

DESCRPTION OF UNITS

Middle Pleistocene-Holocene

Qal Alluvium (Holocene) Sand, gravel, and mud in and adjacent to modern arroyo channels. Alluvium is typically at or near the grade of modern channels. 0-10 thick.
Qe Eolian deposits (upper Pleistocene-Holocene) Eolian sands in active sand sheets and small dunes. 0-10 m thick.
Qae Eolian deposits (upper Pleistocene-Holocene) Eolian sands and loessic silts locally reworked by alluvial processes. Deposits are stabilized by vegetation in most areas. Includes thin, discontinuous eolian veneers on stable upland surfaces. 0-5 m thick.
Qvy Younger piedmont alluvium (upper Pleistocene) Gravel, sand, and minor mud deposited at low elevations (less than about 10 m) above modern stream grad Alluvium is representative of deposition in a variety of piedmont environments, including alluvial fans, paleovalley and arroyo fills, strath terraces, fill terraces, and pediment surfaces. 0-15 m thick.
Qvo Older piedmont alluvium (middle(?) Pleistocene)Gravel, sand, and mud deposited at higher elevations (more than about 10 m) above modern stream. Range depositional environments is similar to Qvy. 0-10 m thick.
SANTA FE GROUP Late Miocene(?) to middle(?) Pleistocene
QTp Piedmont facies undividedWeakly consolidated sandstone, conglomerate, and minor mudstone. Conglomerate is typically poorly sorted and clast support Sandstone is typically medium to very coarse and crossbedded or horizontally stratified. Matrix-supported debris-flow deposits are rare. QTsp includes gravelly veneers on pediment surfaces. Clasts consist mostly of Permian sandstone and limestone.
Oligocene
Tsc South Canyon TuffLight gray to light purple, densely welded, crystal-poor to moderately crystal-rich rhyolite ignimbrite. Crystals are mostly sanidine and quartz; lithic fragments are common. About 230 m thick. 40Ar/39Ar age is 27.4 Ma (all 40Ar/39Ar ages are from McIntosh et al., 1991).
T Lemitar TuffPink, densely welded, moderately crystal-rich rhyolite ignimbrite. Crystals are sanidine, plagioclase, quartz, and biotite; lithics are minor. Thi ness is about 40 m. 40Ar/39Ar age is 28.0 Ma.
Typ Vicks Peak TuffLight gray, moderately welded, crystal-poor rhyolite ignimbrite. Thickness is about 50 m. 40Ar/39Ar age is 28.6 Ma.
Tj La Jencia TuffPink to gray, densely to moderately welded, crystal-poor, rhyolitic ignimbrite that exhibits compound cooling. Upper part of unit is promine flow-banded. Crystals are mostly sanidine and quartz; lithics are typically sparse. Thickness is about 95 m. 40Ar/39Ar age is 28.9 Ma.
Tsu Upper Spears GroupDark- to medium-gray volcaniclastic sandstone and conglomerate. Debris-flow breccias are locally present. Clast lithotypes are mostly dark gray basaltic andesite (plagioclase- and clinopyroxene-bearing) but also andesite-dacite (plagioclase- and amphibole-bearing) and ignimbrite clasts. 0-80 m this Spears Group terminology used as defined by Cather et al. (1994).
Tp La Jara Peak Basaltic AndesiteAphanitic to slightly porphyritic mafic flows and associated breccias of mostly basaltic andesite composition. Phenocrysts a mostly plagioclase and clinopyroxene. In the quadrangle, the unit occurs as two tongues 0-60 m thick, above the Datil Well Tuff and above the Rock House Canyor Tuff.
Ti Andesite to basaltic andesite dikesMafic to intermediate-composition dikes typically less than 3 m in width. Phenocrysts are mostly plagioclase and clinopy ene. Commonly exhibits greenish alteration. Probably represents intrusive equivalent of the La Jara Peak Basaltic Andesite.
Tdd Dacite extrusive rocksMedium brownish gray, plagioclase and amphibole-bearing dome rocks. Forms a single flow unit ~90 m thick with an autobrecciate base. Undated, but disconformably overlies Datil Well Tuff and Rock House Canyon Tuff in north-central part of the quadrangle.
The Rock House Canyon TuffLight gray, crystal-poor rhyolitic ignimbrite. Phenocrysts are mostly sanidine with rare quartz, biotite, and hornblende(?). Poorly moderately welded. Contains local zones of abundant flattened pumice. About 65 m thick. 40Ar/39Ar age is 34.4 Ma
Tdw Datil Well TuffMedium brownish gray, crystal-rich rhyolitic ignimbrite. Crystals are mostly sanidine with subordinate plagioclase and minor quartz, bio and pyroxene(?). Lithic-rich and pumice-poor. About 50 m thick. 40Ar/39Ar age is 35.5 Ma.

Τd

Eocene

MESOZOIC ERATHEM Upper Cretaceous

Kmd D-Cross Tongue of the Mancos Shale (Upper Middle Turonian-Lower Coniacian)--Noncalcareous, medium gray, marine shale. About 90 m thick with a sharp basal contact and a gradational upper contact. Fossils Prioncyclus wyomingensis (Meek) and Scaphites warreni Meek and Hayden, Prioncyclus novimexicanus (Marcou), Forresteria sp., Lopha sannionis (White), and sparse Ostrea elegantula White.

Kh Tres Hermanos Formation (Middle Turonian)-Sandstone and shale unit that forms a regressive-transgressive wedge of nearshore marine and non-marine deposits that is about 80 m thick with a gradational base and a sharp top. Consists of three unmapped members, in descending order: Fite Ranch Sandstone Member (upper Middle Turonian)--highly bioturbated, coastal barrier sandstone that coarsens upward from very fine grained to fine grained. Sandstones are light gray, but weather light to dark brown and constitute a 10-12 m thick ridge-forming unit with sharp top and gradational base. Contains Lopha bellaplicata novamexicanum Kauffman. Carthage Member (middle Middle Turonian)--marine, marginal marine, and non-marine sandstone and shale slope-forming unit 58-64 m thick; lower two-thirds contains thin, fine grained sandstone beds of paludal-lacustrine or crevasse splay origin and discontinuous, cross-bedded channel sandstones. Upper third contains marine shale with fossiliferous concretions and Prionocyclus hyatti (Stanton). Atarque Sandstone Member (lower Middle Turonian)--regressive coastal barrier sandstones that weather light gray to dark brown or buff. Lower sandstones are transitional with underlying shale and constitute a 5-7 m thick, ridge-forming unit that has very fossiliferous lenses and concretionary sandstone bodies with Pleuriocardia (Dochmocardia) pauperculum (Meek) and Gyrodes spp. Uppermost bed is commonly a brackish water coquina of Crassostrea soleniscus (Meek).

Kml Lower part of the Mancos Shale (Middle Cenomanian-Lower Turonian)--calcareous and noncalcareous, gray, marine shale with minor, thin sandstone beds near base and top. Sharp basal contact and gradational upper contact. Calcareous shale in upper part of unit contains abundant Pycnodonte newberryi (Stanton). Thin sandstones in basal 15 m contain common Ostrea beloiti Logan. About 135 m thick.

Kd Dakota Sandstone (Middle Cenomanian)--Gray to yellow, fluvial to marginal marine medium to coarse-grained sandstone and minor mudstone. No body fossils have been found in the Dakota. About 20 m thick.

Triassic

ate, and limestone. Forms slopes and valleys. About 165 m thick.

TRm Moenkopi Formation (Middle and Lower Triassic)--Red-brown, brown, and locally drab continental mudstone, sandstone and minor conglomerate. 0-30 m

PALEOZOIC ERATHEM Permian

Pag Artesia Formation (Permian, Guadalupian? to Ochoan?)--Interbedded moderate red (5R 4/6) to pale reddish-brown (10R 5/4) and very pale orange (10YR 8/2). calcareous and locally gypsiferous siltstones, and very fine to fine-grained quartz, calcareous and slightly micaceous sandstones, with are dark reddish-brown (10R 3/4) to light olive-gray (5Y 6/1), slightly micaceous mudstones, which have scattered halite casts and are broadly lenticular. Thickness is 0 - 30 m.

Psa San Andres Formation (Permian, Leonardian)--Interbedded limestone, dolostone, breccia and gypsum. Limestones are brownish-black (5YR 2/1), pale yellowish-brown (10YR 6/2) and medium gray (N5) and range from wackestone to grainstone. Dolostones are brownish-gray (5YR 4/1) to olive-gray (5Y 4/1), and locally gypsiferous. Local bedded gypsum at top of San Andres Formation mapped separately (Psu). Breccias consist of brownish-black (5YR 2/1) limestone and dolostone breccias that grade laterally into thin-bedded, dark gray (N3) limestones. The gypsums are white (N9) to light gray (N7), laminated and poorly exposed. Thickness about 120-150 m.

Pg Glorieta Sandstone (Permian)--White (N9) to very pale orange (10YR 8/2), fine- to medium-grained, friable to well-indurated, crossbedded quartz arenite (Plate 12). Has scattered coarse-grained, well-rounded, frosted quartz grains, especially in the lower half of the unit. About 40 m thick.

CENOZOIC ERATHEM

lle(?) Pleistocene

Lower Spears Group--Medium- to light-gray volcaniclastic sandstone, conglomerate, debris-flow breccia, and minor mudstone. Clasts are dominated by plagioclase- and amphibole-bearing andesite and dacite. Non-volcanic clasts are locally present above transition with underlying Baca Formation. Thickness is ~760 m. Age range is ~39-36 Ma (Cather et al., 1987). Usage of the term Datil Group is after Cather et al. (1994).

Tb Baca Formation (middle Eocene)--Fluvial red-bed sandstone, conglomerate, and minor mudstone deposited in piedmont environments. Sandstone is commonly cross-bedded; conglomerate contains pebbles, cobbles and boulders of Paleozoic and Proterozoic lithotypes. Sedimentary-clast dominated facies (Tbps) in most places underlies the granite-gneiss dominated facies (**Tbpg**), in opposition to the normal unroofing sequence seen in Baca Formation exposures in surrounding regions. Both facies were derived from the west, from the Sierra uplift of Cather (1983). About 300 m thick.

Kcc Crevasse Canyon Formation (Coniacian-Santonian?)--Drab to gray sandstone, mudstone, and coal deposited in coastal plain and fluvial settings. Thickness is about 300 m. Includes a tongue of marine shale (Mulatto tongue of the Mancos Shale) about 30 m thick, the base of which lies about 50 m stratigraphically above the top of the Gallup sandstone (S.C. Hook, 2007, oral commun.).

Kg Gallup Sandstone (Lower Coniacian)--Fine grained, gray to yellowish gray, regressive coastal barrier-island sandstone and mudstone. About 10-15 m thick. Transitional between underlying marine shale and overlying coastal plain deposits.

TRcp Chinle Group, San Pedro Arroyo Formation (Upper Triassic)--Red, gray and maroon fluvial mudstone with subordinate sandstone, limestone-pebble conglomer-

TRcs Chinle Group, Santa Rosa Sandstone (Upper Triassic)--Medium to coarse-grained, locally pebbly, brown to gray sandstone and reddish mudstone. Pebbles are chert, quartz, and clasts of sandstone and siltstone. 0-70 m thick.

Wes

7000

Cross-section A-A' Cañon Agua Buena Quadrangle 5.M. Cather and G.R. Osburn

Py Yeso Formation (Permian, Leonardian)--Interbedded sandstone, siltstone, dolomitic limestone, mudstone, and gypsum. Consists of four members (in ascending order): Meseta Blanca, Torres, Cañas Gypsum, and Joyita Members. The Meseta Blanca Member constitutes the lower Yeso Formation map unit (Pyl) and the Torres, Cañas Gypsum and Joyita Members constitute the upper Yeso Formation (Pyu). Meseta Blanca Member: interbedded very pale orange (10YR 8/1), pinkish-gray (5YR 8/1) and moderate reddish-brown (10R 4/6), very fine- to coarse-grained quartz sandstone, are very light gray (N8) to dark reddish-brown (10R 3/4) siltstone and are dark reddish-brown (10R 3/4) to grayish-red (5R 4/2) slope forming mudstones and shales. About 90 m thick. Torres Member: interbedded pale to moderate reddishbrown (10R 5/4 to 10R 4/6), grayish-pink (5R 8/2) or grayish-red (5R 4/2), fine- to medium-grained quartz sandstone, white (N9) to light gray (N7) gypsum thin layers and lenses of dolomitized onlitic limestone, and pale yellowish-brown (10YR 6/2) to olive black (5Y 2/1) limestones that ranges from carbonate mudstone to peloidal or oolitic packstones and grainstones and are locally fossiliferous, dolomitic, and argillaceous. About 140 m thick. Cañas Gypsum Member: interbedded very light gray to white (N8 to N9) laminated to chicken-wire gypsum and minor, thin very fine-grained silty sandstone and a thin, medial, fetid, gypsiferous carbonate mudstone. About 0 - 10 m thick. Joyita Member: pale reddish-brown (10R 5/4) to moderate reddish-orange (10R 6/6), friable and calcareous, fine- to very fine-grained quartz sandstones with scattered displacive halite casts and clay flakes on bedding surfaces. The upper beds display low-angle cross beds and ripple cross-laminations. About 50 m thick.

Pa Abo Formation (Permian, Leonardian)--Interbedded dark reddish brown (10R 3/4) mudstone, and grayish red (10R 4/2) to dark reddish brown (10 R 3/4) siltstone, sandstone and, locally, thin conglomerate and rare limestone. About 115 m thick.

Pb Bursum Formation (Permian, Wolfcampian)--Interbedded medium dark gray (N4) to brownish gray (5YR 4/1) with some grayish red (5R 4/2) shale, medium gray (N5) to brownish black (5YR 2/1), peloidal and fossiliferous locally dolomitic limestone, and grayish orange pink (10R 8/2) to grayish orange (10YR 7/4), fine to very coarse-grained, very lenticular and trough cross-bedded sandstones. About 60 m thick. Pennsylvanian

EXPLANATION OF MAP SYMBOLS

Fault showing direction and dip of fault plane. Dashed where approximately located; dotted where concealed. Bar and ball on downthrown block of steep faults. Square teeth on upper plate of moderate- to low-angle fault that parallels bedding or cuts out section (younger over older); triangular teeth on upper plate of low-angle fault that repeats section (older over younger). Arrows show sense of strike slip. Relative strike-slip separation in cross-section shown by T (toward) and A (away). Anticline showing trace of hinge plane and plunge direction. Dashed where approximately located, dotted where concealed.

Strike and dip of bedding.

Horizontal bedding

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IPma Madera Group, Atrasado Formation (subsurface only; Pennsylvanian, Desmoinsian to Virgilian)--Interbedded medium to dark gray (N3 to N5) marine limestones, dark gray (N3) to moderate reddish brown (10R 4/6) shale and siltstone, and marginal marine sandstone and conglomerate. About 250 m thick.

Contact between geologic units. Dashed where approximately located.

Syncline showing trace of hinge plane and plunge direction. Dashed where approximately located, dotted where concealed.

Paleocurrent direction based on pebble imbrication or crossbedding.

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