GEOLOGIC MAP OF THE NORTHEASTERN HIEROGLYPHIC MOUNTAINS, CENTRAL ARIZORA

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INTRODUCTION

This report presents a preliminary 1:24,000-scale geologic map of the northeastern Hieroglyphic Mountains in central Arizona. The mapping, completed between January and June, 1986, was jointly funded by the U. S. Geological Survey and the Arizona Bureau of Geology and Mineral Technology as part of the cost-sharing, Cooperative Geologic Mapping Program (COGEOMAP). The aim of COGEOMAP is to produce high-quality geologic maps for areas that have been inadequately mapped and that have high mineral resource or natural hazard potential.

The mapping was done on 1:24,000-scale topographic maps and on 1:24,000-scale color aerial photographs provided by Raymond A. Brady, U. S. Bureau of Land Management, Phoenix.

GEOLOGIC OVERVIEW

The Hieroglyphic Mountains are composed of a metamorphic-plutonic basement that is overlain by middle Tertiary volcanic and sedimentary rocks. The oldest rocks in the range are Proterozoic schist, gneiss, metasedimentary and metavolcanic rocks, and several generations of plutonic rocks. These rocks are intruded by a small granite pluton that is similar in mineralogy to the Late Cretaceous Wickenburg batholith of the Vulture and Big Horn Mountains (Rehrig and others, 1980; Capps and others, 1985). The entire basement assemblage is cut by numerous felsic to mafic dikes, most of which are inferred to be middle Tertiary in age.

The crystalline rocks are commonly overlain by a thin sequence of pre-20 Ma Tertiary sandstone and conglomerate. These clastic rocks are generally too thin to map separately from the overlying volcanic units.

The Miocene (20 to 16 Ma) volcanic rocks consist of a complex sequence of basalt and andesite flows, latite and rhyolite flows and lithic tuffs, and lesser amounts of volcaniclastic rocks. Basalts are interlayered with areally restricted rhyolite flows and associated lithic tuffs. Stratigraphic relationships and differences in phenocryst assemblages in the rhyolites and latites have been used to designate informal units, each of which probably represents multiple extrusions from one or more vents within discrete eruptive centers.

Low- to high-angle normal faulting and rotation of the volcanic rocks and subjacent crystalline basement occurred soon after the extrusion of the youngest volcanics at 16 Ma. Most normal faults trend north-northwest and are associated with north- and northeast-trending faults that locally accommodated differential rotation or strike-slip displacement. Most northwest-striking faults dip southwest and most beds dip northeast.

The volcanic rocks are overlain by conformable to unconformable coarse fanglomerate and landslide-related megabreccia deposited in the larger half-grabens. Tilting continued during deposition of these deposits because they typically grade upward into conformable to locally unconformable, more gently dipping sandstone and siltstone. Essentially flat-lying basalts probably equivalent to the 14- to 15-m.y.-old Hickey Formation occur adjacent to the map area along the eastern shore of Lake Pleasant.

Argillic and silicic alteration locally occurs in both Tertiary and pre-Tertiary rocks and is most intense in the Cedar Basin area. Precious- and base-metal mineralization also occurs in the crystalline basement and in overlying Tertiary volcanic rocks.

UNIT DESCRIPTIONS

Qs **YOUNGER ALLUVIUM (HOLOCENE)** -- Unconsolidated sand and gravel in modern channels or on low-lying terraces adjacent to these channels.

Qt **UNCONSOLIDATED TALUS (HOLOCENE)** -- Unconsolidated, poorly sorted, angular talus that generally flanks high topography.

Qso **MID-LEVEL ALLUVIUM (HOLOCENE)** -- Unconsolidated gravel-poor sand and sandy gravel deposits in flood plains elevated 0.5 to 2 m above the modern channels. Deposits typically host mature mesquite trees.

QTs **OLDER ALLUVIUM (LATE MIOCENE? TO HOLOCENE)** -- Unconsolidated to semiconsolidated and caliche-cemented sand and gravel deposits that commonly underlie dissected terraces elevated 2 m or more above modern drainages. The deposits are being incised by the present drainages and host palo verde trees, saguaro, and other cacti.

CALCITE VEINS (MIOCENE?) -- Very pale-gray, pinkish-white, and dark-gray massive calcite veins. The calcite veins are generally steeply dipping, are less than 15 cm to more than 2 m wide, and cut Tertiary fanglomerate and volcanics. Zoned dog-toothed calcite crystals as long as 6 cm occur in cavities within these veins. The thickest veins occur near Cow Creek and near the Lake Pleasant dam.

Tqz **CHALCEDONIC QUARTZ, COMMON OPAL, AND INTENSELY SILICIFIED ROCKS (MIOCENE?)** -- Light-gray, pinkish-white, and light-tan, very fine- grained chalcedonic quartz, common opal, silica-cemented phreatic breccia, and intensely silicified rocks. These siliceous rocks contain significant amounts of pyrite and rare galena and are associated with zones of incipient to very strong argillic alteration. Bedded deposits of phreatic breccia are less than 4 m thick and are spatially associated with paleo-hydrothermal vents. These rocks fill a northwest-oriented, high-angle structure between Little Hells Gate and Big Hells Gate and occur on hill tops in the Cedar Basin area.

Tpd PEBBLE DIKES (MIOCENE) -- Anastomosing network of dikes containing heterogenous angular clasts of Proterozoic metamorphic rocks and Tertiary basalt and latite in a medium-reddish-brown sand sized matrix. The dikes are 5 to 30 cm wide and the principle zone strikes N 20° W for at least 100m. The dikes cut an outcrop of crudely bedded Hells Gate latite volcanic breccia about 1.5 km south of Cedar Basin.

Tf FANGLOMERATE (MIDDLE MIOCENE) -- Consolidated to semiconsolidated fanglomerate, and conglomerate, sandstone, and siltstone with a discontinuous thin cover of QTs. Moderately tilted, coarse, consolidated fanglomerate and laharic breccia in the lower parts of the section are generally conformable to slightly unconformable on Tertiary volcanic rocks and commonly grade upward into less consolidated finer-grained conglomerate, sandstone, and siltstone. Stratigraphically higher units in the southern part of the map area are unconformable over the volcanic rocks. This unit was commonly deposited across rugged topography and locally overstepped fault scarps. Paleocurrent direction, as inferred from pebble imbrication, is indicated directly on map.

Tfs SILTSTONE AND SANDSTONE FACIES -- Moderately tilted, consolidated to semiconsolidated siltstone and sandstone associated with fanglomerate. This facies occurs in stratigraphically higher levels within the fanglomerate near Lake Pleasant, but locally occupies the basal part of the fanglomerate section northwest of the lake.

Tbx **MEGABRECCIA AND SEDIMENTARY BRECCIA; PROTOLITH OF BRECCIA IN PARENTHESES WHERE KNOWN (MIDDLE MIOCENE)** -- Shattered landslide blocks (megabreccia) derived from various older rock units. Megabreccia is locally associated with monolithologic and polylithologic sedimentary breccia.

MIOCENE VOLCANIC AND SEDIMENTARY ROCKS

The volcanic rocks overlie basal Tertiary clastic rocks and the crystalline basement, underlie the fanglomerate and megabreccia, and are 20 to 16 m.y. old (Kortemeier and others, 1986; Scarborough and Wilt, 1979). The lower part of the volcanic section is composed of two multiple-flow rhyolite units intercalated with phenocryst-rich basalt, phenocryst-poor basalt, andesite flows, tuff, and volcaniclastic sedimentary rocks. Overlying these rocks is a sequence of highly porphyritic latite flows, flow breccia, debris flows, volcanic breccia, and tuff. The volcanics have been subdivided into the following informal units (from youngest to oldest):

(1) Hells Gate latite

(2) Castle Creek volcanics

(3) Spring Valley rhyolite ----]
 ]--interbedded--(5) Basalts and andesites
(4) Morgan City rhyolite ----]

The two lower rhyolites (numbers 3 - 4) may be partly time equivalent and are both interbedded with basalt and andesite.

The rhyolite flows are underlain and overlain by lithic tuffs that are moderately to poorly welded and contain abundant accessory and accidental lithics. These tuffs are much more extensive than the associated rhyolite flows and represent phreatic and phreatomagmatic base-surge deposits and minor air fall. Some tuffs exhibit low-angle cross-bedding structures and others contain accessory lithics as large as 6 m.

The rhyolite and latite flows and tuffs are ridge-and-cliff formers, whereas the more easily eroded basalts and poorly welded tuffs form valleys and hummocky terrain. Abundant section-repeating normal faults and post-volcanic erosion make estimation of the total thickness of the volcanic section difficult. There are about 520 m of Tertiary volcanic rocks in the fault-bounded, but most complete, section near Garfias Wash.

Abundant hypabyssal rhyolite dikes intrude the prevolcanic basement and Tertiary volcanics and commonly have phenocryst assemblages similar to those in the adjacent and overlying volcanics. Some of the dikes probably represent conduits for the volcanics.

Th **HELLS GATE LATITE** — Medium-gray, light-purplish-gray, medium- to dark-brown and light-grayish-pink porphyritic latite flows, flow breccia, debris flows, lahars, volcanic breccia, and lithic tuff. Very dark-gray porphyritic vitrophyres are locally abundant. Flows contain 25 to 55 percent phenocrysts (0.5 to 35 mm diameter), including 20 to 40 percent oligoclase megacrysts, 5 to 10 percent biotite, a trace to 8 percent hornblende, 1 to 3 percent opaques, a trace to 3 percent pyroxene, and a trace of quartz phenocrysts. The oligoclase (An-12 to An-20) megacrysts and phenocrysts are subhedral to euhedral, are a maximum of 3.5 cm length, and contain inclusions of glass, acicular apatite, zircon, and opaques. Optically zoned oligoclase phenocrysts are essentially the same composition from core to rim (Ward, 1977). Biotite phenocrysts are largely euhedral books, and opaques are euhedral and subhedral. Some flows contain brown euhedral hornblende phenocrysts as large as 1 cm in length and 3 mm in width. Medium-green augite phenocrysts generally occur as 2 to 4 mm cumulophyric inclusions associated with opaques. Rare quartz phenocrysts are highly embayed. Weakly trachytic, devitrified groundmass is composed of plagioclase laths and several percent opaques. Vitric groundmass contains numerous incipient crystallization forms of plagioclase and cristobalite, including microlites, crystallites, and rare spherulites. The younger latite flows are generally more porphyritic than the older flows. The extremely high phenocryst content and major element chemistry of the flows suggest a very high effective viscosity (McBirney and Murase, 1984). Mafic inclusions in the flows conform to the flow structures in the latite and were plastic (molten?) during emplacement. Zones of incipient to very strong argillic and silicic alteration are most abundant in the Cedar Basin area.

The unit unconformably overlies Proterozoic basement and conformably overlies Tertiary basalt and andesite, Castle Creek volcanics, and Spring Valley and Morgan City rhyolite flows and tuffs. Hells Gate latite is the top volcanic unit in the map area and is overlain with small to moderate angular unconformity by Tertiary fanglomerates with a general lack of obvious paleosols along the contact. Hells Gate latite flows are at least 480 m thick on the unnamed mountain along the northern flank of Burro Flats. A K-Ar biotite age for this unit near Castle Creek is 16.1 $\pm$ 0.5 Ma. (Kortemeier and others, 1986). A biotite age of 17.98 $\pm$ 0.43 was obtained from a probable Hells Gate flow in the Buckhorn Mountains, north of the map area (Shafiqullah and others, 1980).

Thd UNDIFFERENTIATED DEBRIS FLOWS, LAHARS, AND VOLCANIC BRECCIA -- Medium-reddish brown, medium-grayish-brown, dark-brown, and light-grayish-pink, debris flows, lahars, and volcanic breccia. Clasts are from Hells Gate flows and tuffs, Tertiary basalt and andesite, Spring Valley and Morgan City rhyolites, and Proterozoic metamorphic and intrusive rocks. Southwest of Squaw Mesa, the stratigraphically lowest debris flows typically contain abundant basalt clasts. Proterozoic clasts dominate this unit north of Big Hells Gate, where brecciated rafted blocks of Tertiary basalt larger than 30 m diameter also occur. The thickness of this unit is greater than 150 m near Big Hells Gate. Clasts in associated volcanic breccias are mainly cognate lithics of Hells Gate flows.

Thb **VOLCANIC BRECCIA** -- Light-purplish-gray, medium-gray, and light-grayish-pink, poorly sorted, and crudely bedded volcanic breccia. The clasts are angular to subrounded and composed of Hells Gate latite flows. They average about 15 cm diameter, but clasts as large as 4 m diameter are present near Cow Creek. Volcanic breccia in Crater Canyon and south of Cedar Basin is crudely bedded and contains some tuff. These rocks are probably massive crumble breccia marginal to very thick flows or domes.

Thfb **FLOW BRECCIA** -- Angular autobreccia associated with Hells Gate latite flows. The maximum diameter of the clasts is about 3 meters.

Th_2 **YOUNGER HIGHLY PORPHYRITIC LATITE FLOWS** -- Medium- to dark-gray, medium-reddish brown, and light-grayish-pink, highly porphyritic latite flows. These flows contain 30 to 50 percent phenocrysts (See general description above).

Tht **LITHIC TUFF** -- Medium-gray, pinkish-white, light-grayish-pink, and light- to medium-brown, poorly sorted lithic tuff. The dominant clasts are angular cognate lithics of Hells Gate latite although lithics of Spring Valley rhyolite, Tertiary basalt and andesite, and Proterozoic intrusive and metamorphic rocks are also locally present.

OLDER PORPHYRITIC LATITE FLOWS -- Medium-gray, light-grayish-purple, medium-brown, and light-grayish-pink, porphyritic latite flows. Flows contain 25 to 35 percent phenocrysts (See general description above).

Tcc **CASTLE CREEK VOLCANICS** -- Dark-greenish-gray, and mottled dark- and medium-gray, dense, porphyritic andesite flows and minor flow breccia. A phenocryst-poor, nonpersistant basal zone is commonly light-yellowish-brown on weathered surfaces. Flows contain 1 to 10 percent phenocrysts (less than 0.5 to 3 mm) including 2 to 6 percent plagioclase, 1 to 3 percent clinopyroxene, a trace to 1 percent biotite, a trace to 2 percent quartz, and trace amounts of oxyhornblende. Opaques are present in the groundmass. The pilotaxitic and weakly trachytic, coarse-grained groundmass textures include plagioclase crystals as large as 0.25 mm. Some clinopyroxene phenocrysts are twinned. Quartz phenocrysts are rounded and embayed.

This unit conformably overlies Tertiary basalt, andesite, undifferentiated tuff, and basal sandstone and conglomerate. Near French Creek, the Castle Creek volcanics rest unconformably on Proterozoic rocks. In the Governors Peak area, the unit is conformably overlain by a thin basalt flow and by Hells Gate latite. Castle Creek volcanics are as much as 200 m thick near Castle Creek, but they are more typically less than 90 m thick.

Ts **SPRING VALLEY RHYOLITE** -- Mottled, light-pink, light-pinkish-gray, and light-gray, weakly to moderately porphyritic, flow-foliated rhyolite flows and minor flow breccia. Dark- to medium-gray and light-mottled-greenish-gray porphyritic vitrophyre is locally abundant. Flows contain 3 to 10 percent phenocrysts (3 to 0.1 mm), including 2 to 5 percent plagioclase and sanidine, 1 to 3 percent quartz, less than 1 percent hornblende, and trace amounts of sphene, cristobalite, and apatite. Most large plagioclase phenocrysts have disequilibrium coronas. Euhedral cristobalite crystals occur in gas cavities and as crystallites in the vitric groundmass. Acicular apatite crystals less than 1 mm long and gas-bubble trains are locally abundant. Opaques occur in trace amounts. Plastically deformed mafic inclusions as large as 5 cm diameter occur in some flows.

The unit unconformably overlies Proterozoic basement and Cretaceous granitic rocks, and conformably overlies cogenetic Spring Valley tuff and Tertiary basalt and andesite. Spring Valley rhyolite is conformably overlain by Tertiary basalt and andesite, Spring Valley rhyolite tuff, and Hells Gate latite. Flows are overlain with some angular unconformity by Tertiary fanglomerate. The remnant of a rhyolite dome at Spring Valley is at least 360 m thick. A K-Ar whole-rock date from a vitrophyre near Garfias Wash is 18.7 ± 0.6 Ma (Kortemeier and others, 1986).

Tst LITHIC TUFF AND TUFFACEOUS SEDIMENTARY ROCK -- Light-yellowish-brown, pinkish-white, light-pinkish-gray, and light-pinkish-brown, poorly to moderately welded, lithic rhyolite tuff that contains accidental and accessory lithics, and locally abundant pumice. The phenocryst assemblage is the same as the associated rhyolite flows. Most of these tuffs are weakly to moderately altered to clay and zeolite minerals. Minor poorly-indurated volcaniclastic sedimentary rocks are associated with the tuffs.

The tuffs are nonpersistant and occur both stratigraphically above and below the rhyolite flows. The Spring Valley rhyolite tuff is as much as 180 m thick on the eastern side of Garfias Wash.

Tt **UNDIFFERENTIATED LITHIC RHYOLITE TUFFS AND TUFFACEOUS SEDIMENTARY ROCKS** -- Light-pinkish-gray, light-tan, and light-pinkish-brown poorly to moderately welded, phenocryst-poor, lithic rhyolite tuff and poorly indurated tuffaceous sedimentary rocks. The lithics range in size from less than 3 cm to about 6 m and are principally fragments of Tertiary volcanic rocks and Precambrian metamorphic and intrusive rocks. The largest lithics occur near Cow Creek. The tuffs are at least 200 m thick in the Burro Flats area. These tuffs are associated with and probably genetically related to Spring Valley rhyolite and Morgan City rhyolites.

The tuffs unconformably overlie Proterozoic schist and are conformably overlain by Tertiary basalt, Castle Creek volcanics, and Hells Gate latite. Tertiary fanglomerate overlie the tuffs with some angular unconformity.

Tmc **MORGAN CITY RHYOLITE** -- Light- to medium-gray, medium-pinkish-gray, and medium-grayish-brown, dense, moderately flow-foliated, porphyritic rhyolite flows and flow breccia. Flows contain 5 to 12 percent phenocrysts (less than 1 to 3 mm) including, 1 to 5 percent plagioclase, a trace to 2 percent quartz, 2 to 5 percent biotite, and 1 to 3 percent opaques. The microgranophyric groundmass texture is composed of quartz and feldspar laths. Plagioclase, biotite, and opaque phenocrysts are both euhedral and subhedral, and quartz is generally subhedral. Biotite phenocrysts are strongly aligned with the flow foliation. Oligoclase (An-13 to An-18) is the most common plagioclase present and most large phenocrysts are optically zoned.

The unit conformably overlies Tertiary basalt and andesite, undifferentiated tuff, and volcaniclastic sedimentary rocks. Conformably overlying the Morgan City rhyolite are Tertiary basalt and andesite, undifferentiated lithic tuff, Spring Valley rhyolite tuff, and Hells Gate latite. The Morgan City rhyolite is 240 m thick at Pikes Peak.

Tb **UNDIFFERENTIATED BASALT AND ANDESITE** -- Very-dark- to medium-gray, pinkish- to reddish-brown, and pinkish-gray, vesicular, amygdaloidal, locally scoriaceous, locally porphyritic, trachytic to pilotaxitic basalt, basalt-derived sedimentary rocks, and andesite flows. Porphyritic flows contain 2 to 12 percent phenocrysts of augite, olivine, and plagioclase. The fine-grained groundmass is composed of about 53 percent plagioclase, 10 percent olivine, 29 percent augite, and 8 percent magnetite (Ward, 1977). Groundmass olivine is typically altered to secondary minerals. Ward (1977) indicates that many of the augite phenocrysts exhibit hourglass zoning. Scoriaceous beds 0.4 to 6 m thick and associated abundant bombs occur near former cinder cones. The bombs are mostly spindle shaped (bipolar fusiform) and are as large as 1.5 m long and 0.3 m wide. Scoria fragments seldom exceed 2.5 cm in diameter. Basal flows are typically highly fractured and incipiently to moderately altered. Secondary quartz, calcite, and rare fluorite are locally present as fracture fillings.

The basalts are intercalated with quartz-bearing and quartz-free andesitic rocks, Spring Valley rhyolite, Morgan City rhyolite, and associated lithic tuff, and Castle Creek volcanics. The unit unconformably overlies Proterozoic metamorphic and intrusive rocks and Cretaceous granitic rocks, and conformably overlies the basal Tertiary sandstone and conglomerate. Basalt and andesite are conformably overlain by Hells Gate latite and an angular unconformity locally exists between this unit and Tertiary fanglomerate. The sequence of basalt and andesite is at least 280 m thick at Baldy Mountain and about 120 m thick along the east side of Garfias Wash. A K-Ar whole rock age date of 16.63 ± 0.35 Ma was obtained from a sample taken along the west side of Lake Pleasant (Scarborough and Wilt, 1979).

Tbq QUARTZ-BEARING ANDESITIC ROCKS -- Mottled, medium-pinkish-gray, poorly porphyritic, fine-to medium-grained, dense rocks with abundant liesegang banding. Flows contain phenocrysts (1 to 3 percent) of biotite, amphibole, pyroxene, and quartz. The mafics are generally altered.

Opaques are abundant in a micrographophyric groundmass. Rare quartz phenocrysts up to 3 mm diameter are anhedral and subrounded. A sample taken from Burro Flats is K-metasomatised. These rocks are complexly intercalated within the lower basalts and andesites.

Tc **BASAL SANDSTONE AND CONGLOMERATE (OLIGOCENE - EARLY MIOCENE?)** -- Reddish-brown to greenish-gray coarse sandstone, conglomerate, and minor laharic breccia. Clasts are of Precambrian metamorphic and intrusive rocks and rare basalt. These clastic rocks are typically about 1 m thick, but are locally 12 m thick near the microwave tower beside the Castle Hot Springs Road. They are strongly silicified at this locality, but are generally more poorly indurated. This unit nonconformably overlies Precambrian metamorphic and intrusive rocks and is overlain conformably by Tertiary basalt, Castle Creek volcanics, and Hells Gate latite. Large outcrop areas occur in the adjacent Buckhorn Mountains.

MIOCENE (?) INTRUSIVE ROCKS

Tia **APHYRIC RHYOLITE INTRUSIONS** -- Light-pink and light-gray, fine-grained rhyolite intrusions with rare quartz, biotite, and feldspar phenocrysts.

Tif **FELDSPAR-RICH LATITE INTRUSIONS** -- Light-pinkish-gray, light-yellowish-brown, and light-greenish-gray fine-grained latitic intrusions. These intrusions contain 15 to 35 percent phenocrysts (less than 2 mm to 2.5 cm diameter) including, 15 to 20 percent zoned plagioclase, less than 1 to 2 percent biotite, and a trace to 2 percent quartz. Euhedral and anhedral opaques are present in the granophyric groundmass. Many of the intrusions are K-metasomatised.

These rocks intrude and locally contain pendants of Precambrian basement and Tertiary clastic and volcanic rocks. Most of the latitic intrusions occur in the west-central map area.

Tim **MAFIC AND INTERMEDIATE INTRUSIONS** — Aphanitic to medium-grained basaltic, andesitic, and dioritic dikes that generally are extensively weathered and poorly exposed.

UNDIFFERENTIATED FELDSPAR-RICH LATITE INTRUSIONS -- Narrow, porphyritic, fine-grained latite intrusions.

UNDIFFERENTIATED INTERMEDIATE INTRUSIONS — Aphanitic to medium-grained intrusions of probable rhyodacitic to andesitic composition.

UNDIFFERENTIATED MAFIC INTRUSIONS — Dark-colored intrusions of aphanitic basalt and fine- to medium-grained diorite.

PRE-TERTIARY ROCK UNITS

Kg **GRANITE (LATE CRETACEOUS?)** — Light- to moderate-gray, coarse- to medium-grained granite averaging 30 to 40 percent orthoclase, 10 to 15 percent plagioclase, 10 to 15 percent quartz, 3 to 5 percent biotite and muscovite, 1 to 2 percent magnetite, 1 to 3 percent anhedral opaques, and a trace to 5 percent sphene, zircon and other accessory minerals. A sample taken from Spring Valley yielded a 129 m.y. K-Ar paragonite (0.6 percent K) age of uncertain significance (Shafiqullah and others, 1980).

QUARTZ VEINS (PROTEROZOIC) — White and very-light-pinkish-gray, massive quartz occurring in Proterozoic metamorphic and intrusive rocks and generally conforming to principal schistosity. The quartz is as much as 6 m wide and extends along strike for greater than 500 m.

Xg **GRANITE (EARLY PROTEROZOIC)** — Medium- to coarse-grained equigranular granite with several percent amphibole and biotite. Granite occurs in the west-central Morgan City Wash area.

Xgb **GABBRO (EARLY PROTEROZOIC)** — Dark-greenish-gray gabbro with abundant pyroxene phenocrysts and lesser amounts of opaques and feldspar. These thin layers within the Proterozoic schists and gneisses generally conform to the principal schistosity.

Xal **ALASKITE, TOURMALINE-BEARING GRANITE, AND PEGMATITE (EARLY PROTEROZOIC?)** — Very coarsely crystalline, leucocratic, weakly-foliated intrusive rocks. Quartz, microcline feldspar, muscovite and locally abundant euhedral schorl tourmaline are the principal components. Minor magnetite and anhedral opaques are present in some outcrops. Muscovite locally comprises 15 percent of the alaskite. The alaskite occurs both as large pods within the enclosing schists as well as narrow, unmapped bodies that conform to the principal schistosity.

Xbif **BANDED IRON FORMATION (EARLY PROTEROZOIC)** — Banded dark-brown and very-light- to dark-gray hematitic quartz and chert. Principal outcrops strike northeast and are southwest of Mòrgan City Wash, near the Pikes Peak iron deposit. Recrystallized carbonate and other metasedimentary rocks are associated with this unit in the southern part of the map area.

Xs **SCHIST, PHYLLITE, GNEISS, AND METAMORPHIC ROCKS (EARLY PROTEROZOIC)** — Light- to medium-silvery-gray, greenish-gray, brown, and dark-gray, foliated, micaceous and chloritic schist, phyllite, quartz and feldspar schist and gneiss, and other metasedimentary and metavolcanic rocks. Garnet and hornblende are locally abundant in the schist. These rocks are part of the Proterozoic Yavapai Supergroup with an age of approximately 1.8 Ga.

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