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Geologic map of the Prescott 30- x 60-minute quadrangle, Arizona

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GEOLOGIC SETTING

The quadrangle is located in the Transition Zone (Peirce, 1984, 1985) between the Colorado Plateau and the Basin and Range physiographic provinces. The map area encompasses about 5,100 sq km (1,970 sq mi) and includes parts of the Prescott National Forest and state, Bureau of Land Management, and private lands.

Three drainage basins are within the map area (fig. 1): those of the Verde, Agua Fria, and Santa Maria Rivers. These basins are separated by the local mountain divides of the Black Hills and the Bradshaw Mountains and, in the western third of the map area, by isolated volcanic and sedimentary plateaus. Elevations range from 2,387 m (7,834 ft) at Mingus Mountain of the Black Hills to 800 m (2,625 ft) on the Santa Maria River in the southwest corner of the map area.

The geologic formations are Proterozoic volcanic, metamorphic, and granitic rocks; Paleozoic shale, sandstone, and limestone; Upper Cretaceous plutons; and Cenozoic gravel and volcanic rock that cover the Proterozoic rocks in most of the southwestern two-thirds of the map area.

Stratified and intrusive rocks of Early Proterozoic age range from 1700 to 1775 Ma in age (Karlstrom and others, 1987, table 1). The stratified rocks in the eastern part of the quadrangle are extensively subdivided, but many problems remain regarding their stratigraphy and structure (DeWitt, 1979; Conway and Karlstrom, 1986; Karlstrom and Conway, 1986; Anderson, in press). For this map, most of the formal Proterozoic stratified units are combined into broad lithostratigraphic units, the Ash Creek and Big Bug Groups (Anderson and others, 1971). These rocks are largely volcanic and volcaniclastic, derived from oceanic island arcs (Anderson, 1986; Condie, 1986), and they have been multiply deformed and metamorphosed to greenschist and locally to amphibolite facies (Karlstrom and Conway, 1986). Pretectonic to posttectonic plutons of Early Proterozoic age, largely granodioritic, are more voluminous than the stratified rocks of the same age. In the Jerome-Prescott area, many of these plutons have been formally named (Anderson and others, 1971), and these names are retained here.

Rocks of Early Proterozoic age exposed in the west half of the quadrangle are not well known. Their contacts and unit designations are highly preliminary. Stratified rocks probably are proportionally much less abundant in the western part of the map area than in the eastern part, and they may be generally more highly metamorphosed. Migmatite terranes (schist and granite or pegmatite dikes) are found only in the western part of the quadrangle, and here also is a wide variety of granitic plutonic rocks but apparently little mafic plutonic rock. Both foliated and nonfoliated plutonic rocks are present in the western part.

The only unit of known Middle Proterozoic age in the quadrangle is the Dells Granite near Prescott (Krieger, 1965); its age is 1400 ± 10 Ma (Silver and others, 1982). Several coarse-grained porphyritic bodies in the quadrangle are petrographically similar to other granites throughout Arizona that have been dated at 1400-1450 Ma (Silver and others, 1977). However, compositional character and local shear zones suggest that some of these granites are probably of Early Proterozoic age (DeWitt, in press).

Basal Paleozoic rocks were deposited unconformably on a surface of low relief, although hills as high as 122 m (400 ft) were scattered above this surface (Hereford, 1975). The Colorado Plateau (in the extreme northeastern part of the map area) is characterized by nearly flat lying Paleozoic rocks capped locally by Cenozoic basalt flows, which form a high tableland dissected by tributaries of the Verde River. Paleozoic rocks are exposed in canyons of the upper Verde River drainage and as isolated outcrops in the Black Hills and Juniper Mountains (fig. 1). Cambrian rocks consist of coarse-grained, brown sandstone of the Tapeats Sandstone and fine-grained, pale-green shale and siltstone and brown sandstone of the Bright Angel Shale. The Cambrian rocks are as much as 61 m (200 ft) thick but have locally been removed by post-Paleozoic erosion. An erosional unconformity separates them from the overlying Devonian Chino Valley Formation and Martin Limestone. The Chino Valley Formation is locally confined to the Chino Valley area and is commonly discontinuous, whereas the Martin Limestone is thicker and more widespread, thus a more mappable unit. Therefore, the Chino Valley is included with the Martin Limestone in this quadrangle. The Chino Valley rocks are thin-bedded, silty, gray dolomites and maroon or purple shales and sandstones (Hereford, 1975, 1977). The overlying Martin Limestone is impure dolomite and dolomitic limestone with thin interbeds of shale and mudstone; it is 0 to 143 m (0 to 470 ft) thick. An erosional unconformity separates the Devonian rocks from the Redwall Limestone of Mississippian age. The Redwall in this region is light-gray, coarsely crystalline, cliff-forming limestone with several white chert lenses. Its average thickness is 76 m (250 ft). The overlying sequence of red sandstone and siltstone of the Lower Member of the Supai Formation averages 122 m (400 ft) in thickness. An arbitrary boundary separates this Pennsylvanian member from overlying Permian members of the Supai: the slope-forming red sandstones and siltstones of the Middle and Upper Members total 366 m (1,200 ft) in thickness. Other Permian rocks are the cliff-forming, buff to white Coconino Sandstone, about 152 to 198 m (500 to 650 ft) thick; the ledge-forming, yellowish-gray limestone and sandstone of the Toroweap Formation, averaging about 46 m (150 ft) thick; and the cliff-forming, light-gray limestone of the Kaibab Formation, as much as 76 m (250 ft) thick. The unconformities separating the last three units are erosional.

Rocks of early Tertiary and (or) Late Cretaceous age are found in the Copper Basin area (fig. 1), where they are tentatively assigned a Late Cretaceous age by Johnson and Lowell (1961) and Krieger (1967 a, b, c). The rocks are mainly quartz monzonite and related rocks.

Thicknesses of the oldest Cenozoic deposits are varied and mostly unknown. Cenozoic basalt flows and gravel were originally local valley-fill deposits that now cap small isolated hills, higher mesas, and plateaus throughout the map area. Lacustrine and fluvial deposits of the Tertiary Verde (Jenkins, 1923) and Perkinsville Formations (Lehner, 1958) fill major valleys in the northeastern map area. The Verde and Perkinsville Formations are tentatively considered equivalent and the mapped Verde includes the Perkinsville. The Hickey Formation of Pliocene(?) and Miocene age is mapped with undivided volcanic rocks (Anderson and Creasey, 1958). The Hickey consists of coarse fluvial materials overlain by and interbedded with several basalt flows of variable thickness. Similar deposits of fluvial and lacustrine sediments, mostly coarse materials, fill valley basins southeast and southwest of Prescott; in many places these deposits are capped by thick andesite or basalt flows. In the western third of the map area, several andesite and dacite flows are interbedded with fluvial deposits that are associated with andesite and dacite domes and breccia tuffs. These deposits may be as old as Paleocene(?) or Eocene; most were locally derived from Proterozoic rocks that were exposed, probably in Late Cretaceous time, throughout most of the southwest half of the map area.

STRUCTURAL GEOLOGY

In Miocene time, the southwestern margin of the Colorado Plateau and the Transition Zone were strucurally and topographically differentiated from the Basin and Range Province southwest of the map area (Young and Brennan, 1974). Prior to this differentiation, Mesozoic and Laramide uplift had resulted in northeastward tilting of the region including these areas. Large volumes of Cretaceous and older rocks were stripped from the entire map area between Late Cretaceous and Oligocene times, and the detritus was transported north and northeastward onto the Colorado Plateau (Young, 1982).

The major Proterozoic structures in the quadrangle are north- to northeast-trending faults, shear zones, and folds. (Some folds in the northern Black Hills area trend northwest.) The principal structural discontinuities are the north-trending Shylock fault zone, the northeast-trending Chaparral fault (both in the southeastern part of the quadrangle), and a fault trending north-northeast on the west side of Granite Mountain, herein named the Granite Mountain fault. The Shylock structure is a zone about 1 mi (1.6 km) wide of probable high strain; it may be characterized more by isoclinal folding than by faulting. Steep lineations throughout the zone indicate that motion has been primarily vertical (Winn, 1982); however, south of the quadrangle, the Shylock fault zone contains late minor sinistral mylonite zones (Darrach and others, 1986). Anderson (1967) argued for 5 miles (8.1 km) of dextral offset on the basis of apparent offset of quartz diorite in the Prescott quadrangle. The Chaparral fault has an unknown amount of dextral offset. The Granite Mountain fault juxtaposes contrasting rock types over many miles, suggesting a large offset, but the amount is unknown. No kinematic work has been done on this fault, but a northeastward projection of it onto the Colorado Plateau would closely coincide with the Phanerozoic Mesa Butte fault (Shoemaker and others, 1978).

The Mesa Butte fault may be one of the best examples in Arizona of Phanerozoic reactivation of a Proterozoic fault. However, the major Tertiary faults in the quadrangle, most of which trend northwesterly, do not appear to have a Proterozoic heritage. Recent detailed mapping of the Verde fault in the Jerome area (Lindberg, 1986) has shown no evidence of an Early Proterozoic fault episode, as postulated by Anderson and Creasey (1958).

Paleozoic and younger rocks are deformed by north- and northwest-trending Laramide monoclines and younger faults. The monoclines are cored by reverse faults superposed by late Cenozoic normal faulting. The Laramide monoclines are crustal-shortening features that generally overlie reactivated Proterozoic normal faults along which the sense of motion was reversed during Laramide compression. Perhaps thousands of feet of Mesozoic and Paleozoic rocks still blanketed the region during the Laramide deformation (Huntoon, 1974). The principal late Cenozoic normal faults, such as those in the upper Chino Valley and the Verde Valley areas, follow reactivated north- and northwest-trending Proterozoic faults and have resulted in the development of extensional basins.

Cenozoic faulting in the map area appears to have commenced after deposition of early Tertiary conglomerate and Miocene volcanic rocks. Cenozoic northeast-southwest extension in the Verde Valley area produced several normal faults where offsets are as great as about 1,500 ft (457.2 m). These post-Laramide faults extend for greater distances along strike than the original monoclines, resulting in intersecting normal faults and grabens that trend north, northeast, and northwest. All Cenozoic units are faulted. Faults in Pleistocene(?) and Holocene(?) alluvium in the upper Chino Valley have displacements of as much as 12 ft (3.7 m).

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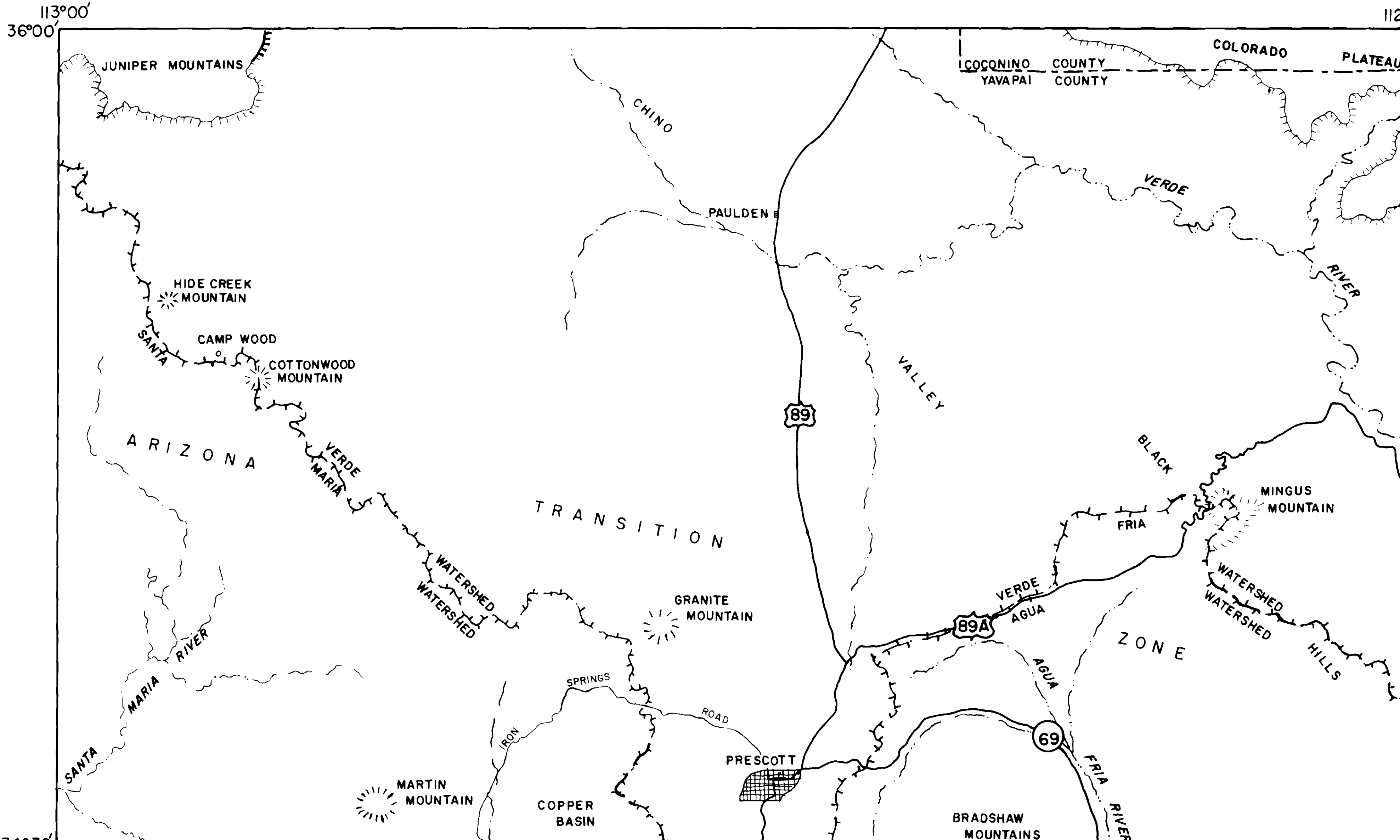

Figure 1. Geographic map of the Prescott 30 X 60 minute quadrangle, Arizona