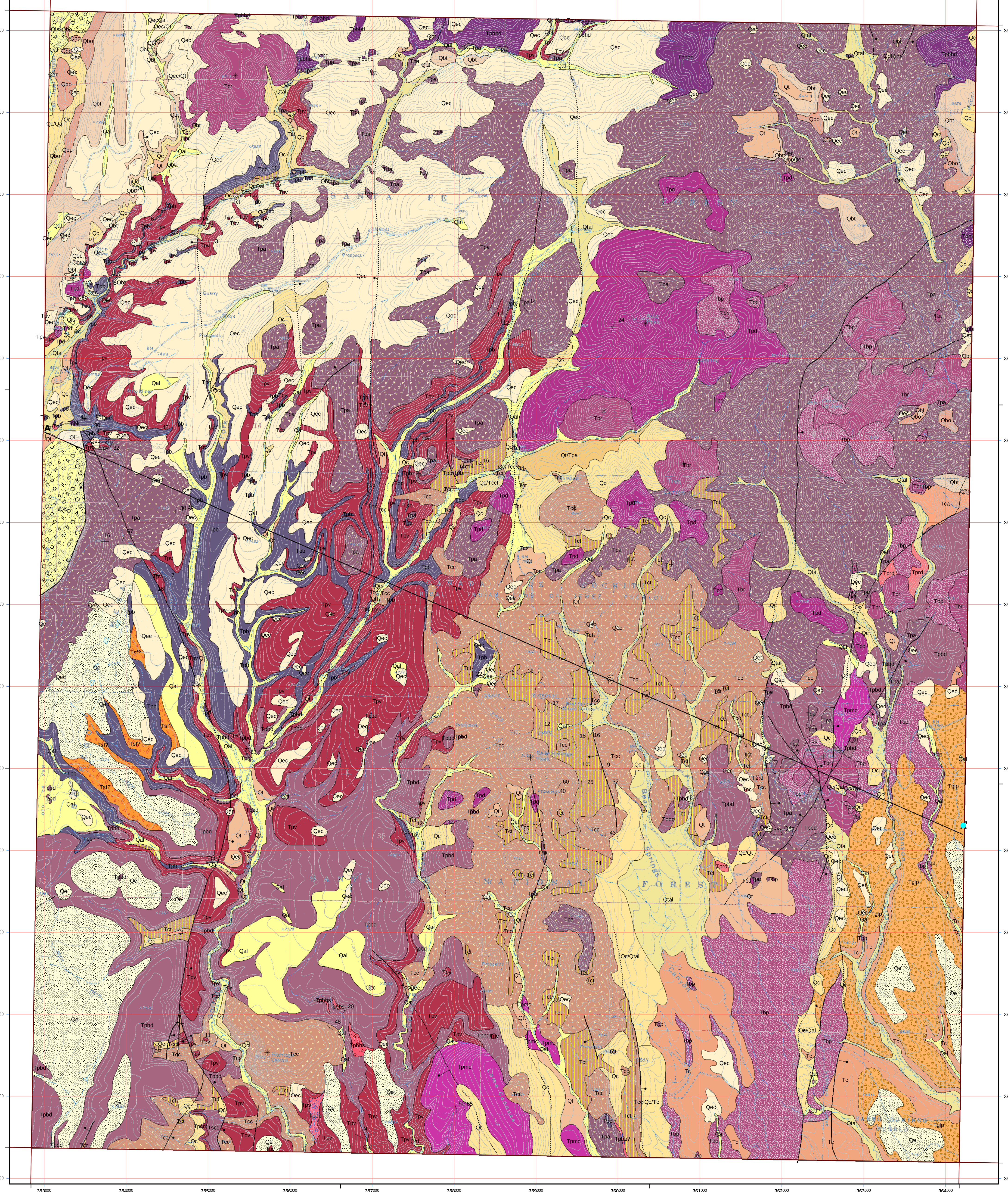
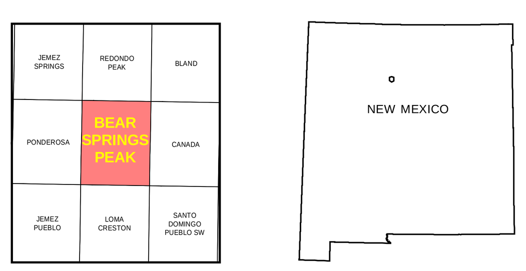
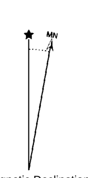


Base map from U.S. Geological Survey1984 from photographs taken 1976, field checked in 1976, edited in 1984.
1927 North American datum, UTM projection -- zone 13N
1000-meter Universal Transverse Mercator grid, zone 13, shown in red



QUADRANGLE LOCATION



Magnetic Declination
May, 2002
10º 16' East
At Map Center

1:24,000

1 MILE

7000 FEET

1 KILOMETER

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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 supercede this preliminary open-file geologic map.

DRAFT

New Mexico Bureau of Geology and Mineral Resources
Open-file Geologic Map 74

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*).

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This and other STATEMAP quadrangles are (or soon will be) available for free download in both PDF and ArcGIS formats at:

http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/home.html

Preliminary geologic map of the Bear Springs Peak quadrangle, Sandoval County, New Mexico.

June 2007

by
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DESCRIPTION OF MAP UNITS

The volcanic rock names used on this map are based on field identification and may not reflect the true rocks names based on geochemistry (see report).

Quaternary

Qal **Alluvium (Upper Pleistocene to Holocene) —** Alluvial deposits in modern drainage bottoms. Deposits include conglomerates, sands, and silts. Holocene terrace deposits less than 1 meter above drainage bottoms are included. Maximum thickness can exceed 5 m.

Qc **Colluvium (Upper Pleistocene to Holocene) —** Poorly-sorted talus, debris, and colluvium in wedge-shaped deposits on hill slopes. Especially common where mesas and cuestas are capped by intermediate to mafic lavas or Tertiary gravels. Thickness can locally exceed 5 m.

Qe **Upland alluvium, colluvium, and eolian deposits, undivided (Upper Pleistocene to Holocene) —** Poorly sorted alluvial gravel, sand, and silt interbedded with fine-grained, well-sorted eolian sand and silt. May be locally interbedded with El Cajete ash (*Qec*). Commonly found in flat, broad areas adjacent to major drainages on the flat tops of ridges and divides in the southwest portion of the quadrangle. Generally <1 m thick.

Qt **Terraces (Upper Pleistocene to Holocene) —** Alluvial deposits near the margins of modern streams or older perched floodplain deposits. Most are fill terrace deposits of sand, silt and gravel < 10 m above modern drainages. Maximum thickness is <10 m.

Qtal **Undifferentiated terraces and alluvium (Upper Pleistocene to Holocene).**

Qls **Landslides (Pleistocene to Holocene) —** Slump or block slides that remain nearly intact after detaching from a steep slope or cliff, or unsorted, chaotic debris emplaced during a single detachment event from a steep slope or cliff. Fan-shaped deposits occur where debris spread out on valley floor. Thicknesses highly variable.

Qec **El Cajete Member (Valles Ryolite) (Quaternary) -** White to beige pyroclastic fall deposits, including pumice, ash, crystals, and lithic fragments associated with the ~50 to 60 ka eruption of the El Cajete Member of the Valles Rhyolite. Primary deposits are exposed in at least two active mines in the northwest corner of the quadrangle where the unit is poorly to moderately sorted. Typically, however, exposures of this unit are reworked, displaying few bedding features. Phenocryst content of pumices is generally less than 10% and includes quartz, sanidine, and biotite. Many of the hills in the northern portion of the quadrangle are covered with >1 meter of primary or reworked tephra. To the south the tephra thins significantly and typically is exposed as isolated patches along hillslopes or capping terrace and other alluvial deposits along drainage bottoms. Maximum thickness in primary deposits exceeds 5 meters.

Qbt **Upper Bandelier Tuff (Tshirege Member) (Lower Pleistocene) —** White to beige non-welded to welded ash-flow tuff containing abundant phenocrysts of quartz and sanidine. Exposed primarily in the northwest corner of the quadrangle and as isolated outcrops in Paliza and Peralta canyons. Basal Tsankawi pumice only recognized in exposures along San Juan Canyon, overlain by multiple (≥ 3) flow units. Erupted at approximately 1.22 Ma during the formation of the Valles caldera. Maximum thickness is approximately 170 m.

Qbo **Lower Bandelier Tuff (Otowi Member) (Lower Pleistocene) —** White to beige non-welded ash-flow tuff containing abundant phenocrysts of quartz and sanidine and sparse mafic phenocrysts. Moderate to abundant lithic fragments, primarily of andesitic or mafic lavas. This unit is best exposed in the northwest corner of the quadrangle where it filled a large paleocanyon, later reincised to form the modern San Juan Canyon. Isolated exposures also occur in Peralta Canyon where capped (preserved) by the Tshirege Member. Erupted at approximately 1.61 Ma during the formation of the Toledo caldera. Maximum thickness is approximately 70 m.

Tertiary

Tglp **Gravel of Lookout Park (Pliocene) —** Stratified cobble to boulder gravel almost entirely derived from upper Miocene volcanic strata. Relative proportions of basalt, basaltic andesite, andesite, dacite and rhyolite clasts vary with the bedrock lithology of the local provenance. The Gravel of Lookout Park, as mapped in the Loma Creston quadrangle to the south of the map area, is both slightly older than and slightly younger than the upper Pliocene basalts (*ca*. 2.5 Ma) that cap Santa Ana Mesa.

Tglp **Cochiti Formation, Santa Fe Group (Miocene to Pliocene) —** Volcaniclastic sediments with pebble to cobble sized clasts derived primarily from Paliza Canyon, Canovas Canyon, and Bearhead rhyolite units in the study area. This unit includes conglomeratic sandstones interbedded with fine-grained sands and silts, covering much of the southern and southeastern portion of the quadrangle. Maximum thickness is approximately 100 m.

Tbp **Peralta Tuff Member of the Bearhead Rhyolite (Upper Miocene) —** Lithic-rich tuffs and minor tuff breccias. Typically white to beige, poorly-welded with sparse phenocrysts of quartz, biotite, plagioclase, and quartz. The most voluminous and widespread tuff of this unit occurs along the footwall of the Yelo fault, extending to the NE towards Bear Peak on the Cañada quadrangle. Pumice from the tuff of Cerrito Yelo on the Cañada quadrangle is 6.29 ± 0.08 Ma. At Cerrito Yelo this tuff is overlain by a younger, phenocryst-rich rhyolite lava. Preliminary correlation of this tuff on the west side of the Yelo fault is stratigraphically above dacite lavas in the vicinity of Ruiz Peak and intercalated with andesite flows on the east side of Tres Cerros. Exposures of this tuff east of Ruiz Peak are strongly bedded with large (> 1 m) and abundant lithics, suggesting a nearby source. Maximum thickness of this unit exceeds 70 m.

Tbr **Bearhead Rhyolite (Upper Miocene) —** Light gray to white rhyolite lavas and associated pyroclastic deposits, typically crystal-poor, with sparse phenocrysts of quartz, sanidine and biotite. Lavas typically high-aspect ratio and erupted along N-S-trending or NE-SW-trending structures. Some rhyolites of this unit, including two domes just north and west of Tres Cerros, are moderately crystal rich, with abundant quartz and sanidine phenocrysts and lesser amounts of biotite. Most of the lavas from this episode of volcanism occur in the southeast portion of the quadrangle, possibly related to a batholithic magma chamber emplaced at approximately 6.8 Ma. The most voluminous and contiguous outcrops of this unit are exposed in Peralta Canyon, where hydrothermal alteration is locally pervasive. A rhyolite lava located east of Tres Cerros (0361690 3950778) has an $^{40}Ar/^{39}Ar$ date of 6.86 ± 0.28 Ma on sanidine and a rhyolite lava north of Paliza Canyon has an $^{40}Ar/^{39}Ar$ age of 6.66±0.61 Ma on biotite. Maximum thickness exceeds 150 m.

Tpmc **Trachyandesite of Mesita Cocida, Paliza Canyon Formation (Miocene) -** Medium to dark gray diktytaxitic lavas, poorly to moderately porphyritic with rare phenocrysts of plagioclase, pyroxene and trace amounts of olivine and hornblende. The weathered outcrop is platy in appearance. Massive, flow banded, and vesicular horizons are common. Chamberlin and McIntosh (2007) determined an age of 7.09±0.21 Ma for this unit based on three samples on Mesita Cocida on the Loma Creston quadrangle. Maximum thickness exceeds 20 meters.

Tpai **Andesite dikes that may be the source of the trachyandesite of Mesita Cocida, Paliza Canyon Formation (Miocene).**

Tpv **Volcaniclastic deposits. Paliza Canyon Formation (Miocene) -** Volcaniclastic conglomerates, sandstones and silts of mixed provenance. Older sediments of this unit are primarily intercalated with thin basalt flows of the Paliza Canyon Formation and tephras of the Canovas Canyon Rhyolite, whereas the younger gravels are intercalated with andesite and dacite lavas. These gravels thicken to the southwest towards Borrego Mesa and exhibit southeast-trending imbrication. Maximum thickness is approximately 100 meters.

Tpdb **Biotite-bearing rhyodacite, Paliza Canyon Formation (Miocene) —** Light to dark gray porphyritic lavas with phenocrysts of plagioclase and biotite.

Tpa **Andesite, Paliza Canyon Formation (Miocene) —** Typically medium gray to reddish purple porphyritic lavas and associated pyroclastic deposits. Phenocryst content is typically <20% and includes acicular plagioclase with less abundant pyroxenes (clinopyroxene and/or orthopyroxene). Flow banding is common, as are vesicular and brecciated horizons. Debris flow deposits, typically less than 5 meters in thickness, occur intercalated with lava flows. A thick package of these andesitic units occurs north and east of Tres Cerros, suggesting a source in this vicinity. One distinctive flow, dark gray and very fine-grained with sparse phenocrysts of plagioclase and pyroxene, occurs in numerous outcrops peripheral to Cerrito Yelo. This unit is offset by several faults that radiate from the Cerro Yelo center and is overlain by the Peralta Tuff Member of the Bearhead Rhyolite. An $^{40}Ar/^{39}Ar$ date for a flow near the top of this unit at Tres Cerros is 10.8 ± 1.5 Ma on hornblende. Maximum thickness of this unit exceeds 200 m.

Tpd **Dacite, Paliza Canyon Formation (Miocene) —** Light to dark gray porphyritic lavas with phenocrysts of plagioclase, hornblende, and biotite. Some lavas also contain small amounts of quartz and pyroxene. Flows are typically massive but can also exhibit flow banding and brecciated horizons. An older sequence of dacites, exposed along Forest Road 266 between Bear Springs Peak and Cerrito Yelo, is stratigraphically below most of the thick andesite package to the north. The andesite package is then capped by a younger dacitic sequence of lavas and domes. These dacitic lavas, including dome complexes at Cerro Ruiz and north of Paliza Canyon, tend to be more coarsely porphyritic, with phenocrysts of plagioclase (up to 1 cm across), pyroxene, and rare hornblende or biotite. Maximum thickness of this unit exceeds 150 m.

Tpbb **Basalt of Bodega Butte, Paliza Canyon Formation (Miocene) -** Dark gray olivine basalt that is massive to vesicular and moderately porphyritic with phenocrysts of plagioclase, olivine and pyroxene. Phenocryst content is typically < 10% with olivine commonly altered to reddish-brown iddingsite. Weathered surfaces on the basalt are covered with distinctive reddish speckles. Basalt breccias and vesicular horizons are common. This widespread unit in the southeast portion of the quadrangle appears to have been emplaced during one eruptive episode, although separate flows may have overlapped. An $^{40}Ar/^{39}Ar$ date for this unit from a sample collected at the confluence of Hondo and West Fork Canyons is 9.10±0.13 Ma. Chamberlin and McIntosh (2007) determined an average age of 9.14±0.12 Ma from four samples on the Loma Creston quadrangle to the south. Maximum thickness of unit exceeds 30 meters.

Tpbbs **Scoria facies of basalt of Bodega Butte. Paliza Canyon Formation. Miocene.**

Tpb/Tpbs **Basalt, Paliza Canyon Formation (Miocene) —** Medium to dark gray lavas and associated scoria deposits (*Tpbs*). Poorly to moderately porphyritic with phenocrysts of plagioclase and pyroxene. Trace amounts of olivine and/or hornblende may be present. Flows are typically flow banded and platey. Brecciated basal and top horizons of flows and vesicular horizons are also common. Most of the flows are intercalated with gravel deposits (*Tpv*) and appear to have originated along N-S structures related to the western Cocido fault zone, flowing to the southeast. An $^{40}Ar/^{39}Ar$ date for a flow from the base of this unit is 9.54±0.08 Ma. Maximum thickness of individual flows can exceed 30 m.

Tpbt **Hydromagmatic tephra associated with basalt of the Paliza Canyon Fomation (Miocene).**

Tpbi **Basaltic dikes associated with basalt of the Paliza Canyon Formation (Miocene).**

Tcc/Tct **Canovas Canyon Rhyolite lavas (*Tcc*) and associated pyroclastic and alluvial deposits (*Tcct*) (Miocene) —** Mostly beige to pinkish-gray, flow-banded, phenocryst-poor lavas. Dark grey to green obsidian facies common in more voluminous flows. Phenocrysts are typically small (< 2 mm) and include biotite, sanidine, and rare quartz. West of the Cocida fault zone pyroclastic deposits are intercalated with sandstones, tuff breccia, and tephra deposits. The largest contiguous flow occurs east of Bear Springs Peak and covers an area of > 6 km^2. Although the thickness of this unit is unknown (the base of the flow is not exposed), the flow is widespread and appears to have a relatively low-aspect ratio more typical of lavas with a lower silica content. A similarly widespread pyroclastic flow overlies the lava and in several locations the two units appear to be intimately associated with one another, suggesting a continuum in the eruption process. Other rhyolite lavas of this unit are of limited lateral distribution (< 1 km^2) and exhibit a more typical high-aspect ratio morphology. Most of the Canovas Canyon rhyolites were erupted along N-S-trending faults active during the mid-Miocene. $^{40}Ar/^{39}Ar$ dates for biotite from flows at 0361786 3948981 and 357602 3946081 are 8.81±0.16 Ma and 9.75±0.08 Ma, respectively. Maximum thickness exceeds 150 m.

Tpcm **Basalt of Chamisa Mesa, Paliza Canyon Formation. (Miocene) -** Dark gray to black, fine-grained aphyric to phenocryst-poor basalt with rare crystals of olivine. Chamberlin and McIntosh (2007) determined a $^{40}Ar/^{39}Ar$ age of 9.9 ± 0.9 Ma on two samples on the Loma Creston quadrangle.

Tscc **Cerro Conejos Formation, Santa Fe Group (Miocene)** - Red to tan sandstone with rounded quartz grains that is moderately- to well-sorted that is interbedded with Canovas Canyon Rhyolite tuffs. These sandstones are included in *Tcct*. This unit is also below the basalt of Chamisa Mesa.

Tku **Undivided Keres Group volcanic rocks (Miocene).** (on cross-section A-A') .

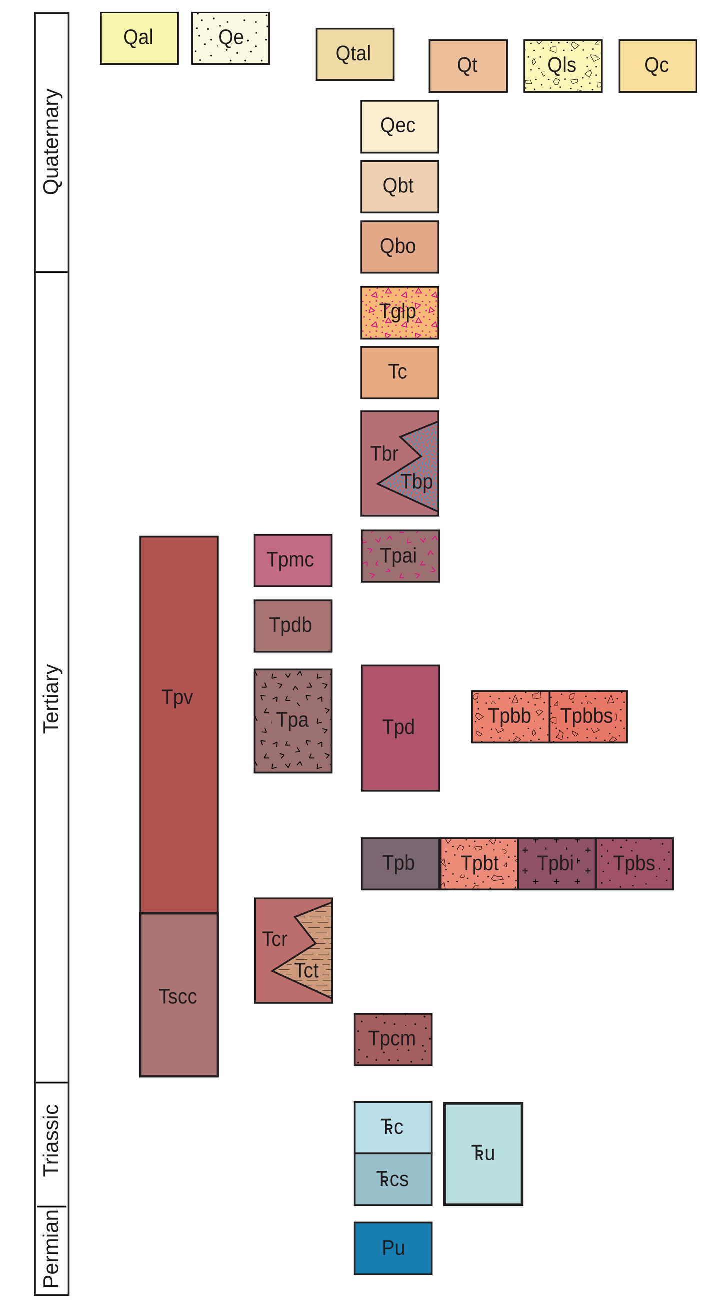
TRc **Undivided Chinle Group (Triassic)** (on cross-section A-A')

TRcs **Shinarump Formation. Chinle Group (Triassic)** (on cross-section A-A') .

Tru **Undivided upper part of Chinle Group (Triassic)** (on cross-section A-A') .

Pu **Undivided Permian sedimentary rocks** (on cross-section A-A') .

Correlation of Map Units



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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.

Explanation of Map Symbols

A ⊢⊣ A' Location of geologic cross section.

Geologic contact. Solid where exposed or known, dashed where approximately known, queried where uncertain.

Normal fault, ball-and-bar on downthrown side. Solid where exposed, dashed where approximately known, dotted where concealed.

15 Strike and dip of bedding.

Strike and dip of volcanic foliation.

Volcanic vent. Queried where uncertain.

Bear Springs Peak Cross Section A - A'