

BASEMENT ROCKS AND STRUCTURAL EVOLUTION OF SOUTHERN OKLAHOMA

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ABSTRACT: Basement rocks in the 17,000 square-mile region of southern Oklahoma crop out in the Wichita and Arbuckle Mountains and have been studied in subsurface samples from 175 wells. The rocks are divided into two contrasting provinces, each completely different from the other in age and petrologic character. Each province has played a different role in guiding the stratigraphic and structural evolution of overlying Paleozoic strata.

The older or Eastern Arbuckle province consists dominantly of Precambrian massive granites isotopically dated 1,050 to 1,350 million years. They are part of an extensive continental craton, upon which the Paleozoic sediments are thin and have been only slightly disturbed, chiefly by gentle folding and block faulting.

Basement rocks of the younger or Wichita Province are sediments, flows, and intrusive igneous rocks of probable Early and Middle Cambrian age. The sediments and flows consist of graywacke, bedded chert, spilitic basalt, and rhyolite. As shown by drilling and supporting seismic data, these framework rocks accumulated to a thickness of about 20,000 feet within an elongate downwarp upon the craton. The downwarp extends northwestward along a belt 100 miles wide and 300 miles long. It is confined mainly to southwestern Oklahoma and northern Texas, but probably continues eastward toward the buried southwesterly extension of the Appalachians. In this major earth segment are rocks representing the beginning or eugeosynclinal stage of the Southern Oklahoma geosyncline.

Layered gabbro and epizone granites, isotopically dated at 500 to 550 million years, and therefore probably of Middle Cambrian age, were emplaced successively within the framework rocks along the southwestern margin of the geosyncline. Through the injection of these rocks the margin was consolidated into a rigid block, which acted thereafter as a structurally independent element. Younger Paleozoic sediments deposited above it are thin, and in Pennsylvanian time it became the site of the Wichita Mountain horst.

The central part of the geosyncline, which was not consolidated by the injection of intrusive igneous rocks, continued to sink and ultimately received 40,000 feet of Upper Cambrian and later Paleozoic sediments above the Wichita Province basement rocks, yielding a total filling of 60,000 feet. It then collapsed by strong folding and locally by reverse faulting during several stages of Pennsylvanian orogeny. Included within the collapsed segment of the Southern Oklahoma geosyncline are the Anadarko basin, Ardmore basin, and Arbuckle anticline. These closely folded structures are underlain everywhere by a thick sequence of stratiform or layered basement rocks.

The present northwest-trending structural grain is the same as that of the basement rocks. Among the early features developed within the basement rocks, which have helped to set the pattern for later structural evolution, is a major or half-graben that is bounded by faults with a throw of at least one mile.

Wells establishing probable world records for penetration of granite (11,423 feet) and of gabbro (8,066 feet) have been drilled in southern Oklahoma, and 17 wells of the region have penetrated more than 1,000 feet of basement rocks. Cores and cuttings representing about 83,000 feet of basement rocks have been collected and studied.