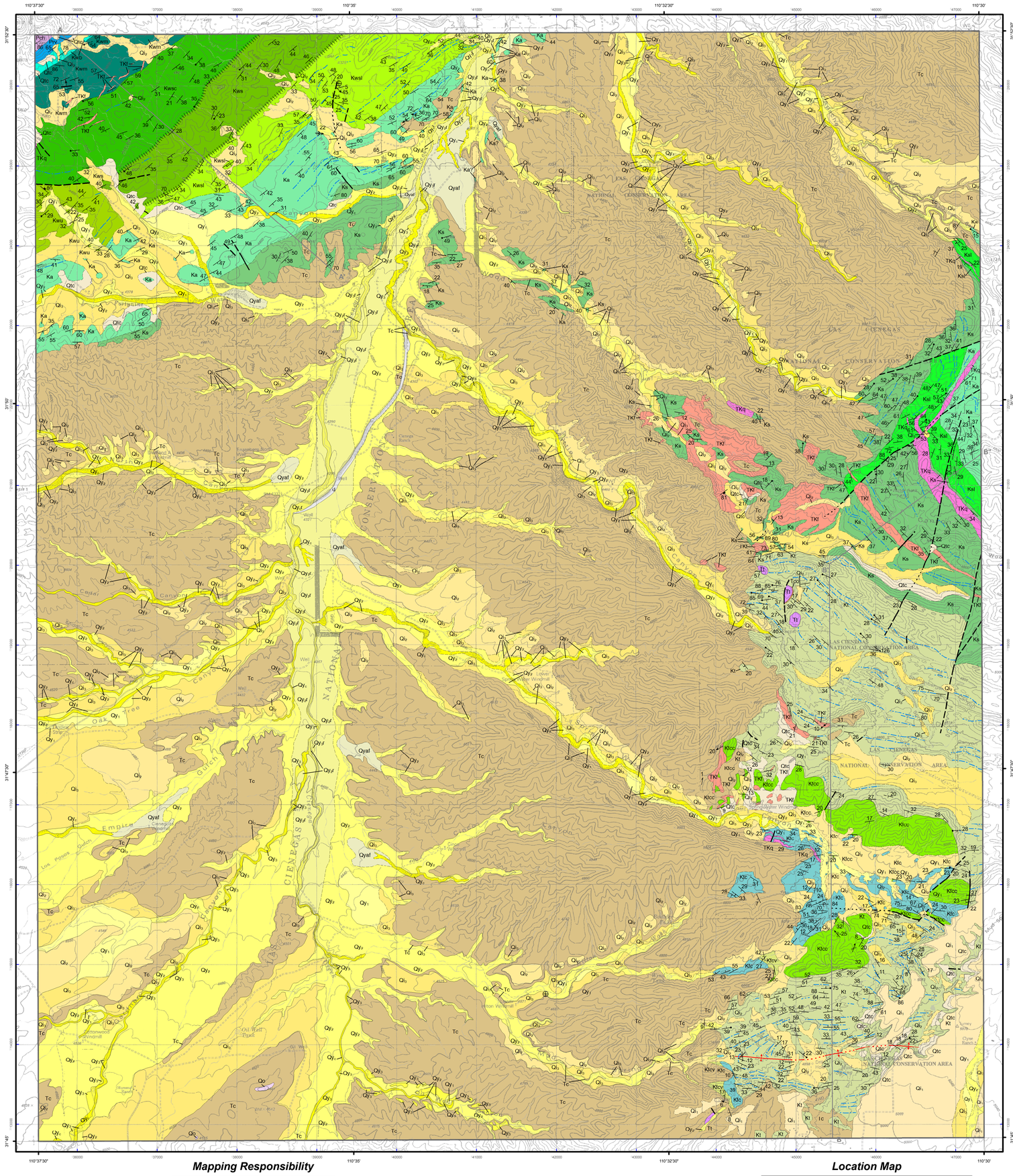

Map Symbol Descriptions

- Horizontal bedding
- Inclined bedding (15)
- Inclined bedding, facing indicators present at this location (34)
- Overturned bedding (56)
- Paleocurrent direction determined from imbricate clasts. Negative plunge value indicates up-dip transport direction (-2)
- Joint (21)
- Cleavage (48)
- Fault dip (10)
- Minor fault or vein (69)
- Flow foliation (45)
- Flow lineation without foliation (39)
- Minor fold (81)
- Z-fold (5)
- Apparent dip (24)
- Contact, location accurate
- Contact, location approximate
- Contact, location inferred
- Gradational contact
- Anticline hinge surface, location accurate where solid, concealed where dotted
- Fault, location accurate
- Fault, location approximate
- Fault, concealed or intruded
- Prominent bed, primarily identified on aerial photography

Surficial Geology

The surficial geology of the Spring Water Canyon 7 ½' Quadrangle was mapped using a combination of aerial imagery, digital elevation models, topographic maps, and field mapping. The physical characteristics of Quaternary alluvial surfaces (channels, alluvial fans, floodplains and stream terraces) were used to differentiate their associated deposits by age. Alluvial deposits of similar ages have a distinctive appearance and soil characteristics because they have undergone similar post-depositional modifications. These differences can be seen in the shape and texture of the surfaces as well as the amount of soil development. Younger surfaces retain evidence of their original depositional topography and have little or no soil development, while older surfaces are generally more eroded and rounded with moderate to strongly developed, reddened and clay-rich soil. The distribution of surfaces of different ages and sources in the Spring Water Canyon 7 ½' Quadrangle is associated with Cienega Creek and its tributaries from the Whetstone, Empire and Santa Rita Mountains. The majority of surficial units in this quadrangle are composed of late Tertiary basin fill deposits (Tc). Remnants of the oldest Quaternary units (Qi1 and Qo) are found only in the southern portion of the mapping area and probably represent the highest aggradation in the basin. Alluvial fan and stream terrace remnants of younger surfaces are found along Cienega Creek and its tributaries.

Arroyo cutting began in Cienega Creek circa 1900, possibly 1905 (Eddy and others, 1983). Prior to this incision, Cienega Creek had numerous marshy areas connected by slow moving streams (Eddy and others, 1983). A canal was constructed in the early 1970s to route floodwaters from Cienega Creek around agricultural fields (J. Simms, BLM, written communication). The canal connected to the channel from Mattie Canyon which then carried the water back into Cienega Creek. The canal was first damaged in a 1983 flood, and the grade control structure was destroyed in a 2000 flood. This resulted in about 3 m of incision into the Mattie Canyon channel (J. Simms, BLM, written communication). The head cut continues to move up Mattie Canyon.

Axial stream deposits

- Qyr — **Active river channel deposits** - Active Cienega Creek channel deposits composed primarily of unconsolidated sand and gravel to dominantly fine-grained sand and silt in marshy areas. Adjacent bars and low terraces may also include lenses of very poorly sorted pebbly to cobbly beds. Clasts are typically rounded to well-rounded but may be angular to sub-angular.
- Qyrr — **Historical river terrace deposits** - Unconsolidated stream and floodplain deposits forming terraces less than 1 m above the active channel (Qycr) and several meters below abandoned historical floodplains (Qy2r). Sediments composing these deposits are poorly sorted silt, sand, pebbles and cobbles. Pebbles and cobbles are well-rounded to sub-angular.
- Qycrr — **Latest Holocene to historical river deposits** - Silt, clay, sand and minor gravel compose floodplain and marshy deposits of Cienega Creek that existed prior to the early historical entrenchment. Qy2r deposits have broadly planar surfaces that locally retain the shape of historical river meanders. Distal piedmont fan deposits (Qyc, Qy2, and Qyaf) onlap onto Qy2r deposits although an interfingering relationship likely exists in the subsurface.
- Qy1rr — **Late to early Holocene river terrace deposits** - Slightly higher terraces representing either higher elements of the early historical floodplain or remnants of older Holocene aggradation periods. These fine-grained terrace deposits have moderate soil development, with surface color ranging from 10 to 7.5 YR, with a thin (< 10 cm) organic soil horizon, and incipient stage I calcium carbonate accumulation.

Piedmont alluvium and surficial deposits

- Qyc — **Modern stream channel deposits** - Active channel deposits composed of very poorly-sorted sand, pebbles, and cobbles with some boulders to moderately-sorted sand and pebbles.
- Qy3 — **Latest Holocene alluvium** - Recently active piedmont alluvium located along active drainages including floodplains, low-lying terraces, and overflow channels. Qy3 deposits are composed of unconsolidated to very weakly consolidated, silty to cobbly deposits. Soil development is generally absent or incipient on Qy3 deposits which exhibit pale buff to light brown (10 YR) surface coloration.
- Qy2 — **Late Holocene alluvium** - Young deposits in floodplains, low terraces and small channels that are part of the modern drainage system. Along the larger drainages, unit Qy2 sediment is poorly to very poorly sorted silt, sand, pebbles, and small cobbles; floodplain and terrace surfaces typically are mantled with sand and finer sediment. On lower piedmont areas and in smaller tributary washes young deposits consist predominantly of moderately sorted sand and silt, with some pebbles and cobbles in channels. Sediments are pale brown in color (10 YR), with no to weak soil development.
- Qyaf — **Late Holocene alluvium, active fan deposits** - Active alluvial fan deposits from tributary channels exhibiting distributary drainage patterns. Sediments are unconsolidated and consist of very poorly sorted sand to cobbles.
- Qy1 — **Early to middle Holocene alluvium** - Terraces along tributary drainages that are slightly higher than adjacent Qy2 surfaces and are not subject to flood inundation except in extreme events. Qy1 soils are weakly developed, with some soil structure but little clay, medium brown (10-7.5 YR) coloration and stage I to II calcium carbonate accumulation.
- Qi3 — **Late Pleistocene alluvial fan and terrace deposits** - Slightly dissected terraces and alluvial fans. Qi3 deposits consist of pebbles, cobbles, and finer-grained sediment. Surface clasts typically exhibit weak rock varnish. Qi3 soils are moderately developed, with brown to reddish brown loamy (7.5 to 5 YR) near-surface horizons and stage I to II calcium carbonate accumulation.
- Qi2 — **Middle to late Pleistocene alluvial fan and terrace deposits** - Moderately dissected relict alluvial fans and terraces with moderate to strong soil development found throughout the map area. Well-preserved, planar Qi2 surfaces are smooth with pebble and cobble lags; surface color is reddish brown; surface clasts are moderately varnished. More eroded Qi2 surfaces are characterized by scattered cobble and pebble lags and broad ridge-like topography. Soils associated with planar surface remnants typically contain reddened (5 to 2.5 YR), clay loam argillic horizons, with clay skins and subangular blocky structure. Underlying soil carbonate development is typically stage II with areas to stage III.
- Qi1 — **Early to middle Pleistocene alluvial fan deposits** - Moderately to deeply dissected relict alluvial fans with strong soil development Well-preserved, relatively planar Qi1 surfaces are smooth with pebble and cobble lags; surface color is reddish brown, and surface clasts are moderately to strongly varnished. More eroded, Qi1 surfaces are characterized by strongly varnished cobble to cobble and pebble lags with broad ridge- like topography. Soils associated with well-preserved Qi1 surfaces are reddish brown to red and very clay-rich with strong subangular to angular blocky structure. Calcic horizon development is quite variable, but ranges from stage II to stage IV.
- Qo — **Plio-Pleistocene alluvium** - Very old, high, dissected alluvial fan remnants capping high ridges in the southwest corner of map area. Deposits are coarse and very thin (< 1 m), consisting of boulders, cobbles, pebbles, and finer clasts. Surfaces are dark reddish brown in color and, where present, soils are clay-rich and reddened (2.5 YR).

Other Quaternary units

- d — **Disturbed ground - canal** - This canal, locally called the 'Panama Canal', was built in the early 1970s to re-direct floodwaters around agricultural fields and into Mattie Canyon upstream of the confluence with Cienega Creek. The canal was heavily damaged in a 1983 flood, and the grade control structure was destroyed in a 2000 flood. Subsequent incision of about 3 m resulted in a head-cut that has since been traveling up the channel of Mattie Canyon (J. Simms, BLM, written communication).
- Qtc — **Holocene and Pleistocene hillslope colluvium (late Quaternary)** - Locally-derived talus or colluvium on gentle to steep hillslopes. Deposits are very poorly sorted, ranging from clay to cobbles and boulders. Clasts are subangular to angular due to limited transport. Some stable hillslopes are covered primarily with Pleistocene deposits, which are typically reddened and enriched in clay. Other more active hillslopes are covered with Holocene deposits, andhave minimal soil development.

Tertiary to Quaternary basin fill deposits

- Tc — **Pliocene to middle Miocene deposits** - Moderately consolidated, poorly sorted conglomerate and sandstone deposited in Sonoita basin during and after late Tertiary faulting. Includes lesser amounts of mudstone and siltstone. These deposits are generally light gray or tan. They commonly form high rounded hills and ridges in modern basins, and locally form prominent bluffs.

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GEOLOGIC MAP OF THE SPRING WATER CANYON 7 ½' QUADRANGLE, PIMA COUNTY, ARIZONA

by
Spencer, J.E., Youberg, A., and Shipman, T.C.

October 2010

Arizona Geological Survey Digital Geologic Map 79
(DGM-79), version 1.0

Citation for this map:
Spencer, J.E., Youberg, A., and Shipman, T.C., 2010, Geologic map of the Spring Water Canyon 7 ½' Quadrangle, Pima County, Arizona: Arizona Geological Survey Digital Geologic Map DGM-79, version 1.0, scale 1:24,000.

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Bedrock Geology

Bedrock in the Spring Water Canyon 7 ½' Quadrangle consists primarily of the Lower Cretaceous Bisbee Group. Formation names were applied during earlier mapping by Finnell (1971). Bisbee Group deposition began during a Late Jurassic period of intracontinental rifting that produced the basal Glance Conglomerate (not identified in the map area). Overlying Lower Cretaceous strata of the Bisbee Group, widely exposed in the map area, were deposited largely in the context of extensional topography inherited from previous Jurassic extension (Dickinson and Lawton, 2001). Overlying strata in the southeastern corner of the map area, previously thought to be middle Tertiary in age, contain dinosaur fossil fragments (Ferguson, C.A., unpublished) and so are interpreted as related to the Laramide Fort Crittenden Formation (e.g., Hayes, 1987). Bedrock units are generally tilted and broadly folded into a southward plunging syncline, presumably of Laramide age. Felsic hypabyssal intrusions are locally abundant, but it uncertain if these are Laramide or middle Tertiary.

Oligo-Miocene (middle Tertiary) bedrock units

- Tt — **Quartz-sanidine ash-flow tuff (Oligo-Miocene)** - Moderately welded rhyolitic ash-flow tuff containing 5-25% quartz, sanidine, and plagioclase phenocrysts with sparse biotite. The main portion is moderately phenocryst-rich and overlies a 0-10m thick nonwelded zone containing 5% phenocrysts.
- Tco — **Older conglomerate (Oligo-Miocene)** - A single exposure of poorly preserved pebble-cobble volcaniclastic conglomerate at the base of the mid-Tertiary ash-flow tuff (Tt).

Laramide or middle Tertiary bedrock unit

- TKf — **Phenocryst-poor, fine-grained, hypabyssal, felsic intrusion (Oligo-Miocene)** - Crystal-poor quartz-porphyry dikes and sills with <2%, <2 mm quartz and <2%, <2 mm sanidine. Unit includes 2-3%, 2-3 mm biotite that is absent in many outcrops because of alteration or because of heterogeneity in concentration. Feldspar is absent in some areas, also indicating phenocryst variation.
- TKq — **Quartz porphyry (Tertiary-Upper Cretaceous)** - Quartz, feldspar phenocryst rich felsic porphyry

Upper Cretaceous - lower Tertiary (Laramide) bedrock units

- Klcc — **Fort Crittenden Formation, conglomerate facies (Upper Cretaceous)** - Typically brown to brownish red, poorly to moderately lithified, massive conglomerate with rounded to subrounded clasts, typically 3-30 cm diameter, locally up to 100 cm. Crude bedding is defined by variations in grain size and resistance to weathering, and by local pebble beds and sandstone beds.
- Klcv — **Fort Crittenden Formation, volcanic facies (Upper Cretaceous)** - Red mudstone, volcaniclastic sandstone, pebbly sandstone, pebble conglomerate, and sparse felsic ash-fall tuff.
- Klc — **Fort Crittenden Formation, undivided (Upper Cretaceous)** - Pale reddish brown to medium brown sandstone and siltstone, moderately to poorly sorted and poorly lithified. Sands are generally more lithic rich and quartz poor than sandstone of the underlying Turney Ranch Formation. Unlike Turney Ranch, this unit also contains locally abundant pebble to cobble conglomerate, locally with clasts up to 50 cm diameter. In most areas the clasts are rounded to well-rounded, but locally range to subangular.

Bisbee Group (Lower Cretaceous)

- Kt — **Turney Ranch Formation (Lower Cretaceous)** - Quartzose sandstone and mudstone. This unit consists of alternating sandstone-rich and mudstone-rich sequences on the order of 5-50m. Sandstone is quartzose, typically cross-stratified, and ranges from thin- to thick-bedded, and fine- to coarse-grained. The base of the formation is defined by the fairly abrupt, first appearance of quartzose sandstone (older sandstones are arkosic and lithic-rich).
- Ks — **Shellenberger Canyon Formation (Lower Cretaceous)** - Fine- to coarse-grained, generally tan sandstone and local pebbly sandstone, interbedded with tan to reddish brown to olive green siltstone and mudstone. Zones of mudstone/siltstone and of sandstone/pebbly sandstone are two to thirty meters thick.
- Ksl — **Lower Shellenberger Canyon Formation (Lower Cretaceous)** - Mudstone, shale, and arkosic sandstone. A stratigraphic interval with sparse limestone beds, which is equivalent to the Mural Limestone, marks the top of the lower Shellenberger Formation. Limestone in some areas is a 1-5m thick ostracode packstone.
- Ka — **Apache Canyon Formation (Lower Cretaceous)** - In eastern exposures, this unit consists of dark mudstone, shale, arkosic sandstone, and dark laminated, nonfossiliferous limestone bed. In western exposures, this unit consists of thin bedded to laminated limestone, silty limestone, variably calcareous mudstone and siltstone, and plane-bedded, fine- to medium-grained sandstone. Question mark with the label indicates potential exposures identified in aerial photographs but not field verified.
- Kwu — **Willow Canyon Formation, undivided (Lower Cretaceous)** - Arkose, mudstone, typically dark green, with a lower part where the mudstones are red. Top defined by the first appearane of laminated dark limestone beds.
- Kwsl — **Willow Canyon Formation, sandstone and siltstone (distal) facies (Lower Cretaceous)** - Fine to medium grained sandstone, red and gray siltstone, and calcareous mudstone. Sandstone is typically plane bedded to laminated and commonly forms 20-200 cm thick, blocky-weathering beds in which faint to clearly visible magnetite-rich laminations reveal bedding.
- Kws — **Willow Canyon Formation, sandstone (medial) facies (Lower Cretaceous)** Fine, medium, and coarse grained sandstone, commonly with magnetite-rich laminations that define plane beds, low-angle planar cross beds, and curviplanar cross beds in sets up to 50 cm thick.
- Kwsc — **Willow Canyon Formation, sandstone and pebble conglomerate (proximal) facies (Lower Cretaceous)** - Medium- to coarse-grained sandstone with less abundant fine grained sandstone and pebble to, rarely, cobble conglomerate. Cross beds and channels are common.
- Kwb — **Willow Canyon Formation, basal clastic unit (Lower Cretaceous)** - Facies are more intimately mixed here than up section in overlying Willow Canyon units, with pebble conglomerate, coarse to fine sandstone, and siltstone present over short stratigraphic intervals (<10 m). This is the defining characteristic of basal unit of Willow Canyon Formation.
- Kwm — **Basal Mesozoic siltstone unit (Triassic to Jurassic)** - Dark brown mudstone and siltstone, with sparse fine-grained sandstone. Unit includes rare carbonate, pale gray laminated to thin bedded calcareous siltstone, maroon siltstone, medium- to coarse-grained sandstone, and pebble conglomerate.

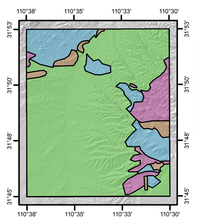
Permian bedrock units

- Prv — **Rainvalley Formation** - Pale gray to medium gray, massive, recrystallized dolostone, and massive, medium gray, recrystallized limestone, with sparse chert nodules and locally abundant fossil debris (crinoid columnals, shell(?) fragments, coral).
- Pch — **Concha Limestone** - Medium to dark gray fossiliferous limestone (crinoids, coral), with sparse, 5-10 cm chert nodules. Limestone is massive to thick bedded and typically contains several percent chert.

Mapping Responsibility

Topographic base from USGS 1:24,000 Quadrangle Series.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.



- Ferguson, C.A.
- Shipman, Todd
- Spencer, J.E.
- Youberg, Ann aerial photograph interpretation; and Finnell, 1971, USGS OFR-71-0106

SCALE 1:24 000
CONTOUR INTERVAL 40 FEET

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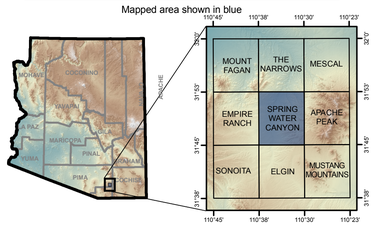
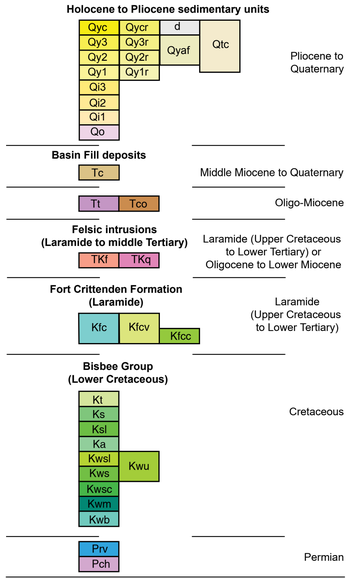
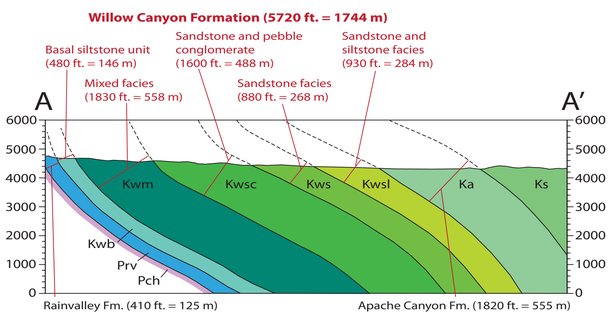
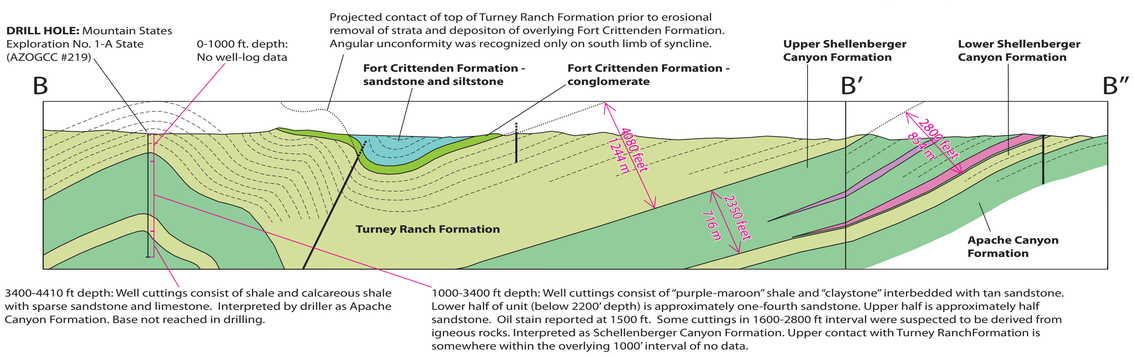
2010 MAGNETIC NORTH DECLINATION

Location Map

Mapped area shown in blue



Stratigraphic Correlation Diagram



Geologic Cross-Sections