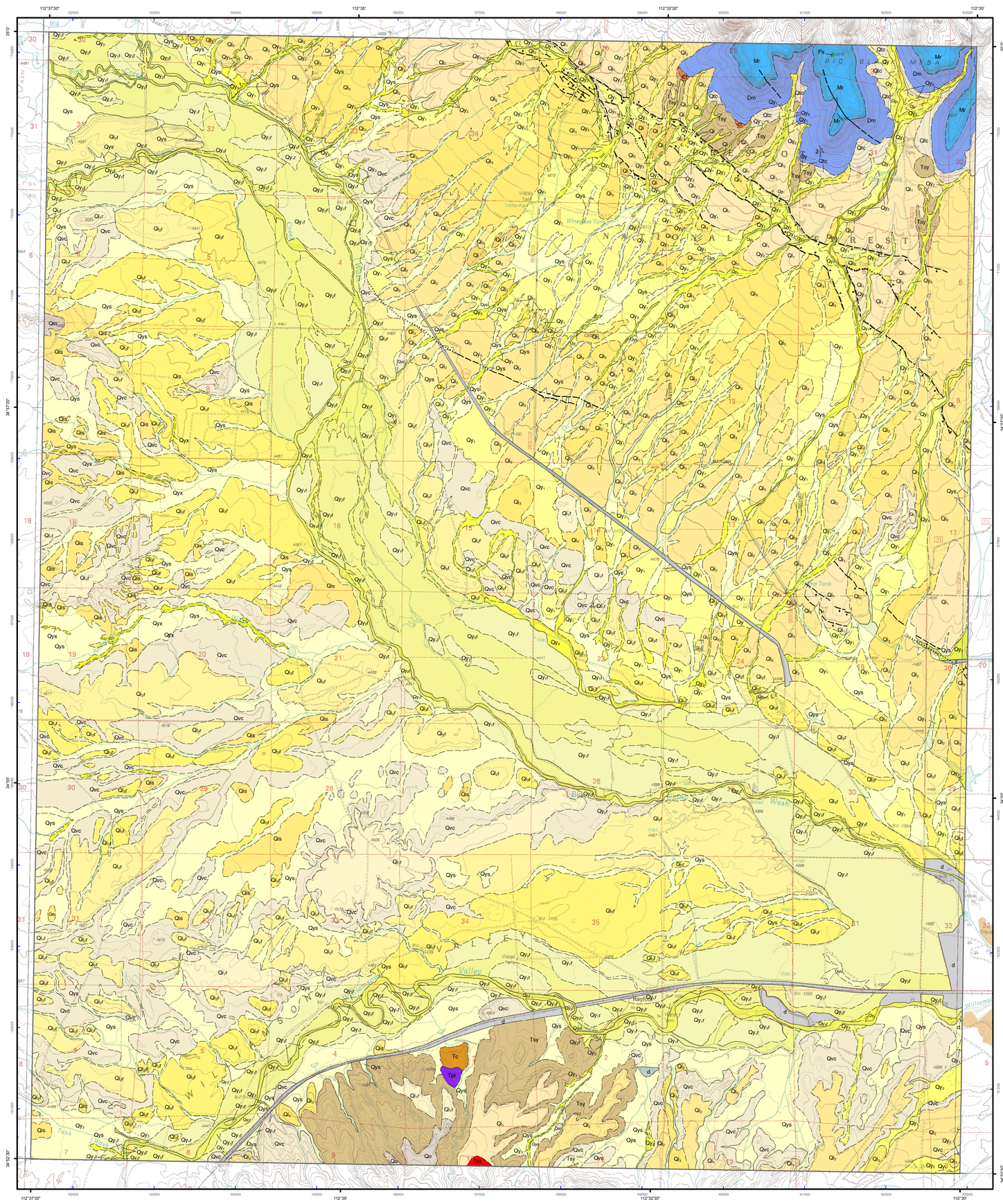


GEOLOGIC MAP OF THE WINEGLASS RANCH 7 ½' QUADRANGLE, YAVAPAI COUNTY, ARIZONA

Arizona Geological Survey Digital Geologic Map DGM-90, version 1.0

Scale 1:24,000

By
Philip A. Pearthree and Charles A. Ferguson

February 2012

Citation for this map:
Pearthree, P.A., and Ferguson, C.A., 2012, Geologic map of the Wineglass Ranch 7 ½' Quadrangle, Yavapai County, Arizona: Arizona Geological Survey Digital Geologic Map DGM-90, version 1.0, scale 1:24,000.

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G09AC00199. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Introduction

This geologic map covers much of southeastern Big Chino Valley and a small part of Big Black Mesa to the north, in Yavapai County north of Prescott. Mapping was conducted under the National Cooperative Geologic Mapping Program, with funding provided by the U.S. Geological Survey and the Arizona Geological Survey. The map was developed through a combination of field mapping and aerial photointerpretation, and was compiled digitally using ESRI ArcGIS software over a 7 ½' U.S. Geological Survey topographic base and digital orthophoto bases (National Agricultural Imagery Program, 2007, 2010).

The Wineglass Ranch quadrangle is in the northern part of the Transition Zone in north-central Arizona. This region is transitional between the highly extended Basin and Range region to the south and west and the mildly deformed Colorado Plateau to the north and east, with structural and physiographic affinities with each (Peirce, 1985). Major normal fault systems have dropped valleys down relative to adjacent mountains and mesas, but structural basins are generally less deep than those of the Basin and Range. The landscape of the Transition Zone is quite rugged, with high mountain ranges and down-faulted valleys that are variably dissected, but Big Chino Valley has undergone modest dissection in comparison to valleys to the south, southeast and west. Bedrock is exposed in Big Black Mesa in the northeastern corner of the quadrangle, but the remainder of the quadrangle is covered by Quaternary deposits and is underlain by variably thick, Cenozoic clastic sediments. The principal geologic structure in the quadrangle is the Big Chino fault, which separates the bedrock of Big Black Mesa from Big Chino with thousands of feet of throw, and has continued to be active in the late Quaternary (Pearthree et al, 1983; Euge et al, 1992). The structural basin underlying Big Chino Valley is asymmetric, with the deepest part of the basin (>2000 ft) adjacent to the Big Chino fault in the north-central part of the quadrangle. Depth to bedrock is much less in the southern and western parts of the quadrangle, and is less than 400 ft in the southeastern part of Big Chino Valley (Richard et al, 2007).

Bedrock Geology. Complete sections of the Devonian Martin and Mississippian Redwall formations are exposed on the southeast flank of Big Black Mesa. The unconformity-bounded units are overlain by a thin remnant of the Permian Supai Formation, and underlain by a small exposure of the uppermost Cambrian Tapeats Formation, neither of which had previously been recognized (Krieger, 1965) in this area. Two small exposures of trachyte lava flows/domes are preserved along the southern edge of the quadrangle (Tinnin, 2009).

Surficial Geology. Surficial geologic units on this map were differentiated based on physical characteristics of the deposits (sediment size and character, soil development) and geomorphic surface characteristics associated with the deposits. Differences in the primary physical characteristics of surficial deposits result from different rock types in watersheds, distance from uplands, and the size and character of the stream systems that transported the sediment. In this quadrangle, deposits north of Big Chino Wash emplaced by fluvial systems draining Big Black Mesa are derived from Paleozoic sedimentary rocks. Deposits on the southern margin of the quadrangle are derived from Tertiary volcanic and sedimentary rocks of the Sullivan Buttes. Deposits covering the valley floor in the central and western parts of the quadrangle were emplaced by larger washes (Big Chino Wash, Williamson Valley Wash, Antelope Wash, and Walnut Creek) and were derived from a wide variety of Tertiary volcanic and sedimentary rocks, granitic rocks, and Paleozoic sedimentary rocks. After emplacement and isolation from further deposition, surficial deposits are altered by processes of weathering, inputs of fine dust from the atmosphere, soil development, and erosion, so the character of the surface and near-surface portion of the deposits is related to the length of time that the deposits have been exposed at the surface. The primary framework of the mapping scheme employed in this map is deposit age and location in the valley (i.e., piedmonts or valley floor). Ages of all surficial geologic units were roughly estimated through correlations to deposits and alluvial surfaces with similar characteristics in the southwestern U.S. (e.g., Gile et al, 1981; Machette, 1985), with additional information about the spatial distribution of the deposits and particle size distributions that are characteristic of the deposits. In addition, a map unit outlining areas of active arroyo development is based almost entirely on its geomorphic expression.

The distribution of older surficial deposits and their positions in the landscape relative to modern fluvial systems provide evidence of the recent geologic evolution of Big Chino Valley. Middle Pleistocene alluvial fan surfaces are preserved 40-60 ft (12-20m) above modern washes northeast of the Big Chino fault zone. These surfaces owe most of their height in the landscape to relative uplift across the Big Chino fault zone. Along the southern margin of the quadrangle, remnants of early and middle Pleistocene alluvial fan surfaces are preserved in landscape positions that are even higher, up to 200 ft (60 m) above adjacent washes. Middle Pleistocene alluvial surfaces in the valley floor are typically ~100 ft (30m)above adjacent large drainages, and one poorly preserved early Pleistocene surface remnant on the western edge of the quadrangle is 150-200 ft (45-60m) above Big Chino Wash. The high landscape positions of these old alluvial surface remnants are not directly related to faulting. They more likely record the progressive incision of Big Chino Valley through the Quaternary, which may have occurred in response to integration of this area into the Verde River system in the early Quaternary.

Geologic Hazards. This geologic map provides insight into several geologic hazards, including late Quaternary faulting and flood hazards. The map covers a small portion of the Big Chino fault zone, which extends for about 35 miles (55km) from Picacho Butte in the northwest to the Verde River east of Paulden. This fault zone was first mapped and named by Kreiger (1965), and its Quaternary history of movement was subsequently investigated by Soule (1978), Pearthree et al (1983), and Euge et al (1992). They concluded that the Big Chino has had recurrent large-displacement events in the middle and late Quaternary, with the most recent occurring approximately 10-15 ka. Patterns of fault displacement and lack thereof documented in our mapping are consistent with the conclusions of previous studies, but the new mapping provides more detail of the fault zone. In addition, we have identified another fault system cutting Quaternary deposits closer to the valley axis (informally named the Pump Tank fault zone) that may be related to the Big Chino fault zone. Along the main fault zone, middle and late Pleistocene fan and terrace deposits are displaced by faulting. Southwest-facing fault scarps formed on the oldest faulted deposits (Qi1) are about 60 ft (20m) high; fault scarps formed on the youngest faulted deposits (Qi3) typically are 6 ft (2m) or less in height, but they are likely partially buried by younger deposits (e.g., Euge et al, 1992). There is no evidence of displacement of deposits we estimate to be Holocene in age (Qy1 and younger). Smaller, northeast-facing antithetic fault scarps exist along most of the fault zone, and are generally <1000 ft (300m) from the main fault scarps. The spatial pattern of fault scarps becomes more complex near the eastern edge of the quadrangle, with multiple down-to-the-south or west fault scarps, each of which is much smaller than scarps on equivalent-age surfaces to the northwest. This pattern of fault complexity continues to the southeast to the end of the fault zone. Evidence for Quaternary displacement along the Pump Tank fault zone is discontinuous, but probable fault scarps exist on Qi1, Qi2, and possibly Qi3 deposits. No Holocene deposits are displaced.

The distribution of young deposits in the quadrangle provides a reconnaissance-level assessment of areas that may be prone to flooding, because they are the cumulative record of deposition in many large floods over the past few thousand years. The spatial distribution of young deposits across piedmonts and the valley floor, and the character of the modern channel networks together record recent fluvial behavior, and thus provide important clues regarding the potential for flooding. Areas of active washes and drainageways (Qyc, Qy3, Qyx) are obviously most prone to flooding. Adjacent young geologic units that are slightly higher in the landscape (Qy2, Qys) are likely prone to inundation in large floods, and most of this inundation is shallow sheetflooding. Active drainage corridors typically are incised 5-10 ft (2-3m) below areas of older Holocene deposits (Qy1) and the youngest Pleistocene deposits (Qi3), or these areas are farther from active drainageways, so they generally are not subject to inundation. Flood hazards generally only are a concern along washes in areas covered by older Pleistocene deposits (units Qi2, Qi1) and bedrock hillslopes. Drainage systems in these areas typically are tributary in nature and topographic confinement is sufficient to contain flood flows to channels and immediately adjacent terraces. On the valley floor, nearly all of the channels of the large washes are incised 5-20 ft (2-6m) below extensive young floodplains. It is likely that much or all of this incision has occurred in the past century or so, and the result is that extensive areas that were formerly prone to shallow inundation (unit Qy2r, possibly Qy1r) are not currently prone to flooding. Lateral bank erosion into young deposits along incised channels is likely, however.

Description of Map Units

Piedmont Deposits

Qyx — **Active tributary channel alluvium** - Deposits in open channels that are large enough to depict at 1:24,000 scale. This unit is composed of moderately-sorted sand, silt, pebbles, cobbles, and some boulders. Channels are incised less than 2 m below adjacent late Holocene terraces and alluvial fans. Channel morphologies consist of single-thread, deeper channels and multi-threaded, shallower channels.

Qyx — **Areas of active arroyo development** - Areas of fine-grained deposits undergoing erosion due to arroyo development. Includes flat-bottomed, steep-sided channels with sand and fine-gravel deposits, and eroded slopes; also includes some areas between gullies where remnants of the pre-incision deposits are preserved. Arroyos are developing primarily in fine-grained Qys and Qy3 deposits.

Qyn — **Alluvium in small channels and active drainageways** - Unconsolidated sand, silt, clay and gravel deposits associated with active drainages. Includes sand and cobbles in low terraces and on active alluvial fans, and more extensive sand, silt and clay in unincised or slightly incised drainages. Fine-grained deposits generally are brown to gray.

Qy2 — **Alluvium on low terraces and floodplains** - Unconsolidated sand, silt and gravel deposits with weak soil development associated with valley floors and low terraces. Deposits are predominantly sand and silt, but in upper piedmont areas include cobbles and small boulders. Topographic relief across Qy2 surfaces is low.

Qys — **Fine-grained sheetflood deposits** - Laterally extensive, unconsolidated fine-grained alluvium in areas with little lateral topographic relief. These sediments are dark brown to light gray in color and consist of sand, silt, clay and minor gravel. In the valley floor, Qys deposits are primarily derived from fine-grained basin deposits and may contain moderate amounts of gypsum fragments.

Qy1 — **Alluvium on young, inactive alluvial fans and terraces** - Sand, silt and gravel deposits associated with low-relief alluvial fans and low terraces adjacent to washes. These deposits are unconsolidated and loose silt and gravel size clasts with a light to medium gray-brown soil. Soil development is weak to moderate, with some structure and visible calcium carbonate accumulation.

Qy — **Holocene alluvium, undivided** - Unconsolidated to weakly consolidated, generally fine-grained Holocene deposits with weak soil development.

Qi3 — **Younger intermediate alluvial fan and terrace deposits** - Gravelly alluvial fan and terrace deposits 3 to 20 ft (1 - 6 m) above active washes. Qi3 deposits are unconsolidated fine to coarse alluvium consisting of pebbles, cobbles, sand, silt and boulders, with minor clay. Clasts include predominantly limestone, dolomite, latite and basalt, and are angular to subrounded. Soils typically are reddish-brown with moderate calcium carbonate accumulation (stage II-III). Soil color varies with position in the piedmont and valley floor due to differences in the parent material.

Qi2 — **Older intermediate alluvial fan deposits** - Unconsolidated to weakly cemented coarse-grained alluvium forming broad, moderately dissected alluvial fans. Clast lithologies include mixed latite and basalt, dolomite and limestone. These deposits generally exhibit reddish-brown soils and moderate to strong calcium carbonate accumulation (stage II to IV). Varnish and pavement development are variable, ranging from none to moderately strong, but gravel lags are common. These deposits stand in relief ranging from 20 to 50 ft (6-15 m) above active channels.

Qi — **Intermediate terrace and fan deposits** - Intermediate gravelly terrace and alluvial fan deposits, undivided

Qi1 — **High relict alluvial fan deposits** - Alluvial fan deposits forming broad planar surfaces to broadly rounded ridges. Qi1 fans are between 20 to 80 ft (6-25 m) above active washes. Qi1 deposits are unconsolidated to poorly cemented, coarse-grained alluvium consisting of cobbles, pebbles, sand, boulders with minor silt and clay. Clasts are generally subangular to subrounded. Rock varnish and desert pavement are weak to moderate. Qi1 deposits exhibit moderate to strong calcium carbonate accumulation (stage III to IV).

Qo — **Very high relict alluvial fan deposits** - Highest preserved alluvial fan deposits preserved only on the piedmont north of Sullivan Buttes. Deposits are poorly exposed, but surface gravel suggests they include cobbles, boulders, pebbles and fines. Surface is planar with well-rounded edges. Preserved fan surface exhibits variable rock varnish and moderate desert pavement and is grayish brown in color.

Tsy — **Younger siliciclastic rocks** - Poorly exposed conglomerate with some finer-grained beds. Deposits are typically weakly indurated and form low hills and ridges flanking bedrock uplands. The relative abundance of conglomerate to fines depends on the proximity to bedrock uplands. Subangular to sub-rounded clasts match bedrock outcrops in nearby uplands. Exposed thickness ranges from 0 to 100 feet (0 to 30 m). In the south, the unit is strongly volcaniclastic. In the north it is composed chiefly of Paleozoic sedimentary clasts.

Basin Floor Deposits

Qyr — **Active river channel deposits** - Unconsolidated, very poorly sorted sandy to cobbly beds exhibiting bar and swale microtopography. Clasts are subangular to well-rounded. Clast lithologies include mixed latite and basalt, Paleozoic limestone and chert. Qycr deposits are typically unvegetated to lightly vegetated and exhibit no soil development. Qycr deposits are entrenched from 3 to 15 ft below adjacent historical floodplain deposits.

Qyr — **Low terrace deposits** - Very young terrace deposits that occupy elevations from 3 to 6 ft above active channels and are inset below the pre-incision historical floodplain. These surfaces are planar to rounded, and locally exhibit bar and swale microtopography. Deposits are poorly sorted silt, sand, pebbles and cobbles. Pebbles and cobbles are well-rounded to sub-angular.

Qyr — **Historical floodplain deposits** - Deposits associated with the floodplain that existed prior to recent entrenchment of the larger washes in the valley. Qy2r deposits are associated with broadly planar surfaces that locally retain the shape of historical river meanders. Qy2r surfaces are 3 to 15 ft above modern channels and are the most extensive river terraces in the valley. These deposits appear predominantly fine grained at the surface due in part to the input of organic matter and windblown dust deposition but are composed of interfingering coarse sandy to pebbly braided channel and fine sand to silty river floodplain deposits. Where Qy2r deposits are moderately to deeply incised they are not subject to inundation by river floods, but they may be flood-prone in areas with less channel incision.

Qyr — **Young river terrace deposits** - Sand, silt, and gravel deposits associated with slightly higher terraces that are remnants of older Holocene aggradation periods. Soil development is moderate and surface color ranges from 10 to 7.5 YR 4/4. A light dusting (incipient stage I) calcium carbonate accumulation is evident on the undersides of some buried clasts. Qy1r surfaces are commonly only slightly higher than adjacent Qy2r surfaces.

Qis — **Intermediate fine-grained deposits** - Unconsolidated to weakly consolidated fine-grained deposits derived primarily from fine-grained basin deposits. Deposits are primarily sand, silt and clay, with minor gravel clasts of limestone. Surfaces are smooth to gently undulating, and orange to reddish brown. Soil development is moderate, with some clay accumulation and stage II-III calcic horizons.

Qi3r — **Younger intermediate terrace deposits** - Weakly consolidated, gravelly, sandy river terrace deposits 10 to 30 ft above active channels. Gravel clasts are reasonably diverse lithologically and subangular to well-rounded. Soil development consists of Stage II calcic horizon development and reddened cambic or weak argillic horizons. Surface color typically is light orange.

Qi2r — **Older intermediate terrace deposits** - Terrace deposits are similar to Qi3r deposits but occupy higher positions in the landscape. Terrace surfaces are slightly to moderately rounded. Clast composition is diverse. Well-rounded pebbles to cobbles with calcium carbonate coating commonly litter Qi2r surfaces. Qi2r soils are moderately well developed, reddened (5YR) argillic horizons, with obvious clay skins and subangular to angular blocky structure. Underlying soil carbonate development is typically stage II to III, with abundant carbonate through at least 1 m of the soil profile.

Qi1r — **High terrace deposits** - Deposits are associated with high-standing terrace remnants mantled with river gravel. Where Qi1r deposits are extensive, remnant planar caps are preserved away from the margins of the surface, but generally surface remnants are rounded. Qi1r deposits are composed of lithologically diverse, well rounded to sub-rounded pebbles and cobbles. Near-surface cobbly beds exhibit stage II+ calcium carbonate accumulation. Moderately to strongly calcium carbonate coated clasts or cemented aggregates of clasts mantle the flanks of Qi1r deposits, but clay accumulation is variable, probably due to poor surface preservation. Where surfaces are well-preserved, Qi1r soils are reddened (5-2.5YR), argillic horizons, with subangular to angular blocky structure. Soil carbonate development is typically stage III-IV, with abundant carbonate through at least 1 m of the soil profile.

Qor — **Highest valley floor deposits** - Deposits are associated with a very high-standing, gravel-mantled valley-floor remnant 100 to 150 ft above modern channels. The lone Qor surface remnant on the western margin of the quadrangle is rounded, and deposits are ~50 ft thick. Qor deposits are composed of lithologically diverse, well rounded to subangular pebbles and cobbles, and are poorly sorted, clay to small boulders. Soil development is variable.

Qvc — **Regolith and colluvium formed on basin-fill deposits** - In situ deposits mantling gentle to moderate slopes on fine-grained basin-fill deposits. Deposits commonly are sand, silt and clay, with minor clasts of reworked carbonate and fine gravel. Soil development is generally weak.

Other Deposits

Qtc — **Talus and colluvium** - Very poorly sorted, angular, weakly bedded to massive, moderately to steeply dipping deposits mantling bedrock-cored hillslopes.

d — **Disturbed ground** - Areas profoundly disturbed by human activities. Includes gravel pits and substantial roads.

Bedrock Units

Tpt — **Pyroxene trachyte lava** - Lava containing 5-10% euhedral to subhedral clinopyroxene phenocrysts <0.5mm with minor subhedral to euhedral biotite (<0.8mm), 0.4-0.5mm subhedral to anhedral plagioclase, quartz, opaque oxides and hornblende. The lava also contains up to 2% xenoliths of <5cm amphibolite and pyroxenite.

Thl — **Hornblende trachyte lava** - Lava containing up to 10% euhedral to subhedral hornblende phenocrysts 0.3 to 8mm, with lesser phenocrysts of < 0.5mm clinopyroxene, plagioclase, orthopyroxene, <0.8mm biotite, and opaque oxides <0.2mm. The lava also contains up to 3% >1cm amphibolite xenoliths.

Tc — **Conglomerate** - **Conglomerate** with arkosic sandy matrix containing clasts of granitoid, and gneiss. A single exposure of this unit along the southern edge of the quadrangle is differentiated from younger conglomerate in the same area (Tsy) which is strongly volcaniclastic.

Ps — **Supai Formation** - Red sandstone, siltstone and shale. Only one small outcrop of the basal part of this formation occurs in this map area, and consists of dark red, fine-grained, well-sorted sandstone with specular hematite concretions. Elsewhere, sinkholes developed in the underlying Redwall Limestone (Mr) are filled with brecciated **Supai Formation** and this may be the case for this exposure. Preserved thickness is <2m thick.

Mr — **Redwall Limestone** - Cliff-forming limestone, and minor dolostone in medium- to thick-bedded, mostly tabular, amalgamated sets. Most of the unit consists of recrystallized, cherty, skeletal packstone and grainstone with abundant crinoid columnals, brachiopods, bryzoans, and echinoid spines. Chert occurs in irregularly interconnected, bread loaf-shaped, bed-parallel masses. A persistent, 10-20m thick, unconformity bounded unit of light brown calcarenite defines the base of the formation throughout the map area which is characteristically devoid of chert, weakly recrystallized, and low-angle cross-stratified. Krieger (1965) cautions that since this basal unit resembles the underlying Martin Limestone, it may locally be included with that unit. In some areas, a marker bed shown at the base of the formation corresponds to the top of this unit and corresponds to a reddish matrix, karst breccia up to 5m thick that grades down into the basal unit. The breccia is sharply overlain by thick-bedded cherty limestone typical of the bulk of the formation. The lower unit sharply overlies a similar, although typically thicker and more recessive karst breccia at the top of the Martin Limestone. Locally, at the contact, a medium-grained to granule quartz sandy laminated to thin-bedded limestone is present. 55-75m thick.

Dm — **Martin Limestone** - Dolostone, minor quartz sandstone, and minor quartzite granule-pebble, carbonate-matrix conglomerate. The unit is dominated by tabular sets of amalgamated, medium- to thick-bedded, variably thin-ribbon cherty, light tan to brown dolostone. The strata are interbedded with 5-30%, ledge and/or cliff-forming, algal laminated, vuggy, thin- to medium-bedded dolostone intervals up to 5m thick. The formation is characteristically devoid of recognizable fossils except for a single, persistent spiriferid brachiopod (Atrypa?) quartz-sandy coquina bed up to 2m thick near the base of the formation. Strata below the coquina include interbeds of light green shale that are probably correlative with a problematic, ~20m thick unit mapped between the Martin and the Tapeats in the southeasterly adjacent Chino Valley North 7.5' Quadrangle (Gottee et al., 2010). Limited and poor exposures preclude mapping it in this area. 105-140m thick.

Ct — **Tapeats Sandstone** - Medium- to coarse-grained and locally granule and pebbly quartz sandstone, typically cross-stratified in medium-bedded, tabular and wedge-shaped sets. Exposed thickness is less than 20m.

References

Birkland, P.W., 1999, Soils and Geomorphology (3rd Ed.), New York: Oxford University Press, 430 p.

Euge, K.M., Schell, B.A., and Lam, I.P., 1992, Development of seismic acceleration maps for Arizona: Arizona Department of Transportation Report No. AZ92-344, 327 p., 5 sheets, scale 1:1,000,000.

Gile, L.H., Hawley, J.W., and Grossman, R.B., 1981, Soils and geomorphology in the basin and range area of southern New Mexico -- guidebook to the Desert Project: New Mexico Bureau of Mines and Mineral Resources Memoir 39, 222 p.

Kreiger, M.H., 1965, Geology of the Prescott and Paulden quadrangles, Arizona: U.S. Geological Survey Professional Paper 467, 127 p., 5 sheets, map scale 1:48,000 and 1:96,000.

Machette, M.N., 1985, Calcic soils of the southwestern United States: in Weide, D.L., ed., Soils and Quaternary Geology of the Southwestern United States: Geological Society of America Special Paper 203, p. 1-21.

Pearthree, P.A., Menges, C.M., and Mayer, Larry, 1983, Distribution, recurrence, and possible tectonic implications of late Quaternary faulting in Arizona: Arizona Bureau of Geology and Mineral Technology Open-File Report 83-20, 51 p.

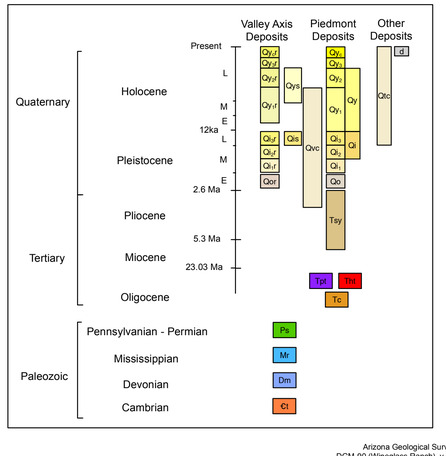
Peirce, H.W., 1985, Arizona's backbone: the Transition Zone: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 15, n. 3, p. 1-6.

Richard, S.M., Shipman, T.C, Greene, L.C., and Harris, R.C., 2007, Estimated depth to bedrock in Arizona: Arizona Geological Survey Digital Geologic Map DGM 52, v. 1.0, 9 p., map scale 1:100,000.

Soule, C.H., 1978, Tectonic geomorphology of the Big Chino fault, Yavapai County, Arizona: University of Arizona, M.S. thesis, unpublished, 114 p.

Tinnin, B., 2009, Volcanology and petrology of the Sullivan Buttes latite, northern Sullivan Buttes, Chino Valley, Arizona: Flagstaff, Northern Arizona, unpublished M.S. thesis, 153 pp.

Unit Correlation Diagram



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

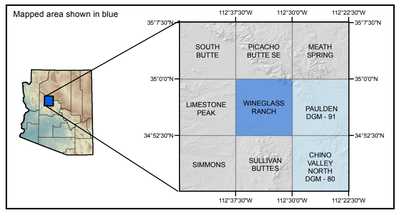
Topographic base from USGS 1:24,000 Quadrangle Series.
Seamless basemap generated using iGage All Topo Pro software.

APPROXIMATE MEAN DECLINATION, 2011

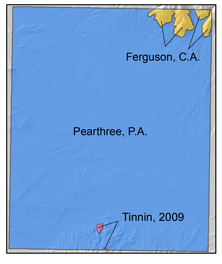
SCALE 1:24,000

CONTOUR INTERVAL 40 FEET

Location Map



Mapping Responsibility



Line and Structural Symbol Descriptions

- bedding
- accurately located contact
- approximately located contact
- accurately located fault - sense of slip unspecified
- approximately located fault - sense of slip unspecified
- approximately located normal fault, bar and ball on downthrown block
- concealed fault - sense of slip unspecified

Acknowledgments

Brian Gootee and Jeri Young provided field assistance and feedback for this mapping. Ryan Clark created GIS tools that facilitated the development of this digital geologic map. Janel Day and Genevieve Pearthree produced the final map and digital information products.

Arizona Geological Survey
416 W. Congress Street, Suite 100
Tucson, AZ 85701
(520) 770-3500
www.azgs.az.gov