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GENERALIZED GEOLOGIC MAP OF THE JEROME REGION
YAVAPAI COUNTY, ARIZONA

Precambrian | Paleozoic | Mesozoic | Cenozoic

older gravel | early volcanics | younger sediments (s); late volcanics (v)

GEOLOGY:
Anderson and Creasey, USGS PP 308
Lehner, USGS Bull. 1021-N
Ariz. Bur. Mines, Co. Geol. Maps

5 0 5 10 Miles

CENOZOIC HISTORY OF THE JEROME REGION, YAVAPAI COUNTY, ARIZONA

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INTRODUCTION

The term "Jerome region" is used here to include parts of the Colorado Plateau, the Black Hills, and the Verde Valley in the general vicinity of the town of Jerome, central Arizona. The well-known United Verde and United Verde Extension mines were once operative here. Highway 89A extends through this region, connecting Jerome with Flagstaff to the northeast and Prescott to the southwest.

The Verde River, which is the chief perennial stream in the region, flows in a southeasterly course, and its valley separates the Black Hills from the plateau to the north and east.

The southern margin of the Colorado Plateau in this area is more than 6,400 feet in elevation. It is marked by a great erosional scarp that forms a precipituous cliff, ranging from 1000 to 2000 feet in height, commonly referred to as the Mogollon Rim. The Rim is serrate in outline as a result of youthful streams cutting steep-walled canyons headward into the tableland. At places, segments of the plateau have been severed from the main mass by erosion and form outlying mesas such as Black Mountain.

The plateau consists essentially of nearly flat-lying sedimentary rocks, chiefly Paleozoic, which are covered in part by basic flows. The relatively even surface of the plateau is interrupted locally by volcanic mountains such as the San Francisco and Bill Williams Mountains.

The Black Hills consist of an elongated fault block about twenty miles long and six to twelve miles wide. The range trends northwest, and is characteristic of other ranges in the mountain region of central Arizona where ranges are somewhat parallel and separated by intermontane valleys and basins. Flanking the Black Hills on the east is the Verde Valley, and on the west are Lonesome and Chino Valleys.

Physiographically, the Black Hills have been considered to be within the Basin and Range Province, the Mogollon Rim being commonly used as the boundary separating the two provinces. Although this boundary does separate each province on a physiographic basis, the two provinces are more difficult to differentiate on structural and stratigraphic grounds. Wilson and Moore (1959, p. 79) have delineated a "transitional belt" between the Plateau and the Basin and Range Provinces. This belt includes those mountain ranges within which the strata are relatively flat, although faulted and locally folded. The Black Hills lie within the "transition zone" so defined, insofar as the gently-dipping Paleozoic strata in the northern part of the range extend northward into the plateau, although they are structurally disturbed by many normal faults and deeply eroded by the Verde River.

PRE-CENOZOIC GEOLOGY

Brief mention will be made here of the general geology of the pre-Cenozoic rocks, although the Cenozoic history is the chief concern of this article. The Black Hills are a horst block tilted slightly to the north, so that older rocks are exposed in the southern half of the range, and successively younger rocks occur to the north. The oldest rocks in the region are older Precambrian in age, and are confined mostly to the southern half of the Black Hills and the east flank of the range as far north as Jerome. Between the older Precambrian and the overlying Paleozoic rocks is a strong unconformity.

The basal Paleozoic formation is the Cambrian Tapeats sandstone, which is overlain with apparent conformity by the Devonian Martin limestone. Above the Martin rests the Mississippian Redwall limestone, which in turn is overlain by the Pennsylvanian-Permian Supai formation. All of these Paleozoic formations, plus Tertiary gravel and volcanic rocks, comprise the northern half of the Black Hills.

The Supai formation, although broken and deeply eroded, extends northward from beneath the volcanic capping of the Black Hills to the base of the Colorado Plateau, where the formation characteristically forms the foothills of the Mogollon Rim. Above the Supai is the Permian Coconino sandstone, which forms most of the escarpment. It is overlain successively by the Permian Toroweap and Kaibab limestone formations. Lower Triassic rocks of the Moenkopi formation have been found in the upper part of Sycamore Canyon (Price, 1949), exposed beneath part of the widespread cover of Tertiary volcanic rocks.

UNCONFORMITY AT BASE OF TERTIARY ROCKS

Sedimentary rocks dipping gently to the northeast were truncated by erosion prior to deposition of overlying Tertiary gravels and lavas.

McKee (1951, p. 486) indicated from his regional studies that the Paleozoic formations in the Colorado Plateau formerly extended farther south, based upon their thicknesses and lithologic characters. He also suggested that, except for a thin sheet of early Triassic Moenkopi, probably no other Mesozoic formations were deposited in the area south of the plateau. During late Triassic time, he postulated that the area was a positive element supplying material for the widespread sheet of Shinarump conglomerate in northeastern Arizona. Kelley (1955, p. 82) substantiated this by stating that the southern rim of the Colorado Plateau was slightly tilted northward in middle Triassic time, based on overlap relationships of sediments. Lithologic characteristics of Miocene(?) gravels also indicate a source area to the southeast in a highland above the level of the plateau.

In the Jerome region, the evidence indicates only that during the interval between early Triassic and Tertiary (Miocene?) time the area was most likely positive and undergoing active erosion. During this interval, the strata were tilted to the northeast prior to deposition of the gravel and the earliest flows.

CENOZOIC ROCKS AND STRUCTURE

Cenozoic rocks of sedimentary and volcanic origin are widespread in the area. Age determinations are difficult because of the lack of fossil evidence. Relative ages

are clear enough, however, due to structural, stratigraphic and physiographic relationships, to provide a rather lucid account of the geological events that took place in the Jerome region.

Early Gravels (Miocene?)

As mentioned earlier, there is a profound hiatus between early Triassic and Miocene(?) rocks in this region. The earliest geologic information during Cenozoic time is provided by gravels beneath Pliocene(?) basalt (early volcanics). These gravels appear to be relics of stream deposits confined to north- and northeast-trending channels. The distinctive rock types (Precambrian and Paleozoic) represented in the gravels indicate without doubt that their source was to the south and southwest. Furthermore, they rest on successively younger formations to the north, which indicates that regional tilting took place before their deposition. These gravels have been recognized by several workers (Koons, 1945; Price, 1950; Lehner, 1958) beneath the earliest flows along the plateau. Although no absolute age has been established for them as yet, they are tentatively considered to be late Miocene or early Pliocene.

Early Volcanics (Pliocene?)

The earliest episode of volcanism in the region consisted of widespread eruptions of basalt from many local vents and fissures. Eruption was most likely associated in time with the earliest extensive volcanic activity of the San Francisco centers to the north. The great thickness of flows capping the Black Hills suggests that extrusion was from fissures. The flows extended to the area of the plateau, burying Miocene(?) gravels in their channels. To what extent these flows were contiguous with the lavas poured from the San Francisco centers is not known.

The most extensive study of the lavas on the plateau north of the Jerome region was by Robinson (1913), who recognized three general periods of igneous activity in the San Francisco area. He assigned a late Pliocene age to the earliest flows. Colton (1937) divided the igneous activity of the San Francisco field into five stages. Koons (1945) correlated stages of eruption he recognized in the Uinkaret volcanic field with those postulated by Colton, and stated that the oldest flows antedate cutting of the Grand Canyon. Longwell (1928) suggested that the plateau was uplifted in late Miocene or early Pliocene time, based on the age of the Muddy Creek formation through which the canyon cuts.

Basin and Range Deformation

Following the period of early volcanic activity, the region underwent the strongest orogeny subsequent to Precambrian time as the result of Basin and Range deformation. The structural features are characterized chiefly by north- to northwest-trending normal faults and minor monoclines. Structural features occurring during this orogeny contributed to the major topographic features present today. During this disturbance, the Black Hills block was elevated along boundary faults, the plateau area uplifted relative to the basins and ranges to the south, and the drainage was reversed from a north-flowing to a south-flowing system. Although many of the normal faults extend northward into the plateau, their vertical displacements diminish in that direction.

This episode of structural activity initiated a vigorous cycle of erosion, whereby elevated areas were eroded, and adjoining basins were filled with sediments. Carving of the escarpment of the plateau was initiated at this time.

Middle Volcanics

In the Jerome region, there is evidence of a short episode of volcanic activity during the early part of the erosion cycle that followed Basin and Range deformation. The flows are not shown on the geologic map because of their limited exposure. They may have erupted from a local fissure. Basalt rests on the Supai formation on both sides of Sycamore Canyon at an elevation 500 feet below that of the early basalts overlying Coconino sandstone on Black Mountain. The difference in elevation represents the amount of erosion that took place between the two episodes of extrusion.

There is a possibility that flows of equivalent age are present also on the east and south sides of the Verde Basin.

Pliocene Sedimentation and Late Volcanism

As a result of the considerable amount of crustal disturbance and uplift caused by the Basin and Range orogeny, thick deposits of sediment consisting of clay- to gravel-size material accumulated in the structural troughs.

Sediments accumulated on the east, north, and west sides of the Black Hills, while Sycamore Creek and probably other drainage ways were actively cutting a canyon and supplying sediments to the Verde Basin. During this deposition, volcanic activity was renewed in the region. Lava flowed south along topographic depressions and drainage courses on the plateau and spilled over the rim. The topographic lows were pre-established in large part by Basin and Range faults that extended into the plateau. Lava flowed down Sycamore Canyon and onto the deposits accumulating in the Verde Basin. Lava also flowed apparently from House Mountain, described by Mahard (1949, p. 118) as a shield volcano. He states that lava flows interbedded with the Verde formation can be traced northward toward House Mountain.

On the east side of the Verde Basin, in the Horse Mesa area (T16N, R6E), there is a break in the profile of the plateau rim where lavas appear to have flowed over and down pediment surfaces. The Oak Creek fault cuts the early flows in Oak Creek Canyon, but the fault does not offset the Horse Mesa pediment to the south. These flows are regarded as the late flows because of their relationship to structure and topography. Robinson (1913, p. 20) indicated that flows of the Stage 3 eruption are present in the Morman Mountain area approximately 13 miles northeast of Horse Mesa.

Jenkins (1923) reported that lavas flowed across the southern end of the Verde Basin about six miles south of Camp Verde; damming of the drainage initiated Verde Lake in which was deposited the thick limestone of the Verde formation (also see Twenter, this guidebook). According to Jenkins, the saline deposits in the southern end of the basin indicate that the lake was probably shallow and possessed no outlet.

Deposition of the Verde formation continued after the main period of volcanism. The Verde River developed a meandering course on the surface of the broad, flat basin. Eventually, the limestone and intercalated gravels were apparently built high enough so that the lava dam was breached, which lowered base level and rejuvenated

the drainage. The meanders of the Verde River and its tributaries were incised and superimposed upon underlying structures. Accelerated erosion exhumed the Verde formation in Sycamore Canyon, where vestiges of the lava and gravels are still present.

Some time after, or during, the accumulation of the Verde formation, there was recurrent movement on the Basin and Range faults that displaced beds of the formation.

According to Mr. Paul Wood of the University of Arizona (personal communication), remains of mammoth and horse have been excavated from a gravel lens in the Verde formation lake beds north of Clarkdale by the Museum of Northern Arizona and the Geology Department of the University of Arizona. He reports that teeth from the horse indicate a Pliocene age for the formation, although a Miocene age is not precluded. If this is true, the late volcanics are older than the generally accepted late Pleistocene age.

Quaternary pediment gravels cover large portions of the basin deposits in the Verde and Chino Valleys, although they are dissected as a result of subsequent changes in base level.

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