GEOLOGIC SETTING OF THE EASTERN WICHITA MOUNTAINS WITH A BRIEF DISCUSSION OF UNRESOLVED PROBLEMS

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INTRODUCTION

Background

Four early publications outlined the surface geologic relations of the eastern Wichita Mountains: Taff (1904) provided the framework by outlining the principal rock groups, igneous and sedimentary; Taylor (1915) described the main granitic units and first identified the Meers Quartzite; Hoffman (1930) mapped in more detail the igneous exposures of the eastern Wichitas, emphasizing the micrographic nature of the granites; and Decker (1939) described the stratigraphy of the lower Paleozoic sedimentary section (Timbered Hills Group and Arbuckle Group), some parts of which have their type sections in the Wichitas. The tectonic setting and geologic relations, as presently understood, are shown in figures 1 and 2. Later, six modifications in interpretation significantly altered our understanding of the geology: (1) Schoonover (1948) recognized the Carlton rocks as extrusive rhyolites, adding a volcanic element not heretofore appreciated; (2) Harlton (1951) noted significant faulting with surface expression in the sedimentary units; (3) H. E. Hunter (Gilbert, 1960; Hiss, 1960; Spencer, 1961) realized that the gabbroic rocks are mostly part of a large, layered, lopolithic complex, entirely similar to other such well-known bodies in the world, an idea also championed by Hamilton (1956, 1959) in somewhat different form; (4) Tilton and others (1962) showed that the granites and rhyolites are Cambrian, thus anomalous for the continental interior; (5) Hoffman and others (1974) popularized the idea that the Wichita Uplift–Anadarko Basin is an aulacogen; and finally (6) Brewer and others (1981, 1982) presented evidence for a deep, large thrust-fault system on the north, representing a strong compressional phase during uplift.

G. W. Chase worked in the Wichita Mountains area for the Oklahoma Geological Survey from 1949 to 1955, producing a number of seminal publications, the most comprehensive of which was Chase and others (1956); the geology of the region as shown on the 1954 state geologic map (Miser, 1954) is due principally to him. Other work by Chase survives only in manuscript form. Finally, three articles should be consulted for their comprehensive presentation and review of available data: Ham and others (1964) laid the groundwork for our modern understanding of the Wichita Mountains–Arbuckle Mountains basement; Powell and others (1980) revised the basement lithostratigraphy, cogently discussing uncertainties of ages and correlations; and Myers and others (1981) discussed the geochemistry of the Wichita Granite Group. Many other individual sources of data or ideas would need to be cited for a complete review of the geology. However, all these may be found in the reference lists of the publications just noted, and to some degree in the list accompanying this guidebook. Only a brief outline of the geologic history is given here. Powell and others (1980), Powell and Fischer (1976), and Johnson and Denison (1973) gave helpful and more detailed reviews.

Geologic Setting

The Wichita Mountains are a series of Cambrian to possibly Proterozoic igneous knobs, and Cambrian to Ordovician sedimentary hills, protruding through the Permian shaly plains of southwestern Oklahoma (fig. 2). The mountains have a maximum relief of about 1,100–1,200 ft on the southeastern end, near Lawton, Oklahoma, but this dwindles along the 120-km length of the range to about 700–800 ft on the northwestern end, near Granite. The primary reason for this difference is the rise in local base level from 1,100–1,300 ft to 1,600 ft (fig. 3). The range is of much greater geologic significance than its topographic aspect might seem to warrant. Only the Wichitas, and Arbuckles of southern Oklahoma, contain useful exposures of basement for the southern Mid-continent. To the west, basement is not exposed until reaching central New Mexico; to the south, not until the Llano region, to the north and east, not until the Saint Francois Mountains of southeastern Missouri or the Black Hills of South Dakota. Furthermore, the basement character in the Wichitas is different from each of these other areas, both in age (the others are Proterozoic, 1.2–1.5 b.y.) and in distribution of rock types. The Wichita axis is also markedly different in tectonic setting in comparison with these other areas of exposed basement. It is part of a regional system called an aulacogen (Burke and Dewey, 1973; Hoffman and others, 1974), which serves to emphasize the role of faulting and extensional strains during an early part of the history. Arguments for significant left-lateral, strike-slip faulting have also been advanced for later in the history, during the uplift phase, specifically for the Arbuckles (for example, Wickham, 1978). By implication, such a style of activity would apply also to the Wichitas. The picture is further complicated by the recent COCORP results for a deep seismic-reflection line from the Hardeman Basin across the Wichita Uplift and Anadarko Basin, as described in this guidebook by Brewer. These results show a hitherto unsuspected deep, large Proterozoic basin beneath the Hollis–Hardeman Basin to the south, and thrust faulting 20–24 km deep on the north, reflecting a strong compressional phase during uplift.