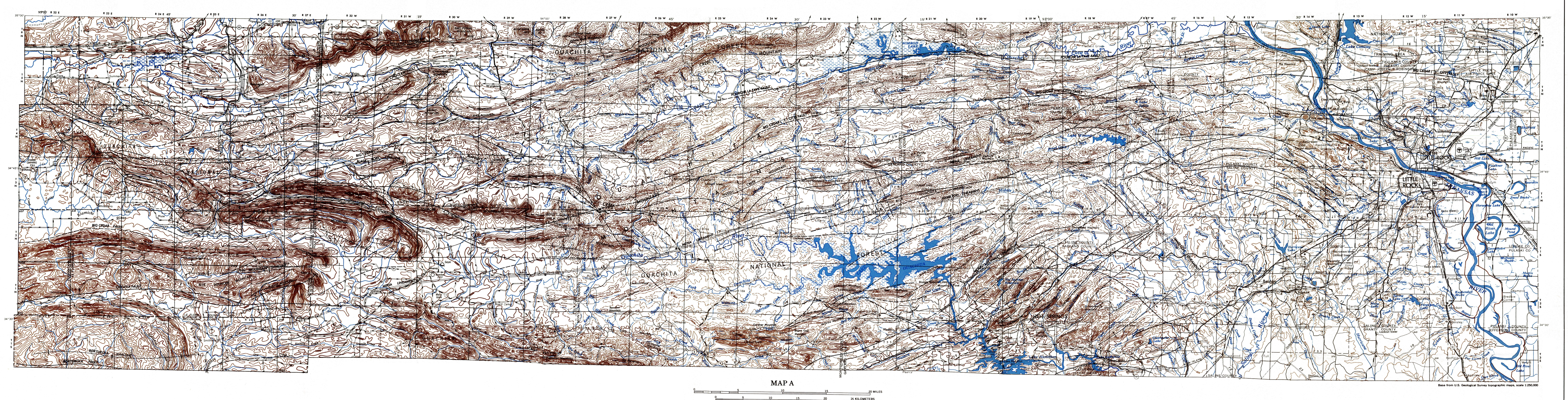
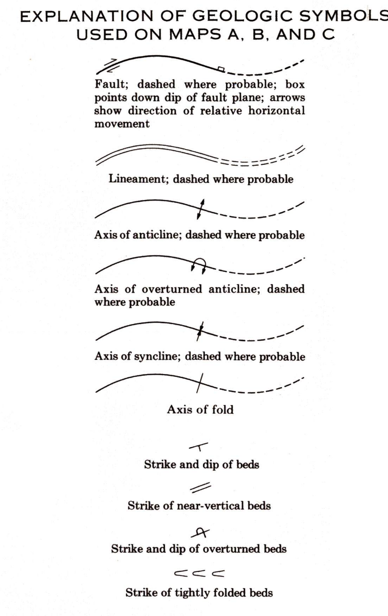
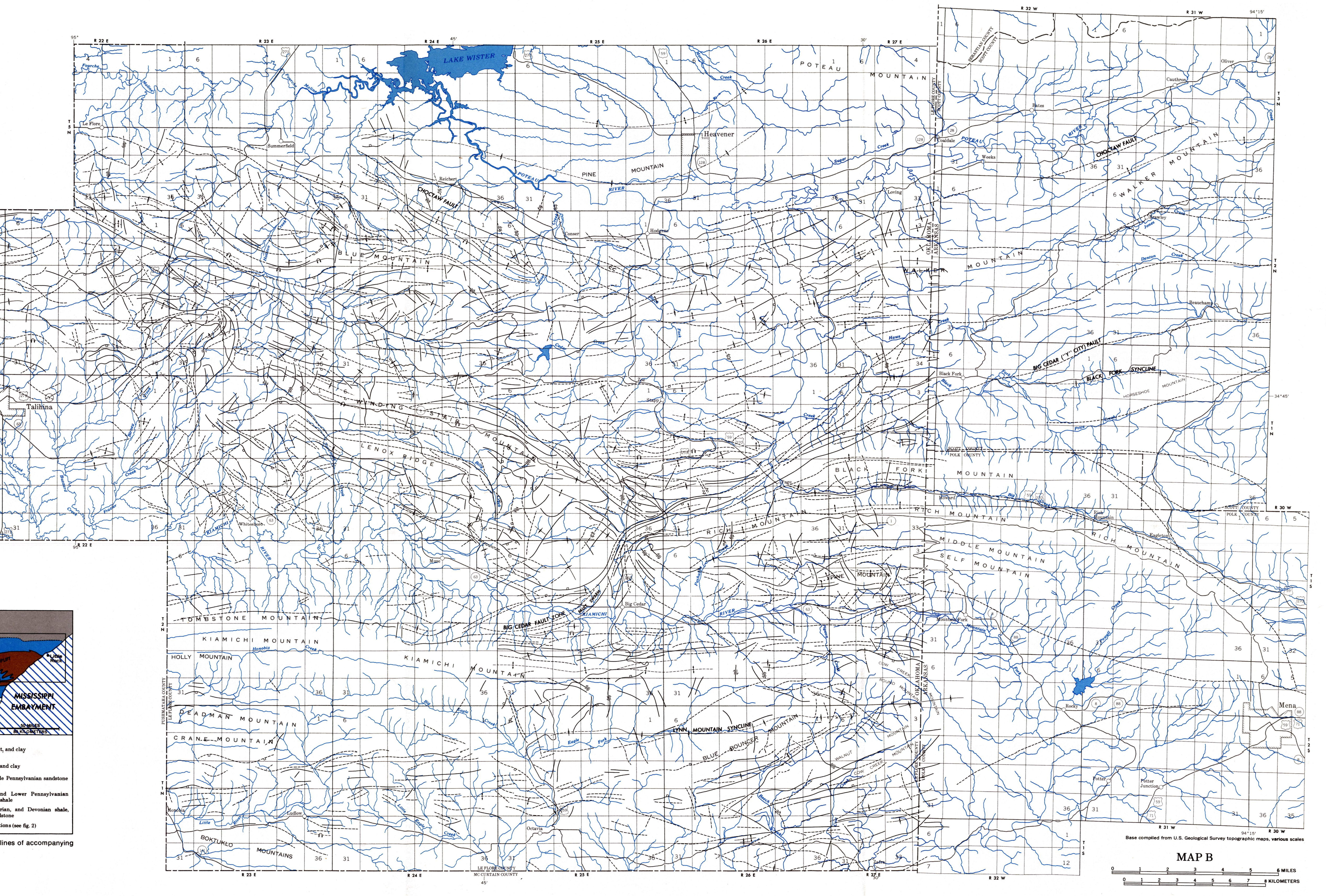
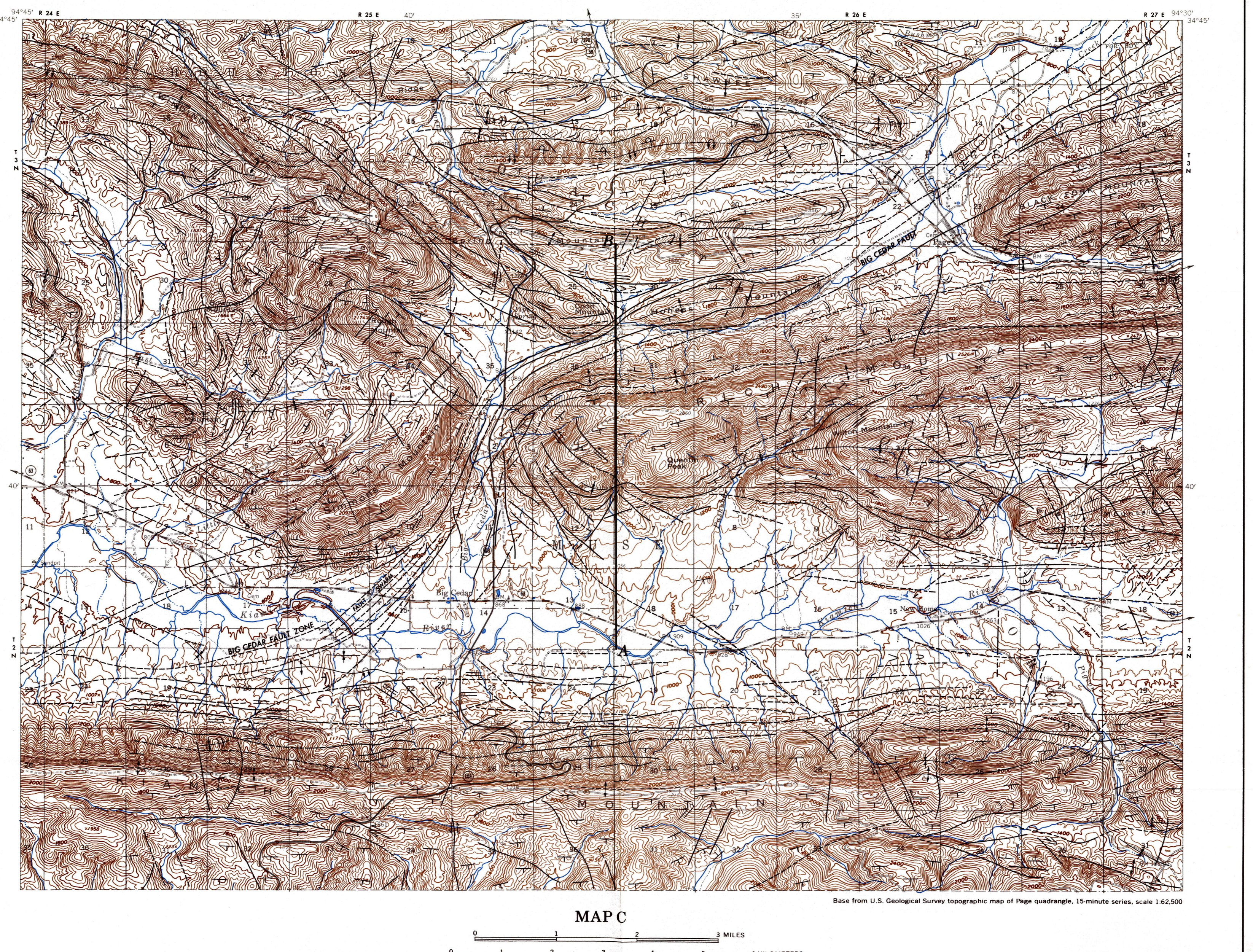








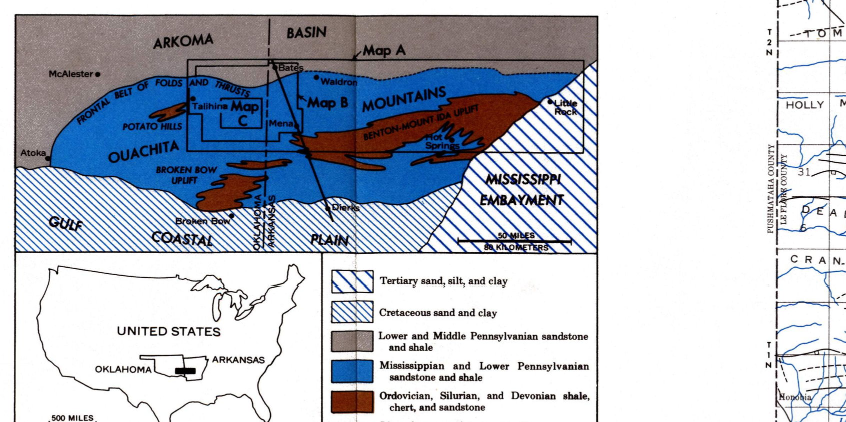
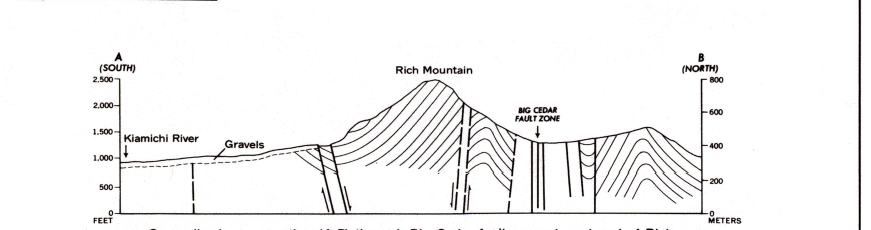


Figure 1. Generalized geologic map of Ouachita Mountains showing outlines of accompanying maps (A, B, and C) and line of cross sections (fig. 2).



Generalized cross section (A-B) through Big Cedar fault zone at west end of Rich Mountain (see Map C for line of section). Vertical exaggeration, 2.64:1.

in the Broken Bow uplift of McCurtain County, Oklahoma, and possibly also in the Potato Hills of Oklahoma. The net result was a complicated series of anticlinoria with very many small folds combining to make big folds. Vertical dimensions of these early uplifts cannot be measured, as there have been several later uplifts probably of the same regions, each accompanied and followed by relatively deep erosion.

Part of the uplift in these anticlinoria definitely took place in Early and Late Cretaceous time. Work by Speer and Melton (1971) describes some of the aspects of these uplifts during Cretaceous time. Part of these uplifts may have even preceded the steep faults of the big synclinal graben (section 5, preceding). Thus these uplifts may have been long lasting and frequently repeated.

The uplifts may have begun in latest Pennsylvanian or Early Permian time. The evidence for this is found in Pennsylvanian and Permian sedimentary rocks northwest and west of the Ouachitas. The coarse, cherty channel conglomerates in the Middle and Upper Pennsylvanian of central Oklahoma and north-central Texas, cited for decades as proof of Ouachita orogenic episodes and uplift during the Pennsylvanian (Ham and Wilson, 1967; Tomlinson and McBee, 1959; Weaver, 1954), do not appear to constitute a complete, normal suite of tectonic or orogenic conglomerates of the type that should result from sharp uplift of this large regional system. These sedimentary rocks lack the vast flood of coarse erosional debris (hard quartzose sandstone clasts of Atoka and Jackfork sandstone) that would have had to be eroded from a rising Ouachita land area before the pre-Stanley cherty beds in the central uplifts could be exposed. Some 20,000 to 30,000 feet (6,100 to 9,150 m) of sandstones and shales would have had to be eroded before the pre-Stanley cherts were uncovered! Once exposed, chert and novaculite could have formed only a small part of the detritus. Even today, their outcrops are only about 5 percent of the total area of the Ouachita Mountains in Oklahoma and Arkansas.

A flood of such coarse-grained quartzose clasts that should have been deposited is not present in the Middle and Late Pennsylvanian sedimentary rocks that are preserved in the vicinity of the Ouachitas. They may have existed close to the Ouachitas in an eastern facies of Early Permian rocks—perhaps of Garber, Duncan-San Angelo, or Whitehorse age. This coarse-grained eastern facies, if it existed, was subsequently eroded, probably during Triassic or Jurassic time. The existing Middle and Upper Pennsylvanian cherty stream conglomerates were probably derived from some area other than the central uplifts of the Ouachitas (possibly from the eastern Arbuckles) and should not be used to date an uplift of the Ouachitas.

A Late Pennsylvanian or Early Permian age for this uplift of the anticlinoria seems most reasonable. Shale of the Boggy Formation (Pennsylvanian, Desmoinesian) is folded and faulted within the frontal zone of the Ouachita Mountains and also in the Arkoma basin. It is only the Late Pennsylvanian and younger strata in the foreland—and well removed from the mountains—that are not deformed by orogeny in the present-day eroded Ouachitas, and the writer (Melton, 1930) found that Late Pennsylvanian and some Early Permian sedimentary rocks contain joint patterns that may be genetically related to the Ouachita crustal movements. In addition, adularia from quartz veins in the Ouachita Mountains gives isotopic ages showing that the last stage of low-grade metamorphism occurred during the Permian (Bass and Ferrara, 1969).

7. Big Cedar Fault

The longest fault observed in the study region appears to extend some 200 miles (322 km) from the east end of the Potato Hills in Oklahoma to Jacksonville in T. 3 N., R. 10 W., Arkansas. The significance of this fault was first recognized at Big Cedar Gap, where it passes between Winding Stair Mountain on the northwest and Rich Mountain on the southeast (T. 2 N., R. 25 E., Oklahoma). It is herein called the Big Cedar fault (maps B and C).

This remarkable fault cuts across or touches a number of different structures in Oklahoma and Arkansas. In Oklahoma, at Big Cedar Gap, it truncates at a sharp angle and apparently postdates other major faults of the area. Big Cedar fault is a fault zone along part of its length: slices and wedges such as Honess Mountain (secs. 28-30, T. 3 N., R. 26 E., Oklahoma) are incorporated within the fault zone, and a swarm of faults makes up the zone just southwest of Big Cedar Gap. It has been referred to as the "Y" City fault over much of its length in Arkansas. The fault appears to show left-lateral movement in the vicinity of Big Cedar Gap. A description of this fault in writing would be fruitless except to point out:

1. Fault erratics large enough to be seen in stereoscopic aerial photographs at a scale of 1:20,000 or larger are usually aligned at a noticeable angle (10° to 30°) to the trend of the fault, whereas erratics in the other fault zones discussed are much more nearly parallel to the fault.

2. The Big Cedar fault touches or borders the following major geologic features in Oklahoma and Arkansas: (1) Potato Hills complex, Oklahoma (south side and east end); (2) east end of Winding Stair Range and west end of Rich Mountain through Big Cedar Gap; (3) west end of Black Fork Range, Oklahoma; (4) Blansett syncline, Arkansas; (5) north of Mill Creek Mountain, Scott County, Arkansas; and (6) 80 miles (128.7 km) farther and nearly straight to the Arkansas River near Roland and 20 miles (32.2 km) farther to the north of Jacksonville, Arkansas, from which it bends slowly southeastward, as indicated by obscure lineaments in the mosaics.

The age of the Big Cedar fault should be later than that of the Potato Hills uplift, since it seems to have a favored position along the south side of the valley of the Kiamichi River, a subsequent stream along the south side of the anticlinorium. The fault definitely followed the steep graben-syncline faulting, since it separates Winding Stair and Rich Mountain Ranges by the narrowest major tectonic gap in the central Ouachita Mountains of Oklahoma.

A Jurassic age is indicated by its near parallelism to certain large subsurface faults in the edge of the Coastal Plain to the south, a distance of about 70 miles (112.6 km).

Later Tectonic Events

From the events of the previously enumerated sections to Holocene time, there have been a series of vertical uplifts of the big anticlinoria, and probably of the entire Ouachita salient and its foreland to the north. The various episodes of uplift were probably similar in form and in the accompanying events, which were: (1) stimulated deeper erosion, followed by (2) planation, and perhaps later by (3) sea advance and sedimentary onlap of marine formations. The latest of these regional uplifts may have occurred in late Pliocene or even Pleistocene time, although such late uplifts were not followed by any known advance of the sea in this region (see Speer and Melton, 1971).

A View from Today's Perspective

The great contrast in rocks below and above the Mena lineament points to a separation of the stratigraphic section along a weak shale zone, below which there may have been underthrusting southward and above which there may have been overthrusting predominantly northward. Many diagrams illustrating subduction in the geophysical literature cause the reader to speculate on the possibility of separation of the section into an underthrust portion and an overthrust portion. If this has happened in the Ouachitas, it may have occurred above the lower Stanley, but of course long after Stanley time. In general, the surface rocks are of different tectonic aspects stratigraphically below and above the Mena (lineament) zone.

The large synclinal-graben upland ranges may also be a phase of the near-surface effects of continued and deeper subduction of a crustal plate in the later stages of its activity. Examples of similar grabens containing Triassic rocks are well known in the eastern Appalachian-Piedmont region.

Finally, the reader should keep in mind that this contribution, together with the associated maps, is not a complete presentation of the geology of the Ouachita Mountain system. This study does emphasize the types of faulting, folding, and erosional remnants and the relative age relationships of structural features. The missing element, which would make a more complete contribution, would be detailed stratigraphic and structural mapping of the areas under discussion. The previously available stratigraphic and structural maps are undoubtedly the best possible that dedicated geologists could have produced at that time. The author feels that the time has come for a detailed structural study to be made, using the best available aerial photographs as well as the published stratigraphic-structural maps. The photographic scale should be larger than 2 inches per mile (1:31,680). Satellite and similar imagery should be used, but it shows only the largest structural features.

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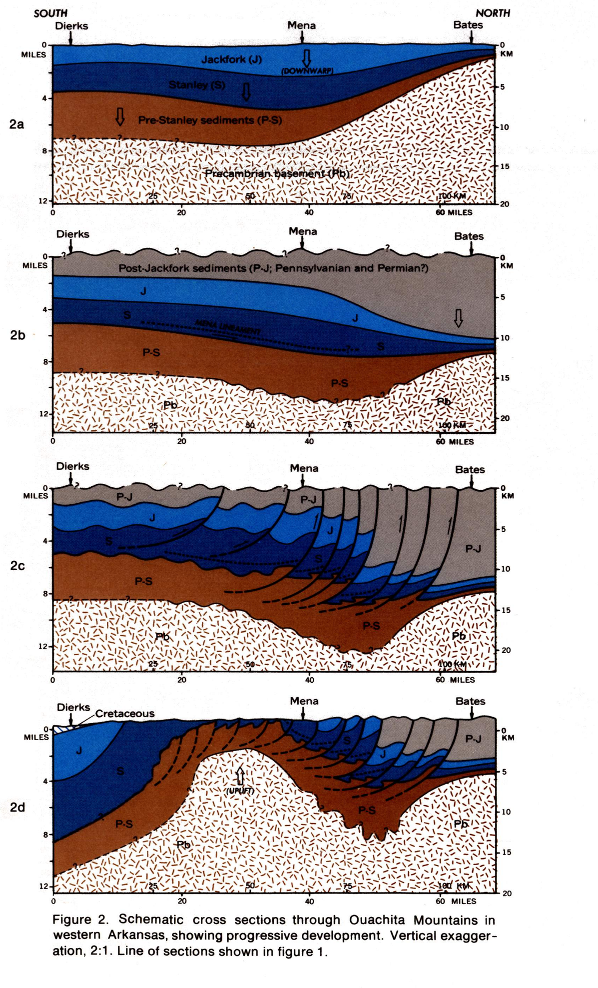

Figure 2. Schematic cross sections through Ouachita Mountains in western Arkansas, showing progressive development. Vertical exaggeration, 2:1. Line of sections shown in figure 1.

STEREOSCOPIC AND MOSAIC AERIAL-PHOTOGRAPH STUDY OF THE STRUCTURE OF THE CENTRAL OUACHITA MOUNTAINS IN OKLAHOMA AND ARKANSAS

By

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1976