Geologic map of the Black Peak and Bobs Well 7 ½' Quadrangles, La Paz County, Arizona

Arizona Geological Survey
Digital Geologic Map 108 (DGM-108), version 1.0

by
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Introduction

The Black Peak and Bobs Well 7 ½' Quadrangles are located approximately 20 km southeast of the town of Parker in La Paz County, western Arizona. The Quadrangles encompass Cactus Plain, as well as part of Osborn Wash and the basaltic Black Peak massif. Geologic mapping was done under the joint State-Federal STATEMAP program, as specified in the National Geologic Mapping Act of 1992, and was jointly funded by the Arizona Geological Survey and the U.S. Geological Survey under STATEMAP assistance award #G12AC20464. Mapping was compiled digitally using ESRI ArcGIS software.

Surficial Geology

Most of the map area is covered by sand dunes and related features of Cactus Plain. The dune field of Cactus Plain is on a low plateau formed primarily on older eroded sediments, with minor bedrock hills protruding from the plain locally. The oldest late Cenozoic deposits in Cactus Plain are undeformed fan deposits composed primarily of crystalline metamorphic clasts, obviously derived from the east and northeast. These deposits are overlain by, and locally may interfinger with, fine-grained clay, silt, sand and minor limestone deposits that we consider to be part of the Bouse Formation. Bouse carbonate deposits are also extensively exposed on the flanks of Black Peak and related hills near the northern margin of the map area. On the western, northeastern, and southern margins of Cactus Plain, there are extensive well-rounded, lithologically diverse gravel and sand deposits that we tentative correlate with the early Pliocene Bullhead alluvium. This major river aggradation sequence is found all along the Colorado River below the mouth of the Grand Canyon (House et al., 2008; Howard et al., in prep.). Much more extensive areas are covered by poorly exposed fine-grained deposits whose upper, eroded surface is covered by minor sand and open gravel lag. Many of these deposits may be part of the Bouse Formation as well, but others are almost certainly younger and are associated with the Bullhead alluvium and the Quaternary dune field. Most of the dune field consists primarily of sinuous, NE-trending medium to large dunes, and interdune areas covered by sand sheets, small dune features, and eroded surfaces on finer-grained underlying deposits. In the eastern part of the map area, the dominant dune morphology is much lower crescent dunes, with very complex dune patterns. Quaternary fluvial deposits are limited to an extensive area associated with Osborne Wash and tributaries in the north, a small portion of Bouse Wash in the southwestern corner of the map, and an unnamed wash system on the south flank of the Black Peak hill complex. In addition, minor local fluvial systems drain to the south and west across parts of the dune field and have eroded the southern flank of the field.

Bedrock Geology

Miocene basalt and underlying tilted red sandstone make up Black Peak at the northwestern edge of the map area, whereas farther east, primarily felsic to intermediate volcanic rocks are exposed at the northern edge of the map area (Grubensky, 1989). The mylonitic footwall of the Buckskin-Rawhide extensional detachment fault (Spencer and Reynolds, 1991) is exposed at the northeastern edge of the map area. Metamorphosed and deformed Paleozoic and Mesozoic strata are exposed in several small hills in the western part of the map area. The basaltic and felsic volcanic rocks are not cut and displaced by the detachment fault, but underlying sandstone and older metamorphic rocks are tilted or affected by hydrothermal alteration, as is characteristic of rocks that were displaced by detachment faulting (Spencer and Reynolds, 1989).

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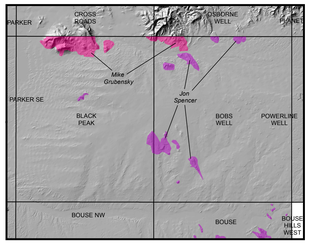
Sources of map data

Surficial mapping compiled by P.A. Pearthree



Structure symbols

- bedding
- mylonitic foliation
- mylonitic lineation
- gneissic layering
- tectonic foliation parallel to bedding (transposed bedding)

Contacts and faults

- contact, accurate
- contact, approximate
- fault, accurate
- fault, approximate

1:24,000 scale

0 0.5 1 2 3 4 5 Kilometers

0 0.5 1 2 3 4 5 Miles

TRUE NORTH
MAGNETIC NORTH
11°
Approximate mean declination, 2013

Projection: UTM Zone 11
Datum: NAD83

AllTopo V7 Pro Topographic Basemap with NAD83 grid. Topographic base map derived from Black Peak and Bobs Well 7.5' USGS topographic quadrangle maps originally with NAD27 datum.

Description of Map Units

d — **Disturbed ground** - Heavily disturbed or altered ground due to extensive excavation that has obscured or concealed original geologic features.

Piedmont units

Qy$_3$ — **Deposits in active channels, low terraces and bars** - Piedmont alluvial deposits located along active drainages including small channels, adjacent low terraces, or floodplain areas. Qy3 deposits are composed of unconsolidated, unvarnished sand, gravel, and silt deposits.

Qy$_2$ — **Young terrace deposits** - Qy2 deposits consist of terrace deposits located primarily along the flanks of incised drainages and low-relief terraces inset into Pleistocene age fan deposits. These deposits consist of unconsolidated sand, silt, and minor clay with sub-rounded to sub-angular pebble to cobble bars on the surface and bedrock cores in cross section.

Qya — **Young alluvial fan deposits** - **Young alluvial fan deposits** that are laterally extensive and composed of gravel, sand, silt. These deposits are associated with distributary drainage systems and broad sheetflood areas.

Qy$_1$ — **Slightly higher terrace and alluvial fan deposits** - Qy1 deposits form planar terraces along larger piedmont drainages and young relict alluvial fan deposits on lower piedmont areas. Qy1 deposits are composed of sandy to pebbly swales with coarser unvarnished to very lightly varnished pebble to cobble bars, and partially overlie Pleistocene deposits in some areas.

Qy — **Young deposits, undifferentiated** - Primarily young fluvial sand and gravel deposits, undifferentiated.

Qa$_4$ — **Youngest intermediate alluvial fan and terrace deposits** - Pebble, cobble, and sand deposits in low terraces and alluvial fans. Moderate varnish on clasts, moderate gravel lags to weak pavements, but pavements not was well developed as Qa3. Soil development is generally weak.

Qa$_3$ — **Young intermediate fan and terrace deposits** - Gravel and sand deposits with moderate to tight desert pavements, dark rock varnish, forming relict alluvial fans and intermediate terraces. Soil development is weak to moderate, with slight reddening, minor clay accumulation, calcic horizon development II-III.

Qa$_2$ — **Older intermediate fan and terrace deposits** - Gravel and sand deposits, with minor silt and clay, associated with moderately eroded relict alluvial fans and intermediate terraces. Rock varnish and pavement development is variable, quite strong on well-preserved surfaces and moderate to weak on more eroded surfaces. Incision of modern washes below Qt2 surfaces ranges from 1-3 m.

Qa — **Intermediate alluvial fan and terrace deposits, undifferentiated** - Middle and late Pleistocene alluvial fan and terrace deposits, undifferentiated.

Qa$_1$ — **Higher dissected alluvial fan and terrace deposits** - High dissected gravelly alluvial fan deposits and dissected terrace deposits. Alluvial fans are deeply eroded, with limited preserved fan surface remnants. Soil development ranges from strong on well-preserved surfaces to weak to moderate on eroded slopes. Qa1 terrace deposits are up to 15 m above Osborne Wash.

Qo — **Very high old alluvial fan deposits** - Coarse gravelly high remnant alluvial fans with very strong calcic soil development where surfaces are reasonably well preserved. Cobbles and boulders are common. Planar surfaces are typically supported by carbonate cementation and coarse grain size, but are also deeply eroded and high above active washes.

Qyd — **Debris-flow deposits and chutes** - Bouldery and cobbly debris-flow levees and snouts, and erosional scars associated with debris flow activity higher on hillslopes.

Qtc — **Hillslope talus and colluvium** - Coarse, very poorly sorted, angular to subangular, locally derived gravel, sand, silt and clay deposits on hillslopes. Deposits are derived from underlying or adjacent bedrock outcrops. Locally include bouldery talus deposits with minimal fine matrix.

QTec — **High, very old carbonate-cemented surfaces** - Deposits cemented by extensive, thick (2-4 m), pedogenic carbonate horizons. Surfaces are covered with plates and fragments from the underlying cemented soil, with scattered darkly varnished cobbles and boulders common. These surfaces are found on high planar surfaces on bedrock, on mountain hillslopes, and on very old alluvial deposits. On hillslopes these units are formed on hillslope colluvium or high alluvial remnants.

Deposits of Bouse and Osborne Washes

Qy$_3$r — **Sand and gravel deposits in active channels** - Sand, pebbles, minor cobbles, minor silt and clay in active or recently active channels. Crystalline rocks are the dominant lithologies, but volcanic rocks are also common and metasedimentary rocks are rare.

Qy$_2$r — **Young deposits in terraces and bars** - Sand, gravel, silt and clay deposits associated with low terraces and bars and islands between channels. Gravel clasts are primarily crystalline lithologies, but volcanic clasts are common. Gravel is primarily subangular pebbles and cobbles. No to minimal soil development.

Qy$_1$r — **Young terrace deposits** - Sand, gravel, silt and clay deposits associated with low terraces. Gravel clasts are primarily crystalline lithologies, but volcanic clasts are common. Gravel is primarily subangular pebbles and cobbles. Weak rock varnish, minimal soil development.

Qu$_4$r — **Young intermediate terrace deposits** - Gravel, sand, silt and clay deposits forming low intermediate terraces flanking Osborne Wash. Gravel clasts are primarily crystalline lithologies, but volcanic clasts are common. Gravel is primarily subangular pebbles and cobbles, with few boulders. Soil development is weak to moderate.

Qu$_3$r — **Intermediate terrace deposits** - Gravel, sand, silt and clay deposits forming intermediate terraces flanking Osborne Wash. Gravel clasts are primarily crystalline lithologies, but volcanic clasts are common. Gravel is primarily subangular pebbles and cobbles, with few boulders. Soil development is moderate, with Stage II to III calcic horizon development.

Qu$_2$r — **Older terrace deposits** - Gravel, sand, silt and clay deposits forming the highest, oldest terraces preserved along Osborne Wash. Gravel clasts are primarily crystalline lithologies, but volcanic clasts are common. Gravel is primarily subangular pebbles and cobbles, with few boulders. Soil development is moderate, with Stage III calcic horizons.

Qu$_1$r — **Older terrace deposits, undifferentiated** - Gravel, sand, silt and clay deposits associated with older, dissected terraces along Bouse Wash. Gravel is primarily crystalline with volcanic lithologies common, but locally contains substantial rounded gravel reworked from older Colorado River deposits.

Deposits of Cactus Plain

Qys — **Sandy deposits in active drainages** - Reworked sand and fine gravel in and along active drainages, where source deposits are predominantly sand. Locally includes coarser gravel deposits in proximity to bedrock or older fan deposits.

Qe — **Dune sand deposits** - Quartz-rich dune sand deposits, with lesser amounts of silt and clay associated with more stable parts of dunes. Most areas in the western Cactus Plain are dominated by linear dunes that trend generally NE; these dunes are up to 40 ft high. Some portions of the Cactus Plain are dominated by much smaller crescent dunes.

Qsi — **Sand sheet deposits** - Interdune and near dune areas covered primarily by sand, with minor gravel, silt and clay; not spatially associated with drainages. Percent coverage of sand is variable, but typically is >50 percent. Includes small areas of gravel lag, and eroded fine-grained deposits.

Qg — **Gravel-mantled surfaces** - Open gravel lags deposits on erosion surfaces. Most erosion surfaces are formed on older fine-grained deposits in interdune areas. In central and eastern parts of the map area, gravel is derived primarily from tributary deposits that were interbedded with the fine-grained deposit, but areas of intact gravel beds are rare and not consistently mappable. Gravel lithologies are predominantly crystalline rocks, with local volcanic clasts and meta-sedimentary rocks. In the western part of the map area, the lithologic mix varies widely,and locally is dominated by rounded, far-travelled clasts from older Colorado River deposits.

Qgs — **Gravel and sand surface lag** - Erosion surfaces with open gravel lag and common, small-scale sandy eolian deposits. Complex spatial relationships between gravel and sand-dominated patches.

Miocene to Quaternary units

QTr — **Regolith, undivided** - Deeply weathered and disaggregated debris derived from unspecified older units.

QTf — **Silt, clay, minor sand deposits** - Silt, clay, and sand deposits underlying much of the eolian dunes of the Cactus Plain. Some QTf deposits are probably poorly exposed Bouse Formation, others are more likely old eolian deposits that post-date Bouse deposition.

QTa — **Deeply dissected alluvial fan deposits** - Locally derived gravel deposits forming deeply eroded ridges. Original fan surfaces are highly eroded.

Tcb — **Bullhead alluvium** - quartz-rich sand and rounded pebbles and cobbles of **Bullhead alluvium**; some finer-grained deposits locally; in a few outcrops, rests over erosional unconformity on Bouse deposits

Tcb? — **Bullhead alluvium?** - Queried - quartz-rich sand and rounded pebbles and cobbles of Bullhead alluvium; some finer-grained deposits locally; in a few outcrops, rests over erosional unconformity on Bouse deposits

Tbs — **Bouse Formation fine siliciclastic deposits** - Tan, gray, greenish gray silt and clay deposits with minor gray limestone beds

Tbc — **Bouse Formation carbonate** - white to gray limestone, thin to thick platy pale gray tufa deposits, less indurated white to cream-colored marl, and minor calcareous sandstone

Upper Miocene volcanic units of north Cactus Plain

Tbu — **Basalt, upper unit** - Basaltic volcanic rocks along the north side of Cactus Plain that were interpreted by Grubensky (1989) to overlie trachytic volcanic rocks, which in turn overlie basaltic volcanic rocks of map unit Tb.

Ttu — **Trachyte lava, upper unit** - Trachyte flow (60 m to 100 m thick) with phenocrysts of coarse-grained anorthoclase and fine-grained clinopyroxene and olivine in a groundmass of sanidine microlites, apatite, zircon, and an opaque mineral (map unit Tt5 of Grubensky, 1989). Anorthoclase phenocrysts are clear to white-colored in hand specimen, subhedral, and locally form 2- to 3-grain aggregates up to 1 cm across. Mesoscopic, spherical inclusions of coarse-grained, darker, vesicular trachyte are present in some exposures. Inclusions range from less than 1 cm to about 25 cm across and contain phenocrysts of coarse-grained plagioclase and anorthoclase and fine-grained, colorless clinopyroxene and olivine. Tridymite(?) is interstitial to sanidine microlites in the groundmass and also coats vesicle walls. Coronas of radially oriented microlites of sanidine and an opaque mineral are present on plagioclase and anorthoclase grains. Vesicles are usually 1 to 2 mm across and spherical to elliptic.

Tt — **Tuff associated with trachyte lava** - Thick bedded ash-flow tuff and thin bedded ash-fall and surge-related tuffs (map unit Tt1 of Grubensky, 1989; AZGS Bulletin 198). Total thickness is up to about 75m.

Tb — **Basalt** - **Basaltic** volcanic rocks at Black Peak, along the north side of Cactus Plain, and locally exposed within Cactus Plain. The basaltic volcanic rocks are generally flat-lying to gently dipping, and overlie tilted middle Miocene strata at Black Peak (Grubensky, 1989, AZGS Bulletin 198).

Miocene sedimentary and volcanic units

Tt — **Tuff** - A single small exposure of lithic tuff east of Black Peak. This is possibly tuff that contains sanidine dated by Buising and Beratan (1993, USGS Bulletin 2053) at 9.2 +/- 0.3 Ma.

Tss — **Sandstone** - Rocks of this unit were described by Grubensky (1989, AZGS Bulletin 198) as tan, poorly bedded, coarse-grained arkosic sandstone and conglomeratic arkosic sandstone.

Tcg — **Conglomerate, undivided** - This unit consists of a single, very small exposure in northwestern Cactus Plain that is associated with small hills of older metasedimentary rocks (from AZGS Bulletin 198).

Paleozoic and Mesozoic sedimentary units

Mzsu — **Metasedimentary rocks, undivided** - Metasedimentary rocks consist at least partly of metasandstone and metasiltstone, possibly slightly calcareous.

Pk — **Kaibab Limestone** - Unit is exposed at a single small hill in northwestern Cactus Plain, and consists of medium gray, probably cherty limestone (from AZGS Bulletin 198, 1989).

Cb — **Bolsa Quartzite** - Quartz-rich metasandstone is exposed at a single small hill in northwestern Cactus Plain (from AZGS Bulletin 198, 1989).

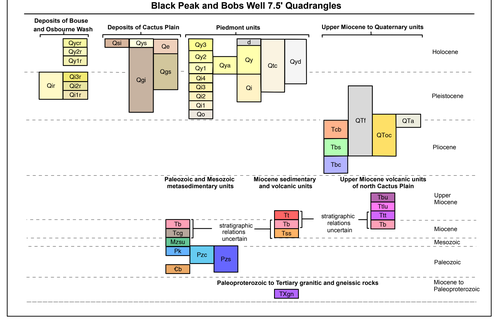
Pzc — **Carbonate rocks, undivided** - Recrystallized carbonate and siliceous carbonate derived from Paleozoic carbonate units (Kaibab Limestone, Redwall Limestone, Martin Limestone). Unit is exposed at a single small hill in northwestern Cactus Plain (from AZGS Bulletin 198, 1989).

Pzs — **Sedimentary rocks, undivided** - Weakly metamorphosed and deformed carbonate, probably with less common calcareous siltstone, fine calcareous sandstone, and sandstone. Unit is exposed at a single small hill in northwestern Cactus Plain (from AZGS Bulletin 198, 1989).

Paleoproterozoic to Tertiary granitic and gneissic rocks

TXgn — **Quartzo-felspathic gneiss, undivided** - Generally consists of fine grained, variably banded, quartzo-feldspathic biotite gneiss, with likely some hornblende and magnetite. At one locality (estermost location of plotted mylonitic lineation measurement), gneiss contains an ~5m wide sliver of tan dolomite(?) marble. Layering is commonly weak, and is associated with preferred orientation of fine biotite. Mylonitic fabric is sparse and weak, but with distinctive lineation characteristic of extensional mylonite, and is inferred to be related to Oligo-Miocene tectonic extension that exhumed these rocks from beneath the Buckskin-Rawhide extensional detachment fault (Spencer and Reynolds, eds., AZGS Bulletin 198, 1989).

Stratigraphic Correlation Diagram, Black Peak and Bobs Well 7.5' Quadrangles



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