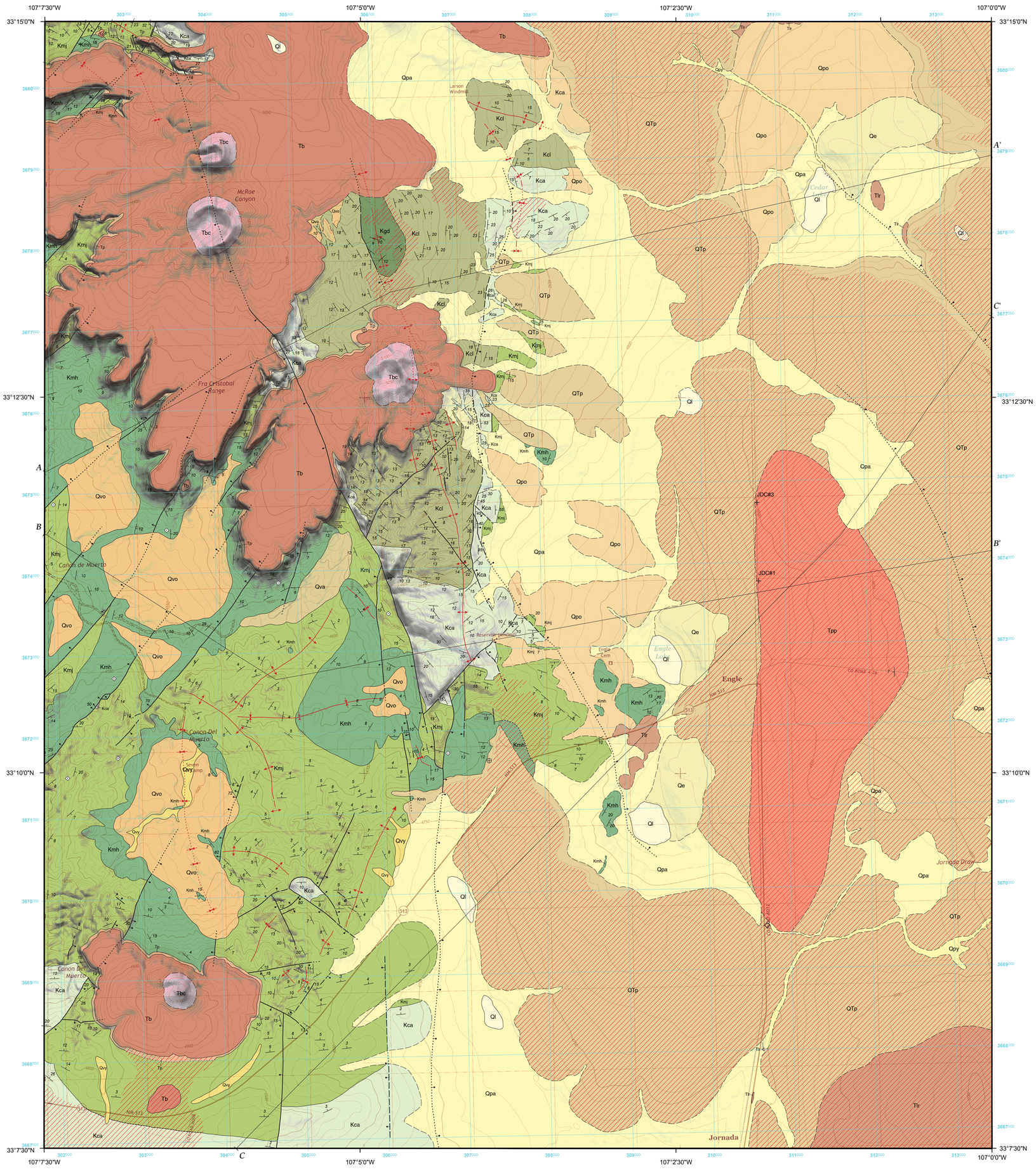
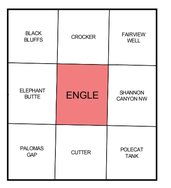
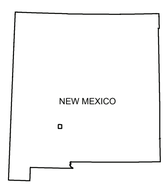


Base map from U.S. Geological Survey 1970, from photographs taken 1965, field checked in 1970, edited in 1993.
1927 North American datum, UTM projection -- zone 13N
1000-meter Universal Transverse Mercator grid, zone 13, shown in blue

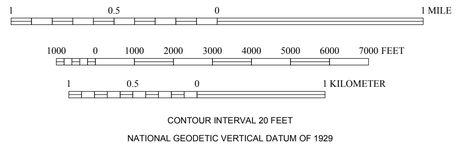
1:24,000



QUADRANGLE LOCATION



Magnetic Declination
August 2012
9° 2' East
At Map Center



CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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87801-4796

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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, (L. Greer Price, *Director and State Geologist*, Dr. J. Michael Timmons, *Assoc. Director for Mapping Programs*).

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

http://geoinfo.nmt.edu

Geologic Map of the Engle Quadrangle, Sierra County, New Mexico

May 1993

by
Greg Mack[1] and William R. Seager[1]

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New Mexico Bureau of Geology and Mineral Resources

Open-file Geologic Map 207

Map Unit Descriptions

Quaternary

Qvy — **Younger valley-fill alluvium**—Sand and gravelly-sand deposits of arroyos, alluvial fans, and terraces, whose surfaces are graded to within a few feet (meters) of the modern Rio Grande floodplain. As much as 10ft (3m) thick.

Qvo — **Older valley-fill alluvium**—Sand, gravel and sandy gravel deposits of arroyos, fans, terraces, and erosion-surface veneers, whose surfaces are graded to as much as 150ft (46m) above the Rio Grande floodplain. Pedogenic carbonate typically is well developed (stage II - III) in the upper parts of the deposits. As much as 25ft (8m) thick.

Undifferentiated Qvo and Qvy

Qva — **Eolian alluvium**—Sand and loamy-sand ridges, dunes, and mounds that accumulated in the lee of playa lakes. As much as 35ft (10m) thick.

Qe

Ql — **Playa-lake deposits**—Silt and clay on the floors of playa lakes. Probably 3 to 10ft (1 to 3m) thick.

Qpy — **Younger piedmont-slope alluvium**—Sand, gravel and silt of shallow drainageways, alluvial fans, and erosion surface veneers that is inset below or overlies older (**Qpo**) deposits. As much as 10ft (3m) thick.

Qpo — **Older piedmont-slope alluvium**—Sand, gravel, silt and silty clay of alluvial fans, erosion surface veneers and basin floors that is inset below or overlies the Cuchillo surface. Stage II-III soil carbonate is typically well developed in the upper part of the deposits. As much as 25ft (8m) thick.

Undifferentiated Qpy and Qpo

Qpa — **Palomas Formation, upper part**—Brown to reddish-brown conglomerate and gravel, consisting largely of cobbles and pebbles of Paleozoic limestone, Abo Sandstone, second-cycle clasts from Cretaceous formations, and basalt. Also locally contains discontinuous beds of cross-bedded sand or sandstone. Unit is remnant of thin, widespread alluvial fans and pediment veneers derived mainly from the Fra Cristobal range and, on the east edge of the map, from the San Andres Mountains. Stage IV pedogenic carbonate marks the upper part of the unit, directly beneath the Cuchillo surface. As much as 20ft (6m) thick.

Qpg

Tertiary

Tb — **Basalt**—Flows and cinder cones of black to dark-gray vesicular to scoriaceous basalt locally containing abundant mantle and crustal xenoliths. As much as 100ft (30m) thick.

Tbc

Tp — **Palomas Formation, lower part**—Tan sandstone and pebbly sandstone containing angular clasts derived from the McRae and Crevasse Canyon Formations. Cross-bedding and cut and fill structures are common within the unit as are multiple paleosols. Stage IV pedogenic carbonate is present at the top of the unit, beneath basalt flows (**Tb**). Zero to 60ft (18m) thick, thickening westward.

Tpp — **Palm Park Formation**—Pale- purple-gray lahar breccia containing clasts of intermediate-composition volcanic rocks; exposed only along the road east of Engle and in a barrow pit south of Engle. A thickness of 5ft (1.5m) is exposed.

Tlr — **Love Ranch Formation**—Basal-boulder conglomerate, consisting of intermediate-composition porphyries, overlain by red siltstone and mudstone, containing conglomerate beds with abundant Abo, as well as intermediate-composition volcanic clasts. Approximate thickness may be 500ft (152m).

Cretaceous

Kmh — **McRae Formation, Hall Lake Member**—Conspicuous purple shale containing interbedded lenticular pebbly, lithofeldspathic, cross-bedded sandstone and, in the lower part, pebble-cobble conglomerate. Clasts include Precambrian granite and quartzite as well as intermediate-composition porphyrys. Local zones of calcic nodules are paleosols. Dinosaur bones and petrified wood are present. At least 770ft (234m) thick.

Kmj — **McRae Formation, Jose Creek Member**—Interbedded olive gray shale, brown, cross-bedded, lithofeldspathic, pebbly sandstone and thin, well-indurated volcanic ash beds. Near the top are one or more purple, bedded chert units as much as 1ft (0. 3m) thick. Pebble and cobble clasts are intermediate-composition porphyries. Dinosaur bones, plant fossils, and petrified wood are present. As much as 558ft (170m) thick.

Kca — **Crevasse Canyon Formation, Ash Canyon Member**—Predominantly tan, medium-grained, cross-bedded, lithofeldspathic sandstone interbedded with lesser amounts of olive-gray mudstone. Chert-pebble conglomerate lenses within sandstone beds are present locally, especially near the top of the unit. Local petrified wood. Approximately 1,200ft (365m) thick.

Kcl — **Crevasse Canyon Formation**—Brown to tan to greenish-brown, fine- to medium-grained, lithofeldspathic sandstone in channel-shaped and lenticular beds, intercalated with olive-gray shale and mudstone. At least 830ft (153m) thick.

Kgd — **Gallup Sandstone and D-Cross Member of Mancos Shale, undifferentiated**—Tan, massive sandstone containing thin beds of pelecypod coquina and gray, fissile marine shale. Base not exposed. At least 100ft (30m) thick.

Mzu-Pzu — **Mesozoic-Paleozoic, undifferentiated**—Cross-sections only.

Map Symbols

Geologic contact–solid where exposed or well-known, dashed where approximately known.

Normal fault–solid where exposed, dashed were approximately known, dotted where concealed. Queried where uncertain. Bar-ball on down-thrown side.

Strike-slip fault–arrows show direction of movement. Dashed were approximately known.

Syncline—showing direction of pluge. Dashed where approximately known, dotted where buried.

Anticline—showing direction of pluge. Dashed where approximately known, dotted where buried.

Strike and dip of bedding.

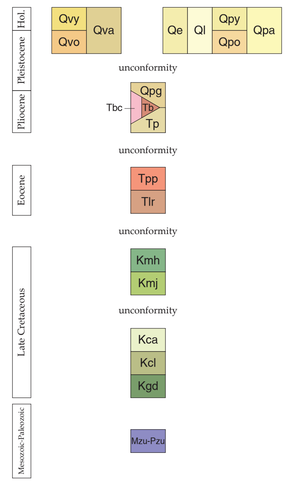
Horizontal bedding

JDC#1 — Well name and location
JDC#1—T.D. 500ft mostly in Palm Park Fm.
JDC#3—T.D. 300ft mostly in Palm Park Fm.; lowest 30ft maybe rhyolite
TAC#2—T.D. 500ft; upper 60ft (Qpg); lower 440ft in Palm Park Fm.

A — A' Location of geologic cross section

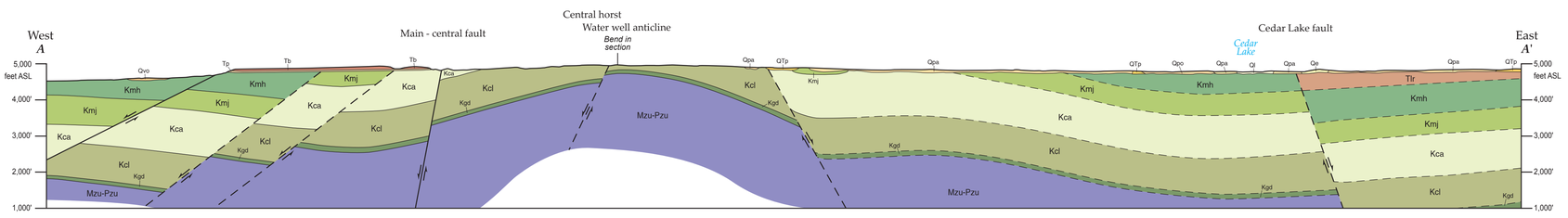
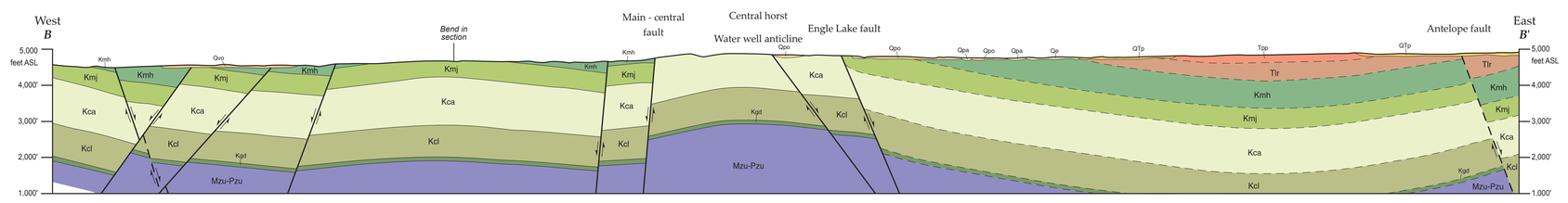
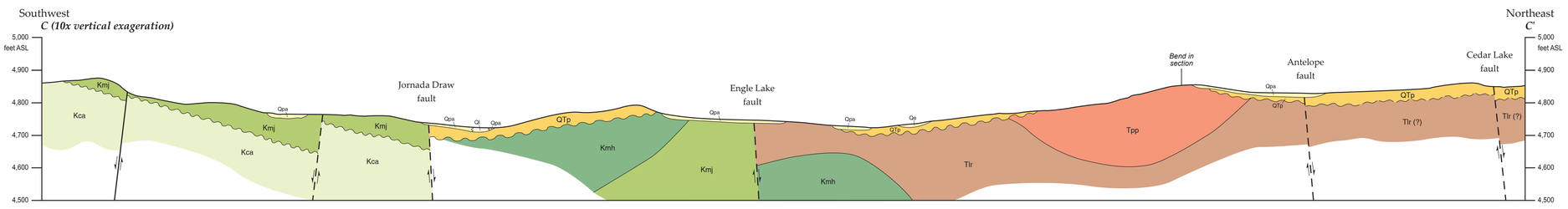
Cuchillo Surface—Upper beds are constructional top of Qpg: Palomas Formation; stage IV–V soil carbonate is well developed; the surface is also locally pediment on bedrock units.

Correlation Diagram



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.