Geologic Map of the Picture Mountain Quadrangle, Gila County, Arizona

by

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INTRODUCTION

The Picture Mountain quadrangle is centered on the southwest flank of the Sierra Ancha (see Figure 1). The geology of the area is dominated by the middle Proterozoic Apache Group and the diabase that intrudes it, and some extensive middle Tertiary conglomerates. Elevations range from about 2800 feet in the southwest corner of the map to 6610 feet at Bear Head Mountain.

Vegetation. In response to the change in elevation the vegetation changes dramatically across the study area. Saguaro and Palo Verde dominate the lowest elevations in the southwest, with many varieties of cacti. The mid-elevations in the central part of the map contain a mix of open Pinyon-Juniper forest and grassland and thick stands of scrub oak. The Pinyon-Juniper zone gives way higher up to larger oak woodlands. The higher elevations up on the plateau in the northeast part of the map are a mix of thick tangles of oak and manzanita and Ponderosa Pine conifer forest. The conifers grow mostly on north-facing slopes and in canyons and are most abundant between Pine Mountain and Bear Head Mountain. The proliferation of dense brush in the higher elevations makes travel and mapping very difficult. This is especially true for the south-facing cliffs and slopes along the main escarpment where a thin cover of colluvium and dense chaparral form an almost impenetrable barrier. The conifer forest is fairly open beneath the canopy but the litter of pine needles and leaves effectively obscures most of the rock exposures.

Access. The best access to the region is Forest Road 71, which connects Punkin Center with Conway Ranch in Greenback Valley. Forest Road 71 begins in Punkin Center immediately south of the building with the large pumpkin out front and heads east where it crosses Tonto Creek. During periods when the creek is swollen the road is impassable. But when the water level is low the road is well-maintained and good even for a 2-wheel-drive vehicle. To get to the northwestern part of the map, the best way is to take Forest Road 604 through the Kayler Butte quadrangle to Quartz Ledge Canyon. The most direct access to the higher elevations is via Forest Road 416 which splits off Forest Road 71 and heads northeast up Juniper Canyon. The road is very rocky and locally steep. A better road, though much longer, is Forest Road 609 which heads west from the Young Road until it eventually connects with Forest Road 416 about 1.5 miles north of Picture Mountain.

PREVIOUS WORK

Bergquist and others (1981) mapped Apache Group rocks and underlying granite to the south and east as part of a larger study of the Sierra Ancha Wilderness and Salome Study area. Spencer and others (1999) mapped the northwestern part of the Greenback Creek quadrangle to the south. Wessels (1991) mapped the northwest corner of the Picture Mountain quadrangle as part of a geologic study of the Jakes Corner area. The Copper Mountain quadrangle to the east was mapped concurrently with this study.

TERTIARY CONGLOMERATES

There are three distinct conglomerate units in the study area, Tco, Tcm, and Tcy (see figure 2). They were subdivided mostly on the basis of relative position in the landscape. The older conglomerate unit (map unit Tco) is exposed at higher elevations up in the Sierra Ancha. This unit forms thick, deeply dissected deposits in the extreme northeast corner of the map. Most exposures are to the east in the Copper Mountain quadrangle. This older conglomerate filled paleochannels previously cut into Apache Group rocks and from outcrop patterns appears to have been associated with a northward-flowing drainage system.
Figure 1. Location map of the Picture Mountain quadrangle.
The middle conglomerate (map unit Tcm) forms thin deposits sloping southward away from the plateau-like crest of the Sierra Ancha. These sediments were deposited at mid-elevations after extension and erosion had formed the southern escarpment of the Sierra Ancha. Deposits of map unit Tcm are very thin compared to both the older and younger conglomerates. These deposits originally formed an extensive sheet that slopes southward from the Sierra Ancha. Subsequent erosion has deeply dissected this unit and left remnants capping small mesas and hills.

The younger conglomerate (map unit Tcy) was deposited at lower elevations below the level of the middle conglomerate. This unit is thick, deeply dissected, and forms the bulk of the basin-fill deposits shed off the Sierra Ancha into the Tonto Basin. In the lower reaches of Juniper Wash these deposits project southwest across an erosion surface in the underlying granite (map unit YXg). This surface is about 800 feet higher in elevation than the middle Pleistocene alluvial surfaces (map unit Qm) in the extreme southwest corner of the map. The granite basement here ends rather abruptly, suggesting the existence of a buried fault. The exposed contact between siltstone (map unit Ts) and granite is clearly depositional, but a basin-bounding fault may be buried beneath the siltstone. The sloping erosion surface and the sharp termination of the granite suggests that faulting may have occurred during at least part of deposition of Tcy, but before siltstone deposition. Immediately to the north, north of the main road, Tcy deposits do not overlie this erosion surface but appear to extend downward nearly to the level of the Qm surfaces. It is possible Tcy deposition was pre-, syn- and post-tectonic.

GRANITIC ROCKS

Two different granite plutons comprise the basement beneath this part of the Sierra Ancha. The older, a coarse- to medium-grained granite is locally heterogeneous and contains irregularly shaped bodies of more leucocratic granite with sharp contacts. Spencer and others (1999) describe the more leucocratic variety as existing as both enclaves and as intrusions, showing that the two varieties are coeval. This older granite is weakly deformed. A northeast-striking foliation is in most places weak and widely spaced, so that at first glance the rock does not appear to be foliated. The foliation is near-vertical and is defined by weak alignment of biotite phenocrysts. This granite is mineralogically and texturally similar to the Young granite to the northeast but also to the older medium- to fine-grained granite in the southwest part of the Four Peaks quadrangle (in press) to the southwest.

A coarse-grained K-feldspar megacrystic granite intrudes the older granite. Large pink K-feldspar phenocrysts and fresh anhedral books of biotite in this granite suggest that this rock may belong to the regional suite of 1.4 Ga (billion year old) granites. The major contact between the older and younger granites is sharp and strikes northwest-southeast—approximately parallel to the southwest-facing escarpment. This contact projects southeast into the area mapped by Bergquist and others (1981). They mapped the granitic basement as Ruin granite, but it is possible their unit includes more than one pluton.

APACHE GROUP ROCKS

The Scanlan Conglomerate at the base of the Pioneer Formation is fairly widespread across the map area. It thins and disappears locally, but in places it is 3-4 meters thick and contains well-rounded moderately sorted clasts of quartz and quartzite in a sandy, arkosic matrix. The Scanlan conglomerate rests on an erosional surface on the underlying granitic rocks that was beveled remarkably flat sometime between about 1.4 and 1.15 Ga. There is very little relief on the erosion surface which probably represents a hiatus of at least 100 million years.
Figure 2. Correlation diagram for the Picture Mountain quadrangle.
The Scanlan grades rather abruptly upward into dark purple argillites and quartzites of the Pioneer Formation. Almost everywhere in the Picture Mountain quadrangle the Pioneer Formation is dominantly fine-grained quartzite with only very minor argillite. In general, it is darker in color than the overlying Dripping Spring quartzite, but locally it is nearly the same color on weathered outcrops. The diabase preferentially intruded along bedding planes in the Pioneer, and as a result much of the formation was assimilated(?) by the mafic magma. Locally, only thin slivers of the unit are exposed.

The Dripping Spring quartzite overlies the Pioneer Formation. It is made up of a lower, cliff-forming quartzite member an upper, slope-forming argillite member. The upper member is usually a light yellow mustard color and contains conspicuous partings along finely planar beds. The lower member commonly has a light pink hue and is characterized by apparently more massive beds with fewer partings. Shride (1967) described the lower member as actually thinly bedded as well, but on most weathered surfaces the bedding is not well expressed. In the map area the upper member forms most of the high plateau of the Sierra Ancha. Exposures on relatively level surfaces are poor due to disruption by and development of clay-rich soil. The canyons generally contain the best exposures.

The Mescal Limestone overlies the Dripping Spring quartzite in the northeast corner of the map. Exposures between Chalk Mountain and Bear Head Mountain are almost everywhere converted to light grey limestone. The unit contains very little chert. Where chert is visible it is light grey to white and pitted with irregular cavities. Some good chert clasts can be found along the road just southeast of Pine Mountain. As with the quartzite exposures, the few good outcrops of the Mescal are found in the deeper gullies on the edges of the outcrop pattern. Algal stromatolites of the upper member of the Mescal are well exposed and accessible at Pine Mountain.

Capping Pine Mountain and overlying the Mescal Limestone is a thin deposit of tan to purple, thin bedded argillite or bedded chert. The exposure is mostly covered in brush and is very poor. Thin-sections of this unit to the east in the Copper Mountain quadrangle show it to be composed mostly of granular microcrystalline chert.

**STRUCTURE**

As a whole, the Apache Group rocks making up the plateau dip very gently to the north-northeast. They have been extensively intruded by dark green diabase sills that have assimilated much of the Pioneer Formation exposed in the central part of the map. Locally, the diabase has deformed the sedimentary rocks into broad, low-amplitude folds. As seen from a distance the bedding undulates slightly but with no apparent preferred orientation. South of Bear Head Mountain bedding in quartzite dipping up to about 30° defines a narrow east-west zone immediately south of the mountain. It is not clear if these dips define a south-facing monocline or if they are related to the fault immediately to the east in the Copper Mountain quadrangle that projects westward. More work needs to be done in this area.

Four faults are exposed in the study area. The fault in the northeast part of the map appears to be a high-angle normal fault, down-dropping the units on the north side about 80 feet. The two northwest-striking down-to-the-south normal faults in the center of the map are south of Juniper Mountain dip moderately to steeply to the southwest. Nowhere was there an exposure of the actual fault plane. The orientation of these faults suggests they are mid-Tertiary in age and are probably related to extension that formed the Tonto Basin. The small fault at the south side of the map offsets the contact between the Pioneer Formation and the underlying granite by about 480 feet. Since the fault is buried by conglomerate of map unit Tey on one end and projects into diabase on the other, it is not known how extensive this structure is.
REFERENCES CITED


UNIT DESCRIPTIONS FOR THE PICTURE MOUNTAIN QUADRANGLE
AZGS OFR-99-23

Quaternary deposits

Qy  Holocene alluvium (< 10 ka)—Unconsolidated sand to small boulders reaching sizes up to 25 cm in diameter upstream but smaller and fewer downstream. Larger clasts are quartzite and granite. Smaller clasts are subangular granitic grus. Qy deposits are characterized by stratified, poorly to moderately sorted sands (in many areas a dark diabase sand), gravels, and cobbles frequently mantled by sandy loam sediment. On this surface the main channel commonly diverges into braided channels. Locally exhibits bar and swale topography, the bars being typically more vegetated. Soil development is relatively weak with only slight texturally or structurally modified B horizons and slight calcification (Stage I). Some of the older Qy soils may contain weakly developed argillic horizons. Because surface soils are not indurated with clay or calcium carbonate, these surfaces have relatively high permeability and porosity.

QI  Late Pleistocene alluvium (10 to 250 ka)—Moderately sorted, clast-supported sandstones and conglomerates in a tan to brown sand and silt matrix. QI surfaces are moderately incised by stream channels but still contain constructional, relatively flat interfluvial surfaces. QI soils typically have moderately clay-rich tan to red-brown argillic horizons. QI soils contain much pedogenic clay and some calcium carbonate, resulting in relatively low infiltration rates. Thus these surfaces favor plants that draw moisture from near the surface. QI soils typically have Stage II calcium carbonate development. These deposits were mapped as low terraces along a couple major creeks and as major colluvium deposits on steeper slopes.

Qm  Middle Pleistocene granitic alluvium (250 to 750 ka)—Sandy to loamy, tan-colored sandstones and minor conglomerates. The deposits are moderately consolidated and locally weakly indurated by carbonate. Argillic horizons typically are weak to moderate, probably because they have been eroded. These deposits were mapped mostly in the southwest corner of the map where they form extensive, flat terraces in the Tonto Basin.

Qo  Early Pleistocene alluvial deposits (750 ka to 1.2 Ma)—These weakly to unconsolidated deposits contain subangular to subrounded pebble- to small boulder-size clasts of quartzite (Yd and Yp), and minor granite (YXg and minor Yg) and diabase (Yd). The matrix contains abundant brown clay. The largest clasts are about 40 cm across—smaller than the maximum clast-size in map unit Qy. This unit is preserved as flat, constructional surfaces near, but not at, the top of the younger conglomerate (map unit Tcy). The matrix contains abundant brown clay. Just to the west of the map, near the east side of the Kayler Butte quadrangle, Qo deposits overlie siltstone (map unit Ts on this map) and apparently truncate the contact between siltstone and conglomerate (map unit Tcy).

QTls  Landslide deposits? (Late Tertiary or Quaternary)—This appears to be a large rotated block of Dripping Spring quartzite. It is mostly intact but is below the level of surrounding outcrops of Dripping Spring quartzite. It is mostly surrounded by younger colluvium so this unit’s relationship to other rocks is not entirely clear. It may also be a block rafted within diabase. It is mapped in only one place just over 1 mile west of Juniper Mountain.
Tertiary rocks

Ts  Siltstone (middle to late Tertiary)—Thinly bedded siltstone, fine-grained sandstone, and minor mudstone. Light grey to light green. Very fissile and crumbles easily. Bedding is very thin, but the unit contains several partially silicified beds 5-15 cm thick that contain lenses of grey chert. The chert contains well-preserved gastropod moulds (at least two different types) up to about 5 mm long. Locally, the unit contains abundant light grey carbonate. A great exposure in a stream cut in section 8, T. 6 N., R. 11 E., in the southwest corner of the map, contains dark grey to black carbon-rich beds and lighter colored gypsum beds, both about 1-2 cm thick.

Tcy  Younger conglomerate (middle Tertiary)—This unit consists of conglomerate and sandstone that form thick, deeply dissected, tan-colored deposits in the southwest corner of the map. The hills are almost everywhere covered by a thin mantle of colluvium and exposures are rare. The best exposures are just to the west of the map in the Kayler Butte quadrangle. There, the deposits are moderately to strongly indurated with carbonate and contain clasts mostly of quartzite and phyllite—very few granite clasts. The matrix is sandy, but the mantling soil is commonly dark brown and clay-rich. Poorly exposed relationships suggest this unit underlies the siltstone (map unit Ts).

Tcm  Middle conglomerate (middle Tertiary)—This conglomerate is intermediate in elevation between the lower, younger conglomerate exposed in the southwest and the older conglomerate exposed to the northeast. It contains mostly angular to subrounded sand- to cobble-sized clasts of Dripping Spring Quartzite, with minor clasts of diabase and possibly lighter-colored Troy Quartzite. Unlike both the younger and older deposits this unit forms a very thin layer a few meters thick that slopes gently away from the southwest facing escarpment on the southwest side of the crest of the Sierra Ancha. Looking edge-on towards the southeast (toward more extensive deposits in the southwest corner of the Copper Mountain quadrangle) this unit once formed a continuous land surface, now expressed as a series of parallel, deeply dissected mesas capping mostly diabase. The unit contains a well-developed brown argillic soil, which is exploited by abundant grasses.

Tco  Older conglomerate (early to middle Tertiary)—This unit contains medium-bedded, moderately consolidated conglomerate interbedded with moderately sorted sandstone, pebble and cobble layers. Clasts are angular to subrounded and range in size from sand to boulders >1 meter across, though typically less than 40 cm. The deposits contain clasts derived entirely from Apache Group rocks, Troy Quartzite, and diabase. Calcite cement is locally abundant and gives the rock a light grey to tan color. Outcrops are almost everywhere mantled by lag gravel. Rare exposures along the bottom of canyons are not very extensive and imbrication could not be measured with confidence. These deposits fill paleochannels cut into older rocks in the northeast corner of the quadrangle. Immediately to the east, in the Copper Mountain quadrangle, thin basalt flows are interbedded with these sediments.

Diabase and Troy Quartzite

Yd  Diabase (Middle Proterozoic)—Dark grey and dark green-grey sills exhibiting a subophitic, diabasic texture. The rock consists of 35-45% 1-3 mm plagioclase laths in a dark green matrix that contains pyroxene. Smaller crystals of magnetite are common.
Locally the rock contains very localized accumulations of light orange feldspar and in these areas the rock looks granitic. Where competent this unit weathers into irregularly shaped dark grey-green boulders. However, almost everywhere the rock crumbles easily and weathers into smooth slopes covered by a thin obscuring mantle of colluvium. This colluvium is so pervasive it was not mapped separately.

**Yt**  
*Troy Quartzite (Middle Proterozoic)*—At Picture Mountain and Bear Head Mountain this rock is thinly bedded fine-grained tan quartzite. East-southeast of Picture Mountain, a coarse sandstone tongue looks very much like Troy Quartzite but the remaining outcrops along the ridge also resemble the Dripping Spring quartzite. Exposures on the southeast side of Picture Mountain are very brushy, but there is a continuous sequence of quartzite from the base of the lower plateau to the top of the mountain, with no breaks. The stratigraphy suggests that the top is Troy. Better exposures crop-out on the south side of Bear Head Mountain, where there is also a continuous sequence of quartzite. It is possible this entire sequence is Dripping Spring quartzite. More work needs to be done on these exposures to clearly divide these formations.

**Apache Group**

**Yma**  
*Argillite (Middle Proterozoic)*—Thinly laminated tan and grey chert layers characterize this unit. In marked contrast to the underlying chert-breccia deposits, these deposits contain continuous, unbroken laminae. In thin-section the rocks are composed of very fine-grained microcrystalline chert with laminations defined by zones of fibrous chalcedony and fine-grained opaque crystals. This unit caps the algal member of the Mescal limestone (map unit Ymu) at Pine Mountain where it is mostly covered by vegetation.

**Ymu**  
*Algal member of the Mescal Limestone (Middle Proterozoic)*—The algal member exposed at Pine Mountain in the northeast corner of the map is composed entirely of stromatolitic limestone, which, according to Shride (1967), was probably once dolomite. There is no obvious break between sequences of stromatolites, although exposures are not everywhere continuous. The base of the unit is defined by a thin platy layer of light grey chert a few centimeters thick. The surfaces of the chert show a myriad of small polygonal cracks. It is not yet clear if these cracks represent desiccation or some other process. The contact with the planar-laminated lower member is sharp.

**Yml**  
*Lower member of the Mescal Limestone (Middle Proterozoic)*—The lower member in the study area is composed of light grey, planar-bedded limestone. Thick forest and leaf litter mostly covers exposures but the sequence contains very little chert. Discontinuous chert lenses and float exposed on the east side of Pine Mountain are light grey granular microcrystalline chert. Some chert clasts contain many small irregularly shaped cavities that may have been carbonate (or evaporite minerals?) now leached away. The area between Pine Mountain and Chalk Mountain is covered with almost impenetrable brush. North of Picture Mountain the lower member has been extensively intruded by diabase.

**Ym**  
*Mescal Limestone, undivided (Middle Proterozoic).*

**Ymc**  
*Mescal basal conglomerate (Middle Proterozoic)*—This unit is massive and commonly mottled in shades of dark grey and tan. Locally the color resembles the underlying Dripping Spring Quartzite, but the absence of bedding sets this unit apart. Locally, the
rock contains discontinuous lens-like layers and nodules of dark grey to black chert. Northeast of Bearhead Mountain some lenses form extensive sheets several meters across. These dark cherts commonly contain spherical pits a few mm in diameter. These pits are commonly filled with light grey silica and terra rosa. The terra rosa suggests the unit was exposed to weathering before deposition of the overlying Mescal Limestone. However, except for the pits, these dark cherts also resemble the dark cherts in the lower part of the Mescal. Shride (1967) described this unit as a chip conglomerate representing an interval of erosion between deposition of the Dripping Spring quartzite and the Mescal Limestone.

Ydu  Upper member of the Dripping Spring Quartzite (Middle Proterozoic)—This unit is composed of thinly bedded light tan-yellow argillite and fine-grained quartzite. Bedding is thin and platy and locally slightly wavy. In general, this unit forms a slope on top of the cliff-forming lower member. Locally, the top of this unit is weathered and pitted, and in places there are thin accumulations of reworked material. Where these accumulations are large enough, they were mapped as map unit Ymc. The argillite commonly displays oriented mud cracks and rarely tool marks.

Ydl  Lower member of the Dripping Spring Quartzite (Middle Proterozoic)—This unit is mostly medium to fine-grained quartzite. Shride (1967) described the unit as an arkose and feldspathic quartzite, but feldspar grains are very difficult to distinguish in hand sample. The rock is generally pale pink to tan and is thin- to thick-bedded. Most exposures appear thick-bedded but along strike thinly bedded layers are revealed on some weathered surfaces. Low-angle planar cross-bedding is visible locally. In general, this unit forms cliffs which are capped by the slope-forming upper member (map unit Ydu).

Yds  Dripping Spring Quartzite, undivided (Middle Proterozoic).

YP   Pioneer Formation (Middle Proterozoic)—Throughout the map area the Pioneer Formation is a dark purple, fine-grained, thinly bedded quartzite and gritty arkosic conglomerate. Exposures are in most places at least partially consumed by diabase sills that preferentially intruded the Pioneer Formation. Locally, the rock contains light yellow and green bleached zones 5-20 cm long parallel to bedding. Pale grey to tan reduction spots are common. East of Quartz Ledge Spring the unit contains rare lenticular chert clasts several centimeters long. The basal Scanlan conglomerate member is discontinuous throughout the study area and is rarely more than about 3 meters thick. The Pioneer Formation forms dark-colored cliffs and steep slopes below lighter tan colored cliffs of the Dripping Spring Quartzite. Where weathering has produced a light tan patina, the two units are difficult to distinguish from a distance.

Ys   Scanlan Conglomerate member of the Pioneer Formation (Middle Proterozoic)—This metaconglomerate is moderately sorted and very strongly cemented. It contains well rounded clasts of white to grey vein quartz and grey quartzite in a sandy matrix of grey quartz and pink feldspar. Feldspar grains are angular and poorly sorted. This unit forms a small resistant cliff at the base of the Pioneer Formation. Locally it is between 3-4 meters thick, but in other places it pinches out such that psammite rocks of the Pioneer Formation are resting directly on granite. The unit is shown on the map where it is thicker than about 1.5 meters.
Granitic rocks

**Ygm** Medium-grained granite (Tertiary or middle Proterozoic)—This medium-grained leucocratic granite contains light grey subhedral feldspar, orange-grey quartz, and ~2% muscovite occurring as spaced, anhedral books. The rock forms very small resistant outcrops completely surrounded by the coarse-grained granite (map unit Yg) with sharp contacts. Jointing is parallel to bedding in the overlying Pioneer Formation (where the two units are in contact).

**Yg** Coarse-grained granite (middle Proterozoic)—This coarse-grained granite contains large 1-4 cm-long subhedral phenocrysts of pink to dark orange K-feldspar, in a matrix of milky grey quartz, light grey plagioclase, and biotite. Where plagioclase is very light grey it may be sericitized. In areas where the rock is orange biotite occurs as felty masses. Where the rock is fresher, biotite occurs in small fresh books up to about 6 mm wide. This rock forms rather smooth, light tan exposures. Outcrops are typically deeply weathered and crumble after a few blows with a hammer. The rock generally erodes into grus, but locally fresh samples are found as clasts weathering out of the younger conglomerate (map unit YXg). This unit forms sharp contacts with the older granite (map unit YXg). The major contact strikes northwest-southeast and parallels the southwest-facing escarpment. The contact does not appear to be a fault. From a distance the two granites are nearly indistinguishable. The presence of foliation in YXg and the absence of foliation in Yg suggests Yg is younger than YXg.

**YXg** Coarse to medium-grained granite (Middle Proterozoic)—This rock is coarse-grained to locally medium-grained, and contains abundant phenocrysts of pink, subhedral K-feldspar a few mm to about 1 cm wide, in a matrix of grey quartz, light grey plagioclase, and biotite (locally muscovite?). Larger, sparsely distributed K-feldspar megacrysts up to 3 cm long are commonly zoned. Plagioclase is less abundant than K-feldspar, and locally seems to be absent. Biotite is commonly partially altered to hematite and occurs in small felty clumps up to about 5 mm wide. Overall the rock weathers light orange to tan and commonly exhibits a weak to moderate varnish. It erodes into steep, blocky outcrops which shed angular clasts. In most places the rock is unfoliated or exhibits a weak, spaced foliation. Only in one place, immediately south of Forest Road 71 near the west edge of the map, is the foliation strong. Spencer and others (1999) subdivided this unit into a coarse-grained phase and an aplite phase. A finer-grained more leucocratic rock with similar mineralogy as YXg occurs as small irregular bodies with sharp contacts in the southwest part of the map area. The contacts were difficult to follow for very far and the two rocks were not mapped separately. The more leucocratic rock may be equivalent to the aplite phase of Spencer and others (1999). They also divided this unit into an older granite (Xg) and a younger granite (YXg) based on the presence or absence of foliation. The very similar mineralogy of these two rocks suggests that they are the same unit. This granite is mineralogically and texturally similar to the Young granite to the northeast and to the older medium- to fine-grained granite in the southwest part of the Four Peaks quadrangle (in press) to the southwest.

Metamorphic rocks

**Xr** Metarhyolite (Middle Proterozoic)—This crystal-rich rock contains subhedral 1-3 mm-wide phenocrysts of light grey K-feldspar and less abundant grey quartz, in a tan aphanitic
matrix. The lower part of the unit contains abundant 1-10 cm-long clasts of dark grey phyllite. The clasts are disc-shaped and are oriented with the plane of the discs parallel to the plane of foliation. This area also contains well-rounded cobbles of quartzite and felsic volcanic rocks. There is no visible pumice in the lower part but the rock resembles a lithic tuff. Exposures farther north and west do not contain any foreign lithics but contain the same phenocrysts and was probably one or more rhyolite flows.

**Xq** Quartzite (Middle Proterozoic)—Light blue-grey to purple, clean, coarse-grained quartzite. Medium bedded. Bedding and cross-bedding are defined by thin laminations of detrital iron-oxide minerals. Contains gritty to pebbly conglomerate layers containing subrounded white quartz and red jasper (chert) up to ~2 cm across. Thin, irregular and locally parallel quartz veins pervasively cut the rock. Towards the top and bottom the unit is locally interbedded with dark grey quartz-rich phyllite. The upper contact is gradational over about 5 meters. Beautifully exposed folds are visible on the ridge immediately northwest of Del Shay Spring. Forms a resistant ridge in the northwest corner of the quadrangle.

**Xs** Metasiltstone (Middle Proterozoic)—Medium grey-green slightly metamorphosed sandstone and siltstone. Thinly bedded. Locally phyllite. Bedding, ripples, and minor cross-bedding features are still visible locally. Bedding is defined by thin laminations of detrital iron-oxide minerals. A weak foliation is parallel to bedding. Intruded by at least one intermediate dike and white quartz veins ~5 cm wide with attitude N130°E, 77°S.

**Xmv** Mafic metavolcanic rocks and greenstone (Middle Proterozoic)—This dark grey-green to steel grey rock contains abundant 1-3 mm-wide vesicles filled with silica, surrounded by a chlorite-rich fine-grained matrix. The silica amygdules were originally subspherical but have been partially deformed and extended in the direction of foliation, such that they are now oblate spheroids and rods. Locally the rock contains abundant spots of fine-grained hematite and is heavy. Towards the base of the unit silica-filled amygdules are not present and the rock is a fine-grained green phyllite, or greenstone. In these areas fresh surfaces are dark grey and fine-grained to massive. Weathered surfaces show fine-grained quartz and muscovite with larger 5 mm lenticular clots of quartz and others of epidote, both parallel to the foliation. These clots may be relict clasts in a siltstone protolith. Locally, near the contact with granite, the rock is compositionally banded with 1mm- to 1 cm-thick bands defined by sillimanite and mica. This entire sequence forms a steep slope below the overlying siliciclastic units and is mostly covered by colluvium.

**Xf** Felsite (Middle Proterozoic)—This rock is mostly aphanitic, but contains small granular phenocrysts of feldspar, quartz and biotite ± muscovite. It weathers into light tan, angular fragments. Foliation is defined by slight color differences and is only visible on weathered surfaces. Fresh surfaces are darker tan to purple-grey. Breaks almost conchoidally. It is very similar to the intrusive rhyolite at Boulder Mountain to the southwest in the Mazatzal Mountains, and may be an extrusive equivalent. At one location the top-most 1 meter contains dark grey lenticular clots which may be fiamme (welded?). Wessels (1991) correlated this rock with the Flying W Rhyolite.