Geologic Map of the Gunsight Canyon 7.5-Minute Quadrangle, Eddy County, New Mexico

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Open-File Geologic Map OF-GM 310

Scale 1:24,000

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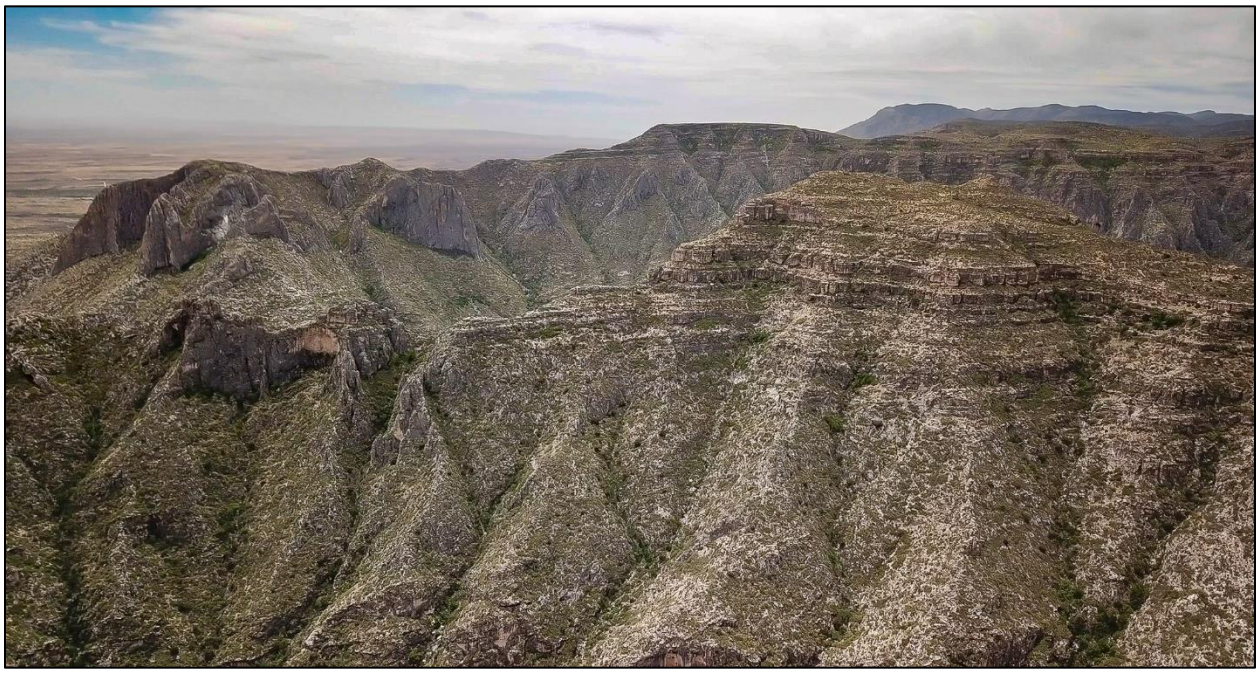

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INTRODUCTION

The Gunsight Canyon 7.5-minute quadrangle is located between approximately 30 and 40 miles southwest of Carlsbad, New Mexico, immediately west of the Serpentine Bends quadrangle. Located along the southern escarpment of the Guadalupe Mountains in southeastern New Mexico, the quadrangle straddles two modern physiographic regions, the Guadalupe Mountains and lower Pecos River Valley, as well as three distinct geologic provenances: the Delaware Basin, Capitan Reef, and Northwest Shelf. Guadalupe Ridge forms a major watershed divide that extends more than 50 miles to the southwest into the Guadalupe Mountains National Park. A hiking trail follows most of this ridge. Elevations in the quadrangle range from approximately 4,360 feet in the southeast corner of the map to 6,940 feet on Guadalupe Ridge on the northwest edge of the map at the Dark Canyon Lookout.

PREVIOUS WORK

Immediately to the west, Boyd (1958) mapped the El Paso Gap 15' quadrangle, which includes the following 7.5' quadrangles: El Paso Gap, Pickett Hill, La Paloma Canyon, and Panther Canyon. Boyd also described the facies relationships, the paleontology, and the structural geology within the 15-minute quadrangle. Skotnicki (2023) mapped the El Paso Gap 7.5' quadrangle. Hayes and Koogle (1958) mapped the Carlsbad Caverns West 15' quadrangle (1:62,500 scale). Immediately to the east, Allen and others (2023) mapped the Grapevine Draw 7.5' quadrangle. King (1948) and, subsequently, Skotnicki and Knight (2021) mapped the Guadalupe Mountains National Park immediately to the south.

METHODS

Geologic mapping was performed during the winter of 2022-2023. Map-unit contacts were augmented using recent-vintage high-resolution rectified color aerial photography contained within the World Imagery (Clarity) obtained from the ArcGIS Map Service and updated to January 2022. The workflow involved a combination of field observations and digitization of map and field data into an ArcGIS geodatabase based on the GeMS data standard (USGS NCGMP, 2020). Coordinates reported herein are given as Universal Transverse Mercator easting and northing, in meters, using the North American Datum of 1983, zone 13. The classification of surficial deposits is briefly discussed below. Paleozoic bedrock-unit names (also shown in the cross section) are those historically employed by petroleum geologists operating in the northern Delaware Basin and Northwest Platform and conform to the Geolex standard classification scheme.

PALEOZOIC ROCKS

Yates Formation

The Yates Formation is exposed diagonally across the center of the quadrangle and forms the resistant plateaus in the higher elevations of the map. The unit is characterized by interbedded dolomite and siltstone/fine-grained sandstone. This unit characteristically contains many more interbeds of dark-yellow-weathering siltstone/fine-grained sandstone than does the overlying Tansill Formation (which does not outcrop within the map area) or the underlying Seven Rivers Formation. Dolomite is typically massive and fenestrate. The sandstone beds typically form darker slopes that are almost everywhere covered by debris shed from upslope dolomite beds and are rarely well exposed. In the lower elevations where not thickly forested, these slopes locally contain more vegetation than the dolomite beds, and, in aerial photos, the sandstone layers are commonly distinguishable because of their slightly darker color. In aerial images, the Yates Formation is commonly characterized by these alternating dark

and light layers of varying thicknesses. In the northeast portion of the map, the trail from Yucca Canyon (to the east of the map) crosses the large plateau formed by the Yates Formation. Here, the Yates contains interbeds of sandstone and minor conglomerate that contain small clasts of chert and appear to contain rare clasts of granite and quartzite. These are Permian-age deposits, not Tertiary.

The Yates-Seven Rivers Contact

The contact between the overlying Yates Formation and the underlying Seven Rivers Formation is here defined as the contact between the lowermost thick sandstone layer of the Yates and the uppermost thick dolomite interval of the Seven Rivers Formation. Nowhere is this contact easy to identify accurately, and hence, it is everywhere drawn on the map as a dashed contact. The difference between the Yates and Seven Rivers Formations is best seen in the northwest portion of the map, west of the fire lookout station and radio antennae. Here, the contact forms a relatively abrupt change in slope from steep within the Seven Rivers Formation to more gentle above within the Yates Formation. This is also one of the more accessible areas in which to see a good section of the Seven Rivers Formation. In many areas of the Yates Formation, material shed from upslope sandstone beds collects locally on lower dolomite ledges, in particular on mesa tops, making them appear to contain more sandstone than they actually contain. Also, on many steep slopes, dolomite debris commonly mantles and obscures the thinner slope-forming sandstone layers, making them appear to contain less sandstone than they actually do.

Seven Rivers Formation

The Seven Rivers Formation is characterized by a rather thick interval of dolomite containing very few sandstone interbeds. The dolomite is commonly thick-bedded and massive, with beds between 1-3 meters thick, separated by thin partings. From a distance, the formation commonly appears regularly bedded. The unit characteristically forms cliffs and steep ledgy slopes that appear light-gray both on the ground and in aerial photos and lack the darker yellowish color imparted by sandstone beds abundant in the other formations. The best and most accessible exposures of the Seven Rivers Formation are along both the east and west sides of Guadalupe Ridge (the ridge that forms the largest drainage divide in the Guadalupe Mountains).

The Seven Rivers-Queen Contact

The contact between the Seven Rivers Formation and the underlying Queen Formation is probably the most difficult to define and recognize. As defined here, the contact is placed between the lowermost thick interval of dolomite of the Seven Rivers Formation and the uppermost thick sandstone bed of the Queen Formation (which may be equivalent to the “Shattuck member” as described by Boyd, 1958; see Skotnicki, 2023, for photos). In practice, however, this is not an easy contact to identify. The sandstone layers in the upper part of the Queen Formation form recessive slopes that are almost everywhere, covered by debris shed from upslope dolomite beds. The unit crops out within the deep drainage in the northwest portion of the quadrangle, where sandstone beds are locally exposed in stream-cuts. Additionally, the upper portion of the Queen Formation contains several light-gray ledge-forming dolomite beds of different thicknesses that appear identical to the dolomite beds within the Seven Rivers Formation. Therefore, this contact was most easily mapped along the change in slope between the steep cliff-forming dolomite beds above, and the mostly slope-forming sandstone beds below. The reader should be aware that this contact is dashed everywhere on the map to denote this uncertainty. Because much of the Queen Formation and overlying Seven Rivers Formation is at least partially vegetated with oak trees and pinon pine trees, it is almost impossible to view the contact on the ground from a nearby hill. Because of this, most of the contact was drawn using aerial imagery along a thick marker bed of dolomite that forms a small cliff.

Queen Formation

The Queen Formation is dominated by relatively planar layers of fine-grained quartz sandstone and siltstone, locally interbedded with thinner and less abundant dolomite layers. The unit exists in the northwestern corner of the map, where it forms covered slopes and a few steeper stream cuts. This unit is characteristically rusty yellow in color and, where extensively weathered, commonly forms rusty orange sandy soils. The formation contains less abundant dolomite beds, commonly interbedded between thicker sandstone beds. On some weathered bedrock slopes, the sandstone and dolomite exhibit a similar color and weathering style, and distinguishing between the two rock types from a distance is very difficult.

Capitan Formation

The Capitan and Goat Seep formations represent the ancient reef (the uppermost portion), and the debris shed off the reef into deeper water (most of the lower portion of the unit). The two formations are identical. Previous researchers subdivided the two based on their lateral association with the Grayburg and Queen Formations (Goat Seep) and the overlying Carlsbad Group (Capitan Formation). This association is exposed in only one location, in a natural cross-section, in the cliff face immediately north of El Capitan in the Guadalupe Peak 7.5' quadrangle to the southwest. Even there, the Goat Seep and Capitan Formations form one continuous unit with no visible contact. From the perspective of defining units on a geologic map, the two units are indistinguishable, and there is nothing to be gained by trying to force-fit this arbitrary distinction onto a map. Therefore, both units are shown as the Capitan Formation. Boyd (1958) stated that the upper sandstone unit of the Queen Formation (the Shattuck member) is approximately equivalent to the highest part of the Goat Seep Formation as he mapped it in North McKittrick Canyon, located immediately southwest of the Gunsight Canyon quadrangle.

STRUCTURE

Folds

Several very broad folds are exposed in the uplands of the Guadalupe Mountains within the quadrangle. They all have axes that trend southwest-northeast and contain limbs that dip very gently (typically five degrees or less) to the northwest and southeast. Because of the gentle dips, most of the folds are difficult to identify, and it is possible that there are other folds that exist but are not shown on the map. The folds are defined by bending of strata within the Yates and Seven Rivers Formations. The fold axes cross portions of the underlying Capitan Formation and may deform this unit, but because there is no discernable bedding to define the folds, the fold axes drawn across the Capitan Formation are all dashed.

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UNIT DESCRIPTIONS, GUNSIGHT CANYON 7.5' QUADRANGLE

Cenozoic

Quaternary deposits

Alluvial deposits

Qpy – **Younger piedmont alluvium (sand, gravel, cobbles, boulders, and mud) (Holocene)** – Coarser debris, including cobbles and boulders in the vicinity of the mountain front, are Permian carbonate rocks derived from the Guadalupe Mountains and from reworking of older piedmont alluvium. Pale-tan to reddish-brown silty sand, sand, and pebbly sand comprise much of the unit in some areas. Includes accumulations of sediment in active channels, together with deposits graded to levels a few meters above active channels and colluvium/slopewash at the base of older piedmont fan remnants. Focusing of surface runoff toward areas underlain by younger piedmont alluvium is commonly expressed by a relative abundance of vegetation and darker shades on aerial imagery. Surface roughness (microtopography) is locally pronounced close to the mountain front where cobble- and boulder-sized clasts are plentiful. Some drainages floored by Qpy deposits exhibit subvertical walls deeply cut into cemented gravel of older piedmont alluvium. Cutbank exposures of Qpy deposits up to a few meters thick are present in some areas.

Qaed – **Alluvial and eolian silt, sand, clay, and gravel in closed or nearly closed depressions (Holocene)** – Primarily silt and sand; may contain gravel and cobbles washed in from depression margins. Fines are generally pale tan to brown. Most of the depressions are probably karstic structures resulting from subsurface dissolution of Permian evaporites. Fills may be thin (< 1 m) to a few meters thick. In the map area, a group of depressions is present on intermediate fan remnants in the vicinity of Double Canyon, suggesting that Castile Formation gypsum/anhydrite is present in the subsurface at least that far south along the Guadalupe Mountains escarpment.

Qac – **Undivided valley alluvium and colluvium in the Guadalupe Mountains (middle Pleistocene to Holocene)** – Includes alluvium along active channels, terrace deposits, hillslope colluvium along canyon walls, and unmapped areas of bedrock along scoured channel reaches and cutbanks. Deposits consist of pale-tan to brown siliciclastic silt and sand, gravel, cobbles, and boulders. Larger clasts are dominantly pale-colored dolomite and gray limestone derived from the surrounding Permian shelf and shelf-margin strata of the Capitan Formation and Artesia Group. Accumulations of sediment above active channels are commonly cemented. Deposits may locally be several meters thick beneath terraces and colluvial wedges. Map unit merges eastward with piedmont alluvium in the vicinity of the mountain front.

Qpi2 – **Intermediate piedmont alluvium, younger subunit (late Pleistocene)** – In the map area, these deposits are graded to a somewhat higher level than deposits of map unit Qpy, and are inset against older piedmont alluvium along the larger valleys and draws that drain eastward from the Guadalupe Mountains. Bar and swale microtopography is evident on depositional surfaces. Comparatively young deposits of gravelly alluvium in the western Delaware Basin, including relatively young deposits underlying the piedmont slope in the map area, are commonly cemented with calcium carbonate. This probably reflects a predominance of carbonate dust and debris in the region, and the arid climate. Preservation of microtopography and inset relations with other piedmont map units suggest a relatively young age for Qpi2 deposits. Erosion of older piedmont deposits, transport of sediment from the Guadalupe Mountains, and Qpi2 deposition may have occurred primarily during the last glacial episode. Thickness of the deposits is variable, ranging from decimeters to perhaps several meters. Exposures in deeply incised drainages near the Guadalupe escarpment generally reveal up to a few meters of Qpi2 sediment overlying surfaces scoured into older alluvium.

Qpi1 – **Intermediate piedmont alluvium, older subunit (middle Pleistocene)** – Deposits are graded to a higher level than deposits of Qpi2, and remnant surfaces are generally smoother. Qpi1 alluvium underlies the land surface over a broad area along the upper piedmont slope between Double Canyon and Big Canyon, and extends eastward along the larger drainages where it is inset against older alluvium up to 20 meters above the floors of adjacent drainages. Gravelly strata are well cemented, and finer-grained deposits are typically poorly exposed, even in deeply incised subvertical drainage cuts. Episodes of landscape erosion, sediment mobilization, and accumulation of Qpi1 alluvium may be associated with any of the glacial-interglacial climatic changes that occurred during the mid-Pleistocene. Unit probably ranges from less than one to several meters in thickness.

Qpo – **Older piedmont alluvium (early? to middle Pleistocene)** – Surface exposures are generally well-cemented conglomerate, containing subangular to rounded pebbles, cobbles, and boulders derived from Permian carbonate rocks in the Guadalupe Mountains. Finer-grained strata are poorly exposed. Remnants of older piedmont alluvium are preserved as east-west oriented ridges that have been eroded and stripped down to resistant conglomeratic strata. Interfluvial summits underlain by Qpo remnants rise up to 40 meters above adjacent drainages. Slumping and tilting of the deposits, likely due to solution subsidence over extended periods of time, is evident in places. A lack of paleontologic or other evidence concerning the age of piedmont deposits along the Guadalupe escarpment leaves their absolute age range open to speculation. Piedmont alluvium apparently overlies the Castile Formation at least as far south as Double Canyon along the mountain front. Several kilometers to the southwest along the escarpment, the Castile has been completely removed and strata of the Bell Canyon Formation are exposed at the surface. Hale (1955), based on borehole lithologic logs available at that time, reported an estimated maximum thickness of about 60 m of accumulated clastic sediment in the upper Black River valley, with gravel (conglomerate) comprising a comparatively small proportion of the total alluvial fill.

Paleozoic

Permian

OCHOAN

Pcs – Castile Formation (Ochoan) – Anhydrite. Composed of alternating regular laminae and thin beds of dark-colored and light-colored anhydrite. Shown only in cross-section.

GUADALUPIAN

Artesia Group

Py – **Yates Formation (Guadalupian)** – Interbedded dolomite and siltstone/fine-grained sandstone. Characteristically contains many more interbeds of dark-yellow-weathering siltstone and fine-grained sandstone than does the overlying Tansill Formation. Dolomite is typically massive and fenestrate, and commonly weathers a dark-tan color compared to the lighter-gray weathering of the Tansill Formation. The Yates Formation forms the high, flat plateaus along the top of the Guadalupe Mountains. Although the top is eroded, the thickness is up to 140 m.

Psr – **Seven Rivers Formation** – Thick-bedded gray dolomite occurs in rather massive beds between 1–3 meters thick, separated by thin partings. From a distance, the formation appears regularly bedded and conspicuously contains very few siltstone/fine-grained sandstone beds up to a few tens of centimeters thick, mostly in the lower

portion of the exposed outcrops. Forms cliffs and steep ledgy slopes. Thickness varies from zero meters, where it pinches out along the Capitan Formation, up to 170 meters.

Pq – **Queen Formation (Guadalupian)** – Quartz siltstone and fine-grained quartz sandstone. Grains are subangular to subrounded. Typically contains very planar thin to thick beds that commonly erode recessively and form slopes. Locally contains very minor thin beds of light-gray dolomite approximately 10–30 cm thick that typically form small resistant ledges. The uppermost 20 meters or so contain several thin to thick, interbedded, light-gray dolomite layers up to several meters thick. The unit commonly forms deep-rusty-orange soils on poorly exposed vegetated slopes in the northwest corner of the map. The maximum thickness exposed within the quadrangle is approximately 120 meters.

Pg – **Grayburg Formation (Guadalupian)** – Light-gray to very pale-yellowish-gray, laminated, fine-grained dolomite, interbedded with pale-orange siltstone and very fine-grained sandstone. Shown only in cross-section.

Capitan Reef Complex

Pc – **Capitan Formation, undivided (Guadalupian)** – Massive cliff-forming limestone and limestone breccia. From a distance, this unit exhibits a weekly developed inclined layering that dips southeastward between approximately 15 and 30 degrees. This layering is more pronounced closer to the Delaware Basin. In outcrop, most exposures appear massive and structureless. A faint brecciated texture is visible locally where angular clasts of dolomite of all sizes are strongly cemented by different generations of carbonate. Coarse-grained light-yellow palisade calcite spar commonly fills dissolution fissures and cracks. Fossils of sponge and brachiopod fragments are locally visible. Forms steep slopes and imposing cliffs. This unit represents the Capitan Reef itself and the fragmented debris shed from the ancient reef down into the Delaware Basin. Thickness exposed along the escarpment is 450 meters.

Delaware Mountain Group

Pbc – **Bell Canyon Formation of the Delaware Mountain Group, undivided (Guadalupian)** – Sandstone and interbedded limestone. Shown only in cross-section.

Pl – **Lamar limestone member of the Bell Canyon Formation (Guadalupian)** – Thin- to thick-bedded limestone. Beds are mostly massive and composed of micrite or contain abundant mostly sand-sized fossil skeletal debris. Sparse light-gray bedded chert is visible locally within the lower half of the unit. Unlike the other limestone members of the Bell Canyon Formation, this unit contains no visible siltstone layers.

Unmapped

U – **Unmapped** – Deeper regions in the subsurface that are where no confidence exists for placing contacts or unit names. Shown only in cross-section.