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How Current Understanding of Basement Outcrops in Oklahoma Can Help Decipher Later Geologic History.

M. C. Gilbert, School of Geology and Geophysics, University of Oklahoma

There are only two significant outcrop areas of basement rock in Oklahoma: the ~1.4Ga Arbuckle basement in the eastern Arbuckle Mountains of south-central Oklahoma, and the ~0.53Ga Southern Oklahoma Aulacogen (SOA) basement in the western Arbuckles and the Wichita Mountains of southwestern Oklahoma. The eastern Arbuckle outcrops are broadly representative of most of the basement in central and NE Oklahoma (Denison, 1981). Although most of the Proterozoic basement of the southern Mid-Continent has been classified with the Southern Granite-Rhyolite Terrane (SGR), which extends through Kansas and into Missouri, more detailed geochemical work by Lidiak and colleagues has shown the Arbuckle basement has a plate-margin character, different from the SGR. This means that southern Oklahoma was at a plate boundary (of Laurentia before it became a part of the supercontinent Rodinia) in the MesoProterozoic. The SOA, if interpreted as the failed arm of the Late NeoProterozoic/Early Cambrian Dallas Triple Junction, indicates the time when a substantial block of continental crust (presumably part of what is known as the Llano craton, which was added to Laurentia in the Grenville, ~1 Ga), once underlying east Texas and west Louisiana, drifted away to become, perhaps, a part of Argentina in today's world.

Control of Paleozoic structures by the basement is subtle in places and dominant in others, such as in the uplifted Wichita-Amarillo-Criner Hills block. The SOA basement occupies a good portion of southern and southwestern Oklahoma and directly influenced many of the later Paleozoic structures developed on or near it. The Pennsylvanian uplift dismembered the "Ancestral Anadarko" Basin (Oklahoma Basin of Johnson) and led to the formation of a new foreland basin, the present Anadarko Basin. The early basin had about 15,000' of sediments; the newer basin had about 25,000' of sediments added on top of the older, yielding the present total of about 40,000'. Thus the present Anadarko is a compound basin with a more complex history than other cratonal basins, such as the Michigan or Illinois or Williston. That the earlier sediments were essentially thickest over the SOA, and that the largest amount of Pennsylvanian uplift occurred coincident with SOA structure, shows that the Early Cambrian history of this rift is crucial in understanding the tectonic and stratigraphic evolution of Oklahoma.

Present mapping of the rock types in the Wichita Mountain area shows 12 granitic units, 3 areas of rhyolite each with somewhat different character, 1 large layered mafic complex, and 5 smaller biotite-bearing gabbroic units. The mineralogic and textural character of these units should and could be utilized to give more detailed provenance analyses of Pennsylvanian and Permian sediments in the Anadarko Basin, and their transportation routes from source to deposition. "Granite Wash," while useful in indicating unroofing of the earlier Paleozoic sedimentary units off the Wichitas, should be analyzed with detailed mineralogy, and in 3-dimensional models, to get maximum benefit from the known basement geology. For example, there are no granites with abundant coarse Ca-plagioclase. When such mineralogy is seen in Granite Wash, it clearly shows derivation from a gabbroic source. Furthermore, because of rapid weathering rates for such feldspars, it shows a rapid erosion and deposition scenario (and thus a high relief--and near in time to deposition, active tectonism). Relatively coarse-grained alkali feldspars can only come from 2 of the mapped granites. Thus provenance and pathways can probably be discerned for some Granite Wash sediments containing such mineralogy. All this argues for the great utility, despite the cost, of getting cores, and looking at cores and cuttings with thin sections.