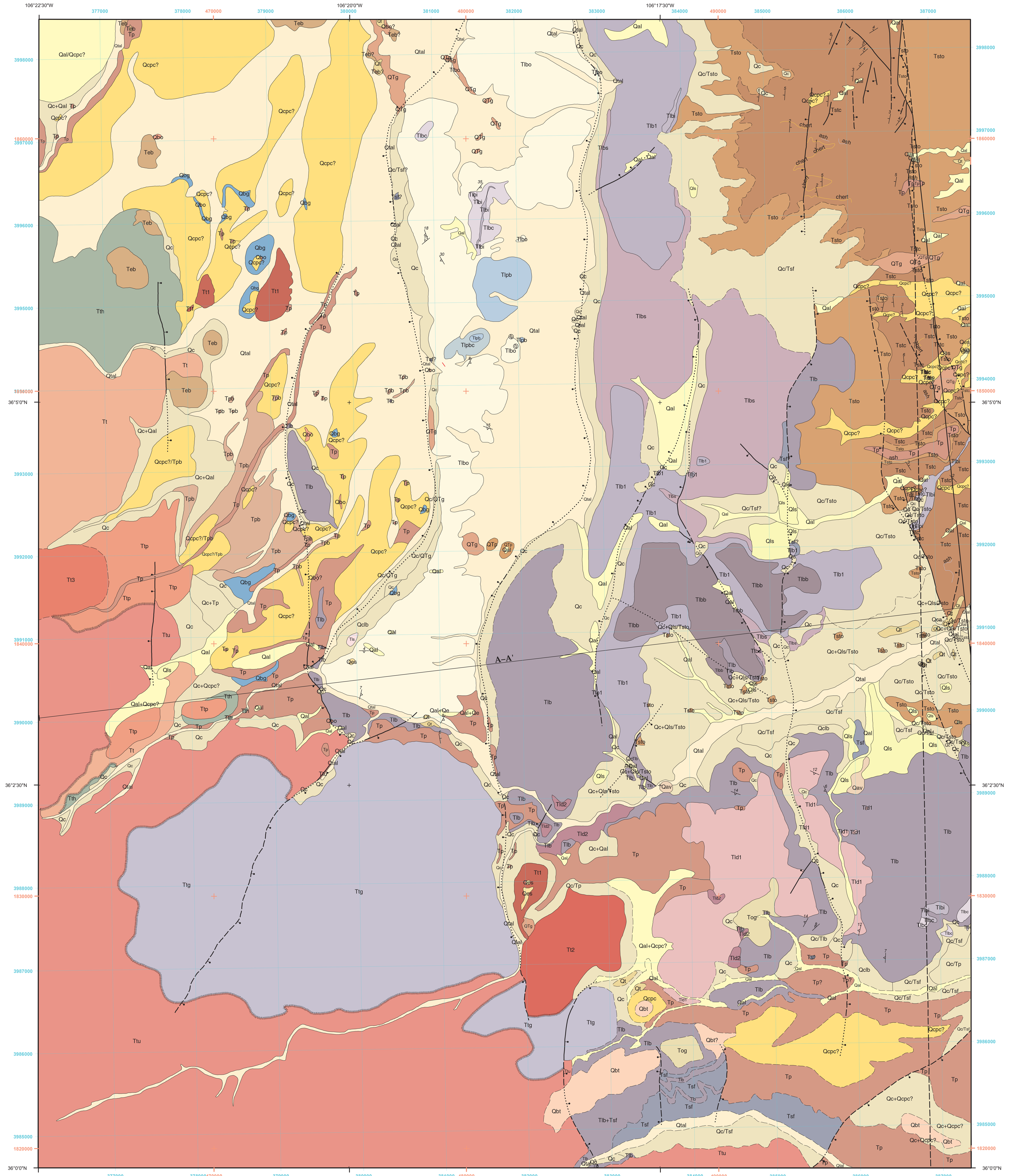
NMBGMR Open-File Geologic Map 108
Last Modified: June 2023



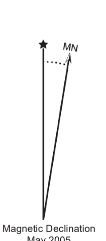
North American Datum of 1927 (NAD27)
Projection and 1,000-meter grid: Universal Transverse Mercator, Zone 13S, shown in blue.
10,000-foot ticks: New Mexico Coordinate System of 1983 (Central Zone), shown in red.

1:24,000

Contour Interval 20 Feet

National Geodetic Vertical Datum of 1929

Quadrangle Location



Magnetic Declination
May 2005
9° 54' East
At Map Center

New Mexico Bureau of Geology and Mineral Resources
New Mexico Tech
801 Leroy Place
Socorro, New Mexico
87801-4796

[575] 835-5490

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

http://geoinfo.nmt.edu

Digital layout and cartography by the NMBGMR Map Production Group:
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New Mexico Bureau of Geology and Mineral Resources
Open-File Geologic Map 108

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Geologic Map of the Vallecitos 7.5-Minute Quadrangle, Rio Arriba and Sandoval Counties, New Mexico

May 2005

by

Kirt Kempter[1], Shari Kelley[2], Dan Koning[3], Charles Ferguson[4], Bob Osburn[5], and Linda Fluk[5]

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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map may be based on any of the following: reconnaissance field geologic mapping, a compilation of published and unpublished work, and photogeologic interpretation.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 may not be shown due to recent development. Cross sections are constructed based upon the interpretations of the author made from geologic mapping and available geophysical and subsurface (drill hole) 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 human-made structures.

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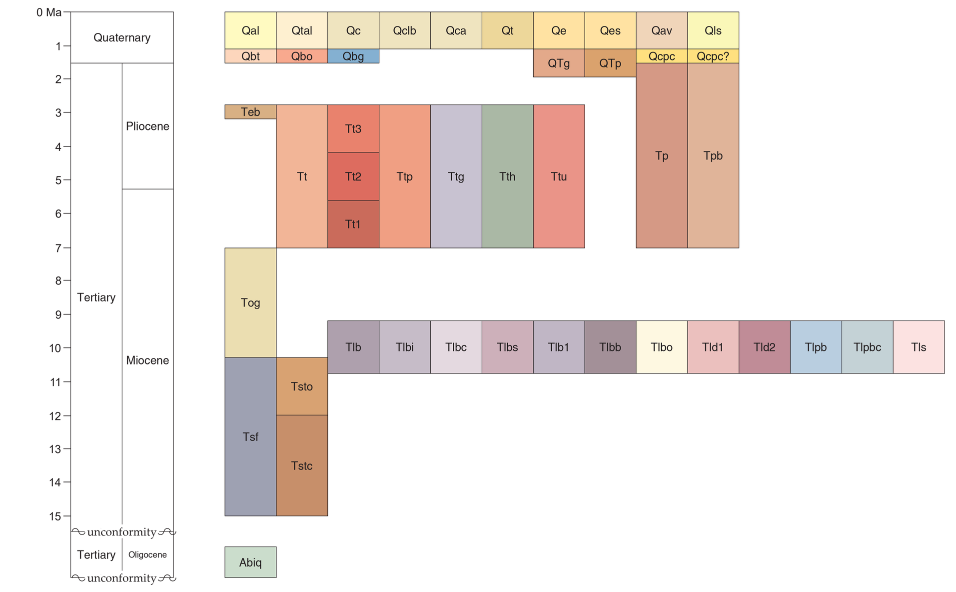
Correlation of Map Units



Explanation of Map Symbols

Contact—Identity and existence are certain. Location is accurate.

Contact—Identity and existence are certain. Location is approximate.

Gradational contact—Identity and existence are certain. Location is accurate.

Fault (generic; vertical, subvertical, or high-angle; or unknown or unspecified orientation or sense of slip)—Identity and existence are certain. Location is accurate.

Fault (generic; vertical, subvertical, or high-angle; or unknown or unspecified orientation or sense of slip)—Identity and existence are certain. Location is approximate.

Fault (generic; vertical, subvertical, or high-angle; or unknown or unspecified orientation or sense of slip)—Identity and existence are certain. Location is concealed.

Normal fault—Identity and existence are certain. Location is accurate. Ball and bar on downthrown block.

Normal fault—Identity and existence are certain. Location is approximate. Ball and bar on downthrown block.

Normal fault—Identity and existence are certain. Location is concealed. Ball and bar on downthrown block.

Chert layer in sediments—Identity and existence certain, location accurate.

Ash layer in sediment—Identity and existence are certain. Location is accurate.

Dike (1st option)—Identity and existence are certain. Location is accurate.

Inclined bedding—Showing strike and dip.

Horizontal flow banding, lamination, layering, or foliation in igneous

Inclined flow banding, lamination, layering, or foliation in igneous rock—Showing strike and dip.

Cross section line and label

Fault in cross section showing local up/down offset—The arrows show the relative motion along the fault plane.

Fault in cross section showing local up/down offset—The arrows show the relative motion along the fault plane.

Description of Map Units

Quaternary—Quaternary

Qal—Alluvium (Late Pleistocene to Holocene)—Alluvial deposits in modern drainage bottoms and elevated basins. Deposits include gravel, sand, and silt. Holocene terrace deposits less than 2 meters above drainage bottoms are included. Alluvium on Mesa El Alto contains abundant quartz and sanidine crystals from Bandelier Tuff, while alluvium in the canyon along the Rio del Oso is dominated by fluvial clasts of Tschicoma Formation dacite (Tt) and Lobato Formation basalt (Tlb). Obsidian fragments are common. Maximum thickness can exceed 4 meters.

Qtal—Undifferentiated terraces and alluvium in modern stream drainages (Late Pleistocene to Holocene)—Undifferentiated terraces and alluvium in modern stream drainages. Obsidian fragments are common.

Qc—Colluvium (Late Pleistocene to Holocene)—Poorly sorted talus, debris, and colluvium in wedge-shaped deposits on hill slopes. Numerous hill slopes beneath mesas of Lobato Formation basalt (Tlb) are covered by basalt colluvium (obscuring the underlying bedrock); mapped only in a few locations (Qclb) but relatively extensive on the flanks of elevated Lobato Formation mesas. Similar colluvial deposits occur along the edges of Tschicoma Formation dacite flows (Tt). Thickness can locally exceed 5 meters.

Qclb—Colluvium (basalt) (Quaternary)—Poorly sorted talus, debris, and colluvium in wedge-shaped deposits on hill slopes. Numerous hill slopes beneath mesas of Lobato Formation basalt (Tlb) are covered by basalt colluvium (obscuring the underlying bedrock); mapped only in a few locations (Qclb) but relatively extensive on the flanks of elevated Lobato Formation mesas. Similar colluvial deposits occur along the edges of Tschicoma Formation dacite flows (Tt). Thickness can locally exceed 5 meters.

Qca—Undescribed unit (Quaternary)—Undescribed unit

Qt—Terrace deposits (Late Pleistocene to Holocene)—Alluvial deposits near the margins of modern streams or older perched floodplain deposits. Mapped only in a few locations. Most are fill terrace deposits of sand, silt, and gravel <10m above modern drainages. Maximum thickness is <5 meters. Coarser gravel terraces along Rio del Oso canyon are mapped as Qtg (but not shown at this scale).

Qe—Eolian deposits (Quaternary)—Poorly bedded fine-grained sand and silt preserved sporadically on terraces, in broad valleys and on mesa tops. Although no sedimentary structures could be identified, these deposits appear to be primarily eolian in origin, capping older alluvial deposits. Generally less than 1 meter in thickness. Eolian deposits are only mapped as a mixed unit with Qal.

Qes—Eolian deposits reworked by sheetwash (Late Pleistocene to Holocene)—Poorly bedded fine-grained sand and silt preserved sporadically on terraces, in broad valleys, and on mesa tops. Although no sedimentary structures could be identified, these deposits appear to be primarily eolian in origin and reworked by sheetwash. The units often cap older alluvial deposits. Generally less than 1 meter in thickness.

Qav—Rock avalanche deposits (Late Pleistocene to Holocene)—Chaotic, angular debris emplaced during a single detachment event from a steep slope or cliff, generally lacking a sedimentary matrix. Mapped only in a few locations. Thickness can exceed 10 meters.

Qls—Landslide deposits (Pleistocene to Holocene)—Unsorted, chaotic debris emplaced during a single detachment event from a steep slope or cliff, generally containing a sediment matrix. Also, slump or block slides, especially along the flanks of high mesas where Lobato Formation basalts cap older Santa Fe Group sediments. Fan-shaped deposits occur where debris spread out on valley floor. Thickness can exceed 20 meters.

Qcpc?—Cerro Toledo Formation, Pueblo Canyon Member (Quaternary)—Older alluvial deposits of gravel, sand and silt that may correlate with Cerro Toledo (Qct, modified to Qcpc) interval deposits in adjacent quadrangles. Dominant clast lithology varies by location, but is typically Tschicoma dacite (Tt) or Lobato basalt (Tlb). These deposits typically contain obsidian clasts, presumably originating from the Toledo embayment or domes of El Rechuelos rhyolite from the Polvadera Peak quadrangle to the west. Quartz and feldspar crystals of Bandelier Tuff are also common, especially in ant mounds capping these deposits. Maximum thickness is approximately 10 meters.

Qcpc—Cerro Toledo Formation, Pueblo Canyon Member (Quaternary)—Alluvial deposits of gravel and sand containing abundant clasts of obsidian. Mapped only where overlain by the Tshirege Member of the Bandelier Tuff (Qbt). Maximum thickness is 5 meters.

Qbt—Upper Bandelier Tuff, Tshirege Member (Quaternary)—White to orange non-welded to welded ash-flow tuff containing abundant phenocrysts of quartz and sanidine. Ash-flow tuff beds consist of multiple flow units in a compound cooling unit with thin surge beds (less than 0.5 meters thick) locally exposed. Exposures in the field area are limited to outcrops on the Santa Clara Reservation north of Santa Clara Canyon. Erupted at approximately 1.25 Ma during the formation of the Valles Caldera (Phillips, 2004). Maximum thickness is approximately 40 meters.

Qbo—Bandelier Tuff, Otowi Member (Quaternary)—White to beige poorly-welded ash-flow tuff containing abundant pumices with phenocrysts of quartz and sanidine and sparse mafic phenocrysts. Moderate to abundant lithic fragments (5-15%), primarily of andesitic or mafic lavas. These deposits occur only as isolated, thin exposures in Mesa El Alto west of Lobato Mesa. Although no primary exposures of the basal Guaje Pumice were observed in the quadrangle, mounds of pumice (Qbp, modified to Qbg) typically occur adjacent to these thin tuff deposits. The Otowi Member erupted at approximately 1.61 ± 0.01 to 1.62±0.04 Ma (Izett and Obradovich, 1994; Spell et al., 1996) during the formation of the Toledo caldera. Two dates on pumice and tuff in this area yield slightly older, but statistically overlapping ages(1.68 ± 0.04 and 1.72 ± 0.04 Ma; Table 1). Maximum thickness is approximately 4 meters.

Qbg—Bandelier Tuff pumice deposits (Quaternary)—Mounds and poorly-exposed strata of reworked Bandelier Tuff pumices. The lack of primary Bandelier Tuff deposits in the area make it difficult to determine whether this is Guaje or Tskankawi pumice. Most likely these deposits are reworked Guaje Pumice Bed tephra, due to their association with thin Otowi Member tuff deposits (see above). Maximum thickness is approximately 15 meters.

QTg—Alluvial deposits that range from sandy gravels to coarse boulder conglomerates (Late Tertiary to Early Quaternary)—These deposits may correspond with Puye Formation fanglomerates (Tp), but where mapped, are of uncertain age. Dominant clasts are typically Tschicoma dacite (Tt) or Lobato basalt (Tlb). Deposits mapped along the western flank of Lobato Mesa (mixed with Lobato basalt colluvium) may represent a basin fill maximum (~8100 foot elevation). Locally, dacitic tephra (QTp) is found within these deposits, although outcrops are rare. Obsidian fragments are rare if present at all. Maximum thickness is 5 meters.

QTp—Dacite pumice deposits, slightly reworked (Late Tertiary to Early Quaternary)—Phenocrysts include biotite and hornblende. Mapped in a small region adjacent to QTg deposits at the south end of Vallecitos de los Chamisos. Maximum thickness is 1 meter.

Tertiary—Tertiary

Tp—Puye Formation fanglomerates (Pliocene to Early Pleistocene)—Sands, gravels and conglomerates derived from nearby highlands of Tschicoma Formation dacite (Tt) and Lobato Formation basalt (Tlb). Also includes a bouldery unit 10-15 meter thick east of Polvadera Peak that may have been deposited by a rock avalanche (Tpb) . Individual blocks can exceed 5 meters across. Locally, dacitic tephras and thin pyroclastic flow deposits (less than one meter thick) occur within the sediments. Reworked tephras, silts and fine- to medium-grained sands of this unit occur beneath the dacite of Mesa de la Gallina (Ttg) along Gallina Creek (roadcuts on FR-144). In general, however, Puye Formation deposits are poorly exposed in the quadrangle, and often occur as rounded fluvial clasts of surface colluvium. Maximum thickness is approximately 25 meters.

Tpb—Puye Formation fanglomerates (Pliocene to Early Pleistocene)—Sands, gravels and conglomerates derived from nearby highlands of Tschicoma Formation dacite (Tt) and Lobato Formation basalt (Tlb). Also includes a bouldery unit 10-15 meter thick east of Polvadera Peak that may have been deposited by a rock avalanche (Tpb) . Individual blocks can exceed 5 meters across. Locally, dacitic tephras and thin pyroclastic flow deposits (less than one meter thick) occur within the sediments. Reworked tephras, silts and fine- to medium-grained sands of this unit occur beneath the dacite of Mesa de la Gallina (Ttg) along Gallina Creek (roadcuts on FR-144). In general, however, Puye Formation deposits are poorly exposed in the quadrangle, and often occur as rounded fluvial clasts of surface colluvium. Maximum thickness is approximately 25 meters.

Teb—El Alto basalt (Middle Pliocene)—Basalt, not described by author.

Tt—Tschicoma Formation (Late Miocene to Late Pliocene)—Light gray to dark gray, moderately to coarsely porphyritic lavas of dacitic composition in the Vallecitos quadrangle (Figure 1). This formation includes thick, overlapping flows and high-aspect ratio domes. Age analyses for Tschicoma lavas in the northern Jemez Mountains range from ~ 5 to 3 Ma (Goff et al. 1989, Table 1). Most of the flows in the quadrangle were undifferentiated, mapped as Tt or are broadly grouped by age (Tt1-3). Note: Tt2 is not present on this map. WoldeGabriel et al. (2006) dated a lower dacite flow and an upper dacite flow in Tschicoma Formation in Santa Clara Canyon just north of the quadrangle boundary. The 40Ar/39Ar age of the higher flow on the north wall of the canyon is 3.79±0.17 Ma and a topographically lower flow on the south side of the canyon is 4.39±0.13 Ma. The sample from the north wall is porphyritic with phenocrysts of plagioclase, hornblende and biotite. The sample from the south side is very porphyritic with plagioclase, quartz, and little biotite.

Tt3—Tschicoma Formation flows (Late Miocene to Late Pliocene)—A lobe coming from the west sourced on Polvadera Peak that is the youngest of the Tshicoma lavas; this porphyritic dacite has plagioclase as the dominant phenocryst.

Tt2—Tschicoma Formation flows (Late Miocene to Late Pliocene)—Deposits which include dacites commonly containing cognate clots of more mafic magmas (vesicular basaltic andesite) ranging in size from 2 to 25 cm. These flows represent an age span between 4.5 to 3.2 Ma.

Tt1—Tschicoma Formation domes and flows (Late Miocene to Late Pliocene)—Older sequence of domes and flows, including plagioclase-dominated flows with both hydrous (biotite + hornblende) and non hydrous mineralogy. In the NE quadrant these older flows and domes are mostly dacitic to rhyodacitic, with abundant phenocrysts of plagioclase, biotite, hornblende, and pyroxene. A few of the larger flows characterized by abundant phenocrysts (20-35%) including hydrous mafic minerals, such asbiotite and hornblende.

Ttp—Tschicoma Formation flows (Late Miocene to Late Pliocene)—Flows that lack distinctive hydrous minerals, typically dominated by plagioclase phenocrysts, often including plagioclase megacrysts that exceed 1cm in length.

Ttg—Tschicoma Formation flows (Late Miocene to Late Pliocene)—One of the largest single flow units of the entire Tschicoma Formation occurs in the southwest corner of the quadrangle where a broad, northeast-sloping surface known as Mesa de la Gallina represents the surface of this massive flow, covering more than 102 kilometers. The flow, informally named the dacite of Mesa de la Gallina (Ttg) is dated at 3.90±0.15 and 4.29±0.49 Ma (Goff et al., 1989, Table 1) and originated from the northeast side of Tschicoma Peak. Forest Road 144 traverses the upper surface of the flow as it ascends Tschicoma. The flow contains abundant phenocrysts (25-35%), including biotite and hornblende. Plagioclase phenocrysts are abundant but typically small to medium in size (less than 0.5 cm). The flow is often highly flow-banded, including spectacular flow contortions along its margins. To the north the Gallina flow overlies older plagioclase-rich, mafic-pheonocryst-poor Tschicoma flows and is bordered by the Rio del Oso. To the west, the Gallina flow overlies fine- to medium-grained fluvial deposits of the Puye Formation, exposed along FR 144 in Gallina Creek. The maximum thickness of Tschicoma lavas in the quadrangle occurs in upper Gallina Creek, exceeding 500 meters.

Tth—Tschicoma Formation flows (Late Miocene to Late Pliocene)—Larger dacitic lava flows, abundant phenocrysts(20-35%) of hydrous mafic minerals such as biotite and hornblende.

Ttu—Undescribed unit (Tschicoma Formation flows?) (Late Miocene to Late Pliocene)—Not described by author. This unit could indicate undivided Tschicoma flows, but this is not clarified by author.

Tog—Alluvial and colluvial deposits, Cochiti Formation? (Late Miocene to Late Pliocene)—Near source alluvial and colluvial deposits, possibly corresponding with older Puye Formation. The deposits include angular to subrounded blocks of Lobato-age dacitic and mafic lavas and are perched at higher elevations than other Puye fanglomerates (up to 8100 feet). Maximum thickness is approximately

Tlb—Lobato Formation flows (Miocene)—These deposits represent a wide variety of mafic lava flows, including basalt, basaltic andesite, basaltic trachyandesite, and associated deposits. Undivided flows (Tlb) represent the majority of this unit in the quadrangle. These lavas are black to gray, sparsely to moderately porphyritic, containing phenocrysts of plagioclase, olivine, ± clinopyroxene in a variety of groundmass types. Flows are typically massive and flow banded with brecciated lower and upper surfaces. Thin fluvial sandstones that occur locally between mafic lavas across Lobato Mesa may correspond with the Ojo Caliente sandstone member (Tsfo, modified to Tsto) described below. Intrusive facies (Tlbi) occur as fine- to medium-grained dikes and crystalline gabbroic sills or plugs. One of these gabbros is well exposed along Forest Road 144 as it first enters the quadrangle from the east. In Cañada Almagre along the eastern boundary of the quadrangle a spectacular combination dike/sill intrudes the Chama-El Rito member (Tsfc, modified to Tstc), the sill forming a resistant floor in part of the valley bottom. This intrusion, dated at 9.74±0.21 Ma, is offset by the Cañada del Almagre fault (Koning and Kempter, 2007). Scoria and cinder deposits (Tlbc) occur in several places in the quadrangle but are only mapped in a few areas where nearby vents are suspected. Mafic lavas on the west side of Lobato Mesa are differentiated based on phenocryst content. Those with abundant olivine phenocrysts (typically altered to iddingsite) are identified as Tlbo, while a younger series of olivine-poor, plagioclase-rich lavas are mapped as Tlbp. A prominent dike flanked by cinder deposits of this later unit is located immediately south of Cerrito del Chibato (mapped as Tlbi and Tlbc). On the eastern flank of Lobato Mesa, three groups of mafic lavas are distinguished that overlie undifferentiated Tlb lavas. These include olivine-phyric basalts of La Sotella shield (Tlbs) that contain 2-15% 1-8 mm euhedral plagioclase phenocrysts overlain by basaltic lavas containing 2-10% phenocrysts of 1-3 mm mafic phenocrysts (olivine±pyroxene) mapped as Tlb1. The youngest lavas occur at the southern portion of the mesa, erupted from a vent near La Bentolera. These distinctive lavas (Tlbb) have a crystalline matrix and are nearly aphyric, containing 0-2% phenocrysts (and xenocrysts) of pyroxene, pyroxene-olivine aggregates, quartz and potassium feldspar. Rare granitic xenoliths also occur in this unit. Mafic lavas of Lobato Mesa were primarily emplaced over a 1.5 Ma span (9.0 to 10.5 Ma), with the bulk of the eruptions occurring between 9.5 to 10 Ma. In contrast, Lobato Formation basalt and basaltic trachyandesite exposed in Santa Clara Canyon are generally older (10.16 to 13.13 Ma) and are less voluminous compared to the unit on Lobato Mesa, consisting of thin flows interbedded with the Santa Fe Group (WoldeGabriel et al., 2006). The 5 to 7 m thick mafic flows in Santa clare Canyon are interbedded with altered volcaniclastic deposits, sandstone, and pumice beds. The basalts are fine-grained. The interbedded sequence of sediment and basalt is capped by a vesicular, porphyritic, purple-gray andesite flow with phenocrysts of palgioclase and altered mafic minerals. Maximum thickness exceeds 200 meters on Lobato Mesa.

Tlbi—Lobato Formation intrusive facies (Miocene)—Intrusive facies (Tlbi) occur as fine- to medium-grained dikes and crystalline gabbroic sills or plugs. One of these gabbros is well exposed along Forest Road 144 as it first enters the quadrangle from the east. In Cañada Almagre along the eastern boundary of the quadrangle a spectacular combination dike/sill intrudes the Chama-El Rito member (Tsfc, modified to Tstc), the sill forming a resistant floor in part of the valley bottom. This intrusion, dated at 9.74±0.21 Ma, is offset by the Cañada del Almagre fault (Koning and Kempter, 2007).

Tlbc—Lobato Formation scoria and cinder deposits (Miocene)—Scoria and cinder deposits (Tlbc) occur in several places in the quadrangle but are only mapped in a few areas where nearby vents are suspected. Mafic lavas on the west side of Lobato Mesa are differentiated based on phenocryst content.

Tlbs—Lobato Formation flow (Miocene)—On the eastern flank of Lobato Mesa, three groups of mafic lavas are distinguished that overlie undifferentiated Tlb lavas. These include olivine-phyric basalts of La Sotella shield (Tlbs) that contain 2-15% 1-8 mm euhedral plagioclase phenocrysts overlain by basaltic lavas containing 2-10% phenocrysts of 1-3 mm mafic phenocrysts (olivine±pyroxene) mapped as Tlb1. The youngest lavas occur at the southern portion of the mesa, erupted from a vent near La Bentolera. These distinctive lavas (Tlbb) have a crystalline matrix and are nearly aphyric, containing 0-2% phenocrysts (and xenocrysts) of pyroxene, pyroxene-olivine aggregates, quartz and potassium feldspar. Rare granitic xenoliths also occur in this unit. Mafic lavas of Lobato Mesa were primarily emplaced over a 1.5 Ma span (9.0 to 10.5 Ma), with the bulk of the eruptions occurring between 9.5 to 10 Ma

Tlb1—Lobato Formation basalt flow (Miocene)—On the eastern flank of Lobato Mesa, three groups of mafic lavas are distinguished that overlie undifferentiated Tlb lavas. These include olivine-phyric basalts of La Sotella shield (Tlbs) that contain 2-15% 1-8 mm euhedral plagioclase phenocrysts overlain by basaltic lavas containing 2-10% phenocrysts of 1-3 mm mafic phenocrysts (olivine±pyroxene) mapped as Tlb1. The youngest lavas occur at the southern portion of the mesa, erupted from a vent near La Bentolera. These distinctive lavas (Tlbb) have a crystalline matrix and are nearly aphyric, containing 0-2% phenocrysts (and xenocrysts) of pyroxene, pyroxene-olivine aggregates, quartz and potassium feldspar. Rare granitic xenoliths also occur in this unit. Mafic lavas of Lobato Mesa were primarily emplaced over a 1.5 Ma span (9.0 to 10.5 Ma), with the bulk of the eruptions occurring between 9.5 to 10 Ma

Tlbb—Lobato Formation basalt flow (Miocene)—On the eastern flank of Lobato Mesa, three groups of mafic lavas are distinguished that overlie undifferentiated Tlb lavas. These include olivine-phyric basalts of La Sotella shield (Tlbs) that contain 2-15% 1-8 mm euhedral plagioclase phenocrysts overlain by basaltic lavas containing 2-10% phenocrysts of 1-3 mm mafic phenocrysts (olivine±pyroxene) mapped as Tlb1. The youngest lavas occur at the southern portion of the mesa, erupted from a vent near La Bentolera. These distinctive lavas (Tlbb) have a crystalline matrix and are nearly aphyric, containing 0-2% phenocrysts (and xenocrysts) of pyroxene, pyroxene-olivine aggregates, quartz and potassium feldspar. Rare granitic xenoliths also occur in this unit. Mafic lavas of Lobato Mesa were primarily emplaced over a 1.5 Ma span (9.0 to 10.5 Ma), with the bulk of the eruptions occurring between 9.5 to 10 Ma

Tlbo—Lobato Formation basalt flow (Miocene)—Basalts that exhibit abundant olivine phenocrysts (typically altered to iddingsite) are identified as Tlbo, while a younger series of olivine-poor, plagioclase-rich lavas are mapped as Tlbp(not on map).

Tld1—Lobato Formation dacite lavas (Miocene)—At least two large volume dacitic lavas were erupted during Lobato Formation volcanic activity in the quadrangle. The younger lava, Tld1, was erupted from a vent source at Los Cerritos in the southwest area of the quadrangle and covers at least 3 km2, flowing in a northeasterly direction. The lava is beige in color, fine-grained with 2-6% phenocrysts of plagioclase and minor hornblende. A brecciated, block and ash-flow horizon is locally exposed in lower and distal portions of the flow. This flow caps all Lobato mafic lava flows erupted from the Los Cerros shield to the east. An age of 9.6±0.15 Ma (Goff et al., 1989) for this unit provides an upper age limit for Lobato-age volcanic activity in this area of the quadrangle. The flow also provides a superb stratigrahic marker for a major down-to-the-east fault that offsets the flow by at least 100 meters along its eastern edge. Older dacitic flow(s) (Tld2) are intercalated with Lobato mafic lavas. These flow(s) are similar in appearance to younger Tschicoma dacite lavas (Tt), moderately to coarsely porphyritic with 20-25% phenocrysts of plagioclase (up to 0.7 cm), biotite and hornblende. Three isolated exposures of these lavas are exposed near Los Cerritos with another group of exposures in Rio del Oso at the south end of Lobato Mesa. In this area Lobato mafic lavas underlie and overlie the porphyritic dacite. Maximum thickness of Tld1 is exceeds 100 meters, Tld2 is approximately 75 meters.

Tld2—Lobato Formation dacite lavas (Miocene)—At least two large volume dacitic lavas were erupted during Lobato Formation volcanic activity in the quadrangle. The younger lava, Tld1, was erupted from a vent source at Los Cerritos in the southwest area of the quadrangle and covers at least 3 km2, flowing in a northeasterly direction. The lava is beige in color, fine-grained with 2-6% phenocrysts of plagioclase and minor hornblende. A brecciated, block and ash-flow horizon is locally exposed in lower and distal portions of the flow. This flow caps all Lobato mafic lava flows erupted from the Los Cerros shield to the east. An age of 9.6±0.15 Ma (Goff et al., 1989) for this unit provides an upper age limit for Lobato-age volcanic activity in this area of the quadrangle. The flow also provides a superb stratigrahic marker for a major down-to-the-east fault that offsets the flow by at least 100 meters along its eastern edge. Older dacitic flow(s) (Tld2) are intercalated with Lobato mafic lavas. These flow(s) are similar in appearance to younger Tschicoma dacite lavas (Tt), moderately to coarsely porphyritic with 20-25% phenocrysts of plagioclase (up to 0.7 cm), biotite and hornblende. Three isolated exposures of these lavas are exposed near Los Cerritos with another group of exposures in Rio del Oso at the south end of Lobato Mesa. In this area Lobato mafic lavas underlie and overlie the porphyritic dacite. Maximum thickness of Tld1 is exceeds 100 meters, Tld2 is approximately 75 meters.

Tlpb—Undescribed unit (Miocene)—Not described by author.

Tlpbc—Undescribed unit (Miocene)—Likely related to Tlpb, not described by author.

Tls—Undescribed unit (Miocene)—Not described by author.

Tsto—Ojo Caliente Member of the Tesuque Formation of the Santa Fe Group (Miocene)—Light brown to light pink fine- to medium-grained sand, subrounded to rounded, moderately to well sorted. Planar sand sheets to high-angle crossbeds of eolian origin (suggesting a prevailing paleowind direction to the northeast. Thin fluvial layers occur in the upper portions, containing rounded pebbles of various volcanic lithologies and lesser quartzite and granite. This unit is generally weakly consolidated and seldom outcrops where overlain by Lobato mafic lavas. Its presence often indicated by tan quartz sand amongst basalt colluvium, along with occasional fluvial pebbles. On Lobato Mesa, fluvial sandstones containing abundant clasts of Lobato mafic lavas may correspond to Ojo Caliente sandstone. The age of the Ojo Caliente sandstone is interpreted to range from 13.4 to 12.5 Ma (Koning et al., 2007). Maximum thickness in the quadrangle (along the eastern margin of Lobato Mesa, is approximately 275 meters.

Tstc—Chama-El Rito Member of the Tesuque Formation of the Santa Fe Group (Miocene)—Light pink to reddish brown floodplain deposits of siltstone, mudstone, fine-grained sandstone and thin channels of low-angle crossbedded channel gravels. In contrast to the Ojo Caliente member which tends to have massive, poorly-consolidated eolian sandstone beds, the Chama-El Rito sediments tend to be moderately consolidated, with alternating planar to low cross-stratified beds of varying shades of pink to brown. Fluvial channels contain rounded volcanic pebbles of intermediate and felsic composition, poorly to moderately sorted. These channels are typically cemented by calcium carbonate. The age of the unit is 18 to 13.4 Ma (Koning et al., 2007). Maximum thickness of the deposit, approximately 100 meters, is exposed in the northeastern corner of the quadrangle.

Tsf—Undifferentiated Santa Fe Group deposits (Miocene)—Undifferentiated Santa Fe Group deposits (most likely Ojo Caliente Member).

Abiquiu Fm?—Abiquiu Formation? (Oligocene)—Only present in cross-section. Not described by author.

Geologic Cross Section A–A'