

**GEOLOGIC MAP OF THE  
CENTRAL GILA BEND  
MOUNTAINS,  
WEST-CENTRAL ARIZONA**

by  
Elizabeth A. Scott

Arizona Geological Survey  
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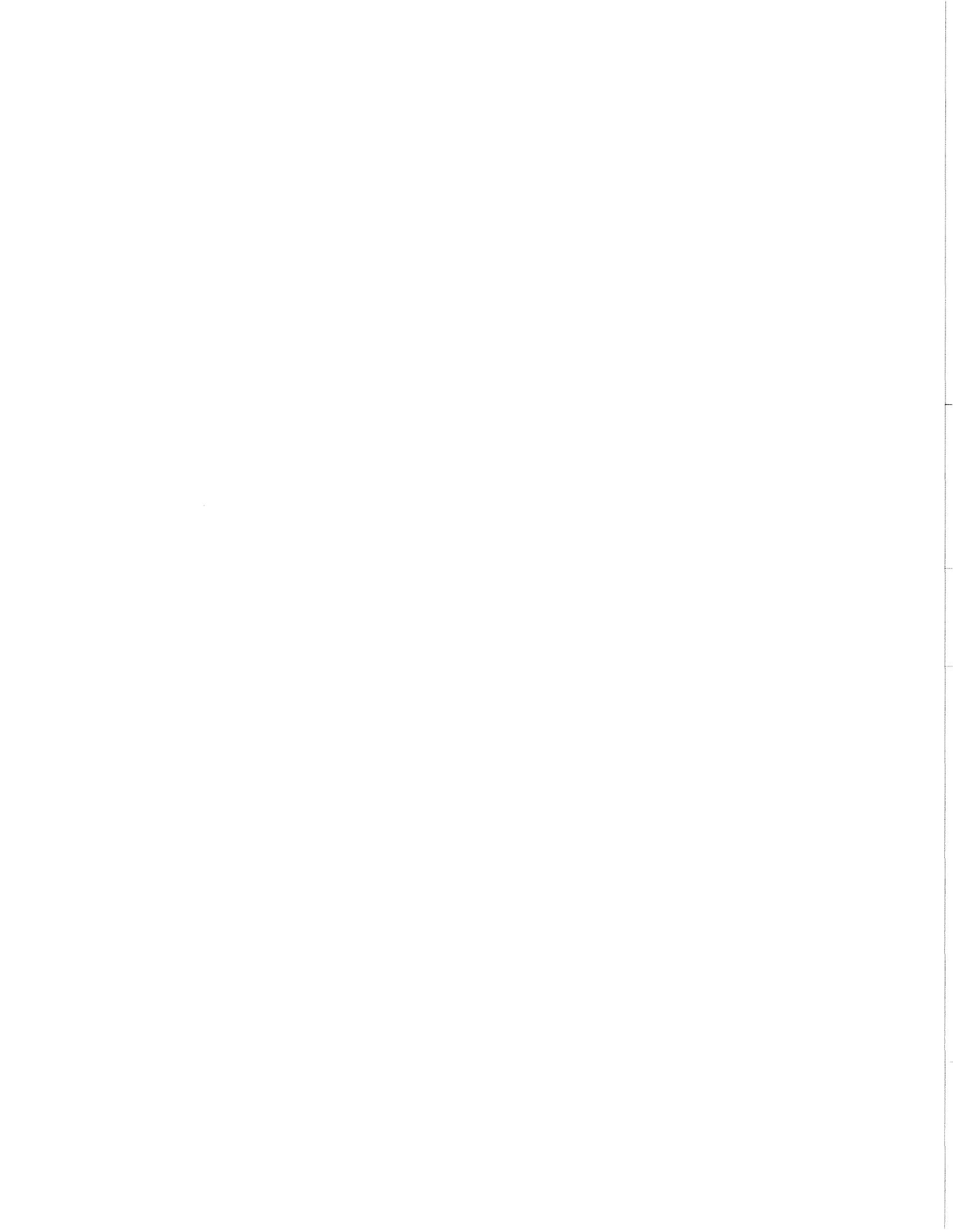
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1 map, scale 1:24,000, with text, 11 p.

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# GEOLOGIC MAP OF THE CENTRAL GILA BEND MOUNTAINS, WEST-CENTRAL ARIZONA

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## INTRODUCTION

This report includes a 1:24,000 scale geologic map of a portion of the central Gila Bend Mountains. The map covers portions of the Fourth of July Butte, Gillespie, and Quail Springs Wash 7.5' quadrangles and was produced as part of the U. S. Geological Survey - Arizona Geological Survey Cooperative Geologic Mapping (COGEMAP) Program. The goal of this ongoing program is to map areas for which inadequate geologic information exists. The central part of the Gila Bend Mountains was chosen because it had previously been mapped only at reconnaissance scale, and has been recently explored for its metallic mineral resources.

The mapping was done on 1:24,000-scale topographic maps and color aerial photographs provided by the Bureau of Land Management. Descriptions of adjacent portions of the Gila Bend Mountains are given in Gray et al. (1989), Peterson et al. (1989), and Cheeseman (1974).

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## GEOLOGIC OVERVIEW

The central Gila Bend Mountains are composed of a metamorphic-plutonic basement that is overlain by middle Tertiary sedimentary and volcanic rocks. The oldest rocks are Proterozoic or possibly Jurassic gneiss, schist, and minor quartzite (probably Paleozoic), intruded by granite, pegmatite, and diabase dikes. Older metamorphic and plutonic rocks are intruded by non-foliated granodiorite, diorite, and granite thought to be Late Cretaceous in age, based on similarities to Cretaceous plutons elsewhere in the region.

Basement rocks are cut by numerous intermediate to mafic dikes related to Tertiary volcanism. A large, sill-like body of hypabyssal dacite intrudes basement rocks in the eastern portion of the map area. Extrusive equivalents of the dacite are present at the eastern margin of the map area, and further east near Signal Mountain.

Crystalline basement rocks are overlain by a locally thick sequence of Tertiary sedimentary rocks. The sequence includes conglomerate, arkosic sandstone, siltstone, and shale. Conglomerate is present several tens of meters above the base of the sedimentary sequence and includes clasts of basement rocks and of reworked conglomerate, rarely with volcanic material. Much of the sedimentary sequence was deposited before the onset of volcanism and tectonism, although the local presence of clasts of volcanic origin suggests at least some synchronicity. The sedimentary rocks are commonly in low-angle normal fault contact with underlying basement rocks. Gentle folding and warping, along with poorly developed cleavage, are generally present within a few meters to a few tens of meters of the fault contact.

Tertiary volcanic rocks are dominantly intermediate to mafic flows with lesser amounts of pyroclastic material. Dacitic flows and tuff of the Signal Mountain area intertongue or are in fault contact with some of the younger andesite and basalt flows on the eastern margin of the map area. Thin lenses of quartz porphyry, interpreted to be a tuff related to the Signal Mountain volcanics, also are present in the vicinity of the Jackpot and Dixie mines where they host deposits of copper+silver±gold.

On a regional basis, the older Tertiary mafic volcanics constitute a single unit similar to mafic rocks that are present in several other ranges. In this report the mafic volcanics have been divided into four sequences, based on composition, distribution, and relative age. The oldest of these, the Fourth of July volcanics, is dominated by andesite flows and tuff that form the prominent ridges between Dixie Peak and Fourth of July Butte. The Dixie Mine volcanics, which form the low hills and ridges south of the Agua Caliente fault (between Quail Springs Wash and the Dixie mine), are a series of flows and pyroclastic rocks that range in composition from basalt to andesite. The basaltic to andesitic rocks north of the Agua Caliente Fault are thought to be lateral equivalents of the Dixie Mine Volcanics, but are separated here because of the lack of clear correlation between specific units within the sequences. The upper portions of these two sequences are roughly coeval with the Signal Mountain volcanics, which have been dated at  $20.7 \pm 0.6$  Ma (Peterson and others, 1989). True thicknesses of each of these sequences are not known due to numerous fault repetitions within the section. However, each is estimated to be 1 - 2 km thick.

The youngest volcanics in the area are andesite and basalt that have not been affected by the normal faulting which has tilted blocks of the older volcanics. The older of these is a widespread andesite unit with interlayered tuff, agglomerate, and vesicular basalt and scoria. The youngest is a regionally extensive basalt which caps the mesas and higher peaks of the area. Similar younger basalt flows in the region are dated at 15.0 Ma (Shafiqullah et al., 1980).

## Structure

Volcanism was accompanied and followed by low- to high-angle normal faulting produced by northeast-southwest crustal extension. Major northwest-trending normal faults, which dip 35 to 60 degrees southwest, cut and tilt Tertiary rocks and crystalline basement rocks, producing repetition of the section. These show displacements of several hundred meters. Northwest-trending faults that dip moderately northeast are interpreted as antithetic faults, and may reflect irregularities in the underlying low-angle fault. Northeast- to east-trending complex fault zones probably accommodated differential extension and tilting between fault blocks during displacement on both moderate- and low-angle faults. A significant component of south- to southeast-side-down normal slip on these faults can be demonstrated in places. The Agua Caliente Fault, which belongs to this class of structures, is used here as a convenient boundary between the Dixie Mine volcanics and similar but distinct units to the northwest.

The intrusive dacite provides evidence that faulting was contemporaneous with volcanism. The dacite body, equivalent to Signal Mountain volcanics, both intrudes and is cut at its southern margin by a low-angle fault. Normal faulting continued at least through the time of deposition of Dixie Mine volcanics, but ceased before the extrusion of the younger andesite and basalt units. A few large blocks of megabreccia derived from Fourth of July volcanics were produced by oversteepening of the section during tilting.

Pre-Tertiary structures in the map area include isoclinal folds in the metamorphic basement rocks. Foliation is generally not developed in Cretaceous(?) plutonic rocks, which suggests that folding and foliation development occurred before their intrusion.

## Alteration and Mineralization

Most of the volcanic rocks in the map area are affected by regional potassium metasomatism, which is thought to be the result of alkaline, saline waters circulating through brittlely deformed rocks (Roddy and others, 1988). Metasomatism imparts a distinct reddish hue to the rocks that is at least partly the result of oxidization of iron-bearing minerals. Calcite with or without clay and minor amounts of sericite replace plagioclase and up to about 30% of the groundmass in the mafic flows. Olivine is largely altered

to iddingsite.

Hydrothermal alteration in prospects is associated with copper-silver ± gold deposits in Tertiary and crystalline basement rocks. Many of the deposits are hosted in moderate- to high-angle faults and shear zones. Tertiary basaltic dikes are commonly mineralized along their margins. High-angle fracture zones subsidiary to faults and dikes host smaller mineral deposits. Mineral deposits typically consist of quartz and calcite veins, locally with barite and minor fluorite. Calcite is commonly manganiferous. Narrow zones of argillization and leaching extend up to a few meters into the wall rock. Visible mineral deposits consist of pyrite and copper sulfides, and their oxide counterparts. Chrysocolla in particular is common, and wulfenite is present in minor amounts. Mineralization did not occur in younger andesite and basalt units, and is therefore middle-Miocene in age.

A possible source for the mineral deposits is the copper + precious metals veins in Proterozoic rocks, such as those in the Webb district (Cheeseman, 1974). Mineral deposits in the Proterozoic and possibly Mesozoic basement rocks may have been remobilized and deposited in faults and fractures during circulation of fluids involved with regional low-angle normal faulting.

Two areas that have been heavily prospected are the Dixie and Jackpot mines. At the Dixie mine, mineralization is primarily hosted in strongly sheared quartz porphyry, and in a southwest-dipping, moderate-angle fault zone at or near the contact between quartz porphyry and basalt. A strongly sheared, moderately northeast-dipping contact between a basalt dike and quartz porphyry is the locus of mineralization just west of the Jackpot Mine. Moderately to steeply dipping fault and fracture zones entirely within basalt host mineral deposits at the main Jackpot mine area. A west-northwest-trending fault is the primary mineralized structure, but mineral deposits are also present in north-trending, near vertical minor faults. The Dixie and Jackpot Mines have historically produced a small amount of copper with minor silver and gold credits. Mineral deposits at numerous other prospects in the area, mostly shallow trenches, is summarized in Appendix A.

## UNIT DESCRIPTIONS

### Quaternary Units

- Qs     **Younger alluvium**--Unconsolidated sand and gravel in modern channels.
- Qt     **Unconsolidated talus**
- Qc     **Unconsolidated colluvium**
- Qa     **Alluvium, undivided**
- Qa<sub>2</sub>   **Younger mid-level alluvium**--Unconsolidated sand and gravel in flood plains elevated 0.5 - 2 m above modern channels.
- Qa<sub>1</sub>   **Older mid-level alluvium**--Unconsolidated to poorly consolidated and caliche-cemented sand and gravel deposits that have undergone some dissection.

### Middle to Upper Tertiary Units

- Tb     **Mesa capping basalt**--Black to dark grey, aphyric to olivine phyric, variably vesicular basalt. Calcite and zeolites locally fill vesicles. Consists of blocky flows up to 10 m thick that cap mesas and high hills. Equivalent rocks have been dated at 15.0 Ma (Shafiqullah et al., 1980).
- Tab    **Andesite and basalt**--Light- to medium-grey, locally platy andesite and andesitic basalt.

Contains 0 - 7% clinopyroxene, 3 - 10% olivine, and 0 - 10% fine, feathery plagioclase. Upper part of unit includes grey-brown agglomerate, vesicular basalt, and scoria. Individual flows generally do not exceed 10 m in thickness. Andesite and andesitic basalt flows and pyroclastics are extensive, with an estimated thickness of 300 - 500 m.

- Tib **Basalt dikes**--Dense, black, generally aphyric dikes.
- Tid **Hypabyssal dacite**--Moderately to coarsely porphyritic, light-colored dacite. Contains 5 - 15% subhedral plagioclase, 0 - 7% anhedral quartz, and 1 - 4% subhedral biotite. Forms as a thick sill intruding a northwest-trending, southwest-dipping structural zone of weakness in crystalline basement rocks.
- Tbx **Megabreccia and large blocks of fault breccia commonly with a carbonate cement**--Prototype lithology shown in parentheses.
- Tts **Airfall tuff, tuffaceous sediments, and surge deposits**--Unit was derived mainly from adjacent units.

### Signal Mountain Volcanics

- Tsmd **Dacite and rhyodacite**--Dark red-grey to reddish pink flows and tuff. Contains 1 - 5% subhedral plagioclase and 0 - 3% anhedral quartz. Possibly intertonguing with youngest basalt of Dixie Mine volcanics (Tdb<sub>4</sub>).
- Tsmt **Andesitic to dacitic lapilli tuff**
- Tsma **Andesite**--Light green-grey flows and tuff. Contains 10% subhedral to euhedral plagioclase partially altered to calcite and clay, 3 - 5% subhedral to anhedral augite, and 1 - 2% opaque minerals.
- Tqp **Quartz porphyry**--Possibly a pyroclastic rhyodacite associated with Signal Mountain volcanics. Light greyish-green to white, with 2 - 5% subhedral to euhedral plagioclase, 2% angular anhedral quartz, and 1 - 3% biotite. Thickest exposure at the Dixie Mine is estimated to be 35 - 50 m.

### Dixie Mine Volcanics

- Tdb<sub>4</sub> **Dark-weathering basalt flows and pyroclastic rocks**--Three to eight percent olivine, three to five percent pyroxene, less commonly a few percent fine plagioclase. Outcrops of very low relief. Estimated thickness of 250 - 300 m.
- Tda<sub>3</sub> **Andesite flows**--Dark-colored andesite flows of limited extent in the hills east of the Jackpot mine. Contains 3 - 10% euhedral plagioclase phenocrysts, locally 0.5 - 1 cm long.
- Tda<sub>2</sub> **Platy andesite**--Orange-weathering, dark-colored, resistant, platy andesite that is aphyric to plagioclase phyric (1 - 3%). Liesegang banding is common. Forms high ridges south of the Dixie Mine. Roughly 200 m maximum thickness.
- Tdb<sub>3</sub> **Red aphyric basaltic andesite and basalt flows**--Rocks of this unit form ridges of moderate relief and are of relatively limited extent. About 250 m thick, tapering off sharply to the southeast and northwest.
- Tda<sub>1</sub> **Pink-, tan-, and grey-weathering andesite, with interlayered dark basalt flows, and tuffs**--Contains 1 - 8% subhedral plagioclase crystals that are greater than >0.5 cm long, 3 - 5% subhedral to anhedral pyroxene, and trace to 2% olivine. Bright red pyroclastic rocks are exposed at base of the unit in places. Scoria commonly separates flows. Forms low rubbly hills and ridges. Maximum thickness is about 275 m.

- Tdb<sub>2</sub>** Black and red basalt flows, scoria, pyroclastics, and andesitic basalt--Highly variable phenocryst content, but generally containing a few percent olivine, a trace to several percent pyroxene, and minor plagioclase. Forms ledgy outcrops in low hills and ridges. Maximum thickness is about 400 m.
- Tdb<sub>2a</sub>** Resistant basalt--Green-tan-weathering basalt that caps a few higher hills. Contains a few percent clinopyroxene and minor olivine. This unit is a subunit of Tdb<sub>2</sub>.
- Tdab<sub>2</sub>** Aphyric basalt--Gritty, brown-weathering basalt that forms ridges of moderate relief in the southeastern part of the map area. Unit is 5 to 30 m thick.
- Tdab<sub>1</sub>** Platy andesite, basaltic andesite, and light grey and pink andesite flows with some pyroclastic material--Interlayered with map units Tdab<sub>2</sub> and Tdb<sub>2</sub> to the northwest. Contains 5 to 15% plagioclase phenocrysts up to 3mm long, <1 to 4% clinopyroxene and locally 1 to 2% hornblende. Platy andesite forms ridges of moderate relief; other units primarily form low rubbly hills. Total thickness is about 300 m.
- Tdb<sub>1</sub>** Red- and grey-weathering, platy, aphyric basalt flows--Present on flanks of young basalt- and andesite-covered peaks in the southeast part of the map area. Total thickness not more than a few tens of meters.

#### Volcanics north of the Agua Caliente Fault

Volcanic rocks north of the Agua Caliente fault comprise most of the hills of low relief north of the Agua Caliente Road. Thicknesses for each unit within these volcanics are difficult to determine, mainly due to the fact that faults possibly repeating the units are largely obscured by rubble and alluvium. Minimum thickness for the entire sequence is 1 - 1.5 km.

- Tab<sub>2</sub>** Grey-weathering, olivine-pyroxene phyric basalt and andesitic basalt flows--Forms low, rubbly hills.
- Taa** Red and grey, largely aphyric flows with a small amount of interlayered black vesicular basalt and minor scoria--May contain a few percent each of olivine and clinopyroxene, and rarely plagioclase. Forms rubbly hills of very low relief.
- Ta<sub>3</sub>** Pink-tan-weathering andesite--Contains 0 to 12% subhedral to euhedral plagioclase and is locally platy. Underlain in places by light grey pyroclastic rocks with <20% plagioclase. Forms low, rounded hills. Estimated to be 500 - 600 m thick.
- Ta<sub>2</sub>** Red, plagioclase phyric andesite--Contains 5 to 15% subhedral to euhedral plagioclase. Grey and brown agglomerate at base. Forms resistant outcrops capping hills of slightly greater relief as well as low rubbly outcrops.
- Tab<sub>1</sub>** Light grey basaltic andesite and basalt--Contains 1 - 5% pyroxene, 3 - 10% largely altered olivine, and 0 - 2% subhedral plagioclase. Forms low, rubbly outcrops and hills.
- Ta<sub>1</sub>** Red- and grey-weathering plagioclase-phyric andesite--Contains 5 - 8% subhedral to euhedral plagioclase, 2% subhedral pyroxene, and about 1% altered olivine.

#### Fourth of July Volcanics

- Tfa<sub>2</sub>** Dark red, reddish purple, tan- and grey-weathering andesite flows--Unit makes up the prominent peaks between Fourth of July Butte and Dixie Peak. Phenocryst-poor in most places, but may contain up to 10% euhedral plagioclase and several percent pyroxene in very fine clots. Commonly flow-banded and locally platy. Potassium metasomatism of this unit

- is extensive and obscures original features. Thickness is difficult to establish, but probably not more than 250 - 300 m.
- Tft **Light grey and yellowish grey andesitic tuff**--Unit is of limited areal extent. Unit contains up to 5% subhedral to euhedral plagioclase and a trace pyroxene and opaque minerals. Occurs with Tfa<sub>2</sub> flows on high ridges near Fourth of July Butte. Maximum thickness of unit is 35 - 40 m.
- Tfba **Light-grey-weathering basaltic andesite and andesite**--Unit is commonly flow-banded. Unit contains up to a few percent each of fine phenocrysts of plagioclase, pyroxene and, in places, olivine. Limited areal extent, primarily on high ridges near Fourth of July Butte.
- Tfa<sub>1</sub> **Orange- to tan-weathering platy andesite**--Unit is interlayered with Tfb. Contains more than 7% subhedral plagioclase and a trace pyroxene. Distinctive thin flows not exceeding about 25 m form low hills southwest of Dixie Peak and Fourth of July Butte.
- Tfb/Tfbt **Dark-weathering vesicular basalt flows, scoria, pyroclastics, and thin basaltic andesite flows near top of the sequence**--Variable phenocryst content, but generally contains several percent olivine, a few percent pyroxene, and minor plagioclase. Forms low rubbly outcrops and hills south of high ridges. Total thickness is on the order of 400 - 500 m. Tfbt is a subunit which includes light colored andesitic tuff and flows at the southwesternmost exposures of the unit.
- Tfab<sub>2</sub> **Pink-tan- or red-weathering, platy, flow-banded andesite**--Phenocryst poor, but may contain a few percent plagioclase and clinopyroxene in very fine clots. Includes dark red, black, and maroon vesicular basalt that may have scoria at its base.
- Tfab<sub>1</sub> **Light-gray basaltic andesite**--Weathers tan or brown. Unit has mottled, spotted appearance with moderately well developed flow foliation. Contains 5-7% very fine grained, red, oxidized, mafic mineral. Locally may contain interlayered scoria and vesicular basalt.

### **Sedimentary Rocks Units**

- Ts **Sedimentary Rocks, undivided**--Most of the sedimentary rocks of this map unit are clearly derived from pre-Tertiary rocks, indicating deposition before Tertiary volcanism. Basement-derived clasts include granite, granodiorite, diorite, schistose diabase, quartz-muscovite schist, and quartz-biotite schist. In the northeast corner of the map area near Yellow Medicine Butte, however, the upper few meters of sandstone may contain a small amount of pyroclastic material. Another occurrence of volcanic-bearing conglomerate lies south-southeast of Dixie Mine near the contact between sedimentary rocks and dacite. These beds contain boulders of breccia of volcanic origin along with clasts of sheared quartz porphyry.
- The sedimentary sequence is as much as 300 m thick, but is nowhere exposed in its entirety. The lower portion of the section consists of coarse conglomerate interbedded with sandstone. Conglomeratic beds thin and fine upwards in the section. The conglomerate portion of the unit is about 60 - 75 m at its thickest. Sandstone and siltstone make up the remainder of the unit. Thin shale layers are present locally, notably in the vicinity of Fourth of July Wash, but they are a small portion of the section.
- Tss **Sandstone and siltstone with minor shale**--Reddish brown, tan, and greenish grey.
- Tsc **Conglomerate and sandstone**--Reddish brown, tan, and buff.

### **Pre-Tertiary Rock Units**

Most of the metamorphic-plutonic basement rocks are thought to be Proterozoic in age, but may be as young as Cretaceous. Non-foliated crystalline rocks are probably Late Cretaceous, based on the lack of metamorphic textures and on lithologic similarities to Late Cretaceous plutons elsewhere in the region. Foliated rocks are believed to be Proterozoic in age based on their high-grade metamorphic character and dissimilarity to metamorphic rocks derived from Mesozoic protoliths.

- KXg Granodiorite, diorite, diabase dikes and minor felsic crystalline rocks**--Unit is generally not foliated.
- JXg Gneiss, schist, and minor quartzite**--Dominantly orthogneiss of granite to quartz monzonite protolith, intruded by numerous diabase, aplite and less commonly pegmatite dikes. Biotite and muscovite schist and amphibolite gneiss are rare and of uncertain protolith. Gneiss and schist are probably Proterozoic but may be as young as Jurassic. One small block of quartzite megabreccia near Fourth of July Wash was probably derived from Paleozoic quartzite.

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APPENDIX A -- PROSPECT SUMMARY

<u>Prospect Type</u>	<u>Location</u>	<u>Geology &amp; Mineralization</u>
Dixie Mine	NE4 s12 T2S R8W	Several shallow shafts and declines, prospect pits explore NW trending, moderately NE or steeply SW dipping faults and shear zones. Pyrite, chrysocolla occur with quartz, barite, and calcite in Tqp and Tdb4.
Jackpot Mine	NE4 s 7, NW4 s8, T2S R7W	NW trending, moderately NE dipping, and N trending, verticle veins and shears in Tdb4 and basalt breccia. Chrysocolla, barite and calcite with variable quartz
Jackpot West	NE4 s7 T2S R7W	Two short adits and several shallow prospect pits on WNW trending, 45 NE dipping fault between a basalt dike and Tqp.
Prospect pit	NE4 s5 T2S R7W	Chalcedony stringers in NW fractures in Ta3 andesite. Also some barite.
Trenches	SW4 s5 T2S R7W	Shallow trenches in alluvium, no bedrock exposed.
Prospect pit	NW4 s6 T2S R7W	Small block of brecciated basalt overlying Ta3, abundant caliche.
Caved shaft	NW4 s7 T2S R8W	N 65 W, 75 NE vein at sheared contact between Tdb4 and Ts. Barite, hematite, calcite, and Mn oxides.
Prospect pit	NW4 s8 T2S r7W	NW trending, SW dipping narrow quartz-chrysocolla vein in JXg granite. Hematite, Mn oxides.
Prospect pits	NW4 s8 T2S R7W	Several pits and shallow trenches in dacite and JXg granitic gneiss. Some bull quartz and calcite veining.

Trenches	SW4 s1 T2S R8W	Shallow trenches in unaltered dense, light grey basalt.
Prospect pit	NE4 s2, NW4 s3 T2S R8W	Rubble of chalcedony veining in light grey basalt flow.
Prospect pit, trenches	NE4 s11 T2S R8W	Calcite, quartz and chalcedony stringers with trace Cu oxides in weakly leached basaltic andesite.
Trenches	NE4 s11 T2S R8W	Shallow trenches in weakly leached basaltic andesite. Hematite, trace Cu oxides, quartz and calcite.
Prospect pit	NE4 s12 T2S R8W	N 52 W, 44 SW fracture zone in Tss. Quartz +/- calcite, barite supported breccia with Chrysocolla, limonite, jarosite, hematite, and chlorite. Other fractures: N 60 E, 65 NW, N 10 W 70 NE.
Trench	NE4 s12 T2S R8W	Tss in N 25 W, 40 NE contact with overlying Tqp. N 65 W, 75 SW Quartz-barite-calcite veinlets with hematite, limonite, chrysocolla and clays.
Trench	NE4 s12 T2S R8W	Shallow cuts in alluvium barely exposing Tss.
Prospect pit	NE4 s12 T2S R8W	N to N10 W, 55 SW basalt dike cutting Tss. Late quartz, white calcite.
Decline	NE4 s12 T2S R8W	N 55 W 35 SW propylitized intermediate to mafic dike. Cut by veinlets of carbonate, chrysocolla, hematite, barite. Minor quartz.
Trench	NW4 s12 T2S R8W	Shallow cut exposing a small amount of Tss. Surrounding float contains quartz chrysocolla, hematite, clay, and carbonate vein material with a minor malachite.
Trench	NW4 s12 T2S R8W	Shallow cuts in alluvium barely exposing Tdb4.

Trench	NW4 s12 T2S R8W	Shallow cuts in alluvium exposing Tdb4.
Trench	NW4 s12 T2S R8W	Shallow cuts expose weakly foliated Tss in shear contact with a basalt dike. Calcite-quartz-chrysocolla-hematite veinlets, and strong chloritic alteration.
Trench	SW4 s12 T2S R8W	Fractured basalt exposed in shallow cuts. Minor leaching, quartz, and calcite.