise, native copper, sphalerite, galena, quartz crystal, stibnite, and cinnabar have also been mined within 25 miles of the wilderness. Neither the literature nor the field investigations and subsequent analyses of samples suggest the occurrence of commercial deposits of any of these minerals in Caney Creek Wilderness.

DESCRIPTION AND RESOURCE POTENTIAL OF MINERAL DEPOSITS IN THE CANEY CREEK WILDERNESS

METALLIC MINERALS

MANGANESE

The manganese deposits in the Caney Creek area occur mainly at two stratigraphic horizons in the Arkansas Novaculite, one in the upper novaculite unit and the other near the top of the lower novaculite unit (Miser and Purdue, 1929). The manganese occurs as oxides in nodules, irregular masses, and short narrow veins in fractured and brecciated novaculite. The veins occur in zones ranging from a few feet to several tens of feet in length and from 1 in or less to about 3 ft in width. The high-grade manganese oxide masses are rarely more than a foot or two in maximum dimension. The manganese oxides are commonly concentrated along bedding planes and fractures or form cement or cavity filling in brecciated novaculite. The manganese minerals at most localities are intimately associated with iron oxides, and weathered outcrops tend to be heavily stained with these oxides. Manganese oxide minerals identified in recent work (Wagner and others, 1978) include cryptomelane, $K(Mn^{+4}, Mn^{+2})_8O_{16}$; lithiophorite, $(Al, Li) Mn^{+4}O_2(OH)_2$; pyrolusite, MnO_2; and hausmannite, $Mn^{+2}Mn_2{}^{+3}O_4$.

The grade of the manganese oxide deposits in the Caney Creek Wilderness ranges broadly. Apparently the best-grade ore was produced in the Buckeye Mountain area (localities 18 and 20, fig. 14). Lenard Aleshire (oral commun., 1978) reported that the 80 tons produced from one of these prospects was more than 40 percent manganese and very low in metallic impurities. The sample collected from this prospect (sample 321, table 3) contains 38.5 percent Mn, and the average of four samples from Buckeye Mountain (316 and 321-323) was 39.4 percent Mn. The Samples 328 and 330 (table 3) from the prospects in the vicinity of Tall Peak (localities 28 and 29, fig. 14) are either low in Mn (average 29.6 percent) or high in Fe, Cu, or Zn. These analyses probably are more or less typical of the Tall Peak deposits, and the low Mn value and high values for other metals would account for the lack of reported production in this vicinity. Samples of manganese oxide from Short Creek prospects (samples 307-312, table 3) show that the material is not exceptionally high in Mn. Although one sample is 46.8 percent Mn, the average of the other five samples is only 29.6 percent. The significant percentages of Zn, Ni, and Co shown by the analyses are undesirable in manganese ore. The average of metal impurities for the six samples is: 0.5 percent Cu, 0.3 percent Zn, 0.2 percent Ni, and 0.3 percent Co; a USGS geochemical sample (sample 57, table 1) contained 1.5 percent Cu, 0.3

TABLE 3.—*Analyses of manganese- and iron-oxide-rich samples from prospects and mines in and near the Caney Creek Wilderness*

[All elements by means of atomic absorption methods except Si, by neutron activation; P, by X-ray fluorescence; S, by wet chemistry; and Ag, by fire assay. All samples contained less than 0.01 percent Pb. ND, not detected. Analyses made at USBM, Metallurgy Research Center, Reno, Nev.]

	Weight percent										Oz/ton
Sample No.	Mn	Fe	Si	P	S	Cu	Zn	Ni	Co	Li	Ag
302	42.5	5.6	0.4	0.2	0.06	0.30	0.16	0.17	0.14	0.08	0.2
303	30.5	2.5	.4	.2	.01	1.40	.20	.88	.84	.44	<.1
307	29.5	.8	4.9	.2	.15	1.10	.27	.39	.23	.34	ND
308	35.0	.4	.3	.2	.16	1.20	.49	.50	.17	.38	.1
309	46.8	5.0	.7	.5	.36	.08	.22	.03	.08	ND	ND
310	32.5	2.9	7.4	.4	.16	.32	.16	.20	.79	.17	.3
311	33.5	.3	1.8	.2	.26	.35	.88	.58	.25	.53	ND
312	17.6	7.3	24.0	.3	.22	.04	.04	.02	.06	ND	.8
313	.1	43.4	7.6	1.3	.10	.02	.04	.01	ND	ND	.2
315	.1	54.1	1.4	.6	.09	.03	.03	.01	.01	ND	ND
316	41.0	8.0	3.4	.5	.10	.05	.16	.04	.06	.01	ND
321	38.5	11.6	2.7	.7	.03	.02	.06	.02	.12	.01	<.1
322	41.5	10.8	.9	.8	.03	.01	.03	.01	.10	ND	.1
323	36.5	1.3	13.6	.1	.12	.04	.05	.04	.11	.01	.1
325	9.0	15.6	21.7	.7	.10	.10	.11	.15	.12	.07	.3
326	18.0	22.5	11.5	1.0	.02	.02	.08	.04	.09	.01	<.1
328	28.8	18.5	5.3	1.0	.04	.02	.13	.02	.07	ND	.1
330	31.0	.6	2.0	.1	.03	1.10	.39	.38	.50	.32	<.1

percent Zn, 0.2 percent Ni, and 0.2 percent Co. Foley (1960) also found that manganese ore from one locality on Short Creek averaged 1.4 percent Cu and additionally contained 0.02 oz of gold and 0.67 oz of silver per ton. One of the Short Creek samples taken during this investigation (sample 312, table 3) contained 0.8 oz of silver per ton. Six Short Creek samples contained an average of 0.2 oz silver per ton, whereas the silver content of all USBM samples from the wilderness average 0.1 oz per ton. No gold was detected in the samples.

It is probable that additional small manganese deposits of the size and grade of some of those previously mined in and near the Caney Creek Wilderness are present in it. However, such undiscovered deposits are not likely to be larger than those already known. Low-grade deposits of this size are virtually impossible to mine profitably under present-day mining costs. Therefore, the present evaluation of the manganese deposits in the Caney Creek Wilderness is essentially the same as that expressed by Penrose (1891) for all deposits in southwestern Arkansas:

> "The aggregate amount of manganese in the region is undoubtedly large, but it is distributed over an extensive area, and in almost all places it is hopelessly scattered through the rock in small nests and seams. If these nests and seams were in sufficient quantities the rock might be crushed and the ore concentrated by

washing, but the pockets containing them are too small to permit the expense of machinery."

IRON

Deposits of iron oxides and hydroxides (hematite and limonite) occur at many places in the Ouachita Mountains, but on the whole are smaller and less abundant than manganese deposits. Several claims for iron were filed in and near the Caney Creek Wilderness prior to publication of Penrose's (1892) report on the iron deposits of Arkansas. Branner and others (1940) listed four occurrences of iron oxides in the wilderness. The two richest samples collected in the present study (313 and 315, table 3), from deposits less than 10 ft in greatest dimension, contained an average of 48.7 percent Fe. Other than these samples, the highest Fe value obtained was 22.5 percent for sample 326; other samples contained less than 20 percent Fe (table 3). Penrose (1892) reported that an analysis of a sample from the Arkansas Development Company's adit at Tall Peak showed only 16.22 percent Fe. Clearly, the iron deposits on which the early claims were filed are far too small and impure to be considered as iron ore, and high-grade iron deposits of sufficient size to be mined have not been found. There is no reason to believe that larger or higher grade deposits are present in the wilderness.

BASE METALS

The base metals copper, lead, and zinc, have been prospected near the Caney Creek Wilderness but have not been found within it. Small amounts of copper have been found in five prospects in the valleys of Macks Creek and its tributaries 4–5 mi north of the wilderness, and a little copper is reported to have been produced (Branner and others, 1940). Native copper was identified at one of these prospects, but most of the copper occurs as stains and veins of malachite, azurite, chrysocolla, and chalcopyrite along fractures in the Arkansas Novaculite (Stroud and others, 1969). The geochemical samples show only minimum anomalous values of Cu in association with anomalous Mn, and there is no reason to suspect the presence of minable copper deposits in the wilderness.

Lead in the form of galena nodules, of which some are associated with quartz, pyrite, and the zinc mineral sphalerite, occurs in both the Missouri Mountain Shale (Branner and others, 1940) and the Stanley Shale (Stroud and others, 1969). The largest known deposit, located in SE 1/4, SE 1/4, Sec. 24, T. 1 S., R. 29 W., about 15 mi north of the Caney Creek Wilderness, yielded 1,500 lb of galena in 1952 (Stroud and others, 1969). Galena also occurs in the inactive Lehrock slate quarry 3 mi north of the wilderness. Lead and zinc occurrences have not been reported in the wilderness, and it is unlikely that minable deposits are present.

Several hundred tons of antimony (Sb) were recovered from stibnite-bearing veins in the Stanley Shale in northern Sevier County, about 15 mi southwest of the Caney Creek Wilderness (Stroud and others, 1969). Veins of this type have not been reported in or near the wilderness, but a narrow pyrite vein in the Missouri Mountain Shale(?) in Sec. 6, T. 4 S., R. 29 W., near the wilderness boundary, was reported (Lenard Aleshire, oral commun., 1978) to contain antimony. Analysis of a sample from this vein showed less than 0.1 percent Sb, which is far below the grade of exploitable Sb ore. Other sulfide veins were not found in the wilderness during the field investigation, and no anomalous Sb values were detected in the stream sediment samples.

NONMETALLIC MINERALS

BARITE

Two barite prospects are near the wilderness. One, a recent, shallow bulldozed trench in the NW 1/4, NW 1/4, SW 1/4, Sec. 32, T. 3 S., R. 29 W., about 1-1/4 mi north of the northwestern corner of the wilderness, exposes a layer of bedded barite in Stanley Shale. The layer is less than 20 ft long and has a maximum thickness of about 8 in. A sample of this material contains 81.4 percent $BaSO_4$. The other, called the Cossatot River prospect by Jones (1948), is about 2-1/2 mi west of the wilderness. Jones reported the workings to consist of a pit and a short adit on a small lens of barite. This prospect was not found during the field investigation.

The thin layer of barite in the new prospect near the wilderness is of sedimentary origin and therefore similar to the deposits in the Fancy Hill district. In contrast, barite in the Hatfield district occurs as veins in the Arkansas Novaculite and may be of hydrothermal origin. Such deposits were not found in or near the wilderness.

Significant barite deposits should be readily detectable by the type of geochemical sampling carried out in this investigation. The fact that the geochemical samples do not show anomalous barium values indicates that large barite deposits are not present in the wilderness. As has been pointed out (p. 27), the stream sediments from the wilderness have relatively uniform background values for barium similar to those for the Stanley Shale. Barite has not been reported in the wilderness, and no barite pebbles or fragments were found during this investigation.

CLAY AND SHALE

Clay, shale, and related fine-grained rocks of possible industrial use occur in the Bigfork Chert, Missouri Mountain Shale, and Stanley Shale within the Caney Creek Wilderness. Stroud and others (1969) reported that Stanley Shale near the wilderness was found to be suitable for use in heavy clay products, and two of their samples had the firing properties needed for making stoneware. These authors reported that a slaty material from the Bigfork Chert a few miles north of the wilderness expanded during bloating tests and that it might be suitable for making lightweight aggregate.

During the fieldwork, two samples from the Stanley Shale and one each from the Missouri Mountain and Polk Creek Shales were collected in the wilderness. These samples were evaluated for bloating properties and suitability for use in common brick and other structural clay products. None of the four samples has the bloating properties required for making lightweight aggregate. One sample of the Stanley Shale and the one from the Polk Creek Shale were unsuitable for use in strutural clay products. Because of a short firing range and high carbonate content, the second sample of Stanley Shale was evaluated as being a marginal material for making common building brick. The tests of the sample of Missouri Mountain Shale indicate that it is potentially usable in the manufacture of structural clay products. Although shales suitable for use in structural clay products occur within the wilderness, they have little or no value because very large resources of these materials occur elsewhere in southwestern Arkansas nearer to transportation facilities and markets.

GRAVEL

Small deposits of gravel occur along the Cossatot and Saline Rivers and Caney and Short Creeks. Branner and others (1940) listed one deposit on Caney Creek as containing an estimated 5,000 yd^3 of gravel, consisting of pebbles and cobbles or boulders of hard, flinty novaculite of which only 60 percent are smaller than 2 in. Such a deposit has no value because of its small size and excessive quantities of cobbles and boulders. It is unlikely that better deposits occur in the wilderness.

NOVACULITE

Novaculite is a fine-grained, essentially pure silica (+99 percent SiO_2) rock that is used for railroad ballast, road material, building stone, and whetstones. Though very large resources of Arkansas Novaculite are present in the wilderness, they have little value because even larger resources are located outside the area and nearer to the markets.

SLATE

Slate occurs in three of the formations (Missouri Mountain, Polk Creek, and Stanley Shales) that crop out in the Caney Creek Wilderness. Although slate in the Missouri Mountain Shale has been mined at three localities in Polk County outside of the wilderness, none of the slate in this formation is of particularly high quality (Stroud and others, 1969), and the mines have been inactive since the 1950's. Because no production of slate from the Polk Creek and Stanley Shales has been reported, it appears that the slate in these formations is of even lower quality. The slate resources of the Caney Creek Wilderness have little value because large quantities of higher quality slate occur at other localities nearer to potential markets.

TRIPOLI

Two tripoli deposits are known to occur in the Caney Creek Wilderness, one in Sec. 11, T. 4 S., R. 29 W. and the other in Sec. 25, T. 4 S., R. 29 W. (Branner and others, 1940). The latter deposit, an extension of the deposit in Sec. 26 (locality 32, fig, 14) currently in patent procedure (see p. 9), was recently prospected at two places in the wilderness (localities 30 and 31, fig. 14) by shallow bulldozed trenches. The quality of tripoli at these prospects appears to be the same as that mined at locality 32 (fig. 14) outside the wilderness (see p. 33).

Several million tons of tripoli exist in developed deposits in the Ouachita Mountains outside the wilderness (U.S. Forest Service, unpublished data, 1971). Although of good quality, tripoli in the Caney Creek Wilderness has little potential because foreseeable demand could be supplied from the deposits elsewhere.

TURQUOISE

Turquoise, $CuAl_6(PO_4)_4(OH)_8 \cdot 5H_2O$, has been mined at the McBride property on top of a ridge a short distance west of the southwest corner of the wilderness (locality 33, fig. 14). In March 1978, workings consisted of a caved shaft on the ridge crest and an adit driven to intersect the turquoise zone about 30 ft lower. The total turquoise produced was probably not more than 600 lb. Most of the production was reportedly sold in southwestern states as semi-precious gem material. The turquoise occurs at two or three places on the McBride property as veins, fillings of irregular vugs, and impregnating material in weathered Arkansas Novaculite. The occurrences are small and the possibilities of finding larger or higher grade deposits in this area are poor.

Turquoise veinlets in Arkansas Novaculite were found at two localities in the wilderness during the present study, one in Sec. 12, T. 4 S., R. 30 W. and the other in Sec. 30, T. 4 S., R. 28 W. (fig. 14). The veinlets are not more than a millimeter in maximum thickness and appear to be restricted to areas of limited extent. They do not contain commercial-grade turquoise. Turquoise may be present elsewhere in the wilderness, but it is not likely to be in deposits of commercial grade and size.

CONCLUSIONS

The Caney Creek Wilderness contains many small deposits of manganese oxides and large resources of novaculite, shale, slate, and tripoli. The manganese deposits are too small to be mined profitably at current costs. Milling problems are another factor detrimental to the manganese potential of the wilderness. Fine and Frommer (1956) subjected several ore samples from the region to a variety of mechanical concentration methods and found that in most cases the manganese oxides were too intimately mixed with fine-grained novaculite to beneficiate efficiently. However, according to the USBM, the manganese deposits, although not of value solely for their manganese content, may have potential if certain impurities (copper, nickel, cobalt, zinc, and silver) can be extracted as coproducts or byproducts. Novaculite, a source of natural whetstones, occurs widely in central and western Arkansas so that deposits in the wilderness are of little value. Shale suitable for the manufacture of brick and other structural clay products, of grades equal to or better than those in the wilderness, also are widespread in western Arkansas in areas nearer to markets. The slate in the wilderness is of poor quality and cannot compete with better-quality slate outside the area. Good-quality tripoli many occur in the wilderness, but tripoli of equal or better quality in the Ouachita Mountains outside the wilderness is more than adequate for present and future demand. Two showings of turquoise were found in the wilderness, but the turquoise appears to be of poor quality and the amounts present small.

The Caney Creek Wilderness does not contain fossil fuels nor does it have a potential for geothermal energy.

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