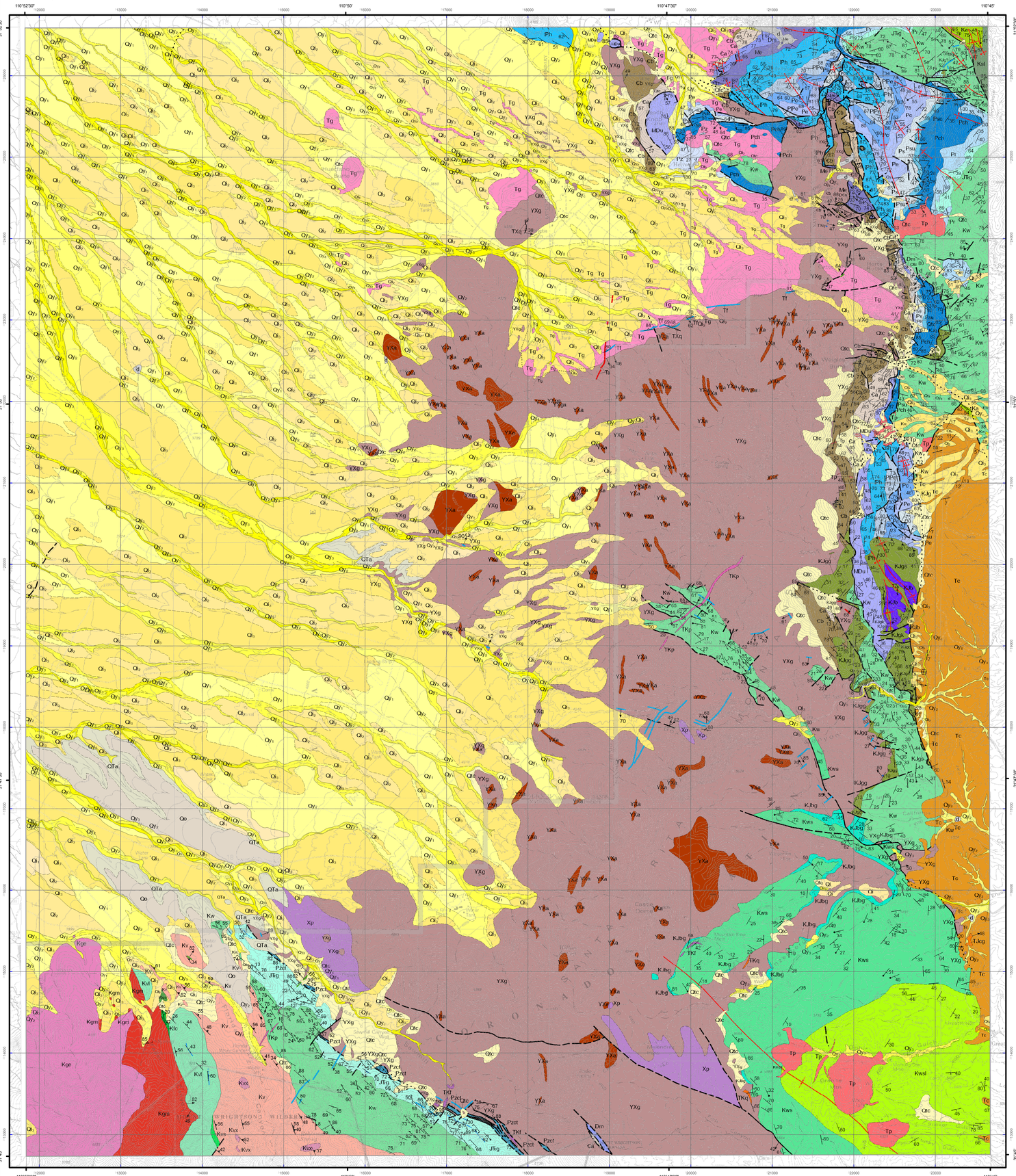
Arizona Geological Survey
OFR-09-06 (Helvetia), v.1.0



Topographic base from USGS 1:24,000 Quadrangle Series.
Seamless basemap generated using iGage All Topo Pro software.
Hillshade generated from NED 10m Digital Elevation Model.

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

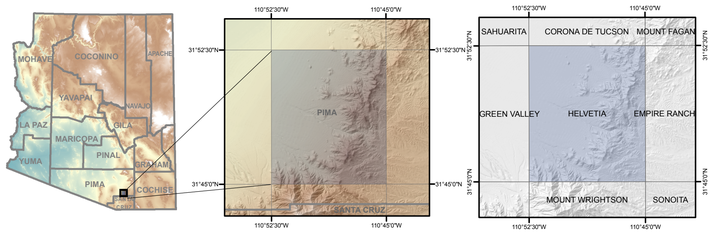
SCALE 1:24 000

1 MILE
1 KILOMETER
CONTOUR INTERVAL 40 FEET

MN
10½°
2007 MAGNETIC NORTH DECLINATION

Location Map

Mapped Area Shown in Blue



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Map Unit Descriptions

Surficial Deposits

Qyr **Active tributary channel alluvium** - Unconsolidated, very poorly sorted sandy to bouldery active channel sediments. Channels commonly exhibit bar and swale microtopography with bars composed of coarser sediments. Qyc deposits are unvegetated to lightly vegetated and exhibit no soil development, with shrubs and small trees on slightly elevated bars. Channels are generally incised less than 2 m below adjacent Holocene alluvial surfaces. Qyc deposits commonly become submerged during moderate to extreme flow conditions and can be subject to deep, high velocity flow and lateral bank erosion.

Qyr **Latest Holocene alluvium** - Very young piedmont alluvium located along active drainages containing small channels, low-lying terraces, shallow sheetflood areas, and overflow channels. Qy3 deposits consist of silt, sand and fine gravel, with some cobbles and boulders. Soil development is absent or incipient on Qy3 deposits, which exhibit pale buff to light brown (10 YR to 7.5 YR) surface coloration. Qy3 deposits support larger and denser vegetation than Qyc deposits due to less frequent inundation. Qy3 surfaces generally exhibit bar and swale microtopography and are susceptible to inundation during moderate to extreme flow conditions.

Qyr **Late Holocene alluvium** - Young deposits located primarily on low terraces along the flanks of incised channels and on broad, low-relief sheetflood areas. These deposits consist of unconsolidated to very weakly consolidated sand, silt, pebbles and cobbles, with boulders. Where inset into older alluvium, Qy2 terrace deposits are planar with remnant bar and swale microtopography. Qy2 sheetflood deposits are laterally extensive with planar to gently undulating surfaces. Soil development on Qy2 deposits is weak, characterized by incipient stage I calcium carbonate accumulation in the form of small filaments and medium brown (7.5 to 10 YR) surface coloration. Vegetation on Qy2 surfaces typically is fairly dense and includes small mesquite trees, grasses, creosote, and acacia. Qy2 terraces are less than 1.5 m above adjacent active channels. These surfaces are subject to inundation during moderate to extreme flow conditions.

Qyr **Early to middle Holocene alluvium** - Slightly higher, weakly consolidated terrace and alluvial-fan deposits with weak to moderate soil development. Surfaces are generally planar to undulating; relict gravel bars are evident. Vegetation cover is variable, ranging from fairly medium mesquite to relatively open surfaces with prickly pear, small mesquite, and numerous small shrubs and grasses. Overall relief between terrace or fan surfaces and adjacent channels typically does not exceed 2 meters. Numerous shallow channels drain extensive Qy1 surfaces. Qy1 deposits exhibit weak calcium carbonate accumulation (stage I to II) and incipient clay accumulation, and surfaces typically are brown (7.5 YR). Deposition of Qy1 sediments has resulted in shallow burial of older piedmont deposits in many areas. This relationship is visible along incised channels where thin Qy1 deposits overly redder, gravelly, clay-rich Qi2 or Qi3 deposits.

Qi3 **Late Pleistocene alluvial fan and terrace deposits** - Widespread relict alluvial fans and terraces with moderate soil development. These deposits consist of weakly consolidated pebbles, cobbles, sand, silt and minor boulders. Soils exhibit weak to moderate calcium carbonate accumulation (stage I-III) and clay accumulation, with reddish shallow subsurface coloration (5 YR). Surfaces commonly have a pebble-cobble lag, and surface clasts have an orange varnish. Qi3 deposits exhibit small to medium mesquite, prickly pear, creosote, acacia, and numerous small grasses and shrubs. Qi3 deposits stand up to 5 m higher in the landscape than adjacent active channels, but more commonly are ~2 m above active channels.

Qi2 **Middle Pleistocene alluvial fan and terrace deposits** - Deposits associated with planar to rounded relict alluvial fans and terraces with strongly developed reddish soils. These deposits generally exhibit reddish (5 YR), moderately clay-rich near-surface soil horizons and moderately strong calcium carbonate accumulation (stage III). Qi2 surfaces are commonly mantled by well-varnished, reddened cobbles and pebbles, and surface have a orange to red color. Qi2 surfaces commonly are planar but can exhibit moderate rounding near incised channels or inset terraces. Vegetation on Qi2 surfaces consists of medium mesquite, prickly pear, cholla, barrel cactus, and numerous small shrubs and short grasses. Where incised, these deposits often exhibit a cap up to 1 meter thick of moderately calcium carbonate cemented clasts. This cap preserves underlying, less-indurated portions of the Qi2 surface as well as any deposits it may overly. Qi2 terraces deposited onto basin fill deposits may stand as much as 30 meters above active piedmont channels.

Qi **Middle to late Pleistocene alluvial deposits, undivided** - Middle to late Pleistocene alluvial deposits, undivided

Qi1 **Early to middle Pleistocene alluvial fan deposits** - Moderately consolidated pebble, cobble, sand and boulder deposits associated with high-standing, moderately to well-rounded alluvial fan remnants. Qi1 surfaces exhibit strong, dark reddish (2.5 YR), clay-rich shallow subsurface soil horizons and (stage II-IV) calcium carbonate accumulation. Where laterally extensive, Qi1 deposits retain a remnant, resistant planar cap due to strong soil development, but surface edges typically are moderately to well rounded. Narrow Qi1 surfaces are generally well-rounded with moderatestrong soil development on the slopes. Qi1 terraces are commonly mantled by coarse pebbles to boulders and support vegetation consisting of mesquite, acacia, prickly pear, cholla, barrel cactus, and grasses.

Qo **Early Pleistocene alluvial fan deposits** - Moderately consolidated cobble, boulder, pebble, and sand deposits with very strong soil development associated with high relict alluvial fans. These deposits are found only near the mountain front, and overlie slightly less coarse uppermost basin-fill deposits. Qo fan surfaces typically are very smooth where laterally extensive, but the margins of the surfaces are well-rounded. Very clay-rich shallow subsurface soil horizons are reddish brown to red (2.5 YR to 10R), and calcic horizon development is variable. These deposits typically support moderate to dense grass, with scattered small mesquite trees.

QTa **Late Pliocene to early Pleistocene fan gravel** - Poorly exposed, coarse gravel deposits that underlie older Quaternary deposits in a few places near the mountain front. QTa deposits are composed of moderately indurated, very poorly sorted subangular cobbles, pebbles, boulders and sand. Locally these deposits are capped by very old, very high relict Qo alluvial fan deposits.

Qtc **Talus and colluvium** - Locally-derived, very poorly sorted and weakly bedded, hillslope colluvium and coarse, subangular to angular, bouldery to cobbly talus mantling bedrock-cored slopes.

d **Disturbed areas** - Areas profoundly disturbed by human activity. Primarily stockponds and mining disturbance.

Basin fill deposits

Tc **Gila Conglomerate (Miocene to Pliocene)** - Boulder-cobble-pebble, clast-supported conglomerate and pebbly sandstone. Conglomerate occurs in fairly massive to very thick-bedded units with stratification defined by grain-size variations. Clasts are sub-angular to sub-rounded, and consist of arkosic sandstone (Bisbee), phenocryst-rich quartz-feldspar-biotite ash-flow tuff (Kr), argillite and limestone (Bisbee and Paleozoic), quartzite (Cambrian Bolsa) and Proterozoic granitoid. Clasts of white quartz porphyry (TKq) are sparsely present.

Bedrock Units

Ta **Granitic dikes (Eocene?)** - Granitic dike 2-20 m thick, containing 15-20% K-feldspar phenocrysts (2-3 mm) and 8-10% mafic minerals (biotite up to 2 mm, magnetite) in an aplitic groundmass of quartz and feldspar.

Tf **Feldspar-quartz porphyry (Eocene?)** - Porphyry dikes containing 5-12% quartz and 1-10% feldspar phenocrysts in a light gray to light pink aphanitic groundmass. Quartz is 1-3 mm, subhedral to anhedral, and commonly embayed. Feldspar is pale pink, 1-3 mm, subhedral to euhedral, and commonly altered to carbonate. Flow foliation parallels dike margins.

Tp **Quartz-feldspar porphyry (Paleocene - Eocene)** - Light gray to pink felsic porphyry containing 8-15% phenocrysts of anhedral to euhedral quartz (1-5 mm), up to 25% subhedral to euhedral feldspar (3-5 mm, white to pink), and 1-2% biotite. The biotite forms thin 1-2 mm flakes that commonly weather out of the rock. The groundmass ranges from aphanitic to aplitic and is commonly silicified. The porphyry forms small stocks and dikes that are associated with copper mineralization in the Rosemont, Helvetia, and Greaterville areas.

Tg **Helvetia granite (Paleocene - Eocene)** - White to light gray, medium- to coarse-grained monzogranite and granodiorite, typically containing 1-10% euhedral K-feldspar megacrysts 1-2 cm long. Mafic minerals, mostly biotite and magnetite, form fine-grained aggregates 1-5 mm across and constitute 5-12% of the rock.

TKp **Feldspar porphyry (Tertiary - Cretaceous)** - Feldspar porphyry dikes containing 15-20% feldspar phenocrysts (1-3 mm) and 1-2 % mafic phenocrysts (1-2 mm) in a pink to purple aphanitic groundmass. Feldspar phenocrysts are euhedral to subhedral, are mostly sericitized, and some appear broken or embayed. The mafic phenocrysts are iron-oxide-stained and appear to be mostly altered biotite.

TKf **Crystal-poor to aphyric felsite** - Crystal-poor to aphyric felsite. Locally this unit is flow-banded and contains 1-2%, <1mm oxidized pyrite.

TKq **Quartz porphyry felsite** - Crystal-poor dike with ~1%, < 1mm quartz.

TJcg **Massive granite-clast conglomerate** - Granite clasts are lithologically diverse, with fine, medium, and coarse porphyritic granite clasts, typically 2-20 cm, that all could have been derived from local heterogeneous granite (Continental Granodiorite)

TXq **Quartz veins (Tertiary - Proterozoic)** - Quartz veins and stockwork

Kge **Elephant Head pluton (Late Cretaceous)** - Leucocratic syenogranite composed of 60-70% K-feldspar, 8-10% plagioclase, 20-30% quartz, 2-3% biotite, and 1-3% magnetite. Texture grades from fine-grained porphyritic to bimodal fine- to medium-grained, depending on the abundance of light gray K-feldspar crystals 3-10 mm long which form 15% to >50% of the rock.

Kgm **Madera Canyon pluton (Late Cretaceous)** - Plutonic rock characterized by light gray, tabular, euhedral K-feldspar phenocrysts up to 2 cm long in a fine- to medium-grained groundmass of plagioclase, K-feldspar, quartz, and 15-20% mafic minerals including aggregates of fine-grained biotite, magnetite, sphene, and hornblende. Plagioclase forms euhedral cores of phenocrysts, mantled by K-feldspar.

Kv **Mt Wrightson Formation, ash-flow tuff (Upper Cretaceous)** - Phenocryst-poor, densely welded, rhyolitic ash-flow tuff containing 3-10% 1-4mm phenocrysts of sanidine (or K-feldspar), plagioclase, and sparse biotite. Some tuff in the lower part of the formation also contains a few percent <0.5mm quartz phenocrysts. Most of the ash-flow tuff in this formation is part of very thick sequence of probable caldera-fill. The tuff contains large lithic blocks of older units, chiefly Willow Canyon Formation, but also quartzite of probable Mesozoic age (Kvx).

Kvx **Mt Wrightson Formation, megabreccia (Upper Cretaceous)** - Blocks, some very large of quartz sandstone, green arkosic sandstone and mudstone, and green altered mafic lava contained within the ash-flow tuff (Kv).

Kvl **Rhyolite lava, Mt Wrightson Formation (Upper Cretaceous)** - Rhyolite lava, lava breccia, and minor pyroclastic rocks. This unit is dominated by phenocryst-poor rhyolitic lava containing 5-15%, 1-5mm phenocrysts of K-feldspar and plagioclase and minor biotite.

Kvs **Mt Wrightson Formation, sandstone and tuff (Upper Cretaceous)** - Thin arkosic-lithic sandstone and tuff sequences associated with the rhyolite lava complex (Kvl). The tuffs contain abundant accretionary lapilli and the sandstone, typically quartzose but locally arkosic and lithic arkosic.

Kfcv **Fort Crittenden Formation (volcanic facies)** - gfga

Kfc **Fort Crittenden Formation – Solero Group Conglomerate undifferentiated (Upper Cretaceous)** - Dark green pebbly arkosic sandstone and mudstone, with sparse andesitic lava or dikes that underlies the Mt Wrightson Formation.

Bisbee Group

Ksl **Lower Shellenburger Fornation (Lower Cretaceous)** - Arkosic sandstone and mudstone capped by a distinctive limestone unit <5m thick. This is an oyster packstone that defines the top of this map unit. Sandstones of this unit are fine- to medium-grained arkosic to lithic and argillaceous.

Ka **Apache Canyon Formation (Lower Cretaceous)** - Arkosic sandstone, mudstone, limestone, and rare pebbly sandstone. It is distinguished by its signature lithology; dark, typically laminated, nonfossiliferous micritic limestone. The limestone, making up as much as 50% of the formation, occurs in laminae, and thin- to medium-bedded, rarely thick-bedded sequences of amalgamated laminated to thin-laminated black limestone interleaved with dark mudstone and shale. Sandstone occurs in thin- to thick-bedded units that display bed-scale cross-stratification, but also, and more commonly, graded beds, either massive or plane-bedded stratified. Ripple-laminated sequences are common in individual thin beds and laminae, and as gradational tops to the graded beds. The mudstone, which dominates the formation, occurs in sets that range up to 10m thick. The mudstone is mostly shale or claystone with sparse silty laminae and thin beds.

Kw **Willow Canyon Formation (Lower Cretaceous)** - A succession of fine- to coarse-grained, locally pebbly, arkosic sandstone and arkosic-lithic sandstone interbedded with dark olive gray to maroon to dark purple mudstone. Mudstone is typically silty with rare pure claystone or shale intervals. The sandstone is mostly medium- to thick-bedded, and displays graded bedding, planar bedding, and cross-stratification. Ash beds are locally present near the base.

Kwsl **Willow Canyon Formation, sandstone and siltstone facies (Lower Cretaceous)** - This unit consists primarily of siltstone and medium-, fine-, and very fine-grained sandstone. At stratigraphically low levels, medium- to coarse-grained sandstone is common. Locally near stratigraphic top of this unit are sparse zones of laminated siltstone and shale, calcareous shale, and laminated limestone.

Kws **Willow Canyon Formation, sandstone facies (Lower Cretaceous)** - This unit consists of fine-, medium-, and coarse-grained sandstone with magnetite laminations and cross beds in 10-30 cm thick sets. Color is generally tan to medium brown. Includes a minor component of fine-grained sandstone and siltstone, and local pebble and rare cobble conglomerate. Base of unit is locally conglomeratic.

Kwm **Willow Canyon Formation, mafic lava (Lower Cretaceous)** - Mafic lava flows within the Willow Canyon Formation. The flows are massive to amygdaloidal (calcite and quartz) and typically very fine-grained with sparse mafic phenocrysts up to 2 mm. The matrix consists of fine-grained microlites of plagioclase.

KJbg **Basal grus (Jurassic - Cretaceous)** - Disaggregated, reworked, and oxidized megacrystic Continental Granodiorite that forms poorly sorted, weakly bedded base of Bisbee Group in the Greaterville area. Unit rests directly on Continental Granodiorite. Unit includes poorly sorted maroon siltstone, sandstone, and pebbly sandstone.

KJg **Glance Conglomerate (Lower Cretaceous – Upper Jurassic)** - Conglomerate at the base of the Bisbee Group that contains a wide variety of clast types. The conglomerate is typically massive to thick-bedded, mostly clast-supported, but locally matrix-supported. Clasts are typically pebble-cobble, and range from angular to rounded, with mostly sub-angular to sub-rounded. The assemblages range from monomict to oligomict defined by varying abundances of granite, quartzite, limestone, argillite, lesser arkose, and sparse volcanics. Four varieties are locally recognized, KJgs - sedimentary clasts dominated (quartzite-limestone-argillite), KJgc – carbonate clast dominated, KJgg, granite clast dominated, KJgk – granite and quartz sandstone clast dominated.

KJgk **Glance Conglomerate (Lower Cretaceous – Upper Jurassic)** - Oligomict granite quartz sandstone to quartzite and argillite clast conglomerate, typically massive to thick-bedded and clast-supported.

KJgs **Glance Conglomerate (Lower Cretaceous – Upper Jurassic)** - Oligomict, quartz sandstone – carbonate (limestone and dolostone) – argillite clast conglomerate, typically thick-bedded to massive and clast-supported.

KJgc **Glance Conglomerate (Lower Cretaceous – Upper Jurassic)** - Monomict, limestone clast dominated conglomerate, typically massive to thick-bedded and clast-supported.

KJgg **Granite clast Glance Conglomerate (Lower Cretaceous – Upper Jurassic)** - Monomict granite-clast conglomerate, typically massive to thick-bedded and clast-supported.

KJb **Basaltic lava (Lower Cretaceous - Upper Jurassic)** - Vesicular to amygdaloidal and massive basaltic lava containing sparse altered mafic phenocrysts up to 2mm in a fine-grained plagioclase microlite-rich matrix.

JTsg **Gardner Canyon Formation (Jurassic - Triassic)** - Maroon to tan metasiltstone and sparse fine metasandstone. Includes medium-gray siltstone with sparse sandstone and pebble conglomerate beds up to 40 cm thick. Contains sparse, one- to seven-meter-thick, resistant, white, fine-grained quartzite beds (larger beds are mapped separately), and local conglomerate.

Naco Group

Pr **Rainvalley Formation (Permian)** - Light to dark gray, medium- to thick-bedded dolostone and limestone, interbedded with minor fine- to medium-grained quartzose sandstone and siliceous shale.

Pch **Concha Limestone (Permian)** - Dark to medium gray, thick- to medium-bedded, fossiliferous limestone commonly containing chert nodules 10-30 cm across. Lime mudstone and wackestone are predominant, with minor skeletal packstone. Fossils include brachiopods, gastropods, pelecypods, rugose corals, crinoid columnal fragments, and echinoid spines.

Psu **Sherrer Formation, upper division (Permian)** - Dolostone, limestone, and quarz arenite

Ps **Sherrer Formation, lower division (Permian)** - A unit dominated by white to pink, fine-grained, planar-laminated quartz arenite. Grains are subrounded to rounded and well-sorted, typically fine-grained but ranging from very fine-grained to medium-grained.

Pe **Epitaph Formation (Permian)** - A mixed siliciclastic-carbonate unit consisting of white to medium gray, thin- to thick-bedded limestone and dolostone, and thin- to medium-bedded siltstone, mudstone, and fine-grained sandstone. The carbonate and siliciclastic components have commonly been metamorphosed to, respectively, fine-grained marble and light green hornfels.

Pc **Colina Limestone (Permian)** - Medium- to thick-bedded, white to light gray, micritic limestone. The unit is characterized by tabular beds, creamy white to tan weathered surfaces (locally pinkish gray, rarely medium or dark gray), and lack of resistant-weathered siliciclastic layers. Limestone grades laterally to dolostone, and has been metamorphosed to fine-grained marble in much of the map area.

PPe **Earp Formation (Pennsylvanian-Permian)** - A mixed siliciclastic-carbonate unit consisting of light reddish brown to light green, thin- to medium-bedded, planar-laminated mudstone, siltstone, and very fine-grained sandstone, interbedded with subordinate light gray to pinkish gray micritic limestone and skeletal wackestone. The siliciclastic components are commonly metamorphosed to light green or orange-pink hornfels. The limestone is locally dolomitic and is commonly metamorphosed to fine-grained marble.

IPh **Horquilla Limestone (Pennsylvanian)** - Thick- to thin-bedded, light gray to white, fine-grained, cherty, recrystallized limestone, with interbedded shale, silty mudstone, and fine- to very fine-grained quartzose sandstone. In most of the Helvetia map area, carbonate-dominated intervals are characterized by thick to medium bedsets of light gray to white, fine-grained marble with thin interbeds of siliceous hornfels that form resistant ribs. Siliciclastic intervals consist of thin- to medium-bedded to laminated siliceous hornfels and recessive fine-grained marble.

Me **Escabrosa Limestone (Mississippian)** - Light gray to white, thick-bedded, massive limestone is predominant throughout this unit, and is typically metamorphosed to medium- to coarse-grained marble. Medium-bedded intervals are less common, and few beds exhibit internal lamination. Siliciclastic layers are much less common than in the overlying Horquilla Limestone and are mostly 1-10 cm thick. Large nodules and lenses of pink recrystallized chert are common.

MDu **Escabrosa Limestone (Mississippian) and Martin Limestone (Devonian), undifferentiated** - Light gray, medium- to thick-bedded, amalgamated, massive, locally cherty, recrystallized limestone and marble. Massive dolostone or dolomitic limestone is present in the lower portion locally. Although an unconformity is present between the Martin Formation and the Escabrosa Limestone, these units are not preserved well enough in the Rosemont area to identify the contact between them. In the Peach Knob area near Helvetia, this unit consists of gray marble with siliceous and calc-silicate laminations and stringers that are interpreted as transposed bedding.

Dm **Martin Formation (Devonian)** - A carbonate-dominated succession characterized by medium-bedded, gray to brown to tan limestone and dolostone. The lower part of the unit contains thin- to medium-bedded limestone with thin interbeds and laminations of dolostone and calcsilicate hornfels. Limestone and dolostone are fine-grained and recrystallized (typically metamorphosed to marble). The limestone is weathered tan, light brown, or light to medium gray. In contrast, the dolostone and hornfels typically are weathered dark to medium brown.
The upper part of the formation consists mainly of fine-grained, medium- to thick-bedded, massive to laminated limestone and brown to tan massive dolostone. Some limestone is medium gray and weathered medium to dark gray; other limestone beds are light greenish to pinkish gray and are weathered light brown to orange-brown. On weathered surfaces, some amalgamated carbonate bedsets exhibit alternate gray and brownish-gray (or lighter and darker gray) layers. Mottling of lighter and darker carbonate is also common.

DCu **Martin Limestone (Devonian) and Abrigo Formation (Cambrian) undifferentiated** - Hornfels, skarn, dolomitic and calcitic marble

PZct **Carbonate tectonite in the Sawmill Canyon shear zone (Paleozoic protolith with Mesozoic deformation fabric)** - Massive to laminated carbonate tectonite, locally with siliceous stringers and laminations.

Pz **Marble, hornfels, and skarn** - marble, hornfels, and skarn in varying proportions

Ca **Abrigo Formation (Cambrian)** - A succession of thin- to medium-bedded, white to light-gray, micritic limestone with thin, brown-weathered siliceous beds and laminations. The lower part contains parallel-laminated to ripple-laminated fine-grained sandstone interbedded with siltstone, silty mudstone, and shale. In much of the map area, the unit has been metamorphosed to fine-grained marble and light pinkish-gray to greenish-yellow calcsilicate hornfels. The hornfels forms resistant outcrops with recessive thin beds, lenses, and laminations of carbonate. Thinly interbedded to interlaminated marble and siliceous hornfels also are common. Near the northern edge of the map area west of Chavez Spring, the unit contains intervals of thin-bedded to laminated, light green and orange-pink calcsilicate, consisting in part of dolomite, garnet and clinopyroxene.

Cb **Bolsa Quartzite (Cambrian)** - Light gray, medium- to fine-grained, thick- to medium-bedded, quartzose sandstone that forms cliffs and ledges. The lower part is cross-stratified, commonly coarse-grained, and locally feldspathic, with composition apparently ranging from quartz arenite to subarkosic arenite. Pebbly to granular beds occur near the base of the unit, which unconformably overlies quartz monzonite of unit YXg near Weigles Butte. The upper part of the Bolsa Quartzite is medium gray, fine-grained, commonly bioturbated with planolites ichnofossils, and includes up to 30% silty mudstone and shale near the gradational contact with the overlying Abrigo Formation.

q **Vein quartz** - Vein quartz produced by hydrothermal activity.

YXa **Aplite dike swarms (Proterozoic)** - Clusters of aplite dikes in the Continental Granodiorite as mapped by Drewes (1971a).

YXg **Continental Granodiorite (Proterozoic)** - Granitoid rock ranging in composition from granodiorite to monzogranite, quartz monzonite, and quartz monzodiorite. The rock typically is medium-grained and contains 5-35% K-feldspar megacrysts, is pinkish gray on fresh surfaces, and weathers brown to orange-brown. The distinctive K-feldspar megacrysts are pink to grayish pink, euhedral to subhedral, typically are nearly equant and slightly to moderately ovoid, are generally 1-3 cm, and range up to 5 cm. Mafic minerals, mostly chloritized biotite with subordinate magnetite and sphene, form fine-grained aggregates and constitute 10-35% of the rock.

Xp **Pinal Schist (Paleoproterozoic)** - Fine-grained, heterogeneous, quartz-biotite schist.

References

Drewes, H., 1971, Geologic map of the Sahuarita Quadrangle, southeast of Tucson, Pima County, Arizona: USGS Miscellaneous Geological Investigations Map I-613, 1:48,000 scale, 1 sheet

Map Symbol Descriptions

- Bedding, horizontal
- Bedding, inclined
- Bedding, inclined, approximate
- Bedding, inclined w/tops known
- Bedding, overturned
- Bedding, overturned with tops known
- Bedding, vertical
- Bedding, vertical, approximate
- Generic foliation, inclined, open triangle
- Generic foliation, inclined, closed triangle
- Inclined cumulate foliation
- Inclined flow foliation
- Inclined gneissic foliation
- Transposed bedding, inclined
- Inclined first generation tectonic fabric
- Inclined second generation tectonic fabric
- Close disjunct cleavage, inclined
- Bedding parallel to cleavage, inclined
- Protomylonite
- Mylonite
- Inclined joint, open rectangle
- Inclined joint, closed rectangle
- Minor folds - color red
- Generic lineation
- Slickenside striae lineation
- Lineation at intersection of bedding and cleavage
- Penetrative lineation
- Fault attitude
- Fault or vein orientation
- Paleocurrent direction determined from clast imbri
- Contact, accurate
- Contact, approximate
- Contact, concealed
- Fault, accurate
- Fault, approximate
- Fault, concealed
- Felsic porphyry dike
- Porphyritic aplitic dike
- Mafic dike
- Marker bed
- Vein

Arizona Geological Survey
OFR-09-06 (Helvetia), v.1.0

GEOLOGIC MAP OF THE HELVETIA 7 ½′ QUADRANGLE, PIMA COUNTY, ARIZONA

by
Ferguson, C.A., Johnson, B.J., Pearthree, P.A., Spencer, J.E., Shipman, T.C., and Cook, J.P.

with Proterozoic geology from Drewes (1971)

September 2009

Arizona Geological Survey Open-File Report 09-06 (OFR-09-06), version 1.0

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