GEOLOGIC MAP OF THE CLARK RANCH 7 ½' QUADRANGLE AND THE WEST HALF OF THE RHODES PEAK 7 ½' QUADRANGLE, PINAL AND GRAHAM COUNTIES, ARIZONA

by
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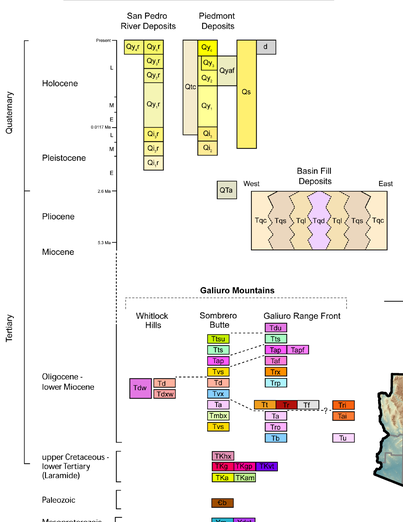
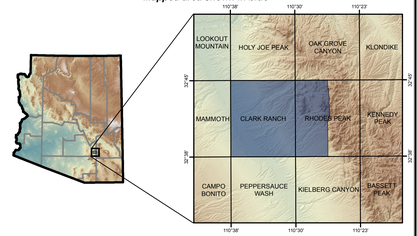
Time-Stratigraphic Correlation of Units



Location Map

Mapped area shown in blue



Map Unit Descriptions

San Pedro River Alluvium

- **Qyr** — **Active River Channel Deposits** - Unconsolidated, very poorly sorted sandy to cobbly beds in active river channels
- **Qyf** — **Flood channel and low terrace deposits** - Unconsolidated sand, gravel and silt deposits on bars, low terraces and flood channels
- **Qyfr** — **Historical river terrace deposits** - Unconsolidated sand, gravel and silt deposits on low terraces inset below the abandoned early historical floodplain
- **Qyyf** — **Latest Holocene to historical river terrace deposits** - Silt, clay, sand and minor gravel deposits underlying the early historical floodplain
- **Qyf'** — **Late to early Holocene river terrace deposits** - Silt, clay, sand, and minor gravel terrace deposits slightly above the early historical floodplain
- **Qlr** — **Late Pleistocene river terrace deposits** - Cobble, gravel and sandy river terrace deposits up to 25 m above the active river channel.
- **Qlr** — **Middle to late Pleistocene river terrace deposits** - Older, higher boulder, cobble, and sandy river terrace deposits.
- **Ql r** — **Early to middle Pleistocene river terrace deposits** - Oldest, highest preserved boulder, cobble, and sandy river terrace deposits.

Piedmont Deposits

- **Qyr** — **Active tributary channel alluvium** - Unconsolidated, very poorly sorted sandy to cobbly ephemeral piedmont-tributary channel deposits.
- **Qyr** — **Latest Holocene alluvium** - Ephemeral tributary channel deposits and low-lying piedmont channel terraces flanking active drainages.
- **Qyr** — **Late Holocene alluvium** - Planar terrace deposits located along incised drainages, broad low-relief distal fan deposits onlapping onto Holocene river alluvium, and infrequently active tributary drainage deposits.
- **Qyaf** — **Late Holocene alluvial fan deposits** - Active portions of young fan deposits exhibiting distributary drainage patterns.
- **Qyr** — **Early to late Holocene alluvium** - Broad, low-relief, undulating fan and sheet deposits exhibiting widespread, shallow braided-drainage patterns.
- **Qls** — **Late Pleistocene alluvium** - Gravelly and sandy, late Pleistocene fan and terrace deposits with moderately developed orange-colored soils.
- **Qls** — **Middle to late Pleistocene alluvium** - Gravelly and sandy, middle to late Pleistocene fan and terrace deposits with moderately developed orange-colored soils.
- **QTa** — **Quaternary-Tertiary alluvium** - Coarse, moderately to well-consolidated gravelly deposits capping high rounded ridges.

Other Surficial Deposits

- **d** — **Disturbed deposits** - Areas modified by human activity, including mining, construction, excavation, and sedimentation due to water impoundment by reservoirs.
- **Plowed areas** - Historically or actively plowed fields, irrigated pastures, and other lightly disturbed ground, including the White Cliffs Diatomite Mine.
- **mine tailings** — **Mine tailings** - Tailings derived from processing ore from the San Manuel mine.
- **Qtc** — **Quaternary talus and colluvium deposits** - Unconsolidated to weakly consolidated, very poorly sorted, massive to weakly bedded, angular rock debris deposited at the base of bedrock slopes.
- **Qa** — **Alluvial deposits, undivided** - Undivided terrace gravels and alluvial deposits within mountain valleys.

Basin Fill Deposits

- **Tqc** — **Late Miocene to Pliocene Quiburis deposits, conglomeratic facies** - gravelly to sandy, moderately to strongly indurated alluvial fan deposits
- **Tqs** — **Late Miocene to Pliocene Quiburis deposits, sandflat facies** - moderately indurated, distal alluvial-fan sandstone and silty sandstone (sandflat facies), lacustrine silty strata, and gypsiferous fine sandy to silty lake-margin deposits.
- **Tql** — **Late Miocene to Pliocene Quiburis deposits, lacustrine facies** - fine-grained, laminated playa and lacustrine deposits
- **Tqd** — **Late Miocene to Pliocene Quiburis deposits, diatomaceous facies** - Interbedded diatomite, mudstone, limestone, and green chert.

Oligo-Miocene Bedrock

- **Tdu** — **Dacitic lava (Oligocene to lower Miocene)** - Fine-grained, phenocryst-poor, dark vitric lava with feldspar xenocrysts and elongate spherulitic lenses <20 cm long and <5 cm wide.
- **Tsu** — **Tuff of Sombrero Butte, upper unit (Oligocene to lower Miocene)** - Upper unit capping Sombrero Butte is differentiated from underlying main tuff of Sombrero Butte by its well defined eutaxitic foliation, with numerous elongate pits interpreted as relict pumice fragments, and by much less resistance to weathering so that unit forms slopes rather than cliffs.
- **Tts** — **Tuff of Sombrero Butte (Oligocene to lower Miocene)** - Massive ash-flow tuff containing ~15% phenocrysts of roughly equal amounts of plagioclase and sanidine, and several percent biotite. Chemical analysis of a sample of basal vitrophyre indicates a trachytic composition.
- **Tap** — **Andesite porphyry lava flows (Oligocene to lower Miocene)** - Dark brown to dark gray lava flows with 5-25%, <3G mm, euhedral, tabular plagioclase and <10% dark mafic minerals (mostly pyroxene?) ("Turkey-track porphyry" of Cooper, 1961).
- **Tapf** — **Andesite porphyry lava flows, fine-grained (Oligocene to lower Miocene)** - Similar to map unit Tap but with generally <10 mm, tabular, plagioclase phenocrysts.
- **Tvs** — **Volcanic-lithic sandstone and conglomerate (Oligocene to lower Miocene)** - Pale green, pale tan, and pale yellowish tan, volcanic-lithic sandstone and pebbly sandstone, massive to moderately well bedded.
- **Td** — **Dacite lava flows (Oligocene to lower Miocene)** - Dacitic or trachydacitic lava flows with 5-35% plagioclase that is typically <3 mm but locally as large as 10 mm, <2%, <2 mm biotite, and 0-3%, <1 mm hornblende or pyroxene. Four thin-sections, stained for potassium, did not reveal any K-feldspar. Unit generally consists of massive lava flows or autobreccia, either of which are vitric in some areas. Chemical analysis of five samples indicate that this unit is a trachyte (four samples) or rhyolite (one sample), but all analyses place this unit close to the dacite field.
- **Tdcw** — **Dacitic breccia and conglomerate of Whitlock Wash (Oligocene to lower Miocene)** - Autobreccia, bedded pyroclastic rocks, and volcanic-lithic conglomerate.
- **Tdw** — **Crystal-poor dacitic lava in the Whitlock Wash area (Oligocene to lower Miocene)** - Dacitic lava flows and autobreccia with 5-8%, 1-3 mm plagioclase and ~1%, <1 mm pyroxene(?). Unit is located in the Whitlock Wash area near the southern edge of the map area.
- **Taf** — **Fine-grained andesite lava flow (Oligocene to lower Miocene)** - Vesicular andesite lava with <10%, 1-5 mm plagioclase, 3%, 1-4 mm hornblende and/or pyroxene mafic minerals.
- **Tai** — **Intrusive andesite (Oligocene to lower Miocene)** - Massive andesite intrusion with 10%, <7 mm pyroxene.
- **Trx** — **Coarse-grained rhyolitic lava (Oligocene to lower Miocene)** - Rhyolite lava flows with 10-15%, <5 mm feldspar, and biotite.
- **Trp** — **Very phenocryst-poor rhyolitic lava (Oligocene to lower Miocene)** - Rhyolite lava and autobreccia with <2%, <2 mm feldspar and <2%, <1 mm biotite. Chemical analysis of a single sample indicates a composition on the border between the dacite and trachyte fields.

Oligo-Miocene Bedrock (continued)

- **Tf** — **Aphyric trachyandesite (Oligocene to lower Miocene)** - Chemical analysis of a single sample indicates that this unit is a trachyandesite.
- **Tvx** — **Bedded volcanic-lithic breccia (Oligocene to lower Miocene)** - Volcanic-lithic breccia with 4-6%, <4 mm feldspar, overlies mafic volcanic-lithic breccia west of Sombrero Butte.
- **Ta** — **Basaltic trachyandesite lava (Oligocene to lower Miocene)** - Lava flows and autobreccia with 1-10%, generally <5 mm pyroxene and up to 10%, <6 mm, plagioclase phenocrysts. Matrix commonly contains abundant <0.1 mm plagioclase needles and equant magnetite.
- **Tmbx** — **Mafic volcanic-lithic breccia of Scanlon Wash (Oligocene to lower Miocene)** - Clast-supported, volcanic-lithic breccia with mostly 3-100 mm diameter, subangular clasts of mafic volcanics containing 3-6%, 1-2 mm plagioclase and 6-8%, <0.4 mm pyroxene(?). Chemical analysis of a single sample indicates that this unit is a trachyandesite.
- **Tr** — **Rhyolitic to trachytic lavas (Oligocene to lower Miocene)** - Rhyolitic lava, autobreccia, and local block and ash flow. This unit contains 5-10% feldspar generally <3 mm but locally up to 6 mm, and minor biotite.
- **Tri** — **Intrusive rhyolite (Oligocene to lower Miocene)** - Flow-foliated rhyolite dikes and a single large intrusion near Mercer Ranch. Rhyolite contains 2-5%, <2 mm feldspar and minor biotite.
- **Tt** — **Nonwelded tuff (Oligocene to lower Miocene)** - Generic non-welded tuff, lithic tuff, and volcanic-lithic sandstone and conglomerate. Rocks of this unit are present between several of the silicic lava flows.
- **Trv** — **Rhyolitic to trachytic lava flows (Oligocene to lower Miocene)** - Lava containing 4-10%, 1-3 mm phenocrysts of plagioclase, sanidine, and <1% biotite. A single sample, analyzed for major elements, has a composition that lies in the trachyte field, but is very near the triple point between dacite, trachyte, and rhyolite fields.
- **Tb** — **Pyroxene-porphyritic basaltic lava (Oligocene to lower Miocene)** - Basaltic lava flows, autobreccia, and scoriaceous lava containing ~5-10%, <8 mm pyroxene and 2-6%, <3 mm plagioclase, and probable olivine.
- **Tu** — **Oligo-Miocene bedrock, undivided** - Small exposure of bedrock at far southeast corner of map area that was not visited but is dark on aerial photograph imagery and is suspected to consist of Oligo-Miocene mafic volanic rocks.

Oligo-Miocene dikes

- **Felsite dike (Oligocene to lower Miocene)** - Discontinuous set of aligned dikes near Rhodes Ranch. Dikes are ~10 m thick and contain 10-15%, 1-6 mm feldspar and less abundant, 1-2 mm biotite and hornblende.
- **Andesite dike (Oligocene to lower Miocene)** - Dike contains 20%, 2-3 cm plagioclase and is <5 m thick. Flow-foliation is parallel to dike.

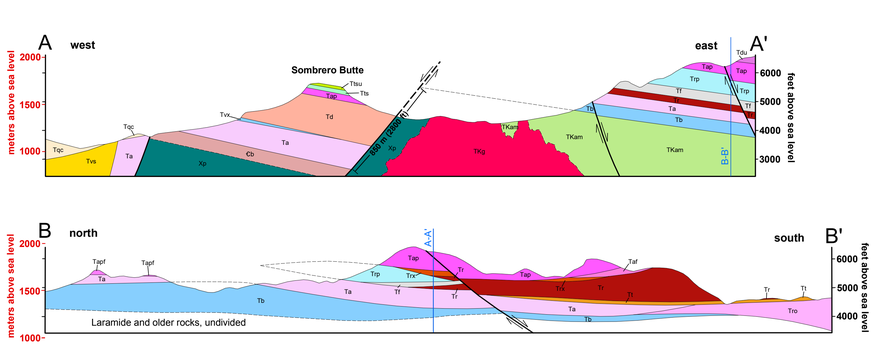
Laramide Bedrock

- **Alteration zone** - Strongly bleached fine-grained quartz-sericite (albite?) granofels
- **TKhx** — **Hydrothermal breccia (Upper Cretaceous to lower Tertiary)** - Massive fragmental rock with generally <20 cm, fine-grained granite(?) rocks altered to silica, iron-oxide, and clay, within silica and sericite matrix that in some breccias is more resistant to weathering than the clasts.
- **TKtt** — **Tourmaline vein (Upper Cretaceous to lower Tertiary)**
- **TKa** — **Andesite lava and autobreccia (Upper Cretaceous to lower Tertiary)** - Locally vesicular, dark- to medium-gray volcanic rocks with 8-30%, <8 mm feldspar and locally occurring, ~2%, <2 mm pyroxene(?), in a microcrystalline to aphanitic matrix. Fragmental textures are common but not ubiquitous. Clasts are generally <20 cm and interpreted as autobreccia.
- **TKam** — **Massive andesite (Upper Cretaceous to lower Tertiary)** - Dark gray, aphanitic, hypabyssal andesite with 15%, <5 mm plagioclase.
- **TKg** — **Medium to fine grained granite to granodiorite (Upper Cretaceous to lower Tertiary)** - Fine-grained, slightly porphyritic granite to granodiorite, generally with 10-20% mafic minerals and 10-20%, 2-4 mm feldspar phenocrysts in a fine-grained granitic matrix.
- **TKgp** — **Porphyry (Upper Cretaceous to lower Tertiary)** - Hypabyssal intrusion with 1-3 mm plagioclase phenocrysts and <1 mm mafic minerals in a microcrystalline matrix. Phenocrysts form 40-50% of rock.

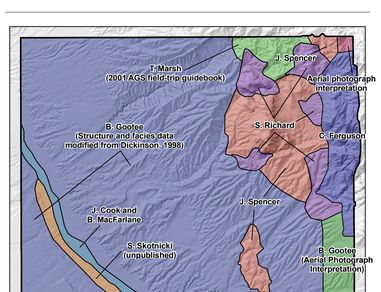
Paleozoic and Proterozoic Bedrock

- **Cb** — **Bolsa Quartzite (Cambrian)** - Fine- to locally medium-grained sandstone, plane bedded to cross bedded with cross-beds forming beds less than ~15 cm thick. Sandstone varies from chocolate brown to orangish tan to, rarely, white.
- **Ym** — **Mescal Limestone (Mesoproterozoic)** - Medium-bedded recrystallized carbonate.
- **Ydst** — **Dripping Spring or Troy Quartzite, undivided (Mesoproterozoic)** - Medium to thick bedded, plane-bedded quartzite, with sparse conglomerate beds containing subangular to rounded quartzite pebbles and cobbles. In northern exposures, this unit consists of mostly massive, pale grayish white quartzite with local, faint, dark, thin bands (1-5 cm thick) and parallel fractures that define bedding.
- **YXa** — **Argillite (Early or Middle Proterozoic)** - Very fine grained, tan, brown, and dark gray phyllite and argillite, with very low metamorphic grade. Bedding laminations are preserved locally. A weak phyllitic fabric is present in most outcrops.
- **Xp** — **Pinal Schist (Paleoproterozoic)** - Weakly metamorphosed, dark gray to greenish gray siltstone and thin-bedded, fine-grained quartzose sandstone. Includes thin-bedded to laminated argillite and siltstone. Unit includes common quartz veinlets and quartz-rich hydrothermal or metamorphic segregations that partly define lithologic layering.

Geologic Cross-Sections



Mapping Responsibility



Map Symbol Descriptions

- Horizontal bedding
- Inclined bedding
- Inclined bedding, approximate orientation
- Inclined bedding, facing indicators present at this location
- Overturned bedding
- Apparent dip
- Eutaxitic foliation
- Flow foliation
- Transposed bedding
- Joint
- Cleavage
- Paleocurrent direction determined from imbricate clasts
- Generic lineation
- Intersection lineation
- Slickenline (fault-surface striae)
- Fault dip
- Minor fault or vein
- Mineralized fault or shear zone

- Accurately located contact
- Approximately located contact
- Approximately located contact, inferred
- Gradational contact
- Boundary between lava flows
- Vein
- Accurately located fault
- Approximately located fault
- Approximately located fault, inferred
- Fault concealed beneath surficial units
- Anticline, solid where accurately located, dotted where concealed
- Syncline, solid where accurately located, dotted where concealed

References cited

Dickinson, W.R., 1998, Facies map of post-mid-Miocene Quiburis Formation, San Pedro Trough, Pinal, Pima, Gila, Graham, and Cochise Counties, Arizona: Arizona Geological Survey Contributed Map CM-98-A, 6 p., 10 sheets, scale 1:24,000.

Cooper, J.R., 1961, Turkey-track porphyry--a possible guide for correlation of Miocene rocks in southeastern Arizona: Arizona Geological Society Digest, v. 4, p. 17-33.

Marsh, T.M., 2001, Geologic field guide to the Copper Creek district: Arizona Geological Society, Field-Trip Guidebook, February 24, 2001, 26 p.

Skotnicki, S.J., undated, Geologic map of the southern half of the Clark Ranch and Mammoth Quadrangles and northern half of the Peppersauce Quadrangle: Unpublished map prepared for SRK Consulting, Tucson, Arizona.

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Seamless basemap generated using iGage All Topo Pro software.

Projection Information:
North American Datum of 1983.
1000-meter Universal Transverse Mercator grid tics, zone 12, shown in blue.

SCALE 1:24 000
1 MILE
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1 KILOMETER
CONTOUR INTERVAL 40 FEET

10°1/2°
2007 MAGNETIC NORTH DECLINATION