

Mapping of this quadrangle was funded by a matching-funds grant from the STATEMAP program of the National Cooperative Geologic Mapping Act, administered by the U.S. Geological Survey and by the New Mexico Bureau of Geology and Mineral Resources, (Dr. Peter A. Scholle, Director and State Geologist, Dr. J. Michael Timmons, Geologic Mapping Program Manager).

New Mexico Bureau of Geology and Mineral Resources New Mexico Tech **801 Leroy Place** Socorro, New Mexico 87801-4796

It is being distributed in this draft form as part of the bureau's Open-file map series

(OFGM), due to high demand for current geologic map data in these areas where

STATEMAP guadrangles are located, and it is the bureau's policy to disseminate

After this map has undergone scientific peer review, editing, and final cartographic

production adhering to bureau map standards, it will be released in our Geologic Map

(GM) series. This final version will receive a new GM number and will supercede

DRAFT

geologic data to the public as soon as possible.

this preliminary open-file geologic map.

[505] 835-5490 http://geoinfo.nmt.edu

This and other STATEMAP quadrangles are (or soon will be) available for free download in both PDF and ArcGIS formats at:

http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/home.html

(0-2m)

Qaes (Pleistocene (?) to Holocene)-Brown (7.5 YR 6/4), silty clay to silt to sand, sticky, plastic, local lithic pebbles, well sorted, subangular to subrounded, grains composed of 70% quartz and 30% carbonate and chert. Weak soil development in upper 1.25 m shows massive silty clay to clayey silt, brown (7.5 YR 5/4), slightly plastic, bioturbated, effervesces strongly, local organic film with granular soil structure in upper 15 cm, gypsiferous and calcareous concretions decreasing downward to 40 cm, prismatic structure down to 1.25 m. Locally weathers into badlands and exhibits piping. Sparsely to moderately vegetated. Common veneer on nearly all Quaternary deposits in the map area.. Up to 10-m thick.

Qasm1-alluvial sand mainstem (Holocene)- Light brown (7.5 YR 6/4), silt to fine-lower sand, subrounded to subangular, well sorted, massive, quartzose and lithic grains, scattered pebbles, rare cobbles, dispersed within matrix, few fine calcic nodules, surface locally reworked into coppice dunes, few thin laminated drapes of dark red mud. Top of this deposit forms a terrace (T1) 5 m above modern Pecos River and deposit is equivalent to flume sand in Carlsbad, can overlie or be inset into Qagm2. (up to 10m thick).

Qagm2-alluvial gravel mainstem (Pleistocene) Pecos River gravel and sand, medium upper to coarse upper with lesser granules and pebbles (3-6 cm in dia, ave.), moderately sorted, well rounded, moderately to well cemented by calcite. Sand fraction is mostly quartz and chert. Pebbles are composed of red, tan, and gray quartzite, variegated cherts, gray limestone, yellow limestone, yellow siltstone, lt grey and yellow dolomite, petrified wood, light tan and gray volcanic porphyry, bull quartz, schist; dominated by locally derived carbonates and Limestone clasts are larger, 15 to 20 cm, while cherts are small, 1-5 cm. Locally derived clasts dominate the deposit. A moderately indusiliciclastics. Large-scale trough crossbeds (m-scale widths and thicknesses). Capped by calcrete (1.5 to 2 m thick), autobrecciated, laminar at top. Inset into TQg. Forms low mesas and knobs along Pecos valley; often forms valley walls. Caps dominantly TQg in this map area and is locally deformed into domes. Fine-grained Holocene fill (Qasm1) lies between this deposit and the Pecos River (Qal) (potential fill-cut bench). (Thickess >15 m, likely similar to Qagdc2 thickness).

Qagdc2-alluvial gravels of Dark Canyon (Pleistocene)- Pink (7.5 YR 8/3) (matrix) and commonly medium gray (N 5) (clasts), fine sand to boulder gravel, sub-angular to rounded, locally-derived clasts of dolomite, limestone, siltstone, and sandstone, tabular to lenticular beds, crossbedded and imbricated, paleocurrent data indicate northeasterly flow. Calcrete cap (1-2 m thick). Correlates to Qagm2. Thickess >15 m, likely similar to other Qagm2 thickness.

TQg Gatuna Formation (late Tertiary to early Pleistocene?) Moderate orange pink (5 YR 8/4) to reddish orange (10 R 6/6) to red (2.5 YR shrubs 30 cm tall. 5/6), well sorted, subrounded to well rounded siltstone to sandstone (silt to fine upper sand), calcite cemented, bluish hue in places, locally gypsiferous, local well rounded granules and pebbles of chert, interbedded with non-calcareous mudstone (weathers blocky). Sandstone and siltstone beds are medium to thick and show horizontal planar laminations, low-angle crossbeds, and cut-and-fill structures. Mudstones in lenticular to tabular thin beds and also in m-scale-thick intervals. Slope former with badland weathering. Capped by mudstoneand gravel-bearing calcrete: plug is 0.5-1.0 m thick, pillar structures penetrate down into bedrock about 2 m. Varying bedding orientations in area show that TQg is warped (salt tectonics). Overlies local Permian bedrock units. Highly variable thickness 0->~100 m.

Prc-Permian Rustler Formation, Culebra Dolomite Member (Ochoan)- Cream to light gray (2.5 Y 7/1, 8/1, 8/2 and 7.5 Y2 8/1), finely crystalline, sugary dolomite and local limestone, prominently fractured, thin to medium bedded, autobrecciated locally, locally exposed and forms core of dome in northeastern map area. (<~12 m thick)

Ptms---Tansill Formation—mixed silty facies (Guadalupian) Mixed dolomite, sandy siltstone to claystone, and gypsum. Forms slopes. Dolomite: Cream color weathered, blue-gray fresh. Thin to medium bedded. Claystone to siltstone to local very-fine-lower sandstone: dominantly olive green, with gray to orange, claystone to mudstone with thin interbeds of siltstone and very fine sandstone. Sandstone is a quartz arenite, subangular to subrounded grains, well sorted, and carbonate, silica and hematite cemented. Contorted beds with very thin gypsum interbeds. Poorly exposed. Likely equivalent to Ocotillo Member of DeFord and Riggs (1941). Lateral facies of Ptm. Thickness >10 feet (3 m).

Ptm--- Tansill Formation—mixed facies (Guadalupian) Mixed dolomite, siltstone, and gypsum. Significantly less silty and gypsiferous than Ptms. Forms ledges. Sandy to silty, sugary dolomite to dolomitic limestone, weathers white to light tan to light grey to yellow, fresh color is light tan to light-medium grey to green. Conchoidally fractures. Interbedded with calcareous grey-green shale and pink siltstone. Alternating intervals of nonvesicular and vesicular dolomite define bedding, as do recessed intervals where shale has weathered out. Intraclastic breccia, peloids, mudcracks, fine laminations, local coated grains and ripplemarks, and teepee structures present. Rare gastropods and ostracods. Horizontal burrows present east of Avalon Hills. Thin to medium beds of dolomite interbedded with gypsum: dolomite shows evapomoldic porosity. Evapomoldic porosity can be mm-3 cm in diameter, pores often coalesced to define bedding. Voids can be lined with calcite and siderite, and are often at the base of individual beds. Terra rosa locally. Mesoscale plunging folds common in this facies: gypsum deposits or caves are associated with mation of units. anticlinal hinges. Secondary calcite veins locally. Unit forms red to yellow to tans soils. Contact with overlying Ptms facies is gradational and grades laterally into Ptmp and Ptms. Thickness >40 feet (12 m).

Interbedded laminated, massive, and pisolitic-oolitic dolomites. Pisolites-oolites are yellowish-tan to reddish-tan to creamy white weathered, grey-tan fresh, and grains are mms to >6 cms. in diameter. Thinly to thickly bedded. Beds are tabular to lenticular and weather blocky. Small (cms thick)- and large (meters-thick)-scale teepee structures present. Laminated and massive dolomites are yellow to grey weathered, light grey fresh, finely crystalline, silty to sandy, and can weather into vesicular and nonvesicular intervals, with vesicles defining bedding. Local intraclasts and coated grains. Cryptalgal laminations and evapomoldic porosity common. Low-angle crossbeds within thick beds present. Gastropods (replaced by silica) and bioturbation present locally. This facies present near central western edge of field area, south of the Avalon Hills. Forms alternating cliffs and ledges. Grades laterally into Ptd facies and Ptm facies. Thickness: up to ~150 feet (46 m).

Ptd—Tansill Formation---Dolomite facies (Guadalupian) Ledgy to cliffy dolomite at the base of the Tansill formation. Sugary dolomite to dolomitic limestone, tan to gray to light tan fresh, light gray to tan to creamy white weathered. Local pisoids and ooids. Planar to crinkly-laminated to massive. Possible mudcracks. Thin to medium tabular beds with undulose to planar bedding contacts. Bedding tabular and blocky. Evapomoldic porosity and "vesicular" weathering. Local solution breccia. Contact with overlying Ptm facies is gradational. Thickness: 0-40 feet (0-12 m).

COMMENTS TO MAP USERS

A geologic map displays information on the distribution, nature, orientation, and age relationships of rock and deposits and the occurrence of structural features. Geologic and fault contacts are irregular surfaces that form boundaries between different types or ages of units. Data depicted on this geologic quadrangle map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation. Locations of contacts are not surveyed, but are plotted by interpretation of the position of a given contact onto a topographic base map; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologist(s). Any enlargement of this map could cause misunderstanding in the detail of mapping and may result in erroneous interpretations. Site-specific conditions should be verified by detailed surface mapping or subsurface exploration. Topographic and cultural changes associated with recent development may not be shown.

Cross sections are constructed based upon the interpretations of the author made from geologic mapping, and available geophysical, and subsurface (drillhole) data. Cross-sections should be used as an aid to understanding the general geologic framework of the map area, and not be the sole source of information for use in locating or designing wells, buildings, roads, or other man-made structures. The map has not been reviewed according to New Mexico Bureau of Geology and Mineral Resources standards. The contents of the report and map should not be considered final and complete until reviewed and published by the New Mexico Bureau of Geology and Mineral Resources. 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 State of New Mexico, or the U.S. Government.

Description of map units—Carlsbad East Quadrangle

Sediment color was estimated by comparing dry sediment/rock to Munsell Color Chart (Munsell Color, 1994).

Hd-disturbed areas (Holocene)— Disturbance areas are quarries, dump, or flooded areas that obscure the local geology.

Qal-alluvium (Holocene) Brown (7.5 YR 6/4), silt to sand, well sorted, subangular to subrounded, dominantly quartz with rare lithics, occupies draws and river channels and associated active floodplains. Little to no vegetation. Overlies or inset into older units. Thickness

Ptmp—Tansill Formation---pisolite facies (Guadalupian)

SURFICIAL DEPOSITS

Qal (Holocene) - Quaternary alluvium, current channel of the Pecos River and Lone Tree Draw, as well as Lake Avalon deposits. Consists of red to light brown silty sands, few clasts of well rounded limestones and chert. Limestone clasts are about 15 cm in size, and cherts are ususally smaller, about 1-5 cm.

Qe (Holocene) - Quaternary eolian sands, coppice dunes consisting of fine to very fine grained red sands, well sorted and texturally mature quartz. Dunes are covered with thick vegetation consisting of tall shrubs and grasses.

Qvf (Holocene) - Quaternary valley fill, comprised of fine grained sand and silt washed off the slopes of the surrounding hillsides by runoff. Redish brown, texturally mature sand grains, but only moderately sorted. Some eolian reworking of these fluvial deposits. Very few angular limestone clasts about 15 to 20 cm in size found beneath the surface.

Qss & Qss/Qt2 (Holocene) - Quaternary sand sheet, sometimes overlying Quaternary terrace approximately 2.5 meters above the current Pecos River channel. The Pecos River is currently incising into Qt2. Sand sheet lines the valleys of the Eastern quad, as well. Consists of thin coverings of red fine grained sand with some local accumulations of silt in the valleys. Fluvially reworked in some areas with some large angular clasts, up to 30 cm. Clasts are salt shattered limestone derived from local bedrock.

Qsc (Holocene/Pleistocene) - Quaternary sand covering caliche, modern red sand covers thick accumulations of moderately indurated calcium carbonate formed in ancient red eolian sand deposits, possibly pleistocene in age. Large salt shattered limestone clasts are present at the surface, and can be up to 40 cm. The ancient sand overlies a thin evaporite deposit over a thick well sorted dark red clay, probably a lake deposit.

Qf1b (Pleistocene) - Quaternary Dark Canyon fan, subangular locally derived clasts of limestone mixed with well rounded chert and limestone gravels of the ancient Pecos River floodplain on the Northeast bank of the Pecos River. Poorly sorted with subrounded sand matrix. rated calcium carbonate has formed in this deposit.

Qf1a (Pleistocene) - Quaternary Hackberry Hills fan, angular limestone clasts derived from hills directly above the deposits. Matrix is a course subrounded sand, fining in the distal portion of the fan. Deposit is poorly sorted, and clasts are approximately 10 to 20 cm. Coalleced in most places, there is a noticeable break in slope at the edge of the fans. Well indurated calcium carbonate development.

Qt1 (Pleistocene) - Quaternary terrace, well rounded gravels of rhyolite, chert, quartzite, granite, and limestone. Limestone clasts are largest, 10 to 15 cm, while others are smaller 1-5 cm. Very well indurated calcium carbonate development with formation of pisoliths, up to two centimeters of calcium carbonate rind formed on gravels. Poorly sorted with course sand grains, tan colored. The upper soil horizons have eroded away and been replaced by light reddish brown fine grained eolian sand. Vegetation is sparce, consisting mainly of small

Map symbols:

Pleistocene bar-and-swale paleocurrent indicators--from air photo interpretation, only

photo

Bedding orientation—dip and strike (azimuth) of bedding

Depositional environments of Permian facies Permian outcrops (in the Carlsbad East quadrangle) are confined to a few places along the western edge and the northeastern part of the quadrangle. Sedimentary structures and macrofossils are rare. The sedimentary characteristics of the Tansill formation facies and Culebra Dolomite suggest a restricted shallow shelf environment (back reef).

Structural geology Mapping reflects gentle folding of Permian though Quaternary units. The random orientation of much of the bedding, and the presence of domes and basins, in combination with many dissolution depressions, suggest that salt mobility is dominantly responsible for local defor-

Geomorphology and landscape evolution of the Pecos River The Gatuna Formation likely represents the earliest Pecos River deposits and may be older than middle Pleistocene, but is likely post Ogallala Fm. The Gatuna Fm. represents a north- to south-directed river system that underwent a significant valley-filling episode. This unit is not fully within the present landscape position in that it is not confined to the modern Pecos Valley, but parallels it in a broader region between uplands to the west and east.

Two hypotheses address the landscape position of the Quaternary deposits in this quadrangle. The preferred hypothesis is that the deposits underlying the hills in the quadrangle (Qamg2) are the same deposit as that in the topographically lower surrounding landscape (Qaes/Qagp2). Another hypothesis is that these deposits at higher elevations are an older deposit and that the hills represent eroded terraces preserved in the landscape. This latter hypothesis is not favored due to: insignificant differences in calcrete development; same composition of clasts (provenance); calcrete surfaces follow land surface; and no terrace risers observed. In keeping with the first hypothesis, Qamg2 and related deposits are the oldest known Quaternary deposits in the field area. They are post-Ogallala Fm (and post Gatuna Fm—TQg) and pre-modern Pecos River, and likely represents the ancestral (Pleistocene) Pecos River in a setting analogous to the modern Pecos River. Although most of the alluvial gravels in the quadrangle may be approximately the same age, they may be polygenetic

Aeolian deposits (Qaes) in the area are dominantly confined to the eastern side of the Pecos River (downwind side), within a mile-wide belt east of the Pecos River. The main sand source for these dunes is from the paleo- and modern Pecos River deposits.

References

DeFord, R.K., and Riggs, G.D., 1941. The Tansill Formation, West Texas and southeastern New Mexico: Am. Assoc. Petroleum Geol., Bull., v. 25, no. 9, pp. 1713-1728.

Bedding contact-dashed where approximately located or where interpreted from air

Anticline-arrows on axis denote plunge direction, dashed where approximate, dotted where concealed

Hatchures- indicate depression made by salt removal/collapse and (or) wind deflation

Oil/gas well location (used in this study)

Water well location (used in this study)