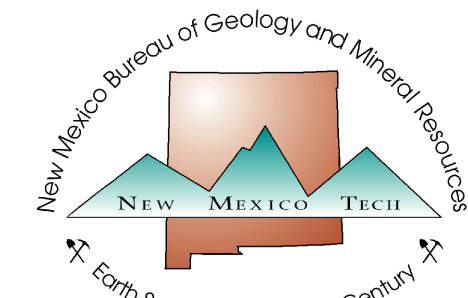


Base map from U.S. Geological Survey 1957, from photographs taken 1955, field checked in 1957.
1927 North American datum. Polygraphic projection. Reprojected to UTM projection – zone 13N
1000-meter Universal Transverse Mercator grid, zone 13, shown in red

QUADRANGLE LOCATION

This draft geologic map is preliminary and will undergo revision. It was produced from either scans of hand-drafted originals or from digitally drafted original maps and figures using a wide variety of software, and is currently in cartographic production. 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 quadrangles are located, and it is the bureau's policy to disseminate geologic data to the public as soon as possible.

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 supersede this preliminary open-file geologic map.



Geologic map of the Mount Taylor quadrangle, Cibola County, New Mexico

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by
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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quadrangle map may be based on any of the following reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation.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 Units

These are mainly the field descriptions used during mapping with a few descriptions from Lipman et al. (1979). Cretaceous descriptions and a few volcanic descriptions are from the Lobo Springs Quail Golf et al. (2008)

QUATERNARY

- Qal** Alluvium—Deposits of sand, gravel and silt in main valley bottoms; locally includes stream terraces, alluvial fans, and canyon wall colluvium; Late Holocene in age; maximum thickness of various alluvium deposits is uncertain but may exceed 10 m. Alluvium in canyon bottoms and along major drainages is typically coarse-grained, cobble to boulder size sandy gravel of mixed volcanic lithologies and subordinate sandstone clasts. Alluvium in embayments adjacent to main drainages is typically finer-grained, silt and sand dominated deposits with pebble-gravel lenses and minor interbedded gravel beds. Valley floor alluvium and low terrace deposits are characterized by weakly-developed soils with 10YR2-3 color, none to minimal carbonate accumulation, and lack of Bt horizon development. Locally includes small areas of colluvium, terrace and fan deposits to small map separately.
- Qa** Alluvium—flat areas of upland alluvium not associated with any obvious valley or piedmont slopes. Usually fine grained and perhaps of eolian origin.
- Q4** Alluvium underlying Q4 terrace surfaces—Deposits of sandy pebble to boulder size gravel underlying terrace surfaces located approximately 3 to 5 m above local base level. Deposit thickness ranges from 2 to greater than 6 m. Soils developed in deposits underlying Q4 surfaces are weakly developed, with 10YR color, minimal horizon development, none to minimal carbonate accumulation, and lack of Bt horizon development (Table 1). Late Holocene in age.
- Q3** Alluvium underlying Q3 terrace surfaces—Deposits of sandy pebble to boulder size gravel underlying terrace surfaces located approximately 7 m above local base level. Typically forms fill terraces with deposit thickness of 7 m or more. Poorly preserved, soil properties not described.
- Q2** Alluvium underlying Q2 terrace surfaces—Deposits of sandy pebble to boulder size gravel underlying terrace surfaces located 12 to 18 m above local base level. Deposit thickness ranges from 4 to 10 m or more. Where preserved, soils are well developed, exhibit Stage II to III carbonate morphology, Bt horizon, with 5YR color. Likely middle to late Pleistocene in age.
- Q1** Alluvium underlying Q1 terrace surfaces—Deposits of sandy cobble to boulder size gravel underlying terrace surfaces located approximately 35 to 40 m above local base level. Deposit thickness ranges with deposit thickness ranging from 6 to 8 m or more. Soils are stripped (eroded). Early Pleistocene?
- Qf** Young Alluvial fans—Typically fan-shaped deposits of coarse bouldery gravel and sand, silt, and clay that emanate from tributary drainages along axis of major drainages. Grades into alluvial deposits along main channels; probable late Holocene age; maximum exposed thickness about 10 m.
- Q4** Deposits underlying Q4 fan surfaces—Part of fan complex at the mouth of Water, Timber, and Castillo Canyons. Q4 surfaces form part of the modern piedmont. Deposits of fine sand to coarse gravel, typically interbedded fine to medium sand and imbricated cobble-to-boulder-size gravel with individual gravel beds 3 m thick. Q4 deposits often bury Q3 deposits and include buried soils (Figure 1). Total thickness 3 to 10 m or more. Where present, Q3 buried soils are 1 to 5 m below the Q4 surface. Q4 soils are characterized by A-Bw-C or A-Bk-C profiles with maximum Stage I carbonate morphology (Table 1), locally include buried A horizons. Middle to late Holocene.
- Q3** Deposits underlying Q3 fan surfaces—Part of fan complex at the mouth of Water, Timber, and Castillo Canyons. Q3 surfaces form part of the modern piedmont. Deposits of sandy pebble to boulder gravel of mixed volcanic lithologies and subordinate sandstone clasts greater than 3 m thick; base of deposit poorly exposed. Soils are partially eroded, but exhibit Stage II to III carbonate morphology, Bt horizon with 5YR to 7.5YR color (Figure 2, Table 1). Likely middle Pleistocene?
- Q2** Q2 Deposits underlying Q2 fan surfaces—Deposits of subrounded to subangular sandy pebble to boulder gravel underlying remnant fan surfaces at mouth of Timber and Castillo canyons. Deposit is 10 to 15 m or more thick. Q2 fan surfaces are 10 to 12 m above local base level. Soils are stripped, however, clasts eroding from deposit exhibit continuous carbonate coatings. Early to middle Pleistocene?
- Q1** Deposits underlying Q1 fan surfaces—Deposits of subrounded to subangular sandy pebble to boulder gravel underlying remnant fan surfaces at mouth of Castillo Canyon. Deposit is 5 to 10 m thick, with upper 2 m comprising basal boulder gravel. Q1 fan surfaces are 15 to 20 m above local base level. Soils are stripped, however, clasts eroding from deposit exhibit continuous carbonate coatings. Early Pleistocene?
- Qc** Colluvium—Poorly sorted slope wash and mass wasting deposits from local sources; mapped only where extensive or where covering critical relations; thickness can locally exceed 15 m. Locally buries terrace surfaces and underlying alluvium along the sides of narrow canyons, including Water, Timber, and Seco canyons.
- Qb** Landslides—Poorly sorted debris that has moved chaotically down steep slopes; slumps or block slides (torva blocks) partially to completely intact, that have moved down slope; slumps and block slides usually display some rotation relative to their failure plane; thickness varies considerably depending on the size and nature of the landslide.
- Qtc** Talus/Colluvium—Slope wash, talus, coarse colluvium, and landslide material where morphology not obvious.

TERTIARY

Basaltic Rocks

- Tub** Upper Basalt (Lipman)—Fine grained dense alkalic basalt and basaltic scoria (Tubc). Sometimes has scattered pyroxene phenocrysts 1 to 1 cm. Several local vent areas, marked by scoria cones, occur around the southern lower flank of Mt. Taylor present in this map area. One scoria cone contains intrusive areas (Tubi). Locally contains interlayers of similar lithology to TPs. These have been observed in a few areas to be gradational in contact and not intercalated flows.
- Toth** Older trachybasalt—Black to dark gray, fine-grained basalt and red to black
- Totc** cinder deposits (Tots) having sparse olivine and plagioclase phenocrysts in interstitial groundmass containing microphenocrysts of plagioclase, augite, olivine, opaque oxides and glass. Some flows have rare orthopyroxene microphenocrysts. Some flows have tiny (<1 mm) ovoid patches very rich in glass and opaque oxides. All flows may have rare quartz xenocrysts. Eroded cone on east side of Rinconada Basin has NNE-trending dike and fissure. Eroded cone on SE side of Horace Mesa contains NE-trending feeder dike.
- Tbta** Pyroxene basaltic trachyandesite—Gray, fine-grained flow and red to black cinder deposits (Tbtcc) containing conspicuous, large (>1.5 cm), resorbed, very dark green clinopyroxene megacrysts (Lipman et al., 1979). Phenocrysts consist of plagioclase, olivine, clinopyroxene, and orthopyroxene in an interstitial groundmass containing plagioclase, olivine, clinopyroxene, opaque oxides, and glass. Many specimens contain quartz xenocrysts. Eroded cinder cone is located west Mt. Taylor quadrangle and contains rare blocks of fine- to medium-grained olivine-pyroxene gabbro. Underlies Tvs but overlies Toth, Tq1a, Upper Cretaceous Dalton Sandstone (Kcd) and the Mulatto Member of the Mancos Shale (Kmm). Unit is not dated. Maximum exposed thickness is about 80 m.
- Tvs** Volcaniclastic sedimentary rocks—Gray to tan to white debris flows, fluvial deposits and interbedded tufts shed from the Mount Taylor stratovolcano during growth. Boulders form a lag deposit on surface of debris flows to the extent that the true mix of facies is usually unknown. Fluvial component contains rounded to subrounded cobbles including a higher proportion of basaltic clasts, especially to SW. Tufts consist mostly of thin beds and lenses of fall deposits with vesiculated pumice having phenocrysts of plagioclase, clinopyroxene ± hornblende ± biotite. Unit is interbedded with practically all lavas on southwest side of Mount Taylor and Horace Mesa. Overlies pyroxene basaltic trachyandesite (Tbta) east of Rinconada Basin and basaltite (Tbb). Maximum exposed thickness is >200 m.
- Tpb** Plagioclase basalt—Distinctive flows of coarsely porphyritic basalt, containing 10-20 percent phenocrysts of plagioclase in tablets as much as 2 cm in diameter and sparse smaller phenocrysts of olivine and pyroxene. Usually interbedded in Tvs. Probably erupted from one or more vent areas near the top of Mount Taylor.
- Tvt** Tufts and tuffaceous sediments—Tan to white ash flow tufts, tephra, pumice falls, sandstones, conglomerates located below Tpb or stratigraphic equivalent. Where well exposed along Water Canyon ash flow and tephra deposits are common, perhaps dominant in this interval.
- Tbi** Basaltic intrusions—Dark gray to black fine grained intrusive equivalents of Tub or other extrusive lavas.

Porphyritic Intermediate Lavas

- Tp1a** Porphyritic Intrusive Rocks—subdivided based on phenocryst mineralogy, in particular presence of hornblende and biotite. Mapped as Tp1a where exposure or time prevented separation.
- Tta** Trachyandesite, undivided—Multiple flows of gray to blue-gray, porphyritic lavas that originate from near the summit of Mount Taylor. Phenocrysts consist of resorbed plagioclase, potassium feldspar, oxidized clinopyroxene, hypersthene, sparse biotite, sparse oxidized hornblende, and magnetite in a plagioclase groundmass containing microphenocrysts of plagioclase, clinopyroxene, apatite, opaque oxides, and devitrified glass. May contain rare, small (<5 mm) hornblende megacrysts. Some specimens show minor Fe-oxide alteration. Overlies small flow of Tpb and flows of hornblende trachyandesite (Tbt). Interbedded with volcaniclastic sedimentary deposits (Tvs). Underlies flow of Tfb on upper north side of Rinconada Canyon. Flow near summit of Mount Taylor is dated at 2.60 ± 0.05 Ma (Perry et al., 1990). Exposed thickness is ~215 m.
- Tp1d** Trachydicite to Trachyandesite lavas—Gray to tan moderately porphyritic rocks with phenocryst assemblage coarse phenocrysts dominated by plagioclase with no obvious biotite or hornblende and little visible pyroxene. Often also contain hornblende. Usually more porphyritic and lighter colored than Tta or Tpb.
- Tb1d** Biotite bearing Trachydicite—Tan to gray rocks with abundant plagioclase phenocrysts and visible biotite. Often also contain hornblende. Usually more porphyritic and lighter colored than Tta or Tpb.
- Tp1td** porphyritic hornblende trachydicite—Pale gray to tan, massive to sheeted porphyritic lava with conspicuous large (<1 cm) phenocrysts of plagioclase, some with apparent rapakivi texture. Additional phenocrysts are hornblende and clinopyroxene. Equivalent to porphyry of San Jose Canyon (Lipman et al., 1979). Intrudes Tba and Tq1a on SW edge of Mount Taylor quadrangle. Unit is not dated. Thickness of poorly exposed flow on SE edge of Lobo Springs quadrangle is about 20m.

- Trt** Bedded tuff deposits. Underlie Tpb1d at one locality along western edge of quadrangle. Mostly light colored medium to fine pumice fall deposits in this exposure.
- Tcp1d** Tq1 of Lobo Springs—Coarse porphyritic trachydicite—Pale pink to tan, very coarse porphyritic lava containing large (< 3 cm) phenocrysts of potassium feldspar. Unit superficially looks like granite and makes a distinctive fine gravely soil. Smaller phenocrysts consist of magnetite, potassium feldspar, plagioclase, oxidized clinopyroxene, and apatite in a hyalopititic groundmass of tiny feldted plagioclase, potassium feldspar, clinopyroxene, opaque oxides and devitrified glass. Unit shows minor Fe-oxide alteration. Unit underlies T1a and probably that in extreme NE corner of quadrangle. Relations with other units in Mount Taylor stratovolcano are unclear. Unit is not dated. Maximum observed thickness is about 80 m.
- Tel** Enclave rich Trachydicite to trachyandesite—gray to brown rocks containing plagioclase, hornblende phenocrysts but also containing abundant (nearly every hand sample) enclaves of more mafic rocks or magmas.
- Tder** porphyritic mixed lava—Distinctive bulbous flow or intrusion on southwest side of Mt Taylor cone. Dark gray to black rock which contains abundant porphyritic enclaves of more mafic rocks or magmas. Similar to T1d but enclaves are very abundant in every sample.
- Tdo** Older Dacite—light gray to white moderately porphyritic rock containing feldspar, hornblende and biotite. Often has a distinctive blocky textured plagioclase. May be more mafic component of Tr dome or a separate dome or intrusion.
- Tr** Rhyolite flow or dome. Light gray to white rocks containing 10 to 20 percent quartz, potassium feldspar and biotite phenocrysts. Sugary texture near margins and in western exposure but more altered and denser to east. Center of exposure are coarser grained, lack quartz and have a distinctively porphyritic texture (Tcd). Exposures are very poor in general. Occurs in core of Mount Taylor cone and forms the first volcanic unit that can be observed in the volcanic sequence.
- Tt** trachyte—fine grained dark lava. Few recognizable phenocrysts.
- Tbo** basaltic lavas—Dark gray to black basalts, usually altered. These flows occur in the center of the Mt Taylor crater area and are some of the earliest rocks from this vent area.
- Tbb** Basaltic lava. Single flow of dark gray to black basaltic lavas. Contains a few obvious phenocrysts of olivine. Underlies Tpb and overlies Tbb in Southeastern portion of the quadrangle. Flow decreases in elevation northward and may have been erupted to the south flowing north before Mt. Taylor became an edifice.
- Tbh** Hawaiiite lava—medium gray mafic lavas. Shown on weathered broken surface. Occur beneath the basaltic lavas in southeastern portion of quadrangle.

Intrusions

- Tb1b** Trachydicite intrusions—Gray to pink rocks containing 15 to 20 phenocrysts of plagioclase, hornblende and biotite. Most common around the center of Mt Taylor.
- Tbi** Trachydicite to Trachyandesite intrusions—Gray rocks containing obvious plagioclase and hornblende phenocrysts but not biotite

CRETACEOUS

Crevasse Canyon Formation

- Kcg** (Kgi) Gibson Coal Member—Interbedded black to brown siltstone, thin to medium bedded tan, golden-yellow, brown, and greenish gray sandstone, and black coal. The sandstones are composed of well to moderately sorted, very fine- to medium-grained angular to subrounded quartz grains with < 10% mafic minerals and < 1% clay (titillareite). The sandstone beds are cross-bedded, ranging from trough cross-beds to large-scale, low amplitude planar cross beds. Ripple marks are locally preserved. Mud clast conglomerates frequently occur at the base of the sandy intervals. Bioturbation is rare. Elliptical to spherical spherulite to goethite concretions with calcite (or more rarely, barite) fill fractures and are present throughout the unit (Figure 10). Perforated wood fragments are common, logs up to 10 cm in diameter and 0.5 m long are locally preserved (Figure 11). The coal beds are generally < 0.5 m thick. A volcanic ash bed that is 2 to 4 cm thick is interbedded with coal at UTM coordinates 254819 3901134 (NAD27)(Figure 12). The lower contact is gradational with the underlying Dalton Sandstone Member; the top is not exposed. Maximum exposed thickness is roughly 350 m.

- Kcd** (Kd) Dalton Sandstone Member—Forms two prominent cliffs, a lower yellowish-orange cliff and an upper white cliff (with an intervening short slope (doublet)). The basal sandstone near the contact with the underlying Mulatto Tongue of the Mancos Shale often has thin beds containing abundant pelecypod casts and molds. The carbonate-cemented basal sandstone is composed of well-sorted, very fine-grained angular quartz grains with < 5% mafic minerals and < 1% clay. The weakly cemented upper sandstone consists of well sorted, fine-grained, angular to subrounded quartz grains with < 1% lithics and 7 to 10% feldspar. The upper and lower contacts are gradational with the overlying Gibson Coal Member of the Crevasse Canyon Formation and the underlying Mulatto Tongue of the Mancos Shale. Maximum exposed thickness is <25 m.

- Kcs** (Ks, Kst) Stray Sandstone Member—Forms two prominent reddish-orange cliffs with an intervening short slope (doublet). On a fresh surface, this medium-bedded, planar cross-bedded sandstone is white to yellowish gray. This sandstone is composed of well to moderately sorted, very fine- to medium-grained angular quartz grains with < 1% mafic minerals and < 1% clay. The top of the Stray Sandstone is a thin (<1 m) conglomerate with pebbles to cobbles of quartzite, chert, and quartz. The upper and lower contacts are gradational with the overlying Mulatto Tongue of the Mancos Shale and the underlying Dilco Coal Member of the Crevasse Canyon Formation. Maximum exposed thickness is <40 m.

- Kcdc** (Kd) Dilco Coal Member—Interbedded black to brown siltstone, thin to medium bedded tan, brown, and olive-green sandstone, and black coal. The sandstones are composed of well to moderately sorted, very fine- to fine-grained angular quartz grains with < 5% mafic minerals, 1 to 5% muscovite, and 1-5% potassium feldspar altered to clay. The sandstones are cross-bedded to ripple laminated. Elliptical to spherical fractured spherulite to goethite concretions, with calcite (or more rarely, barite) filling the fractures are present throughout the unit. The coal beds are < 0.5 m thick and are usually in the lower part of the unit. The upper and lower contacts are gradational with the overlying Stray Sandstone of the Crevasse Canyon Formation and the underlying main body of the Gallup Sandstone. Maximum exposed thickness is <150 m.

Gallup Sandstone

- Kgm** Main body—Yellowish gray, white, or golden yellow, medium to thick-bedded, cross-bedded sandstone. The sandstone consists of moderately sorted, fine to very fine-grained angular to subrounded quartz grains with < 5% mafic minerals, 1 to 2% muscovite, plant debris, and potassium feldspar altered to clay (10 to 30%). Often the sandstone beds are bioturbated with ~10-cm diameter cylindrical, vertically oriented burrows. Carbonaceous shale is intercalated with the sandstone. Locally contains fossiliferous (nonconformable) beds near the top. Faint, very low angle trough cross beds occur locally in sets less than 0.25 m thick, with azimuth of 010° (northerly flow). Beds are primarily planar-tabular or laminated. The lower contact is gradational with Mancos Shale and the upper contact is gradational with the Dilco Coal Member of the Crevasse Canyon

- Kgu** Upper tongue—White medium-bedded, cross-bedded to tabular sandstone that is locally capped by well-cemented, fractured, brown-weathering, planar crossbedded sandstone. The brown sandstone is carbonate cemented, the weakly cemented white sandstone does not react to hydrochloric acid. The sandstone consists of well-sorted, fine-grained angular quartz grains with < 5% mafic minerals and potassium feldspar altered to clay (15 to 25%). The white arkose sandstone has no muscovite, but the brown capping sandstone has trace amounts of muscovite and biotite. Trough cross beds occur in sets less than 0.5 m thick and have azimuths of 025° (northeastern flow direction). Cross beds are moderately steeper than those in unit Kgi (described below). Local internal scour surfaces are present. Hematitic concretions and stained surfaces occur throughout unit. The upper and lower contacts are gradational with Mancos Shale. Maximum exposed thickness is <30 m.

- Kgl** Lower tongue—White medium-bedded, cross-bedded to tabular sandstone that is locally capped by well-cemented, fractured, brown-weathering, planar crossbedded sandstone. Brown sandstone is carbonate cemented, the weakly cemented white sandstone does not react to hydrochloric acid. The sandstone is composed of well to moderately sorted, fine to very fine-grained angular quartz grains with < 5% mafic minerals and potassium feldspar altered to clay (10 to 15%). The white subarkose sandstone has no muscovite, but the brown capping sandstone has trace amounts of muscovite. Cross bed sets are 0.5 meters thick, low angle trough cross beds, with azimuths of 150° (southeastern flow direction). The top of unit is locally conglomeratic with sandstone clasts and shark teeth. The upper and lower contacts are gradational with Mancos Shale. Maximum exposed thickness is <15 m.

Mancos Shale

- Kmm** Mulatto Tongue—Golden yellow, thin-bedded, tabular to ripple-laminated sandstone and black shale. Burrows and scattered pelecypod molds are common in the sandstone beds. Moderately to well sorted, very fine-grained angular to very well-rounded quartz grains with < 1% mafic minerals, ~1% muscovite, and abundant clay (~30%). Coarse to very coarse sandstone beds near the basal contact with the Stray Sandstone and lenses of conglomerate with well-rounded pebbles of black and white chert and black quartzite are locally present. Upper and lower contacts are gradational with the Dalton and Stray Sandstone members of the Crevasse Canyon Formation. Maximum exposed thickness is <50 m.
- Km** Main body—Black to dark brown shale and silty shale intercalated with finely laminated to cross-bedded thinly bedded sandstone. The sandstones are well-sorted, fine-grained quartz arenites. Upper and lower contacts are gradational. Small tongues of Mancos Sandstone are interbedded within the Gallup Sandstone units. Maximum exposed thickness of Main Mancos beneath Gallup Sandstone is <50 m. Maximum drilled thickness including Bridge Creek Limestone (described below) is roughly 145 m (Table 2).

- Kmb** Bridge Creek Limestone—Finely laminated, fossiliferous, light gray limestone interbedded with thin black shale below the Main body of the Mancos Shale. Identified only in narrow north or east side of exposed core of San Fidel dome where it overlies Townells Sandstone; in fault contact with other units. Correlative with the Greenhorn Limestone. Contains abundant invertebrate fossils including *Pyrodicta* aff. *P. kelli*, *Exogyra* sp., *Plicatula* cf. *P. hydrochaera*, cf. *Caryocorbula* and *Turritella* sp. (Barty Kues, University of New Mexico, personal communication). Unit is moderately homolysed from subsurface magmatic intrusions and displays minor hydrothermal alteration, particularly along fractures and planar zones of permeability. Maximum exposed thickness is <25 m.

K

- Ku** Cretaceous Rocks Undivided or uncategorized. (Kun—undivided sandstone), (Kuh—hornfelsed siltstone and shales)—

