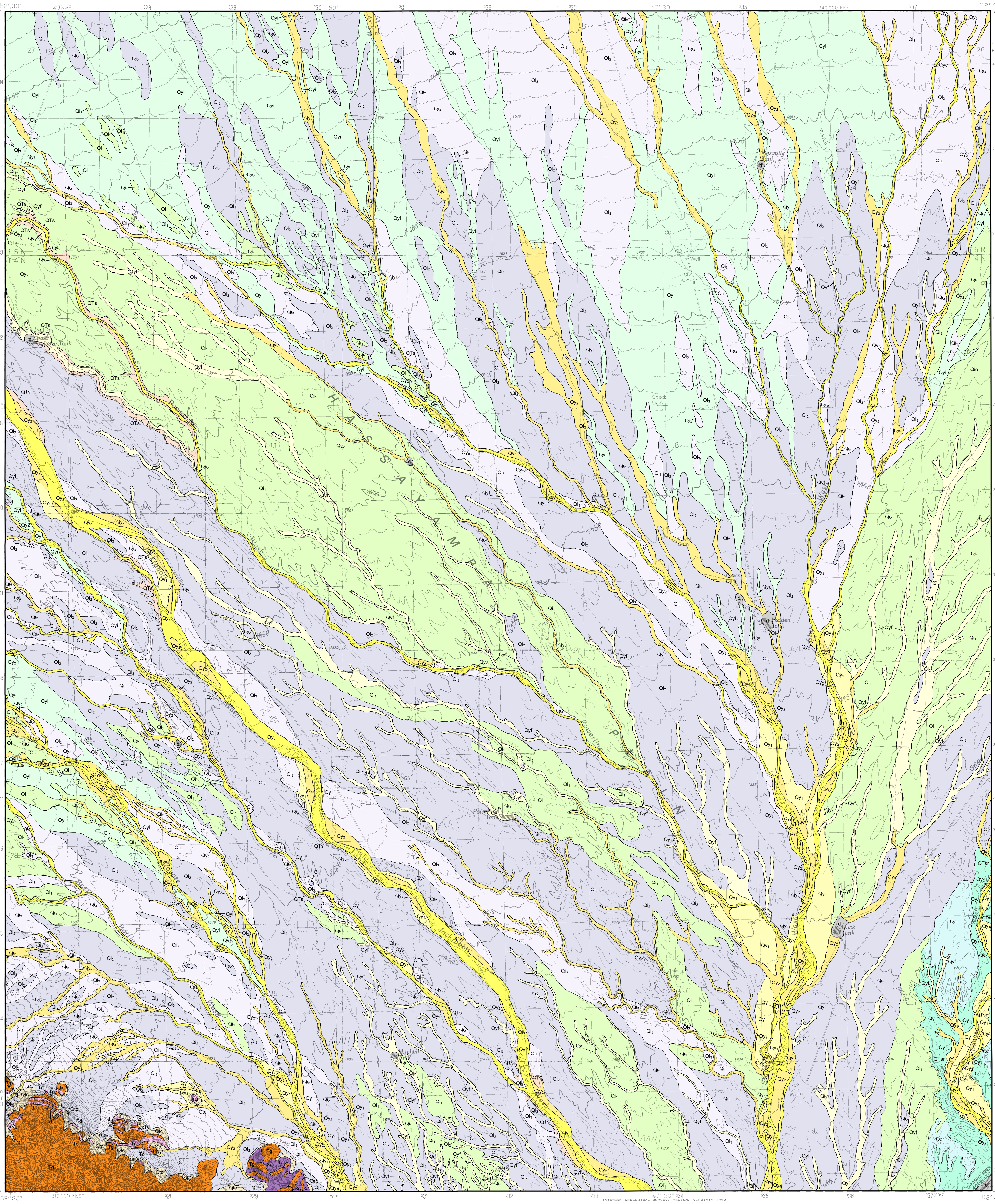

Topographic base from USGS 7½' Star Well quadrangle, compiled from aerial photographs taken 1951 and 1960; field checked in 1962. Transverse Mercator projection; NAD 27, UTM zone 12. Reprojected to NAD 83, stateplane feet. Magnetic declination 12°30' east of true north.

SCALE 1:24,000

contour interval 10 feet

Map Legend

Contact, accurate

Contact, approximate

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GEOLOGIC MAP OF THE STAR WELL 7.5' QUADRANGLE, MARICOPA COUNTY, ARIZONA

by Ann Youberg, Jon E. Spencer, and Charles A. Ferguson

Arizona Geological Survey Digital Geologic Map 42 (DGM-42), version 1.0

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Introduction

Star Well 7.5-minute quadrangle is located approximately 50 miles northwest of Phoenix and approximately 30 miles south of Wickenburg, in the Hassayampa Plain, northwestern Maricopa County. It was mapped in conjunction with other mapping efforts in adjacent quadrangles including Vulture Mine (DGM-41), Wickenburg SW (DGM-40), Daggs Tank (DGM-39), Wagner Wash Well (DGM-38), and Buckeye NW (DGM-37). It is part of a multi-year mapping project to produce complete geologic maps for the expanding Phoenix and Tucson metropolitan areas. Mapping was conducted between November 2003 and May 2004. Spencer and Ferguson mapped bedrock in and around the Belmont Mountains. Youberg mapped the surficial deposits.

Approximately 95% of the quadrangle is covered by Quaternary and late Tertiary distal piedmont deposits in a broad valley. The Belmont Mountains and associated piedmonts are in the extreme southwestern corner of the quadrangle. The Big Horn, Harquahala, and Vulture Mountains are to the west and north of the quadrangle and the Hassayampa River is just east of the quadrangle. Jackrabbit Wash, heading in the proximal piedmonts of the Big Horn and Vulture Mountains, and Star Wash, heading in the Vulture Mountains, are the two major drainages in the study area. These washes are incised up to four meters into older Pleistocene deposits. Smaller tributary washes drain adjacent older Pleistocene deposits and generally are not incised more than two meters.

The Belmont Mountains, which form a southeastern extension of the Big Horn Mountains, consist largely of a middle Tertiary granite that contains sparse fluorite as well as numerous northwest trending felsic dikes (Capps et al., 1985; Reynolds et al., 1985; Stimac et al., 1994; Spencer et al., 1995). The Belmont granite intrudes older Proterozoic metamorphic and granitic rocks that are exposed in the map area and at many locations in the Belmont Mountains. This granite was intruded during a several million year period of volcanic activity and extensional faulting that produced most of the rocks and structures in the Belmont and Big Horn Mountains. Most of this activity occurred between about 16 and 21 Ma.

The climate of the study area is warm and arid. Slightly less than half of the annual precipitation (30-40%) falls during the summer monsoon from July to September. Late summer rainfall occurs as heavy thunderstorms when moist air sweeps northwards from the Gulf of California and the Gulf of Mexico. Occasional intense late summer to early fall precipitation resulting from incursions of moist air derived from dissipating tropical storms in the Pacific Ocean can cause heavy flooding. One such flood occurred in Jackrabbit Wash during October 2000 (Youberg, 2002). Winter precipitation generally is caused by cyclonic storms originating in the Pacific. It is usually less intense and may be more prolonged, and therefore infiltrates into the soil more deeply than summer rainfall (summarized from Sellers and Hill, 1974).

Surficial Mapping Methods

Surficial mapping was conducted using natural-color (scale 1:24,000) aerial photographs from the Bureau of Land Management taken in 1979, and black and white high resolution digital orthophotographs (2001 and 2002) provided by Maricopa County Flood Control District. Preliminary unit designations were field checked throughout the map area and mapping was supplemented by observations and descriptions of soils and stratigraphy. The physical characteristics of Quaternary alluvial surfaces (channels, alluvial fans, floodplains, stream terraces) evident on aerial photographs and in the field were used to differentiate their associated deposits by age. Surficial deposits of this quadrangle were then correlated with similar deposits in this region in order to roughly estimate their ages.

The physical characteristics of Quaternary alluvial surfaces (channels, alluvial fans, floodplains, stream terraces) were used to differentiate their associated deposits by age. Alluvial surfaces of similar age have a distinctive appearance and soil characteristics because they have undergone similar post-depositional modifications. They are different from both younger and older surfaces. Terraces and alluvial fans that are less than a few thousand years old still retain clear evidence of the original depositional topography, such as of bars of gravel deposits, swales (troughlike depressions) where low flows passed between bars, and distributary channel networks, which are characteristic of active alluvial fans. Young alluvial surfaces have little rock varnish on surface clasts and have little soil development, and they are minimally dissected. Very old fan surfaces, in contrast, have been isolated from substantial fluvial deposition or reworking for hundreds of thousands of years. These surfaces are characterized by strongly developed soils with clay-rich argillic horizons and cemented calcium-carbonate horizons, well-developed tributary stream networks that are entrenched 1 to 10 m below the fan surface, and strongly developed varnish on surface rocks. The ages of alluvial surfaces in the southwestern United States may be roughly estimated based on these surface characteristics, especially soil development (Gile and others, 1981; Bull, 1991).

In this map, Quaternary surficial deposits are subdivided based on their source (axial valley stream and smaller tributary washes on piedmonts) and estimated age of deposits. Surface and soil characteristics were used to correlate alluvial deposits and to estimate their ages. Surface pits and exposures along cut banks were used to assess soil characteristics associated with deposits of different ages and from different sources. Soils and surfaces documented in the map area were generally correlated with soils and surfaces described in Quaternary mapping studies of adjacent areas conducted by Demsey (1988) and Field and Pearthree (1991). These correlations were also used to estimate the ages of surficial deposits in the map area.

Acknowledgements

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Unit Descriptions

Surficial map units

Piedmont Alluvium

Quaternary and late Tertiary piedmont deposits from the Vulture Mountains to the north, Big Horn Mountains to the west, and Belmont Mountains to the south cover most of the Hassayampa Plain within Star Well quadrangle. This alluvium was deposited primarily by larger streams, such as Jackrabbit Wash and Star Well Wash, that head in the mountains and proximal piedmonts; smaller streams that head on distal piedmonts have eroded and reworked some of these deposits. Deposits range in age from modern to Pliocene. Abbreviations are ka, thousands of years before present, and Ma, millions of years before present.

Qy_c — **Modern stream channel deposits (< ~1 ka)** – Active channel deposits composed of very poorly-sorted sand, pebbles, and cobbles with some boulders to moderately-sorted sand and pebbles. Channels are generally incised 1 to 2 m below adjacent Holocene terraces and alluvial fans, but may be incised as much as 4 m below adjacent Pleistocene deposits. Channel morphologies generally consist of a single thread high flow channel or multi-threaded low flow channels with gravel bars. Channels are extremely flood prone and are subject to deep, high velocity in moderate to large flow events, and severe lateral bank erosion. Flood flows may significantly change channel morphology and flow paths.

Qy_2 — **Late Holocene alluvium (<~2 ka)** – Young deposits in low terraces and small channels that are part of the modern drainage system. In upper piedmont areas, mainly near the Belmont Mountains, and along the larger drainages, unit Qy_2 sediment is generally poorly to very poorly sorted sand, pebbles, cobbles, and boulders; terrace surfaces typically are mantled with pebbles, sand, and finer sediment. On lower piedmont areas and in smaller tributary washes young deposits consist predominantly of moderately sorted sand and silt, with some pebbles and cobbles in channels. Channels generally are incised less than 1 m below adjacent terraces, but locally incision may be as much as 2 m. Channels are flood prone and may be subject to deep, high velocity flows in moderate to large flow events. Potential lateral bank erosion is severe. Channel morphologies generally consist of a single-thread high flow channel or multi-threaded low flow channels with gravel bars adjacent to low flow channels. Flood flows may significantly change channel morphology and flow paths. Local relief varies from fairly smooth channel bottoms to undulating bar-and-swale topography that is characteristic of coarser deposits. Terraces have planar surfaces, but small channels are common. Qy_2 deposits have no to weak soil development. Equivalent to unit Y2 (Field and Pearthree, 1991).

Qy_1 — **Holocene alluvium (~2 to 10 ka)** – Older Holocene terrace deposits found at scattered locations along incised drainages throughout the study area. Qy_1 surfaces are higher and less subject to inundation than adjacent Qy_c or Qy_2 surfaces. Along Jackrabbit Wash Qy_1 terraces were inundated during the October 2000 flood (Youberg, 2002). Qy_1 terraces are generally planar but local surface relief may be up to 1 m where gravel bars are present. Qy_1 surfaces are 1 to 2 m above adjacent active channels. Surfaces typically are sandy but locally have unvarnished open fine gravel lags or pebble and cobble deposits in the Belmont Mountains piedmont. Qy_1 soils typically are weakly developed, with some soil structure but little clay and stage I calcium carbonate accumulation (see Machette, 1985, for description of stages of calcium carbonate accumulation in soils). Yellow brown (10YR) soil color is similar to original fluvial deposits. Equivalent to unit Y1 (Field and Pearthree, 1991).

Qyf — **Fine-grained Holocene alluvium (<10 ka)** – Thin, fine-grain Holocene alluvial deposits formed in swales on early to mid-Pleistocene fan deposits. These deposits are very thin, typically less than ½ m, but locally may be up to 1 m thick. Sediment is mainly silt and sand, with occasional deposits of open, unvarnished, fine gravel lag. Soil development is minimal. Where it has developed soil is typically a sandy loam and strongly effervescent, from Pleistocene-aged source material, but with no visible carbonate accumulation.

Qyi — **Holocene and Pleistocene alluvium (<10 ka)** – Unit Qyi is composed of slightly incised alluvial fans and broad inset terraces that cover much of the northern portion of the quadrangle, and terraces and scoured benches along smaller tributary washes. Qyi surfaces are less than 1 m above active channels. They are primarily covered by a thin (< 1 m) veneer of Holocene fine-grained alluvium (Qy_2 and Qy_1) over reddened Pleistocene alluvium (Qi_2, Qi_1 or Qio) or eroded basin-fill deposits (QTs). The older units are exposed in scoured, eroded benches adjacent to active channels and in cut banks of washes. Holocene soils vary in development with color ranging from yellow brown (10YR) to slightly reddened (7.5YR) with no to weak subangular blocky structure and no to minor carbonate accumulation, although soils strongly effervesce due to source material. Coarse clasts within these deposits are typically reworked from older deposits and often exhibit carbonate coats or rinds.

Qi_3 — **Late Pleistocene alluvium (~10 to 130 ka)** – Unit Qi_3 is composed of slightly to moderately dissected relict alluvial fans and terraces. Active channels are incised up to about 2 m below Qi_3 surfaces, with incision increasing toward the mountain fronts. Qi_3 fans and terraces are commonly lower in elevation than adjacent Qi_1 and older surfaces. Qi_3 deposits consist of pebbles, cobbles, and finer-grained sediment. Qi_3 surfaces commonly have bar and swale topography moderately preserved, loose to moderately packed pebble and cobble lags, and are moderately reddened. Surface clasts exhibit weak to moderate rock varnish. Lag on some surfaces in the northern and eastern areas of the quadrangle are composed mainly of volcanics and are darkly varnished. Qi_3 soils are moderately developed, with orange to reddish brown (7.5 YR) clay loam to light clay argillic horizons and stage II calcium carbonate accumulation. Equivalent to unit M2 (Field and Pearthree, 1991).

Qi_2 — **Middle Pleistocene alluvium (~130 to 500 ka)** – Unit Qi_2 is composed of moderately to highly dissected relict alluvial fans with strong soil development found throughout the map area. Qi_2 surfaces are drained by broad swales and well-developed, moderately to deeply incised tributary channel networks; channels are several meters below adjacent Qi_2 surfaces. Well-preserved, planar Qi_2 surfaces are smooth with scattered pebble and cobble lags; surface color is reddish brown; surface clasts are moderately to strongly varnished. More eroded, rounded Qi_2 surfaces are characterized by strongly varnished, scattered, cobble to cobble and pebble lag. Soils typically contain reddened (5 YR), clay argillic horizons, with obvious clay skins and subangular to angular blocky structure. Underlying soil carbonate development is stage III and locally stage IV, with abundant carbonate through at least 1 m of the soil profile. This unit approximately correlates to Field's and Pearthree's (1991) unit M1b.

Qi_1 — **Middle to Early Pleistocene alluvium (~500 ka to 1 Ma)** – Unit Qi_1 is composed of deeply dissected relict alluvial fans. Qi_1 surfaces form rounded ridges that are higher than adjacent Qi_2 surfaces. Drainage networks include broad swales on the ridge tops and tributary channels incised 3 to 4 m. Eroded QTs deposits are occasionally exposed along some ridge slopes and along wash banks. Well-preserved Qi_1 surfaces have moderately to tightly packed cobble, boulder, and pebble lag. Surface clasts are strongly to very strongly varnished and often have carbonate rinds up to 2 mm. More eroded, rounded Qi_1 surfaces are characterized by very strongly varnished, scattered, cobble and boulder lags with exposed laminar carbonate horizons. Where well preserved, Qi_1 soils are strongly developed with a dark red (5-2.5 YR), heavy clay argillic horizon and subangular blocky to prismatic structure. Carbonate accumulations are 1-2 m thick and range from stage IV - V. This unit approximately correlates to Field's and Pearthree's (1991) unit M1a.

QTs — **Early Pleistocene to Pliocene alluvium (~1 to 5 Ma)** – Unit QTs is composed of deeply dissected and highly eroded alluvial fan deposits overlain by younger Quaternary units. QTs is mainly exposed on ridge slopes, in wash banks, and in channels as strath terraces. The thickness of QTs deposits is not known. Unit QTs includes poorly sorted, subangular to subrounded, matrix supported, carbonate cemented, tan, pebble to cobble conglomerates, moderately to well sorted, subangular to subrounded, moderately indurated, cross-bedded, red, pebbly sandstones, and buried paleosols.

Axial Stream Deposits

Sediment deposited by the Hassayampa River covers a north-south-trending strip in the extreme southeast corner of the quadrangle. Surfaces consist of very old floodplain and channel deposits. Deposits are a mix of cobbles, pebbles, sand and finer material; they exhibit mixed lithologies and a higher degree of clast rounding, reflecting the large drainage area of this watershed.

Qor — **Early Pleistocene river alluvium (~1 to 2 Ma)** – Unit Qor represents the oldest, highest terraces and floodplain deposits along the Hassayampa River. Deposits are moderately to poorly preserved and incised 10 to 15 m. Qor surfaces consist of moderately sorted, moderately to well rounded, darkly varnished, cobble, pebble, and boulder pavements. Qor deposits vary from cobbles and boulders to sand, silt and pebbles with stage IV - V calcic horizons. Where surfaces are preserved soil development is strong with red (5YR), clay argillic horizons. Equivalent to unit Ort (Field and Pearthree, 1991).

QTsr — **Early Pleistocene to Pliocene river alluvium (~1 to 5 Ma)** – Unit QTsr consists of deeply dissected and highly eroded alluvial fan deposits from the ancestral Hassayampa River. QTsr surfaces are broadly rounded ridges with ridgecrests typically 10 to 15 meters above adjacent active channels. The thickness of QTsr deposits is not known. QTsr deposits include moderately to well sorted, subrounded to rounded, massive, tan, sands, pebbles and cobbles; poorly to moderately sorted, subrounded to rounded, tan, cobble and pebble lenses, and moderately sorted, subrounded to rounded, cross-bedded, red, sand to sand and gravel. Soils on ridgecrests are dominated by carbonate accumulation, which is typically stage IV to V. Small pockets of preserved Qor may be found along QTsr ridges. Equivalent to unit Org (Field and Pearthree, 1991).

Other Deposits

Qtc — **Holocene and Pleistocene hillslope colluvium** – Unit Qtc consists of locally-derived deposits on moderately steep hillslopes in the Belmont Mountains. Colluvium is very extensive in the mountains, but is mapped only where sufficiently thick and extensive as to obscure underlying bedrock. Deposits are very poorly sorted, ranging from clay to cobbles and boulders. Clasts typically are subangular to angular because they have not been transported very far. Bedding is weak and dips are close to the steep depositional environment. Deposits are a few meters thick or less; thickest deposits are found at the bases of hillslopes. Some stable hillslopes are covered primarily with Pleistocene deposits, which are typically reddened and enriched in clay. Other more active hillslopes are covered with Holocene deposits, which have minimal soil development.

d — Disturbed – These are areas where the ground has been heavily disturbed and original deposits obscured. Typically these represent stock tanks but may include quarry areas or the CAP canal.

Mineral deposits

Fine grained to aphanitic, dark gray to almost black mafic dikes are associated with locally pervasive iron-oxide alteration and minor copper mineralization. At one location on the north flank of the Belmont Mountains (UTME 327402, UTMN 3722315), a 1-5 m thick, subhorizontal mafic dike contains numerous fractures along which severe iron-oxide alteration has occurred. Approximately 10% of the dike is so altered that the protolith dike rock is unrecognizable, and about 20% is unaltered. Surface activity (bulldozer cuts) is significant, and gold is suspected to have been the target of prospecting activity.

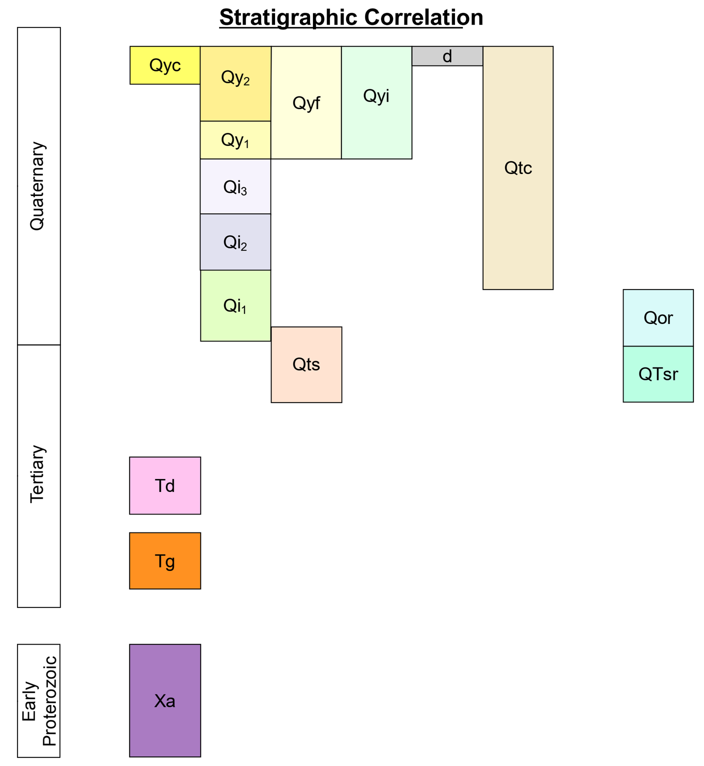
Bedrock map units

Td — Dacite dikes (Tertiary) – Pale tan to pale grayish tan, intermediate composition dikes containing 4-8% <2 mm plagioclase, 1-2% <2 mm altered biotite, and <1% <1 mm hornblende(?). These dikes locally grade into nearly holocrystalline hypabyssal intrusions with 5-10% <2 mm quartz, 60-80% <5 mm feldspar, 1-3% <2 mm biotite. Small isolated hill north of the Belmont Mountains includes a dike containing 10-15% 1-3 mm quartz, approximately 40% feldspar, and 1-2% <2 mm biotite. At one location (UTME 326084, UTMN 3722994), an exposure of this unit contains abundant, 1-20 cm, fine grained, mafic xenoliths.

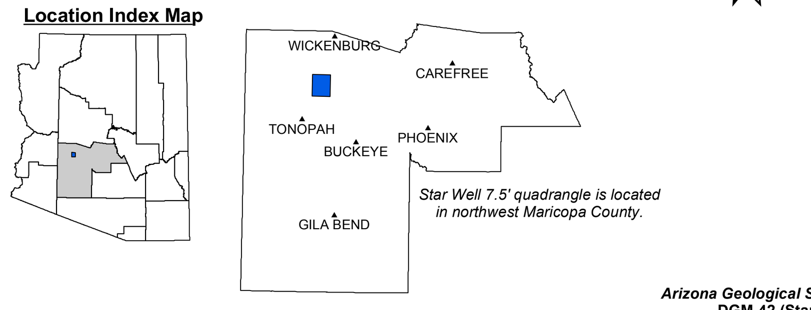
Tg — Belmont Granite (Tertiary) – Fine-grained quartz-rich granite containing miarolitic cavities and 2-3% <3 mm biotite. Chilled margins are visible where granite intrudes amphibolite schist.

Xa — Amphibolite schist (Early Proterozoic) – Fine- to medium-grained amphibolite schist and banded, mafic-rich orthogneiss with lesser amounts of biotite schist, sericite schist, phyllite, and psammitic schist. Small isolated hill north of the Belmont Mountains consists of dark greenish gray quartzose phyllite to fine-grained psammite in which phyllitic character is apparent on foliation surfaces but secondary phyllosilicates are too small to see with a hand lens.

Stratigraphic Correlation



Location Index Map



Star Well 7.5' quadrangle is located in northwest Maricopa County.