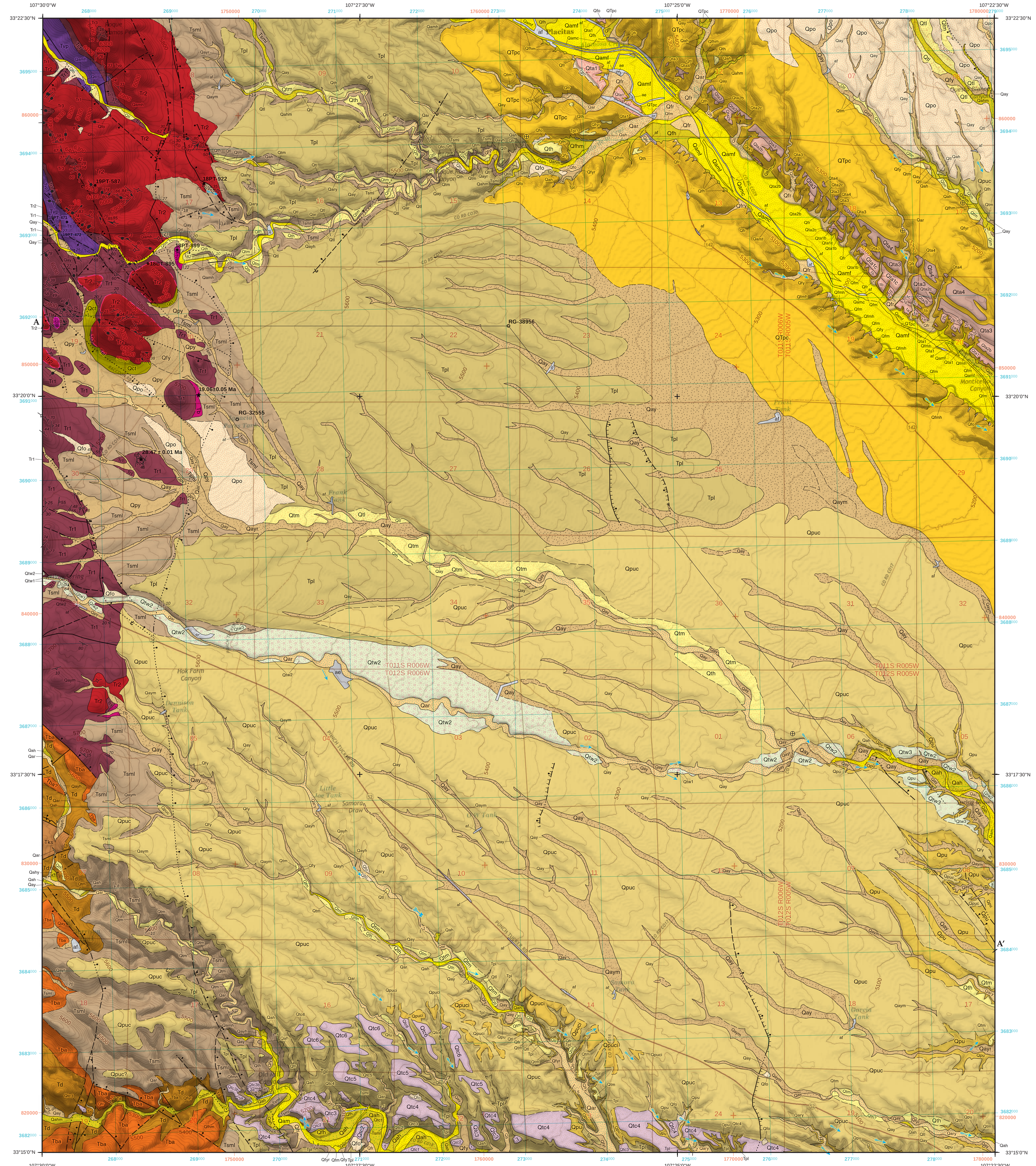
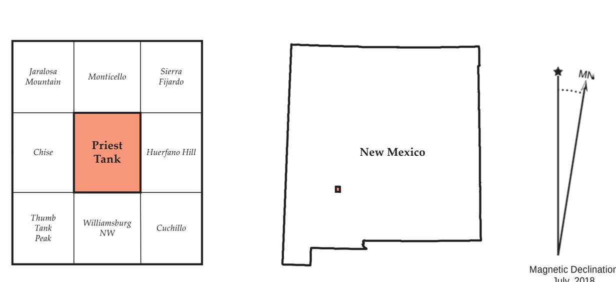


Base map from U.S. Geological Survey 2017.
North American Datum of 1983 (NAD83) World Geodetic System of 1984 (WGS84).
Projection and 1,000-meter grid: Universal Transverse Mercator, Zone 13S, shown in blue.
10,000-foot ticks: New Mexico Coordinate System of 1983 (west zone), shown in red.

Roads....U.S. Census Bureau, 2015-2016
Names....GNIS, 2016
Hydrography....National Hydrography Dataset, 2014
Contours....IFSAR 4.5 m Digital Elevation Model, 2008

1:24,000

Contour Interval 20 Feet
North American Vertical Datum of 1988



Quadrangle Location

New Mexico Bureau of Geology and Mineral Resources
Open-File Geologic Map 275

Mapping of this quadrangle was funded by a matching-funds grant from the STATEMAP program of theNational Cooperative Geologic Mapping Act (Fund Number: G18AC00201), administered by the U. S. Geological Survey, and by the New Mexico Bureau of Geology and Mineral Resources, (Dr, Nelia W. Dunbar, *Director and State Geologist*, Dr. J. Michael Timmons, *Assoc. Director for Mapping Programs*).

Geologic Map of the Priest Tank 7.5-Minute Quadrangle, Sierra County, New Mexico

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

http://geoinfo.nmt.edu

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map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation.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

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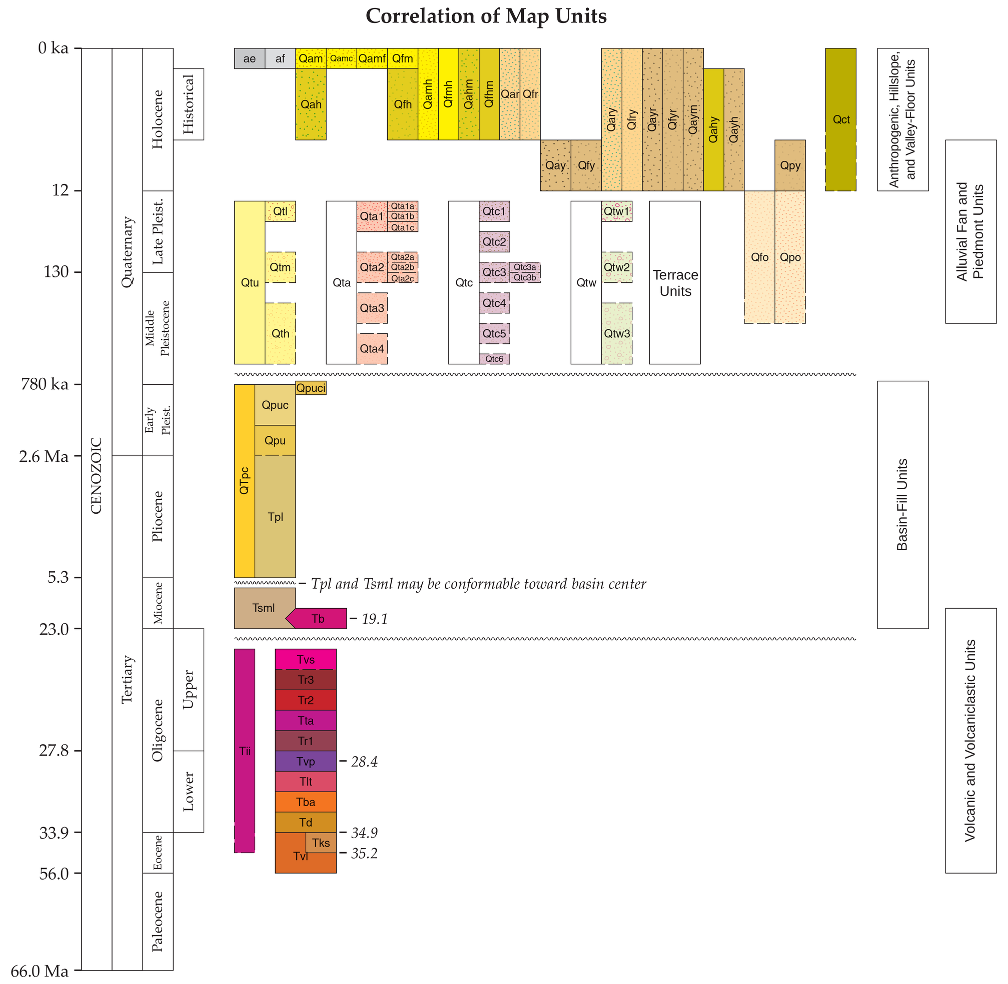
Digital layout and cartography by the NMBGMR Map Production Group:
Phil L. Miller, Amy L. Dunn, Katherine J. Sauer, and Kelly K. Boyd

Correlation of Map Units



Explanation of Map Symbols

Contact—Identity and existence are certain and questionable where queried. The location is accurate where solid and appoximate where dashed.

Gradational contact—Identity and existence are certain. The location is accurate where solid and appoximate where dashed.

Unconformity in the Correlation of Map Units

Normal fault—Identity and existence are certain and questionable where queried. The location is accurate where solid, appoximate where dashed, and concealed where dotted. The bar and ball are on the downthrown block.

Scarp on normal fault—Identity and existence are certain. The location is accurate where solid, and approximate where dashed. The bar and ball are on the downthrown block, and the hatchures point downscarp.

Generic Fault—Identity and existence are certain and questionable where queried. The location is accurate where solid, appoximate where dashed, and concealed where dotted.

Thin flow of trachyandesite—Identity and existence are certain. The location is accurate where solid and approximate where dashed.

Fault (in cross section)—Arrows show the relative motion along the axis of the fault.

Fluvial transport direction

Sediment transport direction as determined from imbrication.

Vertical or near-vertical fault shown along a fault line.

Inclined fault— The arrow shows the direction of dip and the inclination

Minor vertical or near-vertical fault

Minor inclined joint

Minor vertical or near-vertical joint

Minor inclined (dip direction to right) joint, for multiple observations at one locality.

Minor inclined (dip direction to left) joint, for multiple observations at one locality.

Horizontal bedding

Inclined bedding

Apparent inclination of bedding

Inclined eutaxitic (compaction) foliation—Showing strike and dip

Inclined flow banding, lamination, layering, or foliation in extrusive volcanic rock—Showing strike and dip

Vertical flow banding, lamination, layering, or foliation in extrusive volcanic rock—Showing strike

Inclined slickline, groove, or striation on a fault surface

Water well, type unspecified

19PT-308 Sample locality—Showing sample number

19.06±0.02 Ma Selected locality—Location of radiometrically dated sample

A A′ Cross section line

FIGURE 1—Piedmont facies of the lower Palomas Formation (Tpl) in Hok Farm Canyon. This unit consists of pebble-cobble gravel and subordinate silt-sand. Gravel are commonly calcite-cemented and imbricated to low-angle planar cross-stratified with foresets up to 20 cm tall. These were deposited in channels crossing a low-gradient bajada north of present-day Cuchillo Negro Creek. The unit also features massive, fine-grained deposits with floating clasts deposited by hyperconcentrated flows (not pictured). Most calcite in Tpl is groundwater-related, forming sharp internal contacts. Walking stick (white oval) is approximately 1.5 m tall. 13S 272330 mE, 3683900 mN NAD83.

FIGURE 2—Faulted lower and middle Santa Fe Group (Tsml) in Roque Ramos Canyon. Lower facies are conglomerates that range from internally massive to vaguely cross-stratified. These are capped by light-brown (7.5YR 6/4), massive to laminated, very fine- to coarse-grained sandstone. Conglomerate-sandstone contact is offset by two faults in center-left of photo. This unit typically underlies the Palomas Formation with angular unconformity of up to 10–12°. Largest boulders in and alongside channel are up to 1.7 m long. 13S 269200 mE, 3692845 mN NAD83.

Description of Map Units

QUATERNARY
Anthropogenic, Hillslope, and Valley-Floor Units

af **Anthropogenic Artificial Fill**—Thick accumulations of sediment used as road fill along New Mexico Highway 52 as well as levees or berms. 1–8 m thick.

ae **Anthropogenic Excavated Ground**—Disturbed and excavated ground at former borrow pits.

Qct **Colluvium and Talus, undivided**—Loose, poorly sorted, angular to subrounded cobble-boulder gravel forming aprons or mantles at the footslopes of volcanic uplands in the western part of the quadrangle. <5 m thick.

Qam **Modern Alluvium**—Loose, sandy gravel or pebbly sand forming bars and underlying modern channels in ephemeral drainages. Gravel are commonly imbricated, poorly to moderately sorted, subangular to well-rounded, and consist of mostly volcanic lithologies. In longitudinal bars and at channel margins are sandy pebble–cobble and pebble–cobble–boulder gravel deposits; estimated clast proportions are 65–90% pebbles, 10–35% cobbles, and 0–15% boulders. Sand is dark grayish-brown to brown or grayish-brown (10YR 4/2-3; 5/2) and consists of mL-vcU grains composed of 65–70% lithics (volcanics, ferromagnesian minerals), 15–20% feldspar, and 10–15% quartz with no clay. At channel margins, sand or gravel may underlie thin deposits of light yellowish-brown (10YR 6/4) silt to vfU sand. In places, these deposits are several 10s of cm thick and exhibit thin horizontal-planar laminations. No topsoil present. Bar-and-swale topography and occasional steep-walled channels characterize the surface, exhibiting up to 0.6 m of relief. Thickness is 1–3 m. In Monticello Canyon, this deposit is subdivided into fine and coarse facies that obscure historical alluvium (Qah):

Qamc **Coarse-Grained Modern Alluvium in Monticello Canyon**—Gravelly deposits in channelized (single-thread) portions of Monticello Canyon. Gravels are also occasionally found in breaches across natural or artificial levees, deposited during large flood events. Thickness is 1–3 m.

Qamf **Fine-Grained Modern Alluvium in Monticello Canyon**—Clayey to sandy deposits capping the modern floodplain of Monticello Canyon, deposited during large flood events. Color is typically brownish (10YR) and the deposit obscures historical alluvium (Qah). Thickness is 1–2 m.

Qamh **Modern and Historical Alluvium, undivided**—Modern alluvium (Qam) and subordinate historical alluvium (Qah). See detailed descriptions of each unit.

Qar **Recent (Historical + Modern) Alluvium**—Historical alluvium (Qah) and modern alluvium (Qam) in approximately equal proportions. See detailed descriptions of each unit.

Qary **Recent (Historical + Modern) and Younger Alluvium, undivided**—Recent alluvium (Qah + Qam) and subordinate younger alluvium (Qay). See detailed descriptions of each unit.

Qah **Historical Alluvium**—Loose, pebbly silt-sand and sandy gravel in thin to thick (7–40 cm), tabular to lenticular beds underlying low terraces along valley floors. Very weakly to moderately calcareous and massive to moderately well-imbricated or trough cross-stratified. Gravel consist of mostly clast-supported, poorly sorted, subangular to rounded pebbles (typically >85–90%) with up to 30% cobbles and 0–10% small boulders in places. Clast lithologies are mostly volcanics with 10–20% Paleozoic sedimentary lithologies observed in Cuchillo Negro Creek. Matrix consists of dark grayish-brown to brown (10YR 4/2-3), very poorly to poorly sorted, subangular to rounded, fU-vcL sand composed of 70–80% lithics (volcanics>ferromagnesian minerals), 15–20% feldspar, and 10–15% quartz with no clay. Deposit is occasionally capped by 0.3–0.4 m of brown to yellowish-brown (10YR5/3-4), massive to horizontal-planar laminated, pebbly (10–20%) silt to fU sand. This deposit is particularly dominant in Questa Blanca Canyon. No topsoil observed. Bar-and-swale surface relief up to 0.35 m is observed. Tread height is 0.7–0.9 m above modern grade. Maximum thickness is <5 m.

Qahm **Modern and Historical Alluvium, undivided**—Historical alluvium (Qah) and subordinate modern alluvium (Qam). See detailed descriptions of each unit.

Qahy **Historical and Younger Alluvium, undivided**—Historical alluvium (Qah) and subordinate younger alluvium (Qay). See detailed descriptions of each unit.

Qay **Younger Alluvium**—Loose silt-sand and gravel in non-stratified or thin to thick (8–60 cm), tabular to lenticular beds. Weakly calcareous and internally massive to well-imbricated or trough cross-stratified. Gravel consist of mostly clast-supported, very poorly to poorly sorted, subangular to well-rounded pebbles (60–100%), cobbles (0–30%), and boulders (0–15%) of mostly volcanic lithologies. Matrix consists of dark brown to brown (10YR 3/3-4), very poorly sorted, subangular to rounded, fL-vcU sand composed of 85–90% lithics (volcanic) and 10–15% quartz + feldspar with 5–10% dark brownish clay films. Deposit is capped by a 0.2-m-thick A horizon formed in brown (10YR 4/3), pebbly (20-25%, subrounded to rounded, fine to coarse), silt to cL sand of similar composition to gravel matrix but lacking clay. This silty sand is more common in downstream locations across thequadrangle. Rare thin lenses of pebbly, fine to coarse sand are also observed. Calcic soils with stage I carbonate accumulation are rare. Weak varnishing on up to 5% of surface clasts. Commonly bioturbated by fine to very coarse roots and burrows. Tread height is 1–3 m above modern grade. Thickness is 1.0–10.5 m (thicker downstream and in larger drainages).

Qaym **Younger and Modern Alluvium, undivided**—Younger alluvium (Qay) and subordinate modern alluvium (Qam). See detailed descriptions of each unit.

Qayh **Younger and Historical Alluvium, undivided**—Younger alluvium (Qay) and subordinate historical alluvium (Qah). See detailed descriptions of each unit.

Qayr **Younger and Recent (Historical + Modern) Alluvium, undivided**—Younger alluvium (Qay) and subordinate recent alluvium (Qah + Qam). See detailed descriptions of each unit.

Terrace Units

Qtg **Terrace Gravels, undivided**—Loose to weakly consolidated gravel and minor sand [illegible]

Qtl **Lower Terrace Gravel**—Tread lies 2–6 m above valley floors.

Qtm **Middle Terrace Gravel**—Tread lies 4–18 m above valley floors.

Qth **Higher Terrace Gravel**—Tread lies 8–42 m above valley floors.

Terrace Gravels of Alamosa Creek, undivided—Loose to weakly consolidated gravel in [illegible] Subdivided into four to eight allostratigraphic subunits distinguished by tread height above modern grade:

Qta1 **Lower Terrace Gravel of Alamosa Creek**—Tread lies 8–13 m above modern grade. Three subunits, Qta1a, Qta1b, and Qta1c, can be differentiated that differ 2–3 m in geomorphic height. Thickness is 1–2 m.

Qta1a **Lower Terrace Gravel of Alamosa Creek**—Subunit Qta1a

Qta1b **Lower Terrace Gravel of Alamosa Creek**—Subunit Qta1b

Qta1c **Lower Terrace Gravel of Alamosa Creek**—Subunit Qta1c

Qta2 **Lower-Middle Terrace Gravel of Alamosa Creek**—Tread lies 30–42 m above modern grade. Three subunits, Qta2a, Qta2b, and Qta2c, can be differentiated that differ 2–5 m in geomorphic height. Thickness is 2–12 m, thinning upstream.

Qta2a **Lower-Middle Terrace Gravel of Alamosa Creek**—Subunit Qta2a

Qta2b **Lower-Middle Terrace Gravel of Alamosa Creek**—Subunit Qta2b

Qta2c **Lower-Middle Terrace Gravel of Alamosa Creek**—Subunit Qta2c

Qta3 **Upper-Middle Terrace Gravel of Alamosa Creek**—Deposit commonly features matrix-supported pebble gravel in upper 1.5 m, where it is overprinted by a stage III calcic soil. Moderate to strong varnish observed on 35–45% of clasts at surface. Tread lies 45–56 m above modern grade. Maximum thickness is 9 m.

Qta4 **Upper Terrace Gravel of Alamosa Creek**—Deposit commonly features strong calcic soil development in upper 2 m, including stage III soil in upper 1.5 m. Weak to moderate varnish observed on 10–25% clasts at surface (obscured by carbonate coats/rinds). Tread lies 52–70 m above modern grade. Maximum thickness is 7 m.

Terrace Gravels of Cuchillo Negro Creek, undivided—Loose to weakly consolidated gravel in [illegible] distinguished by tread height above modern grade:

Qtc1 **Lower Terrace Gravel of Cuchillo Negro Creek**—Deposit commonly features [illegible] Weak varnish observed on 10–15% of clasts at surface. Tread lies 4–11 m above modern grade. Thickness is 2–4 m.

Qtc2 **Lower Terrace Gravel of Cuchillo Negro Creek**—Deposit commonly features stage I calcic soil in upper [illegible]. Weak varnish observed on up [illegible] above modern grade. Thickness is 4–11 m.

Qtc3 **Lower-Middle Terrace Gravel of Cuchillo Negro Creek**—Topsoil commonly eroded. Weak to moderate varnish observed on 40–45% clasts at surface. Tread lies [illegible] above modern grade. Two subunits, Qtc3a and Qtc3b, can be differentiated that differ several m in geomorphic height. Thickness is [illegible].

Qtc3a **Lower-Middle Terrace Gravel of Cuchillo Negro Creek**—Subunit Qtc3a

Qtc3b **Lower-Middle Terrace Gravel of Cuchillo Negro Creek**—Subunit Qtc3b

Qtc4 **Upper-Middle Terrace Gravel of Cuchillo Negro Creek**—Deposit occasionally features stage III calcic soil in upper part. Weak to moderate varnish observed on [illegible] of clasts at surface. Tread lies 51–67 m above modern grade. Thickness is [illegible].

Qtc5 **Upper Terrace Gravel of Cuchillo Negro Creek**—Tread lies 65–80 m above modern grade.

Qtc6 **Uppermost Terrace Gravel of Cuchillo Negro Creek**—Tread lies 85-95 m above modern grade.

Terrace Gravels of Willow Spring Draw, undivided—Loose to weakly consolidated gravel and silt-sand in medium to very thick (20–130 cm), mostly lenticular beds. [illegible] Deposit lacks bar-and-swale topography and clast varnishing. Thickness is 2–5 m. Subdivided into three allostratigraphic subunits distinguished by tread height above modern grade:

Qtw1 **Lower Terrace Gravel of Willow Spring Draw**—Weak varnish observed on 10–20% clasts at surface. Tread lies 1–4 m above modern grade.

Qtw2 **Middle Terrace Gravel of Willow Spring Draw**—Most extensive Willow Spring Draw terrace deposit in quadrangle. Weak to moderate varnish observed on 15–20% clasts at surface. Tread lies 6–11 m above modern grade.

Qtw3 **Upper Terrace Gravel of Willow Spring Draw**—Deposit commonly features stage I calcic soil (occasionally eroded) in upper part. Weak to moderate varnish observed on 30–45% clasts at surface. Tread lies 8–12 m above modern grade.

Alluvial Fan and Piedmont Units

Qfm **Modern Fan Alluvium**—Loose, sandy gravel underlying fan channels, bars, and levees. [illegible]

Qfmh **Modern and Historical Fan Alluvium, undivided**—Modern (Qfm) and subordinate historical fan alluvium (Qfh). See detailed descriptions of each unit.

Qfr **Recent (Historical + Modern) Fan Alluvium**—Historical (Qfh) and modern fan alluvium (Qfm) in approximately equal proportions. See detailed descriptions of each unit.

Qfry **Recent (Historical + Modern) and Younger Fan Alluvium, undivided**—Recent (Qfh + Qfm) and subordinate younger fan alluvium (Qfy). See detailed descriptions of each unit.

Qfh **Historical Fan Alluvium**—[illegible]

Qfhm **Historical and Modern Fan Alluvium, undivided**—Historical (Qfh) and subordinate modern fan alluvium (Qfm). See detailed descriptions of each unit.

Qfy **Younger Fan Alluvium**—[illegible]

Qfyr **Younger and Recent (Historical + Modern) Fan Alluvium, undivided**—Younger (Qfy) and subordinate recent (Qfh + Qfm) fan alluvium. See detailed descriptions of each unit.

Qfo **Older Fan Alluvium**—[illegible]

Qpy **Younger Piedmont Alluvium**—[illegible]

Qpo **Older Piedmont Alluvium**—[illegible]

QUATERNARY-TERTIARY
Basin-Fill Units

QTpc **Coarse Piedmont Facies of the Palomas Formation, undivided**—A thick package of loose to somewhat consolidated, stacked gravels and minor sand in medium to thick (20–70 cm), mostly tabular (occasionally lenticular) beds exposed on either side of Monticello Canyon. Gravel are clast-supported and well-imbricated to planar cross-stratified (foresets up to 40 cm tall). Clasts consist of very poorly to poorly sorted, subangular to well-rounded pebbles (55–100%) and cobbles (0–45%) of approximately two-thirds felsic volcanics, one-third intermediate volcanics, and trace to 2% jasperoid and basalt (visual estimate). Matrix consists of reddish brown (5YR 5/3-4), non- to weakly calcareous, very poorly sorted, subangular to rounded, fL-vcL sand (15–20% vcU sand to granules) of mostly volcanic grains with 20–30% reddish clay bridges and films. Less common (<5–10%) are beds of reddish brown (5YR 5/4), loose to weakly consolidated, non-calcareous, massive to tabular, medium- to thick-bedded (25+ cm), internally massive, poorly to moderately sorted, subrounded to rounded, vfU-mU sand (5–10% coarse to very coarse sand), composed of 70–80% lithics (volcanic), 15–20% feldspar, and 10–15% quartz with abundant clay occurring as films on coarser grains. These deposits contain 3–7% floating pebbles (fine to coarse) and become browner (7.5YR 5/4) in the upper 20 cm. Illuviated clay (Bt) horizons may be observed in places and are 30–35 cm thick. Well data indicates that this unit may be as much 105–115 m thick.

Qpuc **Upper Coarse Piedmont Facies of the Palomas Formation**—Loose to weakly consolidated, sandy channel-fill gravel intercalated with minor silt-sand and sand in thick (50–80 cm), broadly lenticular beds. Deposits are internally massive (silt-sand) or well-imbricated (gravel) and may exhibit lateral accretion sets dipping 25–30° in places, as well as normal grading within beds. Clasts consist of clast-supported, very poorly to poorly sorted, subrounded to rounded pebbles (40–80%), cobbles (20–60%), and boulders (trace to 3%) up to 45 cm across. Clast lithologies include mostly volcanics with up to 35% Paleozoic sedimentary lithologies and 10% monzonite porphyry in the southern part of the quadrangle. Matrix consists of reddish brown (5YR 4/4), moderately to strongly calcareous, very poorly sorted, subangular to rounded, mL-vcL sand (5% vcU sand to granules) composed of 80–85% lithics (volcanic), ≈10% feldspar, and 5–10% quartz. Minor deposits include: (A) <10% beds of light brown (7.5YR 6/3), slightly bioturbated (massive), well-sorted silt to very fine sand; and (B) <5% beds of sand similar to gravel matrix but grayish (10YR7) and with horizontal-planar laminations or planar crossbeds (foresets up to 20 cm tall). Commonly scours underlying units (e.g., Qpu) by up to 0.8 m. Unit may feature a stage IV K horizon at its top that is up to 0.6 m thick. At its base, an illuviated clay (Bt) horizon is sometimes observed where little scour has occurred. This unit is distinguished from QTpc by greater variety in and proportion of non-gravel beds and a greater array of sedimentary structures.

Qpuci **Upper Coarse Piedmont Facies of the Palomas Formation, inset subunit**—Gravel bed(s) as in Qpuc but underlying a mostly erosional surface inset into local aggradational surfaces by 2–7 m in the southern part of the quadrangle. Moderate to very strong varnish observed on up to 65% of clasts at surface.

Qpu **Upper Piedmont Facies of the Palomas Formation**—Weakly to moderately consolidated, sandy mud interbedded with subordinate silt and sandy channel-fill gravel in medium to very thick (20–110 cm), tabular to lenticular beds. Internally massive (silt and mud) to moderately well-imbricated or trough cross-stratified with possible lateral accretion sets (gravel). Mud constitutes up to 60% of unit by volume and is yellowish-red (5YR 5/6), weakly calcareous, and rarely low-angle cross-laminated. Contains <5% subrounded to rounded, vfL-mU sand grains that are mostly volcanic lithics. Rare stringers or lags of vaguely imbricated, subrounded to rounded, fine to coarse pebbles. Muddy beds feature common cambic (Bw) soil development with occasional stage II carbonate accumulation as nodules (Btk or Bk horizons). Gravel constitutes 20–35% of unit by volume and consists of non- to very weakly calcareous, mostly clast-supported, poorly sorted, subrounded to well-rounded pebbles (75–90%) and cobbles (10–25%). Clast lithologies include subequal proportions of felsic and intermediate volcanics with minor amounts of feldspar porphyry, Paleozoic sedimentary lithologies, and carbonate nodules (<5% each). Gravel matrix consists of reddish brown (5YR 4/3-4), poorly sorted, subangular to rounded, vfU-mU (10% cL-vcL) sand composed of 80–90% lithics (volcanic), 10–15% quartz, and 5–10% feldspar with up to 30% reddish clay bridges and films. Silt-sand constitutes 15–20% of unit by volume and is brown (7.5YR 5/4), strongly calcareous, internally massive, and moderately well-sorted. Contains 25–40% subangular to rounded, vfL-cU sand grains composed of 85–90% lithics (volcanic) and 10–15% quartz + feldspar with 0% to trace reddish clay chips. Silt-sand also contains trace to 3% floating subangular to rounded, fine to medium pebbles and cobbles of volcanic lithologies. Common clay-lined, fine to medium root casts. Overall, unit is 0–35 m thick.

Tpl **Lower Piedmont Facies of the Palomas Formation**—Weakly to moderately consolidated, sandy gravel and minor sand in thin to thick (5–65 cm), tabular to lenticular beds. Gravel are commonly carbonate-cemented and moderately to well-imbricated or low-angle planar cross-stratified (foresets <20 cm tall) to trough cross-stratified or internally massive. Clasts consist of mostly clast-supported, very poorly to poorly sorted, subrounded to rounded pebbles (60–100%), cobbles (0–40%), and small boulders (0–3%) of mostly volcanic lithologies with <10% Paleozoic carbonates and minor proportions of tuffs and monzonite. Matrix consists of brown to dark brown (7.5YR 4/3-4 to 3/3) or occasionally reddish brown (5YR 4/4), weakly to strongly calcareous, very poorly to poorly sorted, subangular to rounded, fU-vcL sand composed of 70–90% lithics (volcanic), <20% quartz, and 5–15% feldspar with 5–20% brownish clay films and bridges. Unit contains rare to occasional (<10–15%) lenses of brown (7.5YR 5/3), weakly to moderately calcareous (not cemented), trough cross-stratified, moderately sorted, subrounded to rounded, mU-vcU sand composed of similar lithologies as gravel matrix. Also present are rare (<5–7%) beds of medium- to thick-bedded (20–85 cm), tabular, internally massive, pebbly silt to fine sand (5–10% floating fine to very coarse pebbles). Soils are very rare and most carbonate is groundwater-related with sharp contacts and concentrated in coarser layers. Thickness is 0–150 m.

Tsml **Lower and Middle Santa Fe Group, Piedmont Facies**—Conglomerate and subordinate sandstone in thin to thick (4–85 cm), tabular beds (minor lenticular or trough-shaped beds). Conglomerate is moderately to strongly indurated, calcite-cemented, and internally massive to moderately imbricated or vaguely trough cross-stratified; it may be either normal- or reverse-graded. Clasts consist of mostly clast-supported, very poorly to poorly sorted, subangular to rounded pebbles (55–100%), cobbles (0–45%), and boulders (<1 to 20%) of volcanic lithologies; intermediate volcanics dominate along Cuchillo Negro Creek whereas felsic clasts are most common near Roque Ramos Canyon. Conglomerate matrix consists of light reddish-brown to pink (5YR 6-7/3) or pinkish-gray to light-brown (7.5YR 6-7/2, 6/3), moderately calcareous, very poorly to poorly sorted, subangular to rounded, mL-cU (≈5% vcL-vcU) sand composed of 55–80% lithic (volcanic) and 15–45% quartz + feldspar grains. Occasional conglomerate beds feature up to ≈30% pinkish clay cement; beds in the northwestern part of the quadrangle typically lack clay. Sandstone beds constitute up to ≈20% of unit by volume and are pink or pinkish gray to light-brown (7.5YR 6-7/2-3; 6/4) or, less commonly light reddish-brown to reddish-yellow (5YR 6/4-6), weakly to moderately consolidated, calcareous, and internally massive to thickly horizontal-planar laminated. Sand is very poorly to poorly sorted, angular to rounded, silty, and consists of vfL-cU grains composed of 35–50% quartz, 15–45% lithics (volcanic), and 5–45% feldspar with <5–8% pinkish red clay bridges. Strongly oxidized layers of sand up to 5 cm thick are observed in places. Sandstones may contain 7–10% floating fine to coarse pebbles (subangular to subrounded) of felsic volcanic lithologies in the northern part of the quadrangle. Rarely, unit contains sandstone beds similar to conglomerate matrix but more pebbly and thin- to medium-bedded (7–30 cm) with abundant pinkish to reddish clay bridges and films. Total thickness is >400 m.

TERTIARY
Volcanic and Volcaniclastic Units

Tb **Basalt**—Poorly exposed, vesicular olivine basalt flows and small intrusive plugs and dikes feeding flows. Corresponds to olivine basalt (unit QTb) of Heyl et al. (1983). $^{40}Ar/^{39}Ar$-dated at 19.06 ± 0.05 Ma by McLemore et al. (2012). Likely <10 m thick [modified from Heyl et al. (1983)].

Tvs **Volcaniclastic Sediment**—Weakly consolidated conglomerate in non-stratified to thick (>60 cm) beds. Clasts consist of matrix-supported, subrounded to rounded pebbles (70–90%) and cobbles (10–30%) of mostly quartz-rich pumice with subordinate light grayish rhyolite containing 4–5% medium to coarse quartz and trace plagioclase phenocrysts. Rare clasts of reddish-brown to purplish, aphanitic andesite <3 cm in diameter may also be present. Tuffaceous matrix consists of very poorly sorted, subangular to rounded, silt to cU-sized particles of >70% lithics (mostly pumice and rhyolite), ≈20% quartz, and ≈10% feldspar (mostly sanidine). This unit grades upward into a buff-colored, clast-supported, pebble-cobble conglomerate with <65% cobbles of mostly quartz-phyric rhyolite. At its top, the unit is a yellowish-tan, pebbly, medium- to very coarse-grained sandstone with a more heterogeneous clast assemblage. Unit is exposed only in Roque Ramos Canyon near the western quadrangle boundary where it underlies Tsml with angular unconformity. Total thickness unknown but probably <15–25 m.

Tii **Intrusive Intermediate Rocks**—Slope-forming, very dark-gray or black, weathering dark-gray to reddish-brown, non-vesicular, massive, porphyritic, intrusive rocks of intermediate composition. Phenocrysts include 3–5% medium quartz (1–3 mm; anhedral), 1–4% medium feldspar (1–3 mm; anhedral to subhedral), and 1–2% fine to medium biotite (0.5–2 mm; subhedral). Occasional cumulophyric texture. Nearly all phenocrysts are strongly altered, featuring halos of whitish, dusty appearance. Feldspars are commonly sericitized and this alteration complicates their exact identification. Whole-rock geochemistry indicates that this rock is similar in composition to trachyandesite (57.99 wt% SiO_2, 6.97 wt% $Na_2O + K_2O$). Forms a small stock or plug in Roque Ramos Canyon. Corresponds to unit Td2 of Heyl et al. (1983).

Tr3 **Upper Rhyolite**—Rubbly weathering rhyolite that is petrographically similar to older rhyolite flows but nearly always massive. Contains 15–20% phenocrysts of quartz and sanidine in a light-gray groundmass. Unit exhibits a dome-like geometry in places. Exposed thickness is up to 35 m.

Tr2 **Middle Rhyolite**—Slope- to ledge-forming, purplish to light-gray, weathering (dark) reddish-brown, well-foliated, porphyritic rhyolite flows and domes. May contain numerous, fist-sized vugs in places; these commonly interrupt foliation. Phenocrysts include 20–25% total quartz + sanidine, with lesser amounts of biotite and plagioclase up to 3.5 mm across. Quartz phenocrysts are more common than sanidine higher in the section, where the latter may be kaolinitized. In a fault block north of Roque Ramos Canyon, the rhyolite weathers light tannish-gray and is non-vesicular and massive. There, the flow contains phenocrysts that include 5–20% medium quartz + sanidine (1–4 mm; anhedral to euhedral), 2–3% very fine to medium pyroxene (<0.5–3.5 mm; subhedral to euhedral; prismatic), 1–3% medium plagioclase (1–2 mm; subhedral; striated), and trace to 1% fine biotite (<1 mm; anhedral to subhedral). Groundmass has strongly frothy appearance. Outcrop faces are manganese-stained in a few locations. The base of this unit contains cobble- to small-boulder-sized rip-ups of andesite (Tta) south of Roque Ramos Canyon. Correlative with the Rhyolite of HOK Ranch of Harrison et al. (1993). Maximum thickness is ≈320 m.

Tta **Trachyandesite**—Very dark-gray or black, weathering grayish-green, massive, dense, aphanitic trachyandesite flow. Commonly columnar-jointed. Flow commonly exhibits scoriaceous texture in upper 0.5 m. Forms a distinct marker bed between lower (Tr1) and middle (Tr2) rhyolite packages. Thickness is 2–3 m.

Tr1 **Lower Rhyolite**—Slope-forming, light-gray, weathering very pale-brown to buff, blocky to spheroidally weathering, well-foliated, porphyritic rhyolite flows. Phenocrysts include 10–15% medium to coarse sanidine (subhedral to euhedral; glassy to chatoyant; commonly shattered), 3–7% medium to coarse quartz (anhedral; clear to smoky), and 1–2% fine to medium biotite (subhedral to euhedral; commonly altered to reddish brown, earthy/dull mineral). Contains trace dark-gray, lapilli-sized lithic fragments. Southeast of Roque Ramos Peak, the unit contains a thin (<10–20 m) interval of white to pinkish gray (7.5YR 8/1 to 5YR 7/2), moderately consolidated, non-calcareous, matrix-supported, thin- to medium-bedded (2–25 cm), tabular, internally massive, poorly to moderately sorted, angular to rounded, volcaniclastic pebble conglomerate. Clast lithologies are bimodal, consisting of dark purplish brown, plagioclase-phyric andesite, and light gray, aphyric rhyolite. Matrix consists of moderately to well-sorted, ashy material with 10–15% outsized cL sand grains to granules of lithics similar to pebble clasts. Matrix also contains fine to medium, intact phenocrysts of quartz and sanidine. Rare beds consisting entirely of ashy material are 2–4 cm thick. Unit is correlative to coarse moonstone porphyritic rhyolite tuff (unit Tort) of Heyl et al. (1983), Rhyolite of Willow Springs of Harrison et al. (1993), and units Tr, Trr, and Trv of the rhyolite-trachyte sequence of Jahns et al. (2006). $^{40}Ar/^{39}Ar$ age of 28.47 ± 0.01 Ma (sample 17PT-193). Thickness is <125 m.

Tvp **Vicks Peak Tuff**—Bench-forming, whitish to very light-gray or very light tan-gray, weathering buff, non-vesicular, massive, aphanitic, rhyolitic ash-flow tuff. Poorly to strongly welded. Phenocrysts include trace to 1% very fine to fine quartz (up to 0.5 mm across; anhedral), trace to 1% fine sanidine (0.5–1 mm; subhedral to euhedral; tabular), and trace fine biotite (0.75–1 mm; subhedral; highly altered). Groundmass is highly devitrified. Contains up to 1% miarolitic cavities lined by drusy quartz and/or sericitized feldspar. Likely an outflow facies of the Vicks Peak tuff (rhyolite) of Furlow (1965) and Farkas (1969). $^{40}Ar/^{39}Ar$ age of 28.4 Ma (McIntosh et al., 1991; Lynch, 2003). Thickness is <120 m.

Tlt **Lapilli Tuff**—Ledge-forming, light purplish-gray, weathering very light-gray or purplish-gray, non-vesicular, porphyritic, rhyolitic ash-flow tuff. Moderately welded and eutaxitic. Fiamme length:width ratios vary from 15:2 to 25:1. Phenocrysts include 3–5% fine to medium biotite (0.5–1.5 mm; anhedral to subhedral; commonly altered), 2–3% medium sanidine (1–2 mm; subhedral to euhedral; tabular; occasionally chatoyant), trace to 2% medium quartz (1–2 mm; euhedral; bipyramidal), and trace to 1% medium plagioclase (1–2 mm; subhedral; striated). Quartz phenocrysts usually occur in lapilli-sized pumice constituting 20–30% of rock and are up to 3 cm across. Devitrified groundmass. Thickness is unknown but probably <10 m.

Tba **Basaltic Andesite**—Rubbly slope- to ledge-forming, very dark-gray to gray or black, weathering brown to grayish-brown, dense to vesicular, thinly foliated, aphanitic basaltic andesite. Phenocrysts include trace to 4% fine to medium pyroxene (anhedral), trace to 2% fine olivine (anhedral), and trace plagioclase. Unit contains up to 5% amygdules filled by calcite or silica. Groundmass may contain trace glass and/or disseminated magnetite. Correlates to units Tb and Tyaf of Heyl et al. (1983), basaltic andesite of Poverty Creek of Harrison et al. (1993), and unit Ta of Jahns et al. (2006). Maximum thickness is estimated at 130 m [modified from Jochems (2015)].

Td **Dacite Flows and Tuffs**—Fine-grained, in part porphyritic dacite flows and. Locally shows good flow banding; elsewhere it is still welded or partly welded tuff that grades into quartz dacite in places and has columnar jointing. Corresponds to unit Tdt of Heyl et al. (1983) and unit Ta of Jahns et al. (2006). Thickness is 90–150 m [description modified from Heyl et al., 1983].

Tks **Kneeling Nun and Sugarlump Tuffs, undivided**—Kneeling Nun and Sugarlump Tuffs mapped by air photo interpretation due to land access restrictions. The Kneeling Nun Tuff contains 15–35% phenocrysts of quartz, sanidine, and biotite. Lithic-rich Sugarlump Tuff contains 3–10% phenocrysts (mostly biotite). $^{40}Ar/^{39}Ar$ ages of 34.9 and 35.2 Ma (McIntosh et al., 1991; Chapin et al., 2004). Total thickness unknown [modified from Jochems (2015)].

Tvl **Lower Volcanic Strata**—Andesitic to rhyolitic tuffs and lavas with intercalated volcaniclastic facies. The upper part is correlative to the Kneeling Nun and Sugarlump Tuffs (Tks). The lower part is partly or entirely correlative to the Rubio Peak Formation and unit Tla of Jahns et al. (2006). Total thickness is unknown. Cross-section only.

REFERENCES

Chapin, C. E., McIntosh, W. C., and Chamberlin, R. M., 2004, The late Eocene-Oligocene peak of Cenozoic volcanism in southwestern New Mexico, in Mack, G. H. and Giles, K. A. eds., The Geology of New Mexico: A Geologic History: New Mexico Geological Society, Special Publication 11, p. 271–293.

Farkas, S. E., 1969, Geology of the southern San Mateo Mountains, Socorro and Sierra Counties, New Mexico [Ph.D. dissertation]: Albuquerque, University of New Mexico, 181 p.

Furlow, J. W., 1965, Geology of the San Mateo Peak area, Socorro County, New Mexico [M.S. thesis]: Albuquerque, University of New Mexico, 83 p.

Harrison, R. W., Lozinsky, R. P., Eggleston, T. L., and McIntosh, W. C., 1993, Geologic map of the Truth or Consequences 30 x 60 minute quadrangle: New Mexico Bureau of Mines and Mineral Resources, Open-File Report 390, scale 1:100,000.

Heyl, A. V., Maxwell, C. H., and Davis, L. L., 1983, Geology and mineral deposits of the Priest Tank quadrangle, Sierra County, New Mexico: U.S. Geological Survey, Miscellaneous Field Studies Map MF-1665, scale 1:24,000.

Jahns, R. H., McMillan, K., and O'Brient, J. D., 2006, Geologic map of the Chise quadrangle, Sierra County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-File Geologic Map OF-GM 115, scale 1:24,000.

Jochems, A. P., 2015, Geologic map of the Williamsburg NW 7.5-minute quadrangle, Sierra County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-File Geologic Map OF-GM 251, scale 1:24,000.

Lynch, S. D., 2003, Geologic mapping and $^{40}Ar/^{39}Ar$ geochronology in the northern Nogal Canyon caldera, within and adjacent to the southwest corner of the Blue Mountain quadrangle, San Mateo Mountains, New Mexico [M.S. thesis]: Socorro, New Mexico Institute of Mining and Technology, 102 p.

McIntosh, W. C., Kedzie, L. L., and Sutter, J. F., 1991, Paleomagnetism and $^{40}Ar/^{39}Ar$ ages of ignimbrites, Mogollon-Datil volcanic field, southwestern New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 135, 79 p.

McLemore, V. T., Heizler, M., Love, D. W., Cikoski, C., and Koning, D. J., 2012, $^{40}Ar/^{39}Ar$ ages of selected basalts in the Sierra Cuchillo and Mud Springs Mountains, Sierra and Socorro Counties, New Mexico, in Lucas, S. G., McLemore, V. T., Lueth, V. W., Spielmann, J. A., and Krainer, K., eds., Geology of the Warm Springs Region: New Mexico Geological Society, Guidebook 63, p. 285-292.

FIGURE 3—Middle rhyolite (Tr2) exposed between Roque Ramos and Bernal Chavez Canyons. Flow foliation or banding is well-defined in Tr2 and is most strongly expressed along planes of coarse, concentrated phenocrysts of quartz and sanidine. Here, chaotic banding implies that the flow either encountered abrupt paleotopography or was deposited in the central part of a small dome. This unit is part of a thick package of Upper Oligocene rhyolite flows and domes overlying the 28.4-Ma Vicks Peak Tuff and correlates to the Rhyolite of HOK Ranch of Harrison et al. (1993). Yucca at upper left is about 1 m tall. 13S 269235 mE, 3694090 mN NAD83.

Geologic Cross Section A–A′