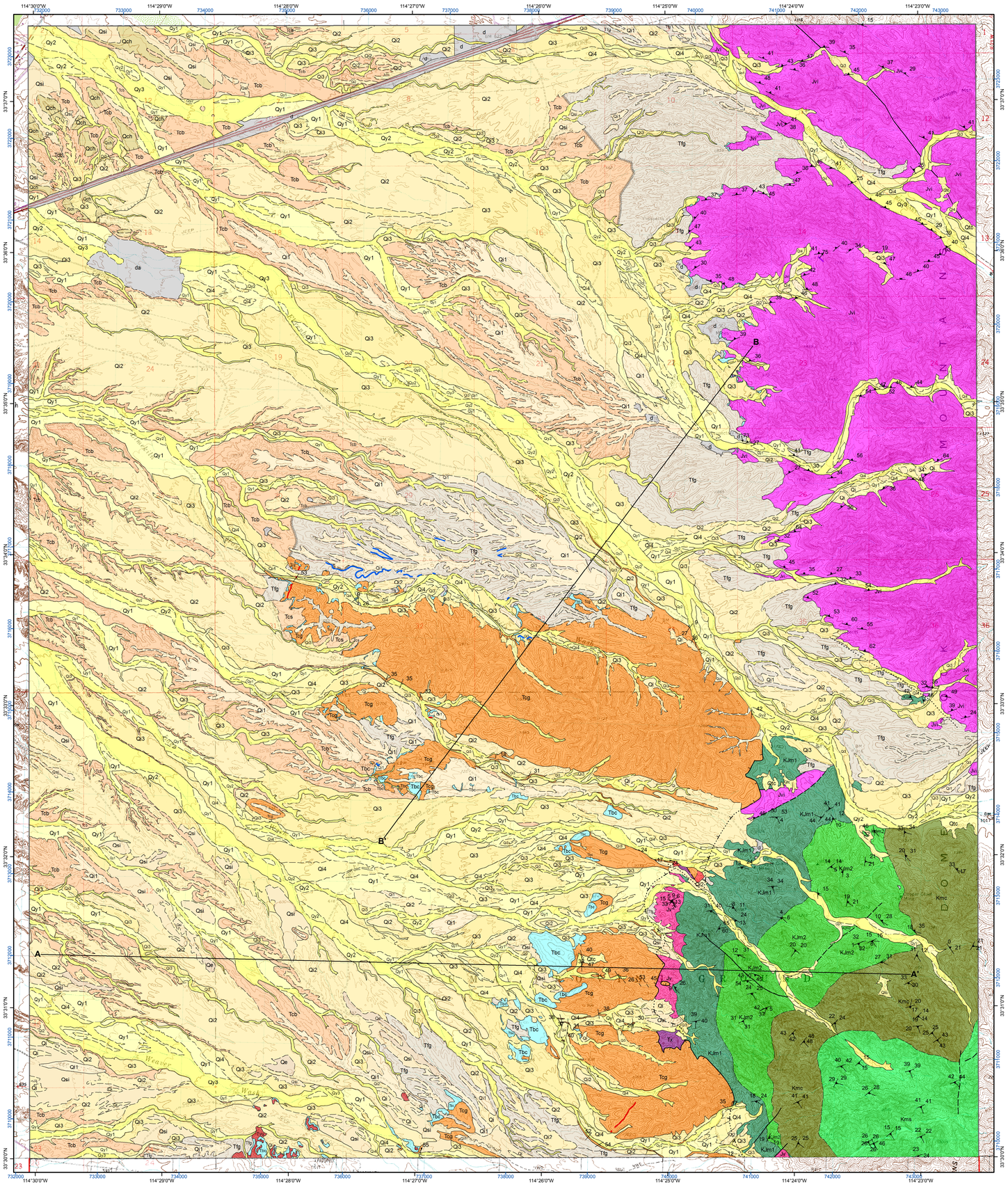
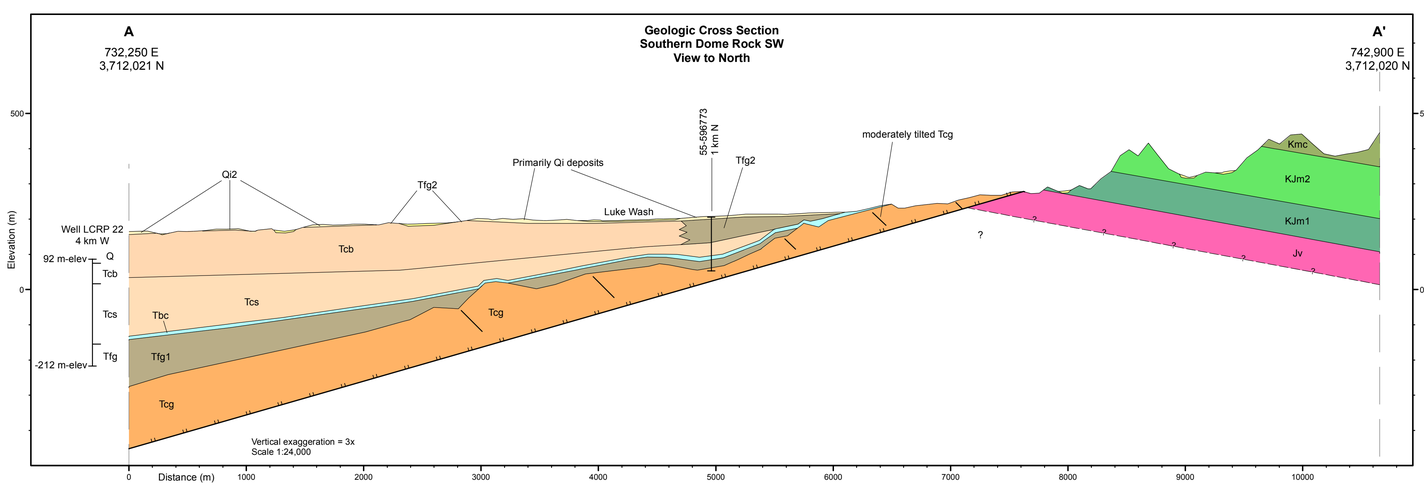
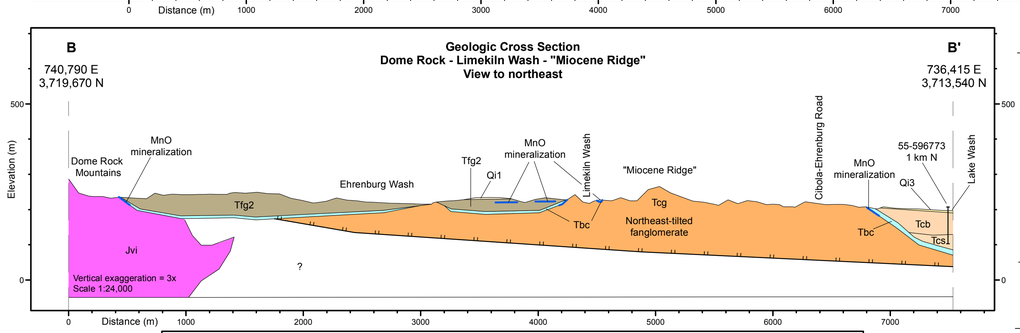






SCALE 1:24,000

1 0.5 0 1 Miles

0.85 0.425 0 0.85 Kilometers

0 980 1960 2940 3920 4900 Feet

CONTOUR INTERVAL 20 FEET

TRUE NORTH
MAGNETIC NORTH
11°
Approximate mean declination, 2013

Topographic base map derived from Dome Rock Mountains SW and North Trigo Peaks 7.5' USGS topographic quadrangle maps originally with NAD27 datum. Reprojected to UTM NAD83 datum (zone 11) using iGage All Topo Maps V9. UTM NAD 83 grid and lat-long markers produced using ESRI ArcMap v. 10.4.

Description of map units

Miscellaneous Units

- d — **Disturbed ground** - Mine dumps and other areas modified by human activity so that original geologic characteristics are obscure.
- da — **aggregate pit** - Disturbed areas associated with active or inactive aggregate operations.
- Qe — **Eolian sand dune deposits** - Quartz-rich sand deposits forming relatively small dunes and associated sand sheets. Lesser amounts of silt and clay are associated with more stable parts of dunes. Dunes that generally SE and NW, and have up to 6 m relief.
- Qsi — **Sand sheet deposits** - Laterally extensive sand deposits, with minor gravel, silt and clay. Includes small and low dunes. Percent coverage of sand is variable, but typically is >50 percent, Includes areas of gravel lag, and eroded alluvial fan deposits.
- Qtc — **Colluvium and talus** - Unconsolidated, very poorly sorted, angular to subangular cobble, pebble, sand, silt and clay derived from adjacent bedrock, on moderate to steep hillslopes. Mapped only where underlying bedrock is obscured.
- Qyd — **Young debris flow deposits** - Bouldery very poorly sorted, angular to subangular deposits associated with small, relatively steep watersheds. Deposits typically form lateral, curvilinear levees along active drainages, or more amorphous snouts. Rock varnish on gravel is weak to moderate, indicative of relatively recent deposition.

Quaternary Piedmont Deposits

- Qy_3 — **Deposits in active channels, low terraces and bars** - Piedmont gravel, sand and silt deposits located along active drainages, including channels, adjacent gravel bars and low terraces, and broader distributary multi-channel expansion reaches. Qy3 deposits are poorly sorted and unconsolidated. Gravel clasts are not varnished unless reworked from older deposits, and soil development is minimal. Vegetation includes desert riparian trees including palo verde, ironwood, and mesquite.
- Qy_2 — **Deposits forming low terraces and active fans** - Gravel, sand, and silt deposits forming low terraces and small alluvial fans, located primarily along the flanks of active washes inset into Pleistocene and Pliocene age fan and river deposits. Some Qy2 deposits comprise extensive low relief alluvial fans in broad valley reaches. These deposits are unconsolidated to very weakly consolidated sediments, poorly sorted with sub-rounded to sub-angular pebble to cobble bars on the surface and beds and lenses in cross section. Topographically low areas commonly are covered by thin mantles of silt and clay. Soil development is minimal. Vegetation includes desert riparian trees and shrubs.
- Qy_1 — **Deposits forming low terraces and young relict alluvial fans** - Gravel, sand, silt and clay deposits forming relict alluvial fans and terraces along larger piedmont drainages. Qy1 deposits are composed of silt to pebbles in swales, and lightly to moderately varnished pebbles to small boulders in bars. These deposits are generally located on the margins of incised valleys away from the more active parts of the drainage systems, and typically are 1-2m above adjacent active washes, and partially overlie Pleistocene deposits in some areas. Vegetation includes sparse, relatively small desert riparian trees, shrubs including creosote, and cacti.
- Qy — **Young alluvial deposits, undifferentiated** - Poorly sorted deposits including pebbles, cobbles, sand, minor silt and clay, and locally boulders. Associated with active and recently active washes, and slightly higher terraces with modest rock varnish, minimal soil development.
- Qi_4 — **Youngest intermediate alluvial fan and terrace deposits** - Gravelly deposits in low terraces and relict alluvial fans. Deposits consist of pebbles, cobbles, small boulders, sand, silt and clay. Moderate varnish on clasts, weak to moderate undulating desert pavements, but not as tight as Qi3. Soil development includes very slight reddening, visible carbonate accumulations. Vegetation is sparse and concentrated along slightly incised small drainageways.
- Qi_3 — **Intermediate alluvial fan and terrace deposits** - Very poorly sorted deposits including pebbles, cobbles, sand, minor silt and clay, locally boulders forming laterally extensive relict alluvial fans and terraces. Surfaces are typically 1-5m above adjacent Holocene deposits and vary from undulating to very smooth. Desert pavements are moderately to strongly developed and rock varnish is quite dark. Locally, multiple levels of surfaces are grouped together, and some latest Pleistocene (Qi4) deposits are included in this unit. Soil development is moderate, with slight reddening, minor clay accumulation, calcic horizon development II-III. Qi3 surfaces are graded to the highest level of late Pleistocene Chemehuevi Formation deposits or younger inset river terraces.
- Qi_2 — **Older intermediate alluvial fan and terrace deposits** - Poorly sorted pebbles, cobbles, sand, some boulders, and minor silt and clay associated with moderately dissected remnant terraces ~5-20 m above active washes. Rock varnish and pavement development is variable, quite strong on well-preserved surfaces and moderate to weak on more eroded surfaces. Soils are obviously reddened beneath pavements, and carbonate rinds are moderately thick.Vegetation is sparse; bushes and small trees are concentrated along small drainages.
- Qi — **Intermediate alluvial fan and terrace deposits** - Undivided deposits with darkly varnished surfaces, variable pavements, primarily equivalent to Qi3 and Qi4, and may include some Qi2 deposits.
- Qi_1 — **Oldest intermediate alluvial fan deposits** - Poorly sorted cobble, pebble, sand deposits, with minor silt, clay, and boulders. Deposits are found capping moderately high ridges, and typically are 15 to 25 m above active washes. Planar surfaces are generally fairly narrow and margins are substantially rounded. Deposits typically are a few meters thick over underlying fan deposits or Bullhead alluvium. Soil development ranges from strong on well-preserved surfaces to weak to moderate on eroded slopes.
- Qo — **Old, very high alluvial fan deposits** - Generally coarse, poorly sorted gravel and sand deposits preserved as narrow remnants high in the landscape, typically as fairly planar to broadly rounded remnants capping high ridges of Miocene and Pliocene (Tfg or Tcg) deposits.

Colorado River-Sourced Deposits

- Qch — **Chemehuevi Formation** - Quartz-rich sand, silt, clay and minor exotic gravel deposits draped over eroded Bullhead Alluvium and locally over older piedmont deposits. These deposits record a period of major aggradation by the Colorado River in the late Pleistocene (Malmon et al., 2011). Northeast-southwest trending scarps represent a series of recessional terraces strathed on older deposits. The earliest Qch deposits are coeval with post-Qi2 and pre-Qi3 tributary alluvial deposits .
- Tcb — **Bullhead Alluvium** - Unconsolidated to moderately consolidated well-rounded to subangular cobbles and pebbles, quartz-rich sand, and lesser amounts of silt and clay. These deposits are commonly mantled by gravel, and gravel beds are common, but sand is the dominant particle size. Rounded pebbles and cobbles of primarily quartzite, chert, and other resistant exotic rock types. Interfingers with locally-derived fanglomerate unit Tfg in in middle to upper piedmont areas. Tentatively correlated with the early Pliocene Bullhead Formation (Howard et al., 2015), but locally may include Quaternary Colorado River deposits.
- Tcs — **Older silt, clay and sand deposits** - Alternating beds of clay and silt, with minor thin quartz-rich sand beds. Locally interfingers with locally-sourced tributary fan deposits, including reworked tufa and bioclastic particles derived from basal Bouse carbonate deposits. This unit may be a siliciclastic phase of Bouse deposition (younger than carbonate deposition) or fine-grained Bullhead alluvium.
- Tbc — **Bouse Formation carbonate deposits** - Carbonate-rich deposits including algal limestone, bioclastic limestone hash, massive tufa drapes on paleohillslopes, thin-bedded bioclastic-rich marl, and calcareous sandstone. Tephra layers have been found in this unit at several localities, however none have yielded datable material. Antelope tracks found on gently-dipping marl were identified at one locality.

Miocene and Pliocene map units

- Tfg — **Younger Fanglomerate** - Poorly sorted, weakly to moderately lithified sandstone, conglomeratic sandstone, and conglomerate. Clasts consist largely of subangular to angular locally derived Tertiary volcanic rocks, granite and diorite. Locally may pre-date Bouse deposition, but more commonly post-dates Bouse deposition and is generally coeval with Bullhead Alluvium and in a few places includes rounded quartzite eroded from coeval Bullhead Alluvium deposits. This unit thus represents mostly locally derived fan material interfingered with minor amounts of Colorado River derived sediments.
- Tcg — **Older Fanglomerate** - Massive to bedded conglomerate, rock-avalanche breccia, and minor pebbly sandstone interpreted as alluvial-fan deposits. Clasts are dominantly angular to subangular and less commonly subrounded, and are composed dominantly of locally derived rock types as seen in the Dome Rock Mountains. Strata typically dip moderately to steeply (30° to 50°) eastward or northeastward. This unit forms the hanging wall of a moderately to gently west-dipping normal fault at the western base of the Dome Rock Mountains.
- Tx — **Rock-avalanche breccia** - Disordered masses of crushed and highly fractured rock derived largely or entirely from Mesozoic metamorphic rocks. All three areas mapped as rock-avalanche breccia are adjacent to the low-angle normal fault at the western foot of the Dome Rock Mountains.
- Tr — **Rhyolitic lava** - Brick-red rhyolitic autobreccia containing 5-8%, <1mm sanidine, 1-3%, <1mm quartz, and 2-4%, <<1mm hornblende(?). This unit is suspected to be strongly affected by potassium metasomatism.
- Tvu — **Volcanic rocks, undivided** - Pale gray, dark brown weathering, lava flows and flow breccias containing <3%, <1mm sanidine, <2%, <1mm quartz, and <3%, <2mm oxidized hornblende(?). Quartz and sanidine are absent in some exposures. Some lavas are slightly vitric. Silica content is variable but in general lavas are likely andesitic to dacitic in composition. This unit is mapped as including the Tuff of Felipe Pass by Sherrod and Tosdal (1991, JGR), but the tuff was not identified in this study.

McCoy Mountains Formation (Jurassic to Cretaceous)

- Kms — **Sandstone Member, McCoy Mountains Formation** - Interlayered brown-weathering psammite and purple to grey weathering phyllite to argillite. Member becomes finer grained up section.
- Kmc — **Conglomerate Member, McCoy Mountains Formation** - Brown-weathering pebble to cobble metaconglomerate, semischist, and grey phyllite. Rocks near the base of the member are rich in metamorphic muscovite. Clasts are dominantly quartz-phyric volcanic rocks derived from underlying Jurassic igneous units, and lesser amounts of granitic rocks, quartzite, and limestone.
- KJm_2 — **Basal Member 2, McCoy Mountains Formation** - Interlayered green-grey weathering chlorite-rich phyllite, calcsilicate schist, and quartz-muscovite phyllite.
- KJm_1 — **Basal Member 1, McCoy Mountains Formation** - Interlayered greenish gray muscovitic quartzite, muscovitic quartzose schist, phyllite, quartzose marble, and calcsilicate hornfels. Cut by milky quartz ± carbonate ± Fe oxide after pyrite veins.

Dome Rock Sequence (Jurassic)

- Jv — **Felsic metavolcanic rocks** - Pale-grey weathering, metamorphosed, felsic volcanic rocks that are probably derived from rhyolitic tuff. Unit is now composed of muscovite schist and gneiss with local garnet. Horizons are locally characterized by quartz blastophenocrysts up to 8 mm in diameter and conspicuous oblate muscovite-rich clots up to 3 cm across that represent relict pumice lapilli reflecting the primary pyroclastic protolith. Other blastophenocryst-poor quartz-muscovite schist likely represents minor reworked tuff and volcaniclastic rocks.
- Jvi — **Massive metatuff or shallow intrusion** - Gray weathering, massive metavolcanic rock or porphyritic hypabyssal intrusion. Unit contains up to 15% tabular and blocky K-feldspar up to 25 mm diameter. K-feldspar phenocrysts vary in size and abundance, with some outcrops containing very few and with maximum size <10 mm. Quartz is generally <1mm but locally the unit contains up to 15% quartz phenocrysts up to 5 mm diameter. Matrix consists of fine (generally <0.05 mm) quartz, feldspar, and biotite. Matrix is foliated with foliation defined by biotite orientation, commonly with elongate clots of subparallel biotite. Unit is massive, with no evidence identified of fragmental or bedded character. In some areas rocks of this unit have been converted to biotite-muscovite quartzofeldspathic gneiss with local garnet. Unit is texturally homogeneous and has dacitic whole-rock compositions. Unit has U-Pb age of 170.7 ± 1.1 Ma (Tosdal and Wooden, 2015, sample from just east of the quadrangle boundary along the northern edge of Ehrenberg Wash).

Legend

Contacts and faults

- Contact, accurately located
- Contact, approximately located
- Contact, inferred, location uncertain
- Fault, accurately located
- Fault, approximately located
- Fault, concealed and inferred
- Fault, gently to moderately dipping fault plane, tics on hanging wall

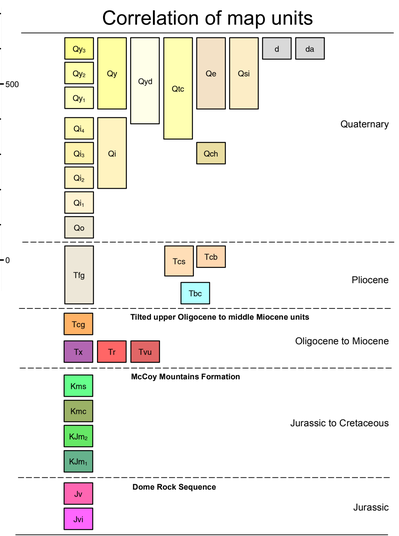
Tuffs, dikes, and marker units

- Volcanic ash bed
- Mafic dike
- Zone of manganese-oxide mineralization

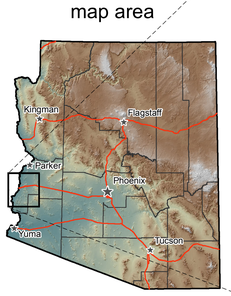
Structure symbols

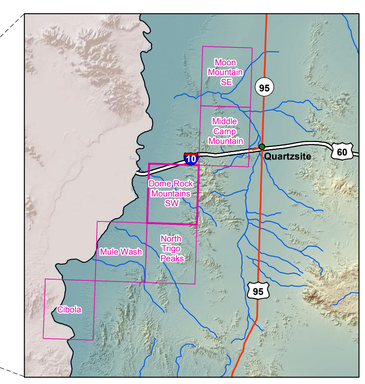
- Bedding, accurate, inclined
- Bedding, approximate, inclined
- Apparent dip of bedding (apparent dip where strike is uncertain)
- Transposed bedding, inclined
- Foliation defined by preferred mineral orientation, inclined
- Mylonitic foliation, inclined
- Joint, inclined
- Tectonic lineation
- Dip of inclined fault plane

Correlation of map units



Location of map area





Named quadrangles are mapped by AZGS or mapping is in progress

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THE UNIVERSITY OF ARIZONA

Geologic map of the Dome Rock Mountains SW 7 ½' Quadrangle, La Paz County, Arizona

2016

Jon E. Spencer, Philip A. Pearthree,
Brian F. Gootee, and Richard M. Tosdal

Arizona Geological Survey Digital Geologic Map DGM-116

scale 1:24,000

Citation for this map:

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Introduction

The Dome Rock Mountains SW 7 ½' Quadrangle is located just east of the Colorado River, east of Blythe, California and southwest of Quartzsite, in western Arizona. The map encompasses the western flank of the central Dome Rock Mountains and most of the piedmont that extends westward from the foot of the range toward the Colorado River. 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 #G14AC00424. Mapping was compiled digitally using ESRI ArcGIS software. Previously unpublished bedrock mapping by Richard Tosdal (former USGS employee) was incorporated into the map with minor revisions.

Surficial and Basin Deposits

Tributary Deposits. Surficial geologic units including tributary and river deposits were mapped using field observations, georeferenced digital orthophotographs and satellite imagery, and digital elevation models (DEMs). Most of the piedmont is covered by a veneer of Quaternary alluvial fan, terrace, and channel deposits transported by alluvial systems that originate from the Dome Rock Mountains. These deposits are predominantly locally-derived gravel with variable amounts of reworked Colorado River gravel clasts, and local and Colorado River sand. Quaternary deposits are thin, and only partially cover underlying late Miocene to Pliocene tributary fan deposits in the upper and middle piedmont areas, and Pliocene Colorado River sand and gravel in middle and lower piedmont areas. Most of the tributary deposits covering the piedmont are middle Pleistocene or younger in age. The lateral extent of Holocene deposition is confined to valleys incised 5-15m below older relict alluvial fan and terrace surfaces. Valley bottoms covered by Holocene deposits are commonly quite wide and distribution of deposits of different ages is quite complex, recording shifting patterns of erosion and deposition during the past 10 kyr.

Colorado River Deposits. Deposits probably or definitely associated with the Colorado River include the latest Miocene to early Pliocene Bouse Formation (Metzger, 1968), the early to middle Pliocene Bullhead Formation (Howard et al., 2015), and the late Pleistocene Chemehuevi Formation (Malmon et al., 2011).

Bouse deposits in the map area consist of one to several meter-thick tufa or travertine, bioclastic limestone, and less commonly, marl. Bouse carbonate outcrops in a fairly narrow band along the boundary between late Cenozoic basin deposits and bedrock and older conglomerate, between 185m and 260m above sea level (asl). The basal carbonate certainly exists in the subsurface in the valley, and the upper limit carbonate outcrops are always erosional. Thus, the current distribution of Bouse outcrops is very much a function of what has been uncovered by subsequent erosion, and what has not been removed by erosion and denudation. The tufa and bioclastic limestone were certainly deposited in shallow water; they record a water surface gradually rising relative to the pre-existing landscape. The basal carbonate deposits were draped over a complex erosional paleo-topographic landscape of hillslopes and valleys formed on crystalline bedrock and eroded Oligo-Miocene conglomerate (see cross-section AA'). For example, along Limekiln Wash in the central part of the map area basal carbonate deposits were draped on S- and N-facing slopes formed on older conglomerate (unit Tcg) on either side of the modern valley. Thus, a paleovalley much like the modern valley existed ~5 Ma. The valley was subsequently filled by river and tributary deposition, perhaps more than once, but has been re-excavated in the late Quaternary. In a few areas we found fine siliciclastic deposits interbedded with local fan deposits, including reworked clasts of Bouse carbonate, between ~175m and 200m asl. These deposits may be the uppermost part of the Bouse Formation recording a regression of the water surface (Gootee et al., 2016), or a fine-grained facies high in the Bullhead sequence.

Exposures beneath Quaternary deposits in middle and lower piedmont areas are primarily Bullhead Formation sand, with common beds of rounded exotic gravel and some silt and clay beds. These deposits are exposed from ~100m asl in the NW corner of the map area to as high as ~245m asl as isolated remnants near the mountain front. They are interbedded with and likely grade laterally into Pliocene tributary fan gravel deposits (Tfg). Thus, Bullhead Alluvium records massive aggradation by the early Colorado River in the early to middle Pliocene, with lesser contributions of sediment from tributary drainages. Based on age constraints farther north along the river, this aggradation culminated 3.5-4.0 Ma (House et al., 2008).

The late Pleistocene Chemehuevi deposits are confined to areas fairly close to the valley axis in the northwest corner of the map area below about 140m asl. They consist of silt, clay, sand, and gravel, and they typically are banked up against and draped over erosional topography formed on Bullhead deposits or older Quaternary tributary deposits. Locally, fairly prominent fluvial scarps associated with Chemehuevi deposition are preserved roughly parallel to the Colorado River and record a series of successively younger recessional scarps and strath deposits. Age constraints developed for the Chemehuevi Formation in other areas indicate that maximum aggradation occurred 70-100 ka (Malmon et al., 2011).

Bedrock Geology and Mineralization

Bedrock in the map area consists of Jurassic igneous rocks overlain by metasedimentary rocks of the Jurassic to Cretaceous McCoy Mountains Formation (Tosdal and Stone, 1994; Spencer et al., 2011; Tosdal and Wooden, 2015). A west-dipping low-angle normal fault at the western foot of the Dome Rock Mountains displaces moderately tilted, upper Oligocene to middle(?) Miocene, dominantly conglomeratic strata. This fault continues southward where it has been mapped in the North Trigo Peaks area (Sherrod and Tosdal, 1991).

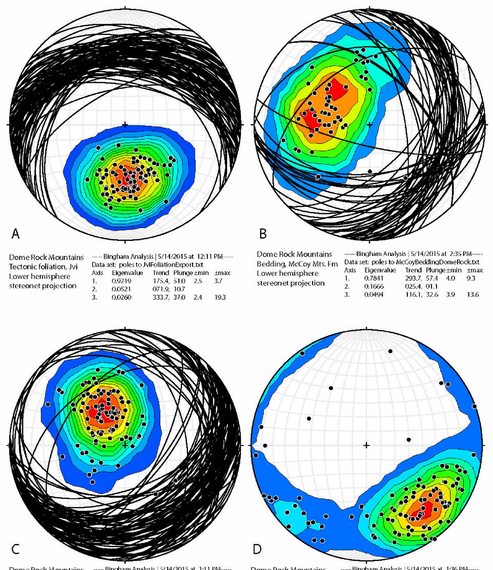
Mineral deposits. Manganese-oxide deposits are present in two settings: (1) At the foot of the Dome Rock Mountains manganese oxides fill fractures in bedrock, fill pore-spaces in sand and gravel, and form replacements in Bouse carbonates. These deposits are located at the base of the Bouse Formation where it overlies Jurassic bedrock, or within coarse clastic sediments directly beneath the Bouse Formation and near bedrock. (2) Manganese oxides fill pore spaces in Pliocene alluvial deposits within a zone one to several meters thick that extends discontinuously over about two kilometers on the north flank of Limekiln Wash. These deposits are Pliocene to Quaternary in age and form the Metate manganese district.

Quartz veins and associated minor minerals including secondary copper-bearing minerals and probably tourmaline are present in the McCoy Mountains Formation and are suspected to be related to regional metamorphism. Prospect pits and minor mine shafts and tunnels indicate widely scattered historic exploration and mining activity. No evidence of mercury mining or processing, as at the main Cinnabar deposits east of the map area, was identified.

Structural geology. The Dome Rock Mountains are a north-south trending range that is probably bounded by buried normal faults that are responsible for uplift of the range. These inferred faults are not visible except for a moderately to gently west -dipping normal fault along the west side of the central and southern part of the range that is exposed in the map area. Hanging-wall rocks consist largely of Oligocene to Miocene conglomerate that is tilted moderately to steeply to the east or northeast, consistent with westward displacement and fault-block tilting above a west-dipping normal fault. This fault is not mapped as an extensional detachment because of the complete absence of chloritic alteration in the fault footwall (e.g., Sherrod and Tosdal, 1991).

The northeastern part of the map area consists of a single Jurassic rock unit, which is a shallow intrusion or massive ash-flow tuff that is now affected by metamorphism and a foliation characterized by biotite crystallization along foliation planes. Characteristic clots of crudely aligned biotite are possibly derived from retrograde metamorphism of hornblende during regional deformation that produced the foliation. This foliation, which is locally represented by joints without significant visible secondary mica, is consistently north dipping, with an average azimuth of 265° and inclination of 39° north (stereonet A; stereonet plots and calculations from Stereonet 8 software as described in Allmendinger et al. [2013], and Cardozo and Allmendinger [2013]).

The McCoy Mountains Formation was deposited on top of the Jurassic igneous rocks (Tosdal and Stone, 1994). Foliation and bedding are oriented differently than in underlying igneous rocks. Both dip moderately to the southeast (stereonets B and C), and are associated with a southeast plunging tectonic lineation (stereonet D). The geometric discordance between foliation orientations in Jurassic igneous rocks and overlying metasedimentary rocks is not understood.



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