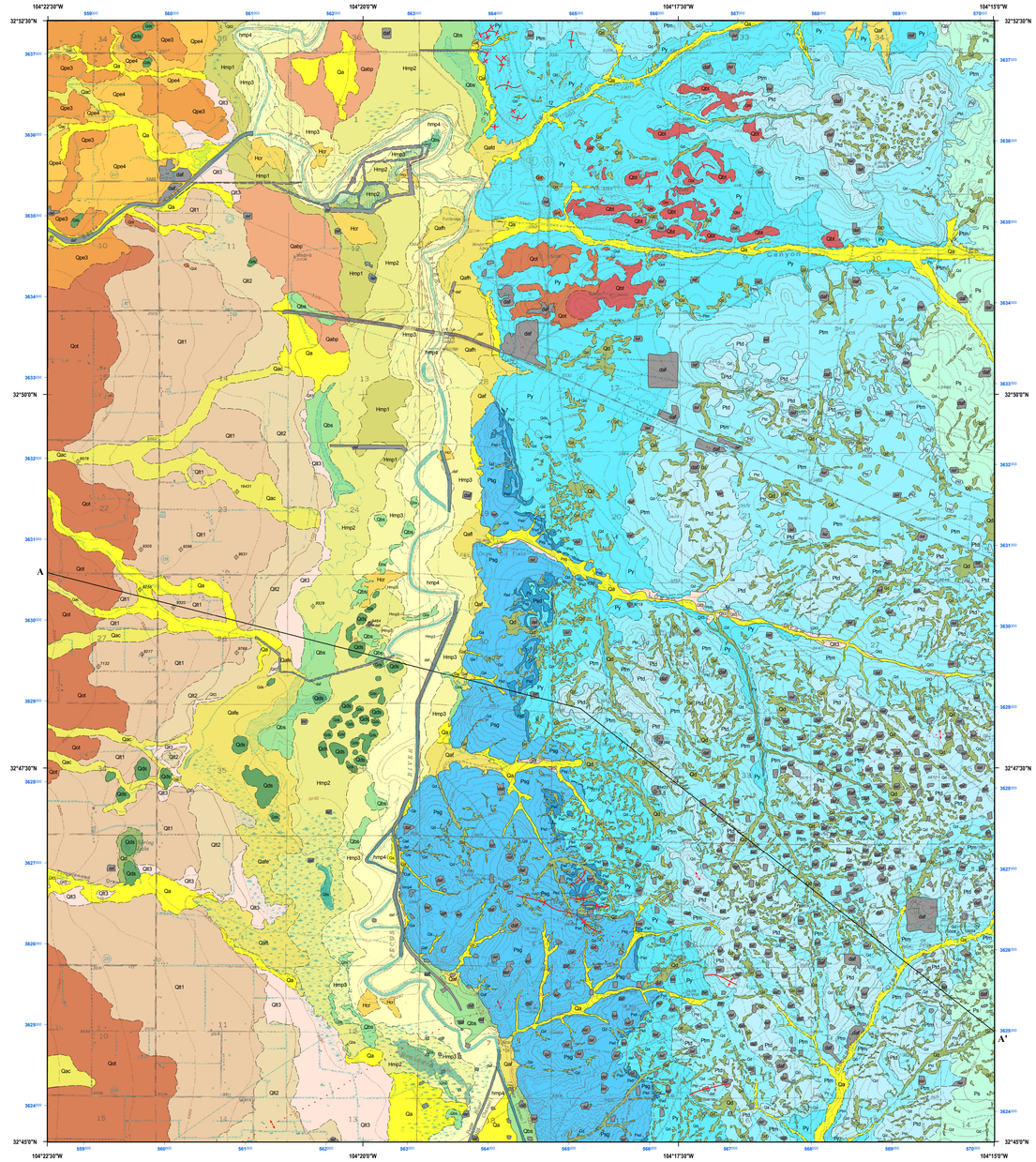
NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES A DIVISION OF NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

NMBGMR Open-file Geologic Map 214
Last Modified June 2011



Base from U.S.Geological Survey 1955, from photographs taken 1947, topography from plane table surveys 1955.
Polyconic projection. 1927 North American datum, UTM projection — zone 13N
1000- meter Universal Transverse Mercator grid, zone 13, shown in red

1:24,000

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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*).

QUADRANGLE LOCATION

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This and other STATEMAP quadrangles are available for free download in both PDF and ArcGIS formats at:

http://geoinfo.nmt.edu

New Mexico Bureau of Geology and Mineral Resources
Open-file Geologic Map 214

Geologic map of the Spring Lake quadrangle, Eddy County, New Mexico.

May 2011

by
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EXPLANATION OF MAP SYMBOLS

- A — A' Location of geologic cross section.
- Geologic contact. Solid where exposed or known, dashed where approximately known, dotted where concealed or inferred.
- Trace of syncline axial plane associated with evaporite collapse.
- Trace of anticline axial plane associated with evaporite collapse.
- Artesia - Vacuum Arch. Subsurface anticlinal arch warping Permian and older strata.
- Inclined bedding showing degrees of dip.
- 8678 Oil & gas exploration well used in cross section construction.

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

CENOZOIC

QUATERNARY and NEOGENE

Alluvium, lacustrine, and anthropogenic deposits

dsf **Disturbed land and/or artificial fill (Historic) —** Dumped fill and areas affected by human disturbances, mapped where deposits or extractions are areally extensive. Especially notable are the numerous constructed oil and gas well pads. Also includes the U.S. Bureau of Reclamation's Kaiser Channel of the Pecos River, as well as other straightened reaches.

Qa **Quaternary tributary alluvium and valley-fill alluvium, undifferentiated (Historic to uppermost Pleistocene)** — Brown (7.5YR4/2) to pinkish gray (7.5YR6/2) (tributaries) to light reddish-brown (5YR 6/4) to reddish brown (2.5YR4/6) (Pecos floodplain valley-fill), unconsolidated, moderately sorted, pebbly sand, silt, and clay. Varies considerably in thickness from <1 to 3 m in tributaries and up to 10-12 m in the floodplain.

Qpec2 **Quaternary alluvial channel swale and/or depression fill deposits of the Eagle Creek piedmont alluvial complex (upper Pleistocene to Holocene)** — Light brown (7.5YR6/4) to pinkish gray (7.5YR6/2), unconsolidated, poorly sorted, fine-grained sand, silt, and clay with mostly carbonate gravels and pebbles occupying thin (<1-1.5 m) channels, swales, and coalescng depressions draining the Eagle Creek piedmont complex (*Qfpe*).

Qac **Quaternary alluvial channel swale and/or depression fill deposits originating from either Eagle Creek or Rio Peñasco piedmont complexes extending across Pecos Valley terraces (upper Pleistocene to Holocene)** — Light brown (7.5YR6/4) to pinkish gray (7.5YR6/2), unconsolidated, poorly sorted, fine-grained sand, silt, and clay, occasional carbonate pebbles, occupying thin (<1-1.5 m) channels, swales, and coalescing depressions.

Qaf **Alluvial-fan deposits, undivided (Historic to uppermost Pleistocene)** — Predominantly carbonate gravels to pebbles, often in stringers, in a brown (7.5YR4/2) to pinkish gray (7.5YR6/2), unconsolidated, poorly sorted, and coarse- to fine-grained sand to silty sand. Two large fans built by both historic former channels of Eagle Creek (*Qafe*), and by Tumbleweed Draw (*Qafj*), debouch from these western tributaries onto the western floodplain margin, interfingering with and/or spreading out onto Pecos floodplain deposits. Thicknesses decrease from tributary mouths from ≥ 6 m to < 1 m at their distal margins. Fans debouching onto the floodplain from eastern tributaries vary considerably in thickness from <1 m for small fans and up to ~ 8 m at the apices of fans built by large tributaries (e.g., Hart Canyon , *Qafh*, and Logan Draw, *Qafl*). Many of these fans have been truncated and their deposits removed by the eastward migrating Pecos River from meander belts Hmp2 to hmp4 (e.g., Dog Canyon , *Qafd*).

Qp **Quaternary playa deposits (upper Pleistocene to Holocene)** — Pinkish white (7.5YR8/2), unconsolidated, well-sorted, fine-grained sand, silt, and clay Thickness unknown (≥ 1m).

Pecos River alluvial valley floor

(Historic map unit labels are given a lower case "h" to differentiate them from Holocene map units.)

Pecos River meanderbelt alluvial deposits (Historic to lower Holocene) — At the onset of the Holocene, the Pecos River switched from a braided regime to a meandering one, and proceeded to build four distinguishable meanderbelts on top of the basal, upper Pleistocene Pecos River braided alluvial valley-fill (*Qahp*). Consisting of channel, channel bar, point bar, and natural levee deposits, undivided, these meanderbelts are differentiated based upon cross-cutting relationships observed in the field, as well as aerial photographic work into an historic unit (hmp_x) and three older Holocene units (Hmp_{x-3}). These older Holocene units reveal a pattern of progressive meanderbelt shifting from west to east across the floodplain.

hmp4 **Historic meanderbelt deposits (Historic to upper Holocene)** — Occasional pebbles of dolomite, limestone, sandstone, chert, and quartzite in a very pale brown (10YR7/4) to reddish brown (2.5YR4/6), unconsolidated, moderately to well-sorted, coarse- to fine-grained sand in the former modern channel and adjacent bar crests, grading to silty sand and sandy clay with distance from this channel. Several reaches of the Pecos River on the quad have been channelized by the U.S. Bureau of Reclamation during the mid 20th Century. The northernmost section of the Kaiser Channel extends into the southernmost part of the quad. Meanderbelt thicknesses commonly range from 1 to 5 m.

Hmp3 **Young meanderbelt deposits (upper Holocene)** — Very pale brown (10YR7/4) to reddish brown (2.5YR4/6), unconsolidated, moderately sorted, occasionally pebbly (dolomite, limestone, sandstone, chert, and quartzite), coarse- to fine-grained sand, silty sand, and sandy clay. Unit primarily lies immediately west of hmp_4 in the center of the floodplain. Thickness 2-5 m.

Hmp2 **Older Holocene meander belt deposits (upper to middle Holocene)** — Very pale brown (10YR7/4) to reddish brown (2.5YR4/6), unconsolidated, moderately sorted, occasionally pebbly (dolomite, limestone, sandstone, chert, and quartzite), coarse- to fine-grained sand, silty sand, and sandy clay. Unit lies immediately west of Hmp_3. Thickness 3-5 m.

Hmp1 **Old Holocene meander belt deposits (lower to middle Holocene)** — Very pale brown (10YR7/4) to reddish brown (2.5YR4/6), unconsolidated, moderately sorted, occasionally pebbly (dolomite, limestone, sandstone, chert, and quartzite), coarse- to fine-grained sand, silty sand, and sandy clay. Thickness 3-5 m.

Hor **Holocene crevasse splay deposits (middle to upper Holocene)** — Very pale brown (10YR7/4) to reddish brown (2.5YR4/6), unconsolidated, graded sand and silty sand closest to the channel bank breached by the crevasse to sandy clay at the distal margins. Thickness <1 to 2 m.

Qhs **Floodplain alluvial backswamp deposits (Historic to upper Pleistocene)** — Light reddish-brown (5YR6/4) to very dark gray (7.5YR3/1), unconsolidated, well-sorted, silty sand, sandy clay, and clay in low-lying, poorly drained areas. These areas commonly received only fine-grained, slack-water flood deposition, prior to channelization. Thicknesses range from 3-15 (?) m.

Qalp **Pecos River braided alluvial deposits (upper Pleistocene to lower Holocene)** — Gravels and pebbles of dolomite, limestone, sandstone, chert, and quartzite in a reddish brown (2.5YR4/6) to light reddish-brown (5YR6/4), unconsolidated, poorly to moderately sorted, coarse- to fine-grained sand, silty sand, sandy clay, and clay. Braided channels and bars typify the surface of *Qahp* elsewhere, but on the Spring Lake quad, its largely featureless. Mostly buried by Holocene meanderbelt. Thicknesses vary (based upon Lyford, 1973) from about 5 to 30 m.

Pecos Valley alluvial terrace complex

Alluvial terraces of the Pecos River and its tributaries were first described in the classic study of Fiedler and Nye (1933). They recognized 3 terraces flanking the floodplain: (from lowest to highest) the Lakewood, the Orchard Park, and the Blackdom. All three terraces are present on the Spring Lake quad.

Lakewood terrace alluvial deposits (upper to middle Pleistocene) — The Lakewood terrace, with an elevation of 6 to 9 m above the floodplain, flanks the inset Pecos floodplain and extends up many of its tributaries. Following McCraw, *et al.* (2007) and McCraw and Land (2008), three distinct, low-lying (upper to uppermost middle(?) Pleistocene) "Lakewood terraces" are recognized. The highest and oldest of which (Qlt_1) would be Fiedler and Nye's original. Surface tread elevations above the floodplain for these three are: ~1-2 m, 2-6 m, and 6-9 m, respectively. They are comprised of occasional gravels and pebbles, brown (10YR5/3) to dark yellowish brown (10YR3/4), unconsolidated, moderately sorted, coarse- to fine- grained sand, silty sand, silt and sandy clay. Pedogenic carbonate increases from stage I to stage II+ (occasionally III) from Qlt_3 to Qlt_1. Mostly non-gypsiferous.

Qlt3 **Youngest Lakewood terrace alluvial deposits (upper Pleistocene)** — Thickness <1 to 1 m.

Qlt2 **Young Lakewood terrace alluvial deposits (upper Pleistocene)** —Thickness 1.5 to 5 m.

Qlt1 **Older Lakewood terrace alluvial deposits (upper to middle Pleistocene)** —Thickness ~2 to 9 m.

Qot **Orchard Park terrace alluvial deposits (upper Pliocene (?) to upper Pleistocene)** — According to Fiedler and Nye (1933), the Orchard Park terrace rises 1.5-3 m above the Lakewood terrace and 10.5-20 m above the Pecos floodplain. It is comprised of gravels and pebbles of dolomite, limestone, sandstone, chert, and quartzite in a very pale brown (10YR7/4) to reddish brown (5YR4/4), unconsolidated, moderately sorted, coarse- to fine- grained sand, silty sand, silt, and sandy clay. Pedogenic carbonate is a strong stage III. Thickness ranges from 3 to 15 m.

Qblt **Blackdom terrace alluvial deposits (middle to lower Pleistocene)** —The Blackdom terrace occurs in isolated remnants primarily atop the Permian Yates formation (*Py*), 25-42 m above and east of the Pecos floodplain. It is comprised of gravels and pebbles of dolomite, limestone, sandstone, chert, and quartzite in a very pale brown (10YR7/4) to reddish brown (5YR4/4), unconsolidated, moderately sorted, coarse- to fine- grained sand, silty sand, silt, and sandy clay. Pedogenic carbonate is III-III+. Thickness ~17 m.

Eagle Creek alluvial piedmont complex

Eagle Creek alluvial piedmont deposits (Upper to middle Pleistocene) — Eagle Creek (or Eagle Draw further west) heads on the easternmost flank of the southern Sacramento Mountains in San Andres Formation (*Psa*) rocks and flows east to the Pecos River. Where it leaves the Permian highlands, it has built a large piedmont alluvial complex, which coalesces with the Rio Felix to the north and the Rio Peñasco to the south. This piedmont complex grades to and onto the Pecos Valley alluvial terraces. Oldest, highest remnant surfaces may be as old as Pliocene, which possibly grades to a river system which forms Gatuña formation deposits today. It is comprised of gravels that are almost exclusively limestone derived from *Psa*, supported in a matrix of light brown (7.5YR6/3), unconsolidated, moderately sorted, coarse- to fine- grained sand, silty sand, silt (largely calcareous), and sandy clay. On the Spring Lake quad, only the two youngest piedmont deposits (Qpe_{2-3}) are mapped. Topographic expression between these deposits are often to subtle to practically non-existent. Distinction is often based upon a stronger developed pedogenic carbonate (Qpe_3 = stage III – II+; Qpe_4 = stage II). Qpe_4 grades to Qlt_1.

Qpe4 **Youngest Quaternary alluvial piedmont deposit (upper Pleistocene)** — Thickness 1 to 3 m.

Qpe3 **Younger Quaternary alluvial piedmont deposit (upper to uppermost middle Pleistocene)** — Thickness 2 to 4 m.

Quaternary depression fill and sinkhole deposits

Qd **Quaternary depression fill, undifferentiated (Holocene to middle Pleistocene)** — Unconsolidated, well-sorted, fine-grained (fine sands to clay) complexes of alluvial, colluvial, eolian, and occasional lacustrine deposits within closed depressions. Colors variable. Depressions are created by either gradual subsidence or sudden collapse followed by gradual subsidence of underlying gypsiferous carbonate terrane. These complexes are often significantly modified by stream erosion and deposition, playa deposition, deflation, and mass wasting. Depression fills have been active since the middle Pleistocene and are usually 1-3 m thick but can reach thicknesses in excess of 30 m.

Qsks **Quaternary sinkhole deposits, primarily caused by collapse (Historic to middle Pleistocene)** — Complexes of unconsolidated, well- to poorly-sorted, coarse- to fine-grained sands to clay, alluvial, colluvial, eolian, and occasional lacustrine deposits within closed depressions. Colors variable. Thickness <1 to 3 m.

PALEOZOIC

Permian Artesia Group

Ps **Salado formation, mixed gypsiferous facies (Guadelupian)** — Irregular masses of gypsum, dolomite, and salt in outcrops with chaotic bedding orientations. Exposed in eastern part of quadrangle. Thickness unknown.

Psd **Tansill formation, dolomitic facies (Guadelupian)** — Light gray dolomite forming the basal part of the section, grading upward into interbedded mixed facies. Thickness <1 to 3 m.

View looking north-northwest of northernmost exposure of *Ptd* as it plunges beneath the alluvim. The roadside business on the north side of U.S. Highway 82 sits on alluvial fan (*Qaf*) east of the modern Pecos River meanderbelt (hmp_4). Photo by D. McCraw.

Ptm **Tansill formation, mixed silty gypsiferous facies (Guadelupian)** — Interbedded mixed gray silty dolomite, siltstone and gypsum, and yellowish sandstone with sublitharenite and orange-red chert grains. Thickness 2 to 50 m.

Py **Yates formation, mixed gypsiferous facies (Guadelupian)** — Very light gray, massive to vesicular gypsum interbedded with pink dolomite, green to white and orange to red siltstone and minor sandstone. Folded into domes and basins on a meter to several decimeter scale. Forms caverns. Outcrop exposures poor. Thickness increases westward from 2 to 50 m.

Psd **Seven Rivers formation, dolomitic facies (Guadelupian)** — Light gray to yellowish to pink, thinly to thickly bedded, vescicular to massive dolomite interbedded with pink dolomitic siltstone, yellowish sandstone and thin beds of milky gypsum. Thickness 1 to 3 m.

Psg **Seven Rivers formation, gypsiferous facies (Guadelupian)** — White to gray, occasionally yellow to red massive gypsum interbedded with thin- to medium-bedded, light gray dolomite and red gypsiferous siltstone, often containing gypsum nodules, and yellowish sandstone, which often exhibit soft sediment deformation. Commonly fractured, occasionally forming caverns, with many low amplitude folds varying in scale from meters to kilometers. Thickness unknown.

Pqg **Queen and Grayburg formations, undifferentiated** (Guadelupian) — Cross section only.

Lower Permian Formations

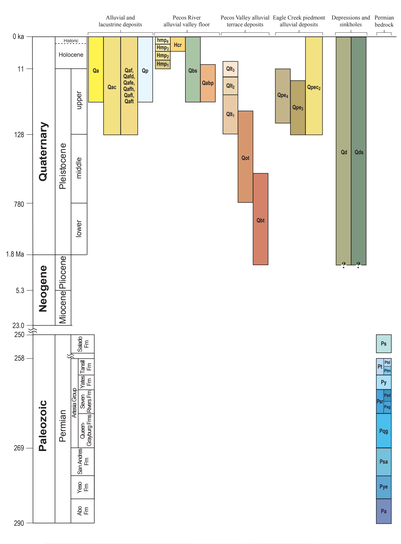
Psa **San Andres formation** — Cross section only.

Pg **Glorieta sandstone tongue** — Cross section only.

Pye **Yeso formation, undifferentiated** — Cross section only.

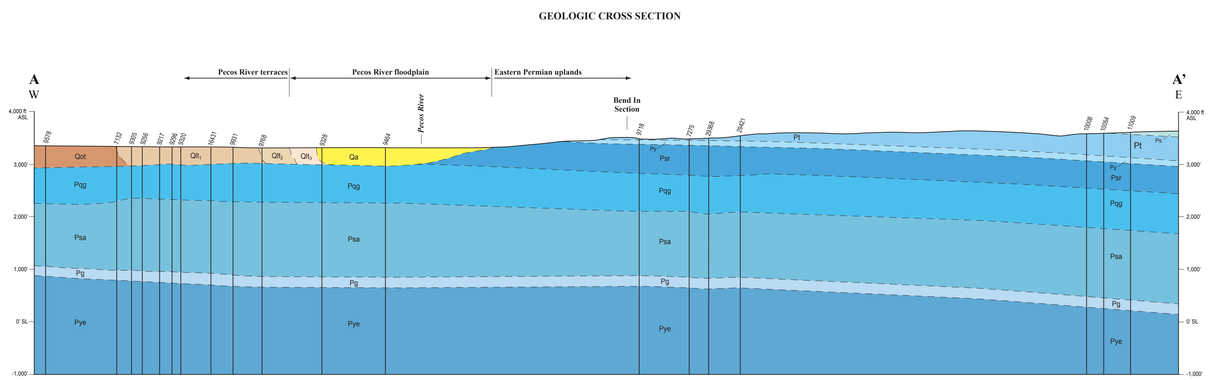
Pa **Abo formation, undifferentiated** — Cross section only.

CORRELATION OF MAP UNITS



View looking north of eastern edge of a small warped synclinal basin developed in Yates formation (*Py*). The outermost oldest exposed bed of gypsum on the far right curving from truck in the distance resurfaces roughly 20 m away to the left within this bed. Photo by D. McCraw.

GEOLOGIC CROSS SECTION



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