GEOLOGIC MAP OF THE HEREFORD 7½' QUADRANGLE AND THE NORTHERN PART OF THE STARK 7½' QUADRANGLE, COCHISE COUNTY, ARIZONA

by
Joseph P. Cook, Todd C. Shipman, and Philip A. Pearthree

Arizona Geological Survey Digital Geologic Map 57 (DGM-57), version 1.0

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(also available as Adobe pdf file on CD-ROM)

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***Note – All bedrock geologic mapping was compiled from a preliminary, unreviewed version of:* Ferguson, C.A., and Johnson, B.A., 2006, Bedrock geologic map and cross sections of the Hereford 7.5' Quadrangle, Cochise County, Arizona: Arizona Geological Survey Digital Geologic Map DGM-58, scale 1:12,000.**

GEOLOGIC MAP UNITS

d – Disturbed – Disturbed due to agriculture, extensive excavation, or blockage of drainages for cattle tanks.

Qc – Colluvium deposits – Unconsolidated to moderately-consolidated colluvium deposits mantling the lower slopes of bedrock outcrops.

Piedmont Deposits

Qy – Undivided Holocene surface (<10 ka).

Qy$_c$ – Modern stream channel deposits – Unconsolidated recently active piedmont channel deposits consisting of very poorly sorted sand, pebbles, cobbles, and isolated boulders.

Qy$_2$ – Late Holocene alluvium – Young deposits located primarily near active channels including floodplain, low-lying terrace, and tributary channel alluvium which are part of the modern piedmont drainage system.

Qy$_1$ – Older Holocene alluvium – Terrace deposits generally not subjected to inundation during channel flow events. Qy$_1$ deposits are located primarily along the flanks of incised drainages at higher elevations than Qy$_2$ deposits.

Qi$_3$ – Late Pleistocene alluvium – Slightly dissected, relatively planar to gently rounded alluvial terraces exhibiting moderate soil development, calcium carbonate accumulation, and tributary drainage networks.

Qi$_2$ – Middle to Late Pleistocene alluvium – Broad, moderately to well-rounded piedmont surfaces exhibiting moderately dissected tributary drainage networks located at significantly higher elevations than younger deposits.

Qi$_1$ – Early to Middle Pleistocene alluvium – High standing, very well rounded, highly dissected piedmont surfaces exhibiting reddish, well-developed soils and strong calcium carbonate accumulation.

Qo – Early Pleistocene alluvium- Deeply dissected very well rounded remnant alluvial fan deposits exhibiting thick, exposed, indurated petrocalcic subsurface horizons.

River Deposits

QTsd – Tertiary to Quaternary basin fill – Basin fill sediments from the middle to upper member of the St. David formation exposed in arroyo cuts east of the San Pedro River.

Qy$_c$r – Holocene alluvium, younger member – Composed of unconsolidated sand, pebbles, and cobbles. Qycr deposits are located within the active drainage of the San Pedro River, and are often inundated when flooding occurs.

Qy$_4$r – Holocene alluvium, younger member – Composed of unconsolidated sand, pebbles, and cobbles. Qy$_4$r deposits compose bars within the San Pedro River which are not overtopped during low flow stages.

Qy$_3$r – Late Holocene floodplain and terrace deposits – Abandoned historical floodplains flanking the main channel along the San Pedro River. Terraces are flat with punctuated incision near tributary drainages. Qy$_3$r deposits consist of thinly bedded, weakly-consolidated to unconsolidated sand, silt, and clay.

Qy$_2$r – Holocene floodplain and terrace deposits – Low terraces flanking the main floodplain along San Pedro River. Terraces are flat with punctuated incision near tributary drainages. Qy$_2$r deposits consist of well-bedded, weakly consolidated sand, silt, and clay.

Qyir – Early Holocene to late Pleistocene alluvium - Planar surfaces deposited along the valley floor composed of mudstone with thin silty to sandy interbeds. Incised from 3-5 m, Qyir deposits form the bank wall of the channel in places.

Qi$_2$r – Late Pleistocene alluvium – Isolated paleoterraces located outside the present-day river floodplain. Qi$_2$r deposits are composed of cobble to pebble clast-supported conglomerate with sub-rounded to rounded clasts. Degraded Qi$_2$r surfaces exhibit beveled edges.

Bedrock Units

TKp – Coarse-grained rhyolite porphyry (Late Cretaceous-Early Tertiary) – Felsic porphyry containing 10-30% phenocrysts of subhedral quartz (2-6 mm), euhedral to subhedral potassium feldspar (1-5 mm), euhedral to subhedral plagioclase (1-3 mm), and biotite (1-3 mm). Age is based on a 63 Ma date of unreported provenance (probably a personal communication) shown on the map of Drewes (1980) for a related, petrographically identical stock just to the north of the map area.

TJp – Phenocryst-poor rhyolite porphyry and aplite (Late Cretaceous-Early Tertiary or Jurassic) – Phenocryst-poor rhyolite porphyry containing <5-7% <2-3 mm feldspar phenocrysts that grades into aplite towards the margins of dikes. Contact zones of some dikes have very fine-grained vitric matrix in some areas. The dikes show little or no evidence of internal brittle deformation suggesting that they are related to the Late Cretaceous-Early Tertiary coarse-grained rhyolite porphyry. The north-northwest striking dikes of this unit are steeply dipping and cross-cut Paleozoic strata at various angles suggesting that they were emplaced after folding.

Jp – Coarse-grained rhyolite porphyry (Jurassic) – Felsic porphyry containing 10-30% phenocrysts of subhedral quartz (2-6 mm), euhedral to subhedral potassium feldspar (1-5 mm), euhedral to subhedral plagioclase (1-3 mm), and biotite (1-3 mm). The Jurassic age of this unit is based on its connectivity to the main mass of the Juniper Flat Granite which has been dated at 171 ± 7 Ma (K/Ar biotite age, Marvin and others, 1973), and 175.2 ± 0.7 Ma (U-Pb zircon, Lang et al., 2001).

Pc – Colina Limestone (Permian) – Medium- to thick-bedded, amalgamated skeletal limestone, typically with matrix-supported texture. Skeletal micrite and skeletal wackestone dominate, with lesser amounts of skeletal packstone, and very little or no grainstone. Skeletal debris consists largely of crinoidal columnals, brachiopods, bryozoans, solitary rugose corals, colonial tabulate corals, echinoid spines, and abundant very large gastropods (up to 30cm). Total thickness is greater than 150 m (500') thick.

PPe – Earp Formation (Permian- Pennsylvanian) – Interbedded thin- to medium-bedded red shale, mudstone, silty mudstone, and fine-grained ripple cross-laminated sandstone with subordinate thin- to medium-bedded carbonate beds, dominated by massive micrite and skeletal wackestone. Skeletal debris is similar to the assemblages of the Colina Limestone. Echinoid spines are particularly abundant in some beds. Total thickness varies from 75-105 m (250-350') thick.

Ph – Horquilla Limestone (Pennsylvanian) – Medium- to thick-bedded cherty limestone with subordinate interbedded siliciclastic units; dark shale throughout the main part of the unit and red shale, silty shale and rare fine-grained ripple cross-laminated and cross-stratified sandstone in the upper part. Limestone beds are dominantly skeletal packstone and wackestone with lesser amounts of grainstone and micrite. In general, clast-supported limestone (grainstone and packstone) dominate in the lower part of the unit, whereas up-section matrix-supported wackestone and micrite are more abundant. Total thickness varies from 300-365 m (1,000-1,200') thick.

Me – Escabrosa Limestone (Mississippian) – Medium- to thick-bedded limestone, dominated by thick-bedded, amalgamated, crinoid columnal grainstone, especially towards the base of the unit, which is typically a cliff-former. The main part of the unit consists of medium- to thick-bedded, locally very thick-bedded skeletal grainstone and packstone with subordinate thin- to medium-bedded, cherty micrite, and skeletal wackestone with minor dark shale interbeds. Total thickness varies from 150-275 m (500-900') thick.

Dmu – Upper Martin Limestone (Devonian) – A two-part sequence that grades upward from lithologies typical of the lower Martin; recessive, medium-bedded micritic carbonate and sparsely skeletal wackestone (typically dolostone) with shale or mudstone interbeds, into lithologies typical of the Escabrosa; medium- to thick-bedded crinoid columnal skeletal packstone and grainstone. The upper Martin is distinguished from the Escabrosa based on fossils (the upper Martin contains sparse 2-20 cm rounded fragments of the colonial rugose coral *Hexagonaria*) and because it includes several erosional unconformities similar to the one that defines the base of the Escabrosa, each defined by a massive thick-bedded grainstone or packstone carbonate overlying a recessive, strongly recrystallized carbonate (typically dolostone) with abundant sparry calcite-filled cavities. The uppermost unconformity is identified as the top of this unit. Total thickness varies from 60-125 m (200-400') thick.

Dm – Lower Martin Limestone (Devonian) – Dolostone, limestone, and shale. A complex sequence of thin- to medium-bedded skeletal wackestone, sparsely skeletal micrite, rare skeletal packstone, shale, calcareous mudstone, and minor quartz sandstone. Carbonates occur in amalgamated sequences 0.5-5 m thick that are typically strongly recrystallized and commonly dolomitized. Total thickness varies from 75-90 m (250-300') thick.

Ca – Abrigo Formation (Cambrian) – Thin- to medium-bedded carbonate, siltstone, silty mudstone, and fine-grained argillaceous sandstone. Carbonate beds are typically micritic and dolomitized and fossils are rarely preserved. Silty mudstone and fine-grained sandstone typically occurs in amalgamated ripple-laminated sets. Bioturbation is intense and ubiquitous in nearly all lithologies. Total thickness varies from 185-215 m (600-700') thick.

Cb – Bolsa Quartzite (Cambrian) – Medium- to thick-bedded, cross-stratified quartz sandstone, and pebbly feldspathic quartz sandstone. The sequence fines upward, and is also more quartzose upwards. The basal portion is commonly thick-bedded in wedge-planar to trough cross-stratified sets and contains abundant, rounded quartz pebbles up to 8 cm. The uppermost part consists, in some areas, of relatively massive, thick-bedded, very fine-grained quartz sandstone. Up-section the abundance of interbedded siltstone and silty mudstone or shale increases. The contact with the overlying Abrigo Formation is defined as the top of the highest quartz sandstone bed in a sequence in which quartz sandstone is more abundant than siltstone or shale. Total thickness varies from 125-365 m (400-1200') thick.

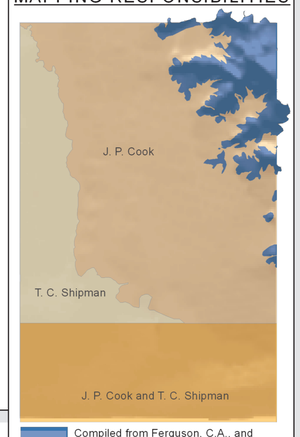
Xp – Pinal Schist (Paleoproterozoic) – Medium- to fine-grained sericitic schist ranging from light green to dark gray. Dark gray, fine-grained to very fine-grained schist commonly contains recrystallized tabular porphyroblasts up to 2 cm. Coarser grained schist tends to be lighter colored and includes psammitic intervals in which are preserved faint laminations and cross-laminations.

Note – see accompanying text document for more complete geologic unit descriptions, mapping methods and references.

STRATIGRAPHIC CORRELATION OF MAP UNITS

			Piedmont Deposits		San Pedro River Deposits	
Cenozoic	Quaternary	Holocene	Qy$_c$	Qc / Qy	Qy$_c$r	d
			Qy$_2$		Qy$_4$r	
			Qy$_1$		Qy$_3$r	
		Pleistocene	Qi$_3$		Qy$_2$r	
			Qi$_2$		Qyir	
			Qi$_1$		Qi$_2$r	
			Qo	QTsd		
	Tertiary					
Mesozoic	Cretaceous		TKp	TJp		
	Jurassic		Jp			
	Triassic					
Paleozoic	Permian		Pc			
	Pennsylvanian		PPe			
	Mississippian		Ph			
	Devonian		Me			
	Ordovician-Silurian		Dmu			
	Cambrian		Dm			
			Ca			
			Cb			
Mesoproterozoic						
Paleoproterozoic			Xp			

MAPPING RESPONSIBILITIES



Arizona Geological Survey
DGM-57 (Hereford)

Topographic base from USGS Hereford and northern Stark 1:24,000 quadrangles, produced in NAD27, reprojected to NAD 83; Latitude-longitude and UTM grids are NAD 83, UTM grid, zone 12.
1000-meter Universal Transverse Mercator grid tics, zone 12, shown in blue.

Map Symbols

- contact, accurately located
- contact, approximately located
- fault, accurately located
- fault, approximately located
- fault, concealed
- bedding, inclined
- bedding, inclined with tops known
- fault attitude
- fault or vein orientation
- foliation

MN
10½°
2007 MAGNETIC NORTH DECLINATION (APPROXIMATE)

SCALE 1:24,000

1 0.5 0 1 Miles
0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 Feet
1 0.5 0 1 Kilometers

CONTOUR INTERVAL 25 FEET

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

Location Index Map
Quadrangle Location Shown in Blue
Hereford and Stark 7.5' Quadrangles are located in southwestern Cochise County.

Cochise County
Mapped Area Shown in Blue

Adjoining 7.5' Quadrangles
LEWIS SPRINGS, TOMBSTONE SE, POTTER MOUNTAIN, NICKSVILLE, HEREFORD, BISBEE, BOB THOMPSON PEAK, STARK, NACO, MEXICO

Stevan Gyetvai was responsible for the cartographic layout of this map.