Geologic map and report for the Avondale SW 7.5′ Quadrangle, Maricopa County, Arizona

by

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INTRODUCTION

The Buckeye Hills are located approximately 30-40 km west-southwest of Phoenix, Arizona, directly south of the Town of Buckeye (see figure 1). Regionally, the Buckeye Hills are sandwiched between two broad alluvial bajadas. To the north, a vast alluvial plain slopes southward toward the hills from the White Tank Mountains, while to the south, another broad bajada slopes northward from the Maricopa Mountains, also toward the hills. The Gila River skirts the northern edge of the bedrock as it flows west across the northern part of the quadrangle.

Although some of the taller hills project over 600 feet above the surrounding plain, topographic relief in the map area is typically very low. Much of the bedrock has been eroded into low-relief pediments. From a distance these pediments deceptively resemble extensive alluvial plains. Several episodes of erosion, sedimentation, and entrenchment have resulted in a myriad of dissected alluvial deposits across the pediments.

The Buckeye hills are composed chiefly of three distinct early Proterozoic granitic rocks: (1) a coarse-grained granite, (2) a medium- to coarse-grained granite and (3) a fine-grained granite. Two varieties of fine-grained granite were mapped in the Buckeye quadrangle to the west, but only one variety was seen in the Avondale SW quad. All of the granitic rocks are foliated. Minor, non-foliated pegmatite dikes (not mapped) cross-cut the fine-grained granite and appear to post-date deformation.

Field work was carried out between November, 2001 and March, 2002. Two days a week were spent in the field for a total of about 36 days of fieldwork for the Buckeye and Avondale SW quads together. The surficial deposits in the southern part of the quadrangle were mapped using aerial photos from the BLM dated at 6/12/78. The Gila River flood plain was mapped using digital photos (not in stereo) obtained from the Maricopa County Flood Control District taken in 2001.

PREVIOUS WORK

Miller (1987) created the first detailed map of the Buckeye Hills in the Buckeye 7.5' quadrangle immediately to the west. She focused on the fine-grained granite (the 'Buckeye Pluton', as she called it) and recognized that it is a peraluminous two-mica (biotite + muscovite) granite with chemistry consistent with other Proterozoic peraluminous granites in the southwest. Sommer (1982) studied the rocks in the northeast section of the Avondale SW quad, and eastward to the north end of the Sierra Estrella, where he determined metamorphic conditions of ~725°C and ~5.5 Kbars (upper amphibolite metamorphic facies). Melchiorre (1993) mapped the bulk of the Sierra Estrella and described the petrology and structure of the range. Cunningham and others (1987) mapped the Maricopa Mountains to the south. They identified a fine-grained peraluminous granite, which Reynolds and Dewitt (1991) informally called the 'granite of Cotton Center', intruding an extensive coarse-grained granite, which Reynolds and Dewitt (1991) informally called the 'granite of the Maricopa Mountains'. Reynolds and Dewitt (1991) determined that rocks in the Maricopa Mountains were also metamorphosed to the upper amphibolite facies. Potochnik (2001) made subsurface interpretations based on seismic lines in the Maricopa Mountains region. This author did some reconnaissance mapping in the Buckeye Hills in 1993 that was incorporated into the 1:100,000 geologic map of the Phoenix South 30′ x 60′ quadrangle (Reynolds and Skotnicki, 1993). This quadrangle was studied concurrently with mapping to the west in the Buckeye quad.

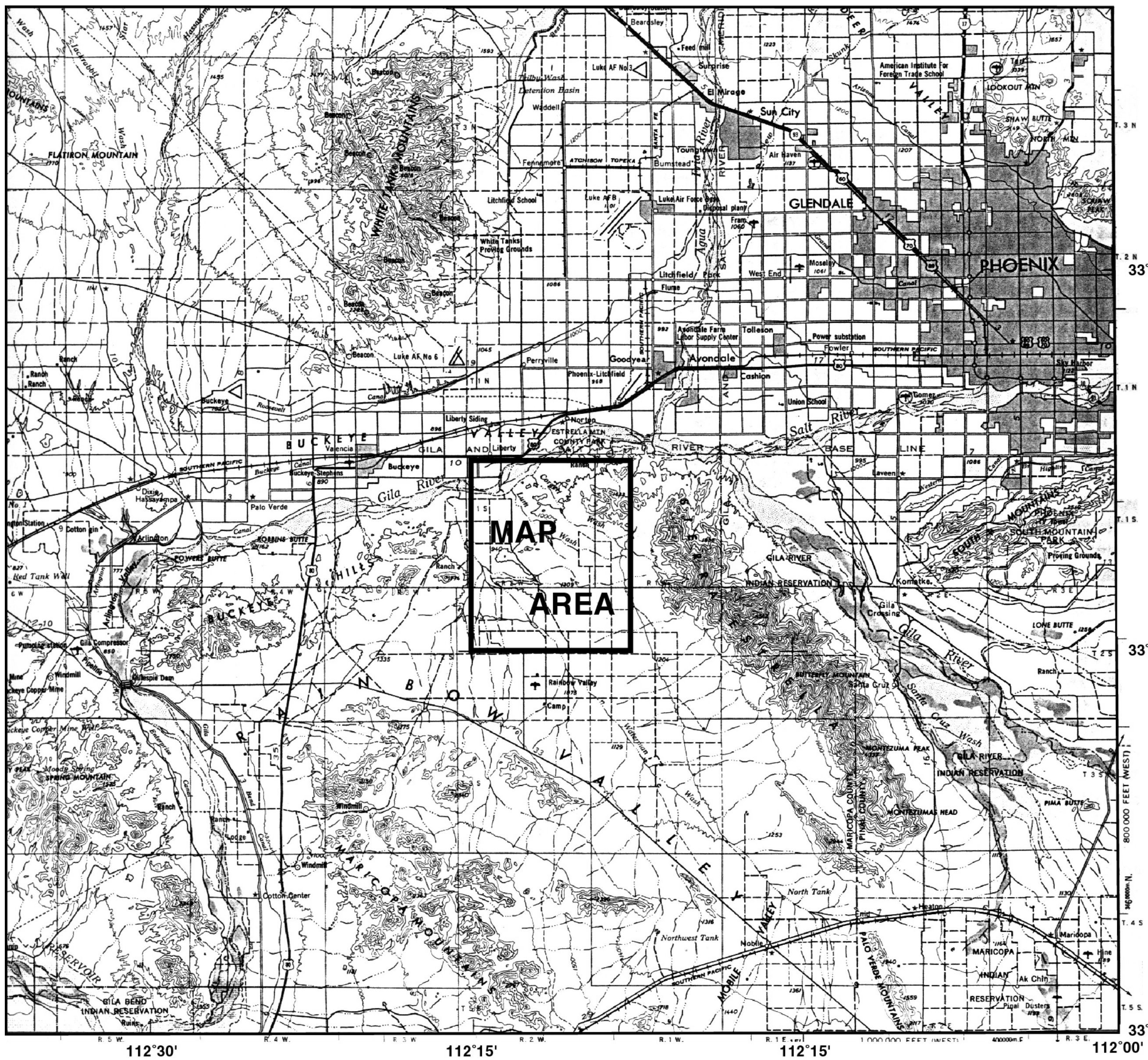

Figure 1. Index map showing the location of the Avondale SW 7.5' quadrangle.

COARSE-GRAINED GRANITE (Maricopa Granite; map unit Xgc)

The coarse-grained granite that crops out in the central part of the map area is very distinct from the other granites in the region. At first glance the granite resembles the typical ~1.4 Ga granites exposed elsewhere in the state. It is very coarse-grained, with K-feldspar phenocrysts up to 2 cm across. The K-feldspar phenocrysts are typically light gray and only locally pink. Biotite varies from about 5% to locally 15%, but overall is mostly between 5 and 10%. Biotite occurs as thin anhedral books and aggregates locally partially altered to hematite and/or chlorite. Cunningham and others (1987) mapped this unit in the Maricopa Mountains to the south as "porphyritic granite". Reynolds and DeWitt (1991) later gave it the informal name "granite of the Maricopa Mountains". Since the boundaries and character of this pluton are now fairly well mapped and understood the more formal designation, "Maricopa Granite", is here proposed.

Most exposures of the Maricopa Granite show strong tectonic foliation to mylonitic foliation. Some of the best-exposed and accessible mylonitic fabrics outcrop in the hills in section 15, T. 1 S., R. 2 W., and on the top of the hill surrounded by houses in the northwest corner of section 14, T. 1 S., R. 2 W. In these areas, and others, the coarse-grained granite has undergone severe stretching and grain-size reduction, such that the original K-feldspar phenocrysts are barely recognizable or are completely obliterated. The matrix of these rocks is a combination of fine-grained quartz, plagioclase, some K-feldspar, biotite, and abundant zircon. Feldspars are locally extensively replaced by fine-grained muscovite. Smeared out biotite and quartz (and zircon in thin-section) define the foliation and a strong lineation. Recrystallization outlasted strain in these highly deformed rocks. As a result, in thin-section the rocks show an annealed, sutured, mosaic pattern with no visible strain shadows nor pronounced undulatory extinction in quartz. Most boundaries between quartz crystals are very irregular and sutured. Small quartz grains commonly occur at the boundaries between the larger quartz grains. Reynolds and Dewitt (1991) recognized this same recrystallization in similar rocks to the south.

The contact between the Maricopa Granite and the leucocratic granite (map unit Xgl) is sharp. Nowhere do obvious dikes of one intrude the other. The Maricopa Granite is intimately associated with the leucocratic granite in the eastern part of the Buckeye quadrangle, where both granites form long, lenticular bodies within the other. Because of these relationships, it is not certain which granite intrudes the other. Because this same leucocratic granite (if it really is the same) intrudes the Maricopa Granite to the south (Cunningham, 1987) and southwest (Gilbert, 1991) it has been inferred here that Xgl intrudes Xgc. The contact between the Maricopa Granite and the Corbett Wash Granite (map unit Xg) is not exposed and the age relationship between these two granites is uncertain.

In sections 35 and 36, T. 1 S., R. 2 W., in the south-central part of the map area, the Maricopa Granite is associated with a darker, fine-grained intrusive rock. The fine-grained rock is composed of feldspar, quartz, accessory zircon, sphene and apatite, and abundant biotite ± amphibole. Many exposures contain abundant, larger, outsized K-feldspar phenocrysts up to 1 cm across, 'floating' in the fine-grained groundmass. Besides being more mafic and finer-grained the overall mineralogy of the fine-grained rock is similar to the mineralogy of the coarse-grained granite, and in this respect it resembles restite. The mineralogy and texture of this rock is also identical to fine-grained, pebble- to cobble-sized, dark-colored inclusions sparsely distributed within the Maricopa Granite.

MEDIUM- TO COARSE-GRAINED GRANITE (Corgett Wash Granite; map units Xg)

This medium- to coarse-grained biotite granite also contains subhedral microcline phenocrysts but is distinct from the Maricopa Granite (map unit Xgc) in two ways: (1) this unit is overall finer-grained than the Maricopa Granite, and (2) biotite in this rock occurs as thin, fresh, black, individual crystals distributed rather evenly, rather than in books. The granite is exposed in the northeast part of the quad where it forms steep hills and low pediments. In the Avondale SW quad the rock tends to weather into small subrounded to subangular boulders and cobbles. The granite is homogeneous over large areas, but varies slightly in texture from slightly coarse-grained and K-feldspar-porphyritic to more medium-grained and nearly equigranular.

The formal name “Corgett Wash Granite” is here proposed for this granite. This unit is named for the large wash that cuts through exposures of this granite in the northern part of the Avondale SW quad. No other place-names are available in the Buckeye quad and the name ‘Buckeye Granite’ was not adopted to avoid confusion with Miller’s (1987) name of ‘Buckeye Pluton’ that she used to refer to the leucocratic granite.

The contact between the Corgett Wash Granite and the leucocratic granite (map unit Xgl) is much more complex than is shown on the map. Where dashed, the contact is actually a zone nearly 1/3 of a mile wide where both granites are intimately interlayered in thin south- and southeast dipping sheets parallel to the local foliation. Time constraints prohibited detailed mapping of this contact zone. Individual sheets range in thickness from 10 cm to 20 meters or more. Contacts between sheets are sharp. Although the contacts are locally slightly discordant to foliation on a large scale they are parallel to foliation. The overall concordant relationship between foliation and intrusive contacts strongly suggests that intrusion of one or both granites was controlled by the existing strain field. One or both of these granites may have intruded syntectonically.

LEUCOCRATIC GRANITE (Cotton Center Granite; map unit Xgl)

This fine- to medium-grained leucocratic granite contains ~5-10% biotite and muscovite. The texture of this unit as mapped varies from fine-grained equigranular to slightly K-feldspar porphyritic. Locally muscovite is more abundant than biotite, and vise versa. Locally, the rock contains books and rounded porphyroblast-like crystals of coarse-grained muscovite. Most outcrops are light to medium gray and weather into steep hills, with variable amounts of varnish. A primary tectonic foliation defined by alignment of micas is difficult to see where micas are sparse. Locally micas are concentrated in specific layers, alternating with lighter-colored leucocratic layers, giving the rock a banded, locally gneissic appearance. Lineation is weak to strong. Considering the surrounding granites show mylonitic deformation, this rock has probably has also probably undergone mylonitic deformation, although the fine-grained nature of the rock and subsequent recrystallization have masked the original mylonite fabric. As described above, the contact between the Cotton Center Granite and the Corgett Wash Granite is a more complex than is shown on the map.

Cunningham and others (1987) mapped a fine-grained leucocratic granite to the south in the Maricopa Mountains. Reynolds and Dewitt (1991) informally named this granite the ‘granite of Cotton Center’ for large exposures of this granite east of the hamlet of Cotton Center. Gilbert (1991) mapped a fine-grained leucocratic granite in the eastern Gila Bend Mountains and adopted the name ‘Cotton Center Granite’. Examination of these outcrops during this study has shown that these separate exposures are mineralogically and texturally identical. Hence, the more formal designation, “Cotton Center Granite” is here adopted. Miller (1987) showed that the geochemistry of this unit is more similar to other Proterozoic peraluminous granites than it is to younger Mesozoic two-mica granites.

TERTIARY DEPOSITS

The Tertiary sedimentary deposits can be divided into two distinct groups: (1) the older, tilted deposits, and (2) the younger untilted deposits.

The older deposits—the breccia unit (map unit Txg)—is composed of very poorly sorted conglomerates exposed in the southwest part of the map. These deposits are composed mostly of angular to rounded clasts of foliated Maricopa Granite (map unit Xgc) ranging in size from pebbles to large boulders 2 meters across. The large, subrounded boulders of Xgc are most conspicuous on the surface. The unit forms steep, dissected hills but no good exposures were found in any of the gullies. Rare exposures of similar deposits to the west in the Buckeye quad show no bedding and contain large shattered blocks of both map units Xgc and Xgl. The matrix is silt, sand and grus. These deposits probably represent rock avalanche deposits shed from a nearby paleotopographic high that likely formed as a result of Tertiary faulting.

The younger Tertiary deposits (map unit Tsy) form rounded, moderately dissected hills in the northeast quadrant of the quadrangle. Bedding in these deposits (where visible) is subhorizontal and the deposits form wedges of material that thicken gradually away from the bedrock. These sediments contain abundant carbonate in the matrix. This commonly gives the unit a lighter tan appearance both on aerial photos and in the field. Exposures are strongly indurated.

The top of the younger Tertiary deposits on the south side of the main mass of the Cotton Center Granite (sections 13 and 24, T. 1 S., R. 2 W.) is at approximately the same elevation as the exposures of early Pleistocene alluvial deposits (map unit Qo). As mapped the early Pleistocene deposits also contain some younger Tertiary deposits, particularly where dissection is deep. Since most of the Qo deposits contain well-formed constructional surfaces with pavements they were mapped as Qo rather than Tsy.

STRUCTURE

Foliation

The primary S_1 foliation is defined mostly by the alignment of mica minerals. In the courser-grained granites containing more than about 5-10 biotite this foliation is obvious. In the finer-grained granites where mica content is typically less than about 5% foliation is more difficult to see. Also, thin-sections have revealed that there has been much recrystallization of quartz such that it forms rather equant grains and not elongated crystals that would better define mylonitic foliation.

The strike of the foliation is highly variable in the map area, forming both broad folds over several kilometers and smaller, tighter folds over several hundred meters. What is most striking about the primary foliation in the region is that it is commonly both low-angle and mylonitic. Dips between 45° and 10° are common. Although dip-directions are also highly variable, most foliations in the eastern part of the map dip either northeast or southeast. Rare asymmetric sheared feldspar augen, sheared quartz veins, and asymmetric west-vergent folds in the primary foliation all consistently indicate a top-to-the-west, reverse, thrust sense of movement. It should be kept in mind that unambiguous sense of shear indicators are not common, so this conclusion is based on very limited such features.

The relatively low-angle mylonitic foliation prompted other workers to interpret the fabrics as belonging to the lower plate of a possible metamorphic-core-complex terrane (S. Reynolds, pers. comm.). The South Mountain core complex lies only about 15 miles immediately to the east (Reynolds, 1980; Reynolds and Rehrig, 1980), so the presence of another core complex would not be surprising. However, even though low-angle mylonitic foliations are widespread in the Avondale SW quad there are no other features that indicate the existence of a core complex here (Sommer, 1982, stated the same thing, p. 98). For instance, there is no obvious detachment fault exposed, and no chloritic breccia. There is no 'mylonitic front'—the rather abrupt transition from less deformed rock up through protomylonite and mylonite adjacent to the detachment fault. Instead mylonitic fabrics are pervasive. Detailed mapping to the east in the Avondale SE quad might reveal some of these features. At the time Sommer (1982) made his map of the area these features had not yet been recognized anywhere. The age of the foliation remains uncertain.

Faulting and Mineralization

A northwest-striking fault in section 12, T. 1 S., R. 2 W., is defined by a poorly exposed, hematite-stained brecciated zone 2-3 meters wide within the Corgett Wash Granite (map unit Xg). Offset is unknown. About ½ mile to the northwest is a deep gully (on both sides of Estrella Mtn. Parkway—not on the map) exposing red, brecciated, hematite-stained granite. The exposure in the gully likely represents the extension of the aforementioned fault. Similar red, brecciated, hematite-stained granite is exposed in the center of section 8, T. 1 S., R. 1 W., where small pits have been dug. Another such zone is exposed in the deep gully in the southeast corner of section 8. The red zone here lines up with a small east-facing scarp bordering red-hematite-stained granite immediately outside the map boundary east of section 17, T. 1 S., R. 1 W.

Sommer (1982) mapped a low-angle fault immediately to the east of the map area in section 9, T. 1 S., R. 1 W., He mapped the fault as an "intensely brecciated zone with numerous slickensides" separating "granitic gneiss" above from "metasediments" below, and interpreted the feature as a thrust fault. From his map the feature is nearly flat-lying. Time constraints prevented an examination of this feature.

Potochnik (2001) examined several seismic lines between the Sierra Estrella and the Gila Bend Mountains. His interpretation indicates the presence of a shallow, west-southwest-dipping normal fault projecting westward under Rainbow Valley and approaching the surface on the west side of the Sierra Estrella. It is unknown if this feature, if it exists, is a low-angle detachment fault, and/or if it is related to ductile deformation in the Avondale SW quadrangle.

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UNIT DESCIPTION FOR THE
AVONDALE SW 7.5' QUADRANGLE
AZGS DGM-16

Quaternary and Tertiary Deposits

Piedmont Deposits

Qyc **Modern alluvium (modern channel deposits).** Unconsolidated sand and gravel in active stream channels. Deposits consist of stratified, poorly to moderate sorted sands, gravels, pebbles, and cobbles. These deposits are highly porous and permeable. Soils are generally absent.

Qy_2 **Holocene alluvium, younger member (<100 yrs).** These deposits are similar to Qy_1 deposits, but are slightly lower in the landscape and, thus, younger. These surfaces were mapped only in the far eastern part of the map area where they are more easily distinguishable from Qy_1 deposits by the greater abundance of vegetation (typically mesquite).

Qy_1 **Holocene alluvium, older member (<10 ka).** Unconsolidated sand to cobbles reaching sizes up to 20 cm in diameter upstream but smaller and fewer downstream. Larger clasts are fine- to medium-grained granites. Smaller clasts are subangular granitic grus. Qy deposits are characterized by stratified, poorly to moderately sorted sands, 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.

Ql **Late Pleistocene alluvium (10 to 250 ka).** Moderately sorted clast-supported sandstones and conglomerates. Ql surfaces are moderately incised by stream channels but still contain constructional, relatively flat interfluvial surfaces. Ql soils typically have moderately clay-rich tan to red-brown argillic horizons. These 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. Ql soils typically have Stage II calcium carbonate development. These surfaces are commonly slightly darker than Qm deposits in the region because the older soils generally contain more, lighter-colored carbonate closer to the surface.

Qm **Middle Pleistocene alluvium (250 to 750 ka).** In the western part of the quad detrital magnetite is locally so abundant that it forms placers. At first glance the anhedral to euhedral, bipyramidal magnetite clasts look nearly identical to the abundant similarly-sized varnished pebbles, but upon closer examination can commonly be distinguished by their dark, metallic sheen.

Qo **Early Pleistocene alluvium (750 ka to 1.2 Ma).** These moderately sorted conglomerates and sandstones are exposed only in the northern third of the map area where they form dissected platforms raised several meters above the surrounding middle Pleistocene alluvial deposits (map unit Qm). They contain angular to subrounded clasts derived from all local bedrock lithologies. Where constuctional surfaces are preserved a well-developed pavement is common. Surface clasts are commonly darkly varnished. Where the top of the soil horizon has been removed by erosion thick laminar caliche (stage IV) is common and in this area is commonly diagnostic for distinguishing Qo deposits from Qm. Interestingly, these deposits locally contain abundant, smooth boulders derived from nearly aphanitic light gray rhyolite dikes. The clasts commonly weather a light rusty orange and are obvious on pavement surfaces. Despite the abundance of these clasts locally, the source rock is exposed nowhere except as one small dike (not mapped) at the top of the hill in the northeast corner of section 13, T. 1 S., R. 2 W.

Axial River Deposits

Qyrc **Modern river channel deposits (< 100 years).** This unit consists of modern river channel deposits of the Gila River. They are composed primarily of sand, gravel, and well-rounded far-traveled cobbles. Deposits are typically moderately to poorly sorted and have well-preserved planar beds and cross-bedding where visible in dissected bars. There is no soil development in these deposits. Modern channels are entrenched up to 1 or 2 meters below adjacent young terraces. The current entrenched channel configuration began to evolve with the development of arroyos in the late 1800's, and is continuing to evolve through this century. As mapped, the current configuration reflects modification of the active channel after the major floods of 1993. Channels are extremely flood prone and are subject to deep, high velocity in moderate to large flow events. Channel banks formed in weakly consolidated Holocene deposit and are subject to severe lateral erosion during floods. As mapped, this unit includes both map units Qyrc and Qyr_2 that were mapped separately to the west in the Buckeye quadrangle. The two units were lumped together here due to a lack of air photo coverage in the northern part of the Avondale SW quadrangle.

Qyr_1 **Holocene terrace deposits (< 10 ka).** Deposits associated with low terraces the Gila River. Typically, they are broad, flat surfaces that are on the fringes of and less than 2 m above the active floodplain, but small channels exist in some places within this unit. Deposits are generally fine-grained, but locally surfaces have weak, discontinuous gravel lags composed of mixed lithologies. Soil development is weak, with cambic horizons and carbonate filaments (stage I calcic horizons). Surface color typically is light brown, and surface clasts have no varnish. Portions of the Qyr_1 surfaces may be inundated in the largest floods.

Tertiary Deposits

Tsy **Late Tertiary sedimentary deposits.** These interbedded conglomerates and sandstones are exposed mostly along the southern edge of the steep hills in the northeast quarter of the quadrangle. Here, these poorly sorted deposits contain mostly angular to subrounded pebbles to small boulders of leucocratic granite (map unit Xgl), and lesser amounts of other local rock types. Deposits in westernmost exposures are locally monolithic and contain cobble- to boulder-size clasts of coarse-grained granite (map unit Xgc). The matrix of this unit is commonly cemented by carbonate. Exposures are well indurated and commonly form small cliffs where dissected by streams. Elsewhere exposures form high rounded hills.

Txg **Breccia** (**Middle to Late Tertiary).** This unit consists of rock fragments of all sizes up to 2 meters across, completely unsorted. Some fragments are subrounded but most are subangular to angular. Most clasts are Maricopa Granite (map unit Xgc). Large, subrounded, spheroidally weathered boulders of Xgc are prominent on the surface. Although the deposits form steep, dissected hills with many gullies, no fresh exposures or bedding were seen. These deposits probably represent rock avalanche deposits.

Tertiary or Proterozoic Intrusive Rocks

TXr **Rhyolite dike (Tertiary or Proterozoic).** This rock contains large round phenocrysts of clear-gray quartz up to 8 mm across, subhedral thin books of green biotite 1-4 mm across mostly altered to chlorite, and spots of epidote up to 2 mm across. The light gray aphanitic matrix contains abundant serricite. Quartz phenocrysts are conspicuous on weathered surfaces. These dikes are exposed only in sections 16 and 20, T. 1 S., R. 2 W.

Early to Middle Proterozoic Intrusive Rocks

YXd **Diorite (early to middle Proterozoic).** This coarse-grained, equigranular intrusive rock contains ~40-50% mafic minerals composed of dark green anhedral to subhedral biotite and hornblende in clots 0.5 to 1 cm across. Light gray areas are quartz and feldspar. Minor amber-colored sphene ~ 1 mm across is visible. In thin-section, plagioclase is locally extensively replaced by fine-grained muscovite. Most biotite has been replaced by chlorite. Amphibole exhibits light to dark green pleochroism and locally contains abundant quartz inclusions. One section contains ~15-20% subhedral to beautifully euhedral zircon. Quartz (~10%) is poikalitic to plagioclase. Most outcrops show no obvious foliation, but localized areas show a weak to moderate foliation. Texture is almost diabasic. The rock is very difficult to break but weathers into low, dark, crumbly outcrops in the northeastern part of the map area where it forms dike-like bodies both concordant and discordant to the local foliation.

Early Proterozoic Intrusive Rocks

Xgn **Mixed mylonitic rocks (early Proterozoic?).** This unit is a mixture of coarse-grained granite (map unit Xgc), medium- to course-grained granite (map unit Xg), leucocratic granite (map unit Xgl), and amphibolite (map unit Xa). All of these units are recognizable as separate lithologies but are arranged in thin *lit-par-lit* sheets tens of centimeters to tens of meters thick parallel to a strong, shallowly south-dipping, locally mylonitic foliation. From a distance of several meters rock outcrops are strongly banded. Locally this banding is gneissic but in many areas the individual lithologies can be distinguished. This unit was mapped only in sections 1 and 2, T. 1 S., R. 2 W., at the northern edge of the map area. The strongest compositional banding occurs to the west. Exposures to the southeast contain mostly medium-grained leucocratic granite (map unit Xgl?).

Xgml **Leucocratic granite (Xgl) and biotite-hornblende granodiorite (Xgr), undivided (early Proterozoic).** This unit contains irregularly shaped bodies of both the Cotton Center Granite and map unit Xgr. Both units are recognizable but time limitations prohibited detailed mapping.

Xgl **Leucocratic granite—Cotton Center Granite (early Proterozoic).** This fine- to medium-grained granite contains ~5-10% biotite and muscovite. The texture of this unit as mapped varies from fine-grained equigranular to slightly K-feldspar porphyritic.

Locally muscovite is more abundant than biotite, and vise versa. Locally, the rock contains books and rounded porphyroblast-like crystals of coarse-grained muscovite. Most outcrops are light gray and weather into sharp, jagged hills with little varnish. A primary tectonic foliation defined by alignment of micas is difficult to see where micas are sparse. Locally micas are concentrated in specific layers, alternating with lighter-colored leucocratic layers, giving the rock a banded, locally gneissic appearance. Lineation is weak to strong and this rock has probably has probably undergone mylonitic deformation, although the fine-grained nature of the rock and subsequent recrystallization have masked the original mylonite fabric. The contact between this unit and the medium- to coarse-grained granite is more complex than shown and includes thin, parallel, alternating *lit-par-lit* sheets of each rock parallel to the contact in a zone several hundred meters south of the mapped contact. Predominant alignment of contacts with foliation suggests this unit was emplaced syntectonically. Joseph Wooden reported a preliminary (unpublished) U/Pb age of about 1627 Ma for a sample of the Cotton Center Granite from southeast of Sheep Mountain in the Maricopa Mountains.

Xg **Medium- to coarse-grained granite—Corgett Wash Granite (early Proterozoic).** This medium- to coarse-grained granite is marginally equigranular to K-feldspar-porphyritic. Clear-gray quartz, plagioclase, and biotite surround subhedral microcline phenocrysts up to 1 cm across. Biotite typically occurs as dark, fresh, individual flakes dispersed rather evenly throughout the rock. This is in contrast to the thin books and aggregates of biotite in map unit Xgc. In thin-section, the rock consists of intergrown anhedral microcline, plagioclase, quartz, and 5-10% biotite. Quartz shows sharp to slightly undulatory extinction. Biotite is fresh. No muscovite is visible. Accessory minerals include abundant, large, anhedral to euhedral sphene, minor zircon, and large conspicuous opaque minerals. In relatively medium-grained, equigranular outcrops, sparse, subhedral magnetite crystals appear as conspicuous dark spots in the rock. This unit is named for the large wash that cuts through exposures of this granite in the northern part of the Avondale SW quad. No other place-names are available in the Buckeye quad and the name 'Buckeye Granite' was not adopted to avoid confusion with Miller's (1987) name of 'Buckeye Pluton' that he used to refer to the leucocratic granite.

Xgc **Coarse-grained granite—Maricopa Granite (early Proterozoic).** This coarse-grained granite contains 5-15% biotite (variable) in thin books, clear-gray quartz, light gray plagioclase, and bluish gray phenocrysts of K-feldspar 1-2 cm across. In the western part of the quad exposures are not as coarse-grained and megacrystic as they are in the east. Here, phenocrysts of light gray K-feldspar are locally as large as 1 cm across, but most exposures are relatively equigranular. In most areas biotite is weakly to strongly aligned in small felty clumps that define the foliation. Locally strongly foliated. Fine- to medium-grained leucocratic veins cut across foliation in the western part of the quad and parallel to foliation in the east. The unit typically weathers into rounded hills with crumbly outcrops. Disk-shaped mafic inclusions in the southwest corner of section 36, T. 1 S., R. 4 W. (in the Buckeye quadrangle) are parallel to a weak foliation defined by alignment of biotite. Together with much stronger alignment of dark-colored disk-shaped xenoliths in section 36, T. 1 S., R. 3 W., this alignment suggests this granite may have intruded in part syntectonically. Joseph Wooden reported a preliminary (unpublished) U/Pb age of 1641 ± 5 Ma for a sample from southeast of Sheep Mountain in the Maricopa Mountains. Eisele and Isachsen (2001) reported a U/Pb date of 1647 ± 1 Ma for a sample of granite in the Hassayampa 7.5' quadrangle that is probably coarse-grained Maricopa Granite.

Xgcm **Mafic phase of the coarse-grained granite (early Proterozoic).** This dark-colored rock has a similar mineral composition to that of the more widespread coarse-grained granite (map unit Xgc), but is typically fine- to medium-grained and contains a greater percentage of mafic minerals. The rock is commonly locally porphyritic. Large subhedral pink K-feldspar phenocrysts up to 1.5 cm across stand out from the finer-grained matrix containing abundant biotite and lesser amounts of pink and gray feldspar and gray quartz. Except for the larger K-feldspar phenocrysts this rock is nearly identical to dark-colored inclusions found locally in the coarse-grained granite.

Xgr **Biotite-hornblende granodiorite—"green granite" (early Proterozoic).** This predominantly medium-grained granite contains up to ~30% biotite and amphibole. Both mafic minerals are extensively altered to chlorite and give the rock a green color. The unit crops out only in the northeast corner of the map area where it is strongly foliated and locally weakly gneissic. Some grain-size reduction appears to have occurred locally. Outcrops are commonly varnished and appear dark gray-green. Eastern exposures are more homogeneous, whereas western exposures contain screens of fine- to coarser-grained leucocratic granites concordant to foliation (not mapped separately).

Xa **Amphibolite (early Proterozoic).** This dark gray to black rock contains fine- to medium-grained, interlocking, anhedral, black amphibole and biotite (commonly 50-60%, but locally nearly 100% amphibole), and light gray quartz and feldspar. The texture varies from fine-grained and nearly massive to medium-grained and 'spotted'. Porphyroblasts of intergrown fine-grained amphibole + biotite form dark spots up to 1 cm long, elongated parallel to foliation. Fine-grained leucocratic veins show very irregular anastamosing patterns. The mineralogy of the veins is similar to the leucocratic granite (map unit Xgl) but the veins locally separate irregularly shaped zones within the host rock of different textures. In this respect the veins look as though they were created by anatexis of the amphibolite itself. Outcrops vary from weakly foliated and nearly massive to platy. Where platy, foliation is defined by differences in grain-size parallel to the local foliation trend (more gneissic than tectonic), but many amphibole crystals are non-foliated and appear to be either syn- or post-tectonic.