

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map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation.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

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Cross sections are constructed based upon the interpretations of the author made from geologic mapping, and available geophysical, and subsurface (drillhole) data. Crosssections 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.

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Fraser Goff¹, Shari A. Kelley², Kate Zeigler¹, Paul Drakos³, and Cathy J. Goff⁴

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¹ Earth and Planetary Sciences Dept., University of New Mexico, Albuquerque, NM, 87131 ² New Mexico Bureau of Geology and Mineral Resources, 801 Leroy Pl, Socorro, NM, 87801 [°] Glorietta Geoscience, Inc., P.O. Box 5727, Santa Fe, NM, 87502 5515 Quemazon, Los Alamos, NM, 87544



	Alluvium,
Qdi	Disturbed Areas (Historic) – Anthropogenically Ridge; not shown in correlation chart or cross se
Qal	Alluvium (Quaternary) —Deposits of sand, grav canyon with 10YR color, none to Stage I carbona maximum thickness of various alluvium deposit
Qt ₃	Alluvium underlying Qt ³ terrace surfaces (Quat approximately 5 to 15 m above local base level; <i>Qt</i> ³ least 14 m.
Qt ₂	Alluvium underlying Qt2 terrace surfaces (Quat located 20 to 30 m above local base level in Rinco morphology, Bt Qt2 deposits in Lobo Canyon loc
Qt ₁	Alluvium underlying Qt1 terrace surfaces (Q oxidized quartz lithic sand underlying terrace su are partially eroded, exhibit from 2 to 10 m or more
Qc	Colluvium (Quaternary) —Poorly sorted slope or where covering critical relations; thickness ca
Qls	Landslide deposits (Quaternary) —Poorly sort partially to completely intact, that have moved relative to their failure plane; ages vary from H size and nature of the landslide.
Qes	Eolian deposits (Quaternary) —characterized by Pleistocene eolian deposit approximately 1 soil i color. Aggregate thickness of unit is \leq 2.2 m.
Qafy	Younger alluvial fan deposits (Quaternary) —n than a few meters; grades into alluvial deposits 15 m.
Qafo	Older alluvial fan deposits (Quaternary)—high
QTg	Older gravels (Pliocene-Early Pleistocene) —Sr that form a lag deposit on Cretaceous sediment possibly correlate with terrace deposit Qt ₁ . Thick
QTtr	Travertine (Pliocene-Early Pleistocene) —Two carbonate) Shale south of Devil Canyon dome i in length and strikes 15°; overlies a fault juxtapo



		Last Modified April 2015
enocrysts of olivine, plagioclase, and ccur in central Horace Mesa. Source w not dated. Maximum thickness is	+ + + + + + Tgro + + + + +	Rhyolite of Grants Ridge —Light gray to white, sparsely porphyritic lava containing phenocrysts of potassium feldspar plagioclase, and very rare quartz. Microphenocrysts consist of potassium feldspar, plagioclase, biotite and quartz. Texture massive to flow banded. Some zones are spherulitic; others contain mariolitic cavities with quartz, alkali feldspar, hematite, garne and topaz. The north lower flank of the dome contains a zone rich in sparsely porphyritic obsidian. Overlies Tgrt, Kcg, and Kc Unit is dated at 3.34 ± 0.16 Ma from unknown location (Lipman and Mehnert, 1979). Maximum exposed thickness is >100 m.
ed to black cinder deposits (<i>Tymtc</i>) Init consists of cinder cone complex is thin hydromagmatic beds (<i>Tymth</i>) e is intersertal to slightly trachytic. vine shows considerable iddingsite hway 457 just north of quadrangle 06 Ma. Thickness of flows is <60 m.	Tgrt	Rhyolite Tuff of Grants Ridge —White to pale pink, bedded pyroclastic fall, flow and surge deposits; some beds have abunda aphyric obsidian clasts. Most lithics consist of pink to gray Precambrian granite and gneiss, chert, sandstone, limestone and ra basanite. Pumice clasts are glassy to slightly devitrified with very rare phenocrysts of potassium feldspar. Pyroclastic fall and flow thicken towards and underlie Grants Ridge rhyolite indicating that source of tuff is beneath the rhyolite, although Shackley (199 suggests that the tuff may originate from rhyolite centers deep within Mount Taylor. Underlies a wide variety of units. Overli basanite (<i>Tba</i>), Kcg, and Kcd. Obsidian clasts from upper tuff beds beneath Mesa La Jara have $Ar^{40/39}$ date of 3.26 ± 0.04 M Maximum observed thickness is about 110 m.
the from near the summit of Mount hypersthene, sparse biotite, sparse plagioclase, clinopyroxene, apatite, me specimens show minor Fe-oxide led with volcaniclastic sedimentary hit of Mount Taylor is dated at 2.60 ±	Tba	Basanite —Black to gray, fine-grained lava with tiny microphenocrysts of iddingsitized olivine and sparse magnetite. Texture intergranular; has splotchy, fine, ophitic patches of plagioclase and glass. Groundmass contains abundant fine magnetite plagioclase, titan augite and analcime. Contains ovoid patches of late-stage sodic plagioclase and what appears to laegerine-augite. Cracks and fractures are locally filled with chalcedony and opal. Source vent is not identified but appears to located somewhere beneath Mount Taylor. Underlies Tgrt and Tvs. Overlies Kcg and Kcd. Flow beneath east side of Horace Me is dated at 3.73 ± 0.09 Ma (Perry, et al., 1990). Flow beneath west side of Horace Mesa has $Ar^{40/39}$ date of 3.64 ± 0.15 Ma. Maximu observed thickness is about 40 m.
avas with conspicuous hornblende lar lavas occur elsewhere on Mount etite. Phenocrysts consist of partly		Volcanic dikes and small plugs
sorbed olivine, orthopyroxene, and gioclase, pyroxene, opaque oxides, oxene jackets over orthopyroxene. e (<i>Tba</i>). Flow in northeastern part of 13 age of 2.60 \pm 0.10 Ma.	Tpd	Picrite —Splotchy, yellow and black, porphyritic, 1-m-wide dike with >20% olivine phenocrysts. Also contains minor augite ar sparse, resorbed plagioclase phenocrysts in an intergranular groundmass of olivine, augite, plagioclase, opaque oxides ar devitrified glass. Olivine and pyroxene are altered to clay-chlorite-serpentine (bowlingite); amygdules are filled wi calcite-chalcedony-clay; fractures contain Feoxides. Dike trends nearly E-W and is located just west of San Fidel dome, possib predating the dome but dike is not dated.
lavas having conspicuous enclaves lagioclase, oxidized hornblende and	Ttbd	Trachybasalt —Black fine_grained dikes with microphenocrysts of olivine, augite, and plagioclase. Olivine is common iddingsitized. Some dikes contain abundant quartz xenocrysts. They commonly intrude a variety of Cretaceous rocks, are general <1 m wide and trend NE, but none are dated.
opaque oxides, minor clinopyroxene ite, and vesiculated glass. Source of int Taylor quadrangle. Underlies Tta 00 m.	Tgi	Gabbro intrusive —Dark gray, fine-grained, allotriomorphic-granular gabbro consisting of black clinopyroxene, pale gray to whi plagioclase, and minor altered olivine. Forms small, circular intrusive body 50 m in diameter on isolated hill west of Rinconae Canyon. Resembles rare, fine-grained gabbro blocks near base of cinder cone deposits associated with unit Tptb.
bedded tuffs shed from the Mount d consists primarily of boulders and lers form a lag deposit on surface of ortion of basaltic clasts, especially to having phenocrysts of plagioclase,	Ttcbd	Clinopyroxene Trachybasalt —Gray, fine-grained, 1-m-wide dike and a small, 30-m-wide plug with megacrysts of dark gree clinopyroxene. Contains small phenocrysts of clinopyroxene and plagioclase in an intersertal to slightly trachytic groundmass plagioclase, clinopyroxene, opaque oxides, and devitrified glass. Contains small, resorbed xenocrysts of quartz and tiny ovoid clo of alkali feldspar opaque oxides and glass. Dike trends nearly E-W cutting prominent N-S-trending fold in Cretaceous rocks in N part of quadrangle. Plug is found in eastern part of Coal Mine Basin. Dike and plug are not dated.
st side of Mount Taylor and Horace (<i>Tbta</i>) east of Rinconada Basin, tuff	Ttdd	Trachydacite —Pale tan to gray, fine-grained, lava with very sparse, small phenocrysts of plagioclase. Forms small, E-W-trendin plug-like body surrounded by Qal in SW part of quadrangle. Unit is not dated.
ng light gray to tan pumice with arse hornblende. Texture is glassy.		MESOZOIC
here pyroclastic flow 3 m thick is $.71 \pm 0.06$ Ma. Most outcrops consist thick Purples close or comparely a		Cretaceous Crevasse Canyon Formation
of Tvs. Overlies tuff of Grant's Ridge	Kcg	Gibson Coal Member —Interbedded black to brown siltstone, thin to medium bedded tan, golden-yellow, brown, and greening gray sandstone, and black coal. The sandstones are composed of well to moderately sorted, very fine- to medium-grained angul to subrounded quartz grains with < 10% mafic minerals and <1% clay (litharenite). 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 cla
ar, intersertal to diktytaxitic. Larger ivine in a groundmass containing Sources unknown but appear to be lacite (<i>Ttd</i>) and biotite-hornblende drangle has $Ar^{40/39}$ date of 2.76 ± 0.06		conglomerates frequently occur at the base of the sandy intervals. Bioturbation is rare. Elliptical to spherical fractured siderite goethite concretions with calcite (or more rarely, barite) fill fractures and are present throughout the unit. Petrified wood fragmer are common; logs up to 10 cm in diameter and 0.5 m long are locally preserved. The coal beds are generally < 0.5 m thick. A volcar ash bed that is 2 to 4 cm thick is interbedded with coal at UTM coordinates 254819 3901134 (NAD27). The lower contact gradational with the underlying Dalton Sandstone Member; the top is not exposed. Maximum exposed thickness is roughly 350
d biotite phenocrysts. Underlies Tvs lated at 2.64 ± 0.08 Ma (Perry, et al.,	Kcd	Dalton Sandstone Member —Forms two prominent cliffs, a lower yellowish- orange cliff and an upper white cliff with a intervening short slope (doublet). The basal sandstone near the contact with the underlying Mulatto Tongue of the Mancos Sha often has thin beds containing abundant pelecypods casts and molds. The carbonate-cemented basal sandstone is composed well-sorted, very fine-grained angular quartz grains with < 5% mafic minerals and <1% clay. The weakly cemented upper sandstone concists of well sorted fine grained angular to subrounded quartz grains with < 1% lithics and 7 to 10% feldener. The upper and
er deposits (Tatc) having rare small ut 3 m wide trends E to NE from the consist of plagioclase, olivine, augite		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. Stray Sandstone Member —Forms two prominent reddish-orange cliffs with an intervening short slope (doublet). On a free
bout 30 m. Aning small phenocrysts of olivine, Qal on south side of central Horace vel from unit Tvs and angular clasts	Kcs	surface, this medium-bedded, planar cross- bedded sandstone is white to yellowish gray. This sandstone is composed of well moderately sorted, very fine- to medium-grained angular quartz grains with < 1% mafic minerals and <1% clay. The top of the Stra Sandstone is a thin (<1 m) conglomerate with pebbles to cobbles of quartzite, chert, and quartz. The upper and lower contacts a gradational with the overlying Mulatto Tongue of the Mancos Shale and the underlying Dilco Coal Member of the Crevas Canyon Formation. Maximum exposed thickness is ≤40 m.
rlie Tgrt on SE side of Horace Mesa. tic lava containing phenocrysts of chytic groundmass containing tiny, Contains rare quartz xenocrysts or onada Canyon has Ar ^{40/39} date of 3.26	Kcdc	Dilco Coal Member —Interbedded black to brown siltstone, thin to medium bedded tan, brown, and olive-green sandstone, are 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 ripp laminated. Elliptical to spherical fractured siderite to goethite concretions, with calcite (or more rarely, barite) filling the fracture 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 low contacts are gradational with the overlying Stray Sandstone of the Crevasse Canyon Formation and the underlying main body
e (≤ 3 cm) phenocrysts of potassium		<i>Gallup Sandstone.</i> Maximum exposed thickness is <150 m.
r phenocrysts consist of magnetite, of tiny felted plagioclase, potassium on. Unit underlies Tta and probably cano are unclear. Unit is not dated.	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% muscovit plant debris, and potassium feldspar altered to clay (10 to 30%). Often the sandstone beds are bioturbated with ~1.0 cm diamet cylindrical, vertically oriented burrows. Carbonaceous shale is intercalated with the sandstone. Locally contains fossiliferor (Innocermid) beds near the top. Faint, very low angle trough cross beds occur locally in sets less than 0.25 m thick, with azimuth 010° (northerly flow). Beds are primarily planatabular or laminated. The lower contact is gradational with Mancos Shale and flow
augite, olivine, opaque oxides and void patches very rich in glass and		upper contact is gradational with the Dilco Coal Member of the Crevasse Canyon Formation. Maximum exposed thickness is ≤25 m.
a Basin has NNE-trending dike and pta and Tbhtd in upper Rinconada leposits in SW sector of quadrangle. grt and Tba in upper Lobo Canyon. dated at 3.24 ± 0.09 Ma (Laughlin, et	Kgu	Upper tongue —White medium-bedded, cross-bedded to tabular sandstone that is locally capped by well-cemented, fracture brownweathering, planar crossbedded sandstone. The brown sandstone is carbonate cemented; the weakly cemented whi 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 arkosic sandstone has no muscovite, but the brow capping sandstone has trace amounts of muscovite and biotite. Trough cross beds occur in sets less than 0.5 m thick and has
a with conspicuous large (≤1 cm) re hornblende and clinopyroxene. Vedge of Mount Taylor quadrangle.		azimuths of 025° (northeastern flow direction). Cross beds are moderately steeper than those in unit Kgi (described below). Loc internal scour surfaces are present. Hematitic concretions and stained surfaces occur throughout unit. The upper and low contacts are gradational with Mancos Shale. Maximum exposed thickness is ≤30 m.
rly exposed flow on SE edge of Lobo ining conspicuous, large (≤1.5 cm), plagioclase, olivine, clinopyroxene, e, opaque oxides, and glass. Many steep dip slope to north suggesting est of uplift and contains rare blocks	Kgl	brown weathering, planar cross-bedded sandstone. The brown sandstone is carbonate cemented; the weakly cemented whi sandstone does not react to hydrochloric acid. The sandstone is composed of well to moderately sorted, fine to very fine-graine angular quartz grains with < 5% mafic minerals and potassium feldspar altered to clay (10 to 15%). The white subarkosic sandston has no muscovite, but the brown capping sandstone has trace amounts of muscovite. Cross bed sets are 0.5 meters thick, low ang trough cross beds, with azimuths of 150° (southeastern flow direction). The top of unit is locally conglomeratic with sandston clasts and sharks teeth. The upper and lower contacts are gradational with Mancos Shale. Maximum exposed thickness is \leq 15 m
s $\operatorname{Ar}^{40/39}$ age of 3.10 ± 0.24 Ma. Lava lulatto Member of the Mancos Shale	Kmm	<i>Mancos Shale</i> Mulatto Tongue —Golden yellow, thin-bedded, tabular to ripple-laminated sandstone and black shale. Burrows and scattered
containing abundant large (≤2 cm), of flow is unknown but presumably ckness is about 20 m.		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 blac 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.
ed to rounded clasts of trachybasalt olite, chert, and Precambrian rocks. sed thickness about 25 m.	Km	Main body—Black to dark brown shale and silty shale intercalated with finely laminated to cross-bedded thinly bedded sandstor The sandstones are well-sorted, fine-grained quartz arenites. Upper and lower contacts are gradational. Small tongues of Ma Mancos are interbedded within the Gallup Sandstone units. Maximum exposed thickness of Main Mancos beneath Gallu
posits (<i>Toxtc</i>) with rare cumulate (?) and pyroxene. Phenocrysts consist phenocrysts of plagioclase, olivine, leposits of Totb mostly bury eroded	Kmb	Sandstone is ≤50 m. Maximum drilled thickness including Bridge Creek Limestone (described below) is roughly 145 m. Bridge Creek Limestone—Finely laminated, fossiliferous, light gray limestone interbedded with thin black shale below the Ma body of the Mancos Shale. Identified only in narrow horst on east side of exposed core of San Fidel dome where it overlies Twowe
but 35 m. sits (<i>Tomtc</i>) containing sparse 1 cm letite in an intergranular to trachytic saltered to iddiingsite. Groundmass		sanastone; in fault contact with other units. Correlative with the Greenhorn Limestone. Contains abundant invertebrate foss including <i>Pycnodonte</i> aff. <i>P. kellumi, Exogyra levis, Plicatula</i> cf. <i>P. hydrotheca</i> , cf. <i>Caryocorbula</i> and <i>Turritella</i> sp. (Barry Kues, Universi of New Mexico, personal communication). Unit is moderately hornfelsed from subjacent magmatic intrusions and displays min hydrothermal alteration, particularly along fractures and planer zones of permeability. Maximum exposed thickness is ≤25 m.
tends from NE side of cinder cone.	Kdt	Dakota Formation Two Wells Sandstone —White, well-sorted sandstone with angular grains below the Bridge Creek Limestone exposed in horst of east side of exposed core of San Fidel dome. Some of the sandstone is cherty and displays pink silicic alteration due to provinity
conspicuous olivine and plagioclase e, augite, opaque oxides, and glass. thern part of quadrangle is dated at		subjacent magmatic intrusions; in fault contact with other units. Maximum exposed thickness is 7 m. Maximum drilled thickness ≤60 m but this includes interbedded Mancos Shale beneath the unit. Dakota Formation, undivided (cross sections only) – Alternating sandstones and shales of Dakota Formation and Mancos Shale
	Kd	Very limited exposure in the extreme SW corner of the map forms a thin sandstone doublet and is probably the Twowells Member Maximum exposed thickness locally is about 13 m (see Owen and Owen, Jr., 2003 for further regional detail).

NMBGMR Open-file Geologic Map 181

Morrison Formation, undivided (cross sections only) – Alternating sandstones and shales identified only in drill holes; as defined here includes Jackpile Member, Brushy Basin Member, Salt Wash Member, Recapture Member, and Main Body Bluff Sandstone (see Lucas and Zeigler, 2003). Todilto Formation, undivided (cross sections only)-Bedded, massive anhydrite and limestone idenified online in one well. Because this is a widespread unit throughout west-central New Entrada Sandstone, undivided (cross sections only)-Massive, bedded to cross-bedded sandstone identified in only one well. (Table 2)/ As defined here, includes only the Slick Rock Member (Lucas and Zeigler, 2003). Because this is a widespread unit throughout west-central New Mexico,