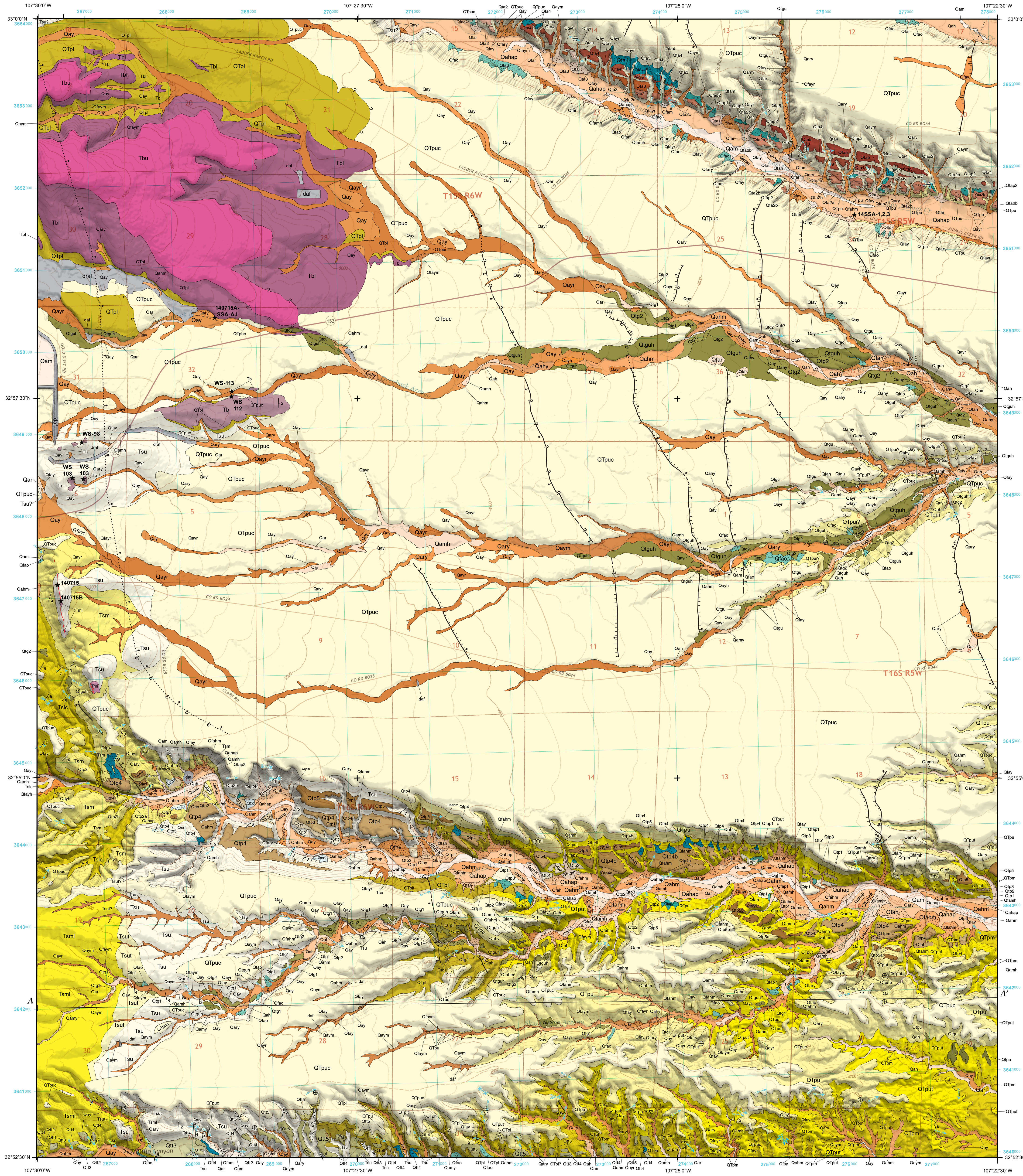


Base map from U.S. Geological Survey 2010.
North American Datum of 1983 (NAD83) World Geodetic System of 1984 (WGS84).
Projection and 1000-meter grid: Universal Transverse Mercator, Zone 13S
10 000-foot ticks: New Mexico Coordinate System of 1983(west zone), shown in blue.

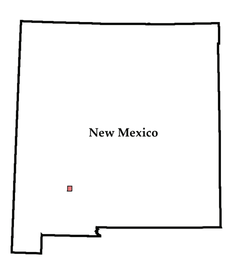
Roads......©2006-2010 Tele Atlas
Names......GNIS, 2008
Hydrography......National Hydrography Dataset, 2005
Contours......National Elevation Dataset, 2000

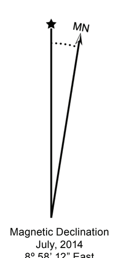
1:24,000

Contour Interval 20 Feet
North American Vertical Datum of 1988

This geologic quadrangle was originally mapped using photogrammetry and field observations at a scale of 1:12,000. This data was then generalized to a scale of 1:24,000 for the publication of this 7.5-minute quadrangle. The 1:12,000 GIS data is available on the New Mexico Bureau of Geology and Mineral Resources website http://geoinfo.nmt.edu/publications/maps/geologic/home.html for download.

Bell Mountain	Saladone Tank	Williamsburg
Hillsboro	**Skute Stone Arroyo**	Caballo
McClede Mountain	Clark Spring Canyon	Garfield





Magnetic Declination
July, 2014
8° 58' 12" East
At Map Center

Quadrangle Location

Geologic Map of the Skute Stone Arroyo 7.5-Minute Quadrangle, Sierra County, New Mexico

June, 2015

by
Koning, Daniel J.; Jochems, Andrew P.; Cikoski, Colin T.

New Mexico Bureau of Geology and Mineral Resources Open-File Geologic Map 252

Mapping of this quadrangle was funded by a matching-funds grant from the STATEMAP program of the National Cooperative Geologic Mapping Act (Fund Number: G14AC00228), administered by the U. S. Geological Survey, and by the New Mexico Bureau of Geology and Mineral Resources, (L. Greer Price, *Director and State Geologist*, Dr. J. Michael Timmons, *Assoc. Director for Mapping Programs*).

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

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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Explanation of Map Symbols

Contact—Identity and existence certain, location accurate where solid and approximate where dashed. Identity and existance questionable where queried.

Gradational contact—Identity and existence certain, location accurate where solid and approximate where dashed.

Normal fault—Identity and existence certain, location accurate where solid, approximate where long dashed, inferred where short dashed, concealed where dotted. Location and existance questionable where queried.

Scarp on normal fault—Identity and existence certain, location accurate where solid and approximate where dashed. Identity and existence questionable where queried.

Horizontal bedding

Inclined bedding

Inclined fault (2nd option)

Vertical or near-vertical fault (1st option)

Inclined slickline, groove, or striation on fault surface (1st option)

Minor inclined joint (1st option)

Sediment transport direction determined from crossbeds

Sediment transport direction determined from imbrication

Fluvial transport direction

Sample locality— location of radiometrically dated sample

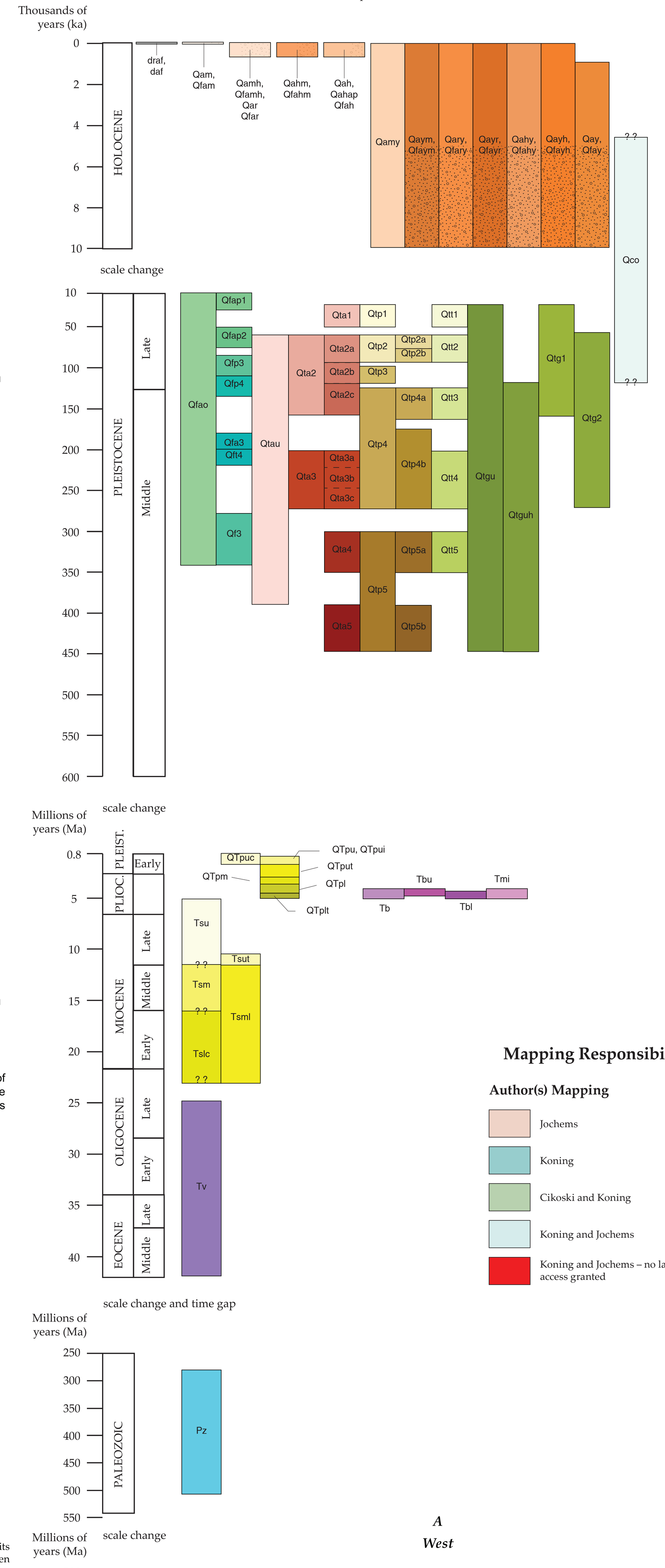
Sample locality—Showing sample number

Dike (1st option)—Identity and existence certain, location accurate

Cross section line

Label Leader: circle indicates inclusion in the label.

Correlation of Map Units



Description of Map Units

(full unit descriptions can be found in Appendix 1)

Valley Floor Deposits (Quaternary)

Anthropogenic

daf — **Dam-related artificial fill**—Valley bottom sand and gravel that has been moved by humans to form dams for impounding water or tailings.

draf — **Dredging-related spoils**—Sandy pebbles and cobbles in mounds, usually conical shaped, or in rows that are up to 5 m tall; these are the product of gold placer dredging along modern valley floors in the northwest part of the quadrangle.

Sedimentary

Qam — **Modern alluvium**—Coarse sand and gravel underlying the floors of active channels. Sedimentary characteristics similar to those of unit **Qah**. Gravel comprised of pebbles with 15-30% cobbles and 1-10% boulders. Sand is mostly medium to very coarse grained. Surface is non-varnished and exhibits much bar-and-swale relief. Inferred scoured basal contact and an estimated thickness of 1-3 m.

Qamh — **Modern and historical alluvium, undivided**—Modern alluvium (**Qam**) and subordinate historical alluvium (**Qah**). See detailed descriptions of those individual units.

Qamy — **Modern and younger alluvium, undivided**—Active alluvium and subordinate younger alluvium. See descriptions for **Qay** and **Qam**.

Qah — **Historical alluvium**—Valley floor sediment typically displaying well-defined interbeds of pebbly sand and sandy gravel. Very weakly developed topsoil, a weak Stage I calcic horizon. Surface has distinct bar-and-swale relief (10-30 cm) and no- to very weak-clast varnishing. Gravel consist of pebbles, subordinate cobbles, and lesser boulders (0-5%). Sand is brown and mostly medium to very coarse grained. 2-4 m thick.

Qahap — **Historical alluvium in Animas and Percha Creeks**—Interbedded floodplain deposits and channel-fills underlying much of Animas Creek and Percha Creek valleys. Floodplain deposits consist of very fine- to medium-grained sand, silty-clayey, very fine- to medium-grained sand, and silt. Channel-fills consist of sandy gravel and pebbly sand. Tread commonly lies 1-2 m above modern stream grade. No to very weak surface clast varnishing. 2-4(?) m thick.

Qahm — **Historical and subordinate modern alluvium, undivided**—Historical alluvium (**Qah**) and subordinate modern alluvium (**Qam**). See detailed descriptions of those individual units.

Qahy — **Historical alluvium and younger alluvium, undivided**—Historical alluvium (**Qah**) and subordinate younger alluvium (**Qay**). See detailed descriptions of those individual units.

Qar — **Recent alluvium (historical + modern)**—Valley-floor sediment that includes subequal proportions of historical (**Qah**) and modern alluvium (**Qam**). See detailed descriptions of these individual units.

Qary — **Recent alluvium (historical + modern) and younger alluvium, undivided**—Recent alluvium (**Qah** and **Qam**: grouped together as a "recent" deposit) and subordinate younger alluvium (**Qay**). See detailed descriptions of these individual units.

Qay — **Younger alluvium, undivided**—Brown, relatively fine sand interbedded with subequal to minor gravelly beds. Mostly a sandy gravel in small, steep canyons. Compared to **Qah**, bedding is slightly less distinct (because of bioturbation or weak cumulic soil development) and the deposit has more fine sand beds; comparably less bar-and-swale relief and surface clasts are weakly varnished. Weakly consolidated and 1-4 m thick.

Qaym — **Younger alluvium and modern alluvium, undivided**—Younger alluvium and subordinate active alluvium, the latter typically occupying an incised channel. See descriptions for **Qay** and **Qam** above.

Qayh — **Younger alluvium and historic alluvium, undivided**—Younger alluvium and subordinate historic alluvium. See descriptions for **Qay** and **Qah** above.

Qayr — **Younger alluvium and recent (historical + modern) alluvium, undivided**—Younger alluvium (**Qay**) and subordinate historic and modern alluvium (**Qah** and **Qam** : grouped together as a "recent" deposit). See descriptions for those individual units.

Hillslope and Valley Margin Deposits (Quaternary)

Hillslope Detritus

Qco — **Older colluvium**—Sandy pebble-cobble gravel with a brown (7.5YR 5/3-4) matrix. Found along Percha Creek in west part of quad. Gravel consist of 85-95% pebbles and 5-15% cobbles that are matrix-supported, angular to subrounded, and poorly sorted. Pebbles commonly aligned in slope-parallel fabric, particularly in upper 1.5-2 m. Deposit is graded to fine-grained valley fill atop **Qtp1**. Unconsolidated and =6 m thick.

Alluvial Fan Deposits

Qfam — **Modern alluvium on alluvial fans**—Modern alluvium deposited on alluvial fans. Very thin to thin beds and common clast imbrication. No surface clast varnishing and no topsoil. 10-50 cm of surface relief due to channel forms, bars, and cobbly-bouldery sieve deposits. Weak- to moderate-vegetative cover, with larger plants showing signs of burial. Unit commonly progrades over historic valley-fill alluvium. Probably <3 m thick.

Qfamh — **Modern and historic alluvium on alluvial fans**—Modern alluvium (**Qfam**) and subordinate historical alluvium (**Qfah**) deposited on alluvial fans. See descriptions of **Qfam** and **Qfah**. <3 m thick.

Qfah — **Historical alluvium on alluvial fans**—Sandy gravel with subordinate gravelly sand deposited on alluvial fans. Very thin- to medium-tabular to lenticular beds that slope away from fan axis. Surface exhibits up to 1 ft of bar-and-swale relief and is commonly cobbly. Soil development not evident or very weak (with faint CaCO3 precipitation around clasts and weak ped development). Weakly consolidated. Mostly 1-3 m thick.

Qfar — **Recent alluvium (modern + historic) on alluvial fans**—Alluvial fan sediment that includes subequal proportions of historical (**Qah**) and modern alluvium (**Qam**). See detailed descriptions of these individual units.

Qfahm — **Historical and modern alluvium on alluvial fans, undivided**—Historic alluvium (**Qfah**) and subordinate modern alluvium (**Qam**) deposited on alluvial fans. See descriptions of **Qfah** and **Qfam**. <3 m thick.

Qfahy — **Historic and younger alluvium in alluvial fans, undivided**—Historic alluvium (**Qfah**) and subordinate younger alluvium (**Qay**) deposited on alluvial fans. See descriptions of **Qfah** and **Qfay**. <3 m thick.

Qfary — **Recent alluvium (historical + modern) and younger alluvium in alluvial fans, undivided**—Historic and modern alluvium (**Qfah** and **Qfam**, grouped together as a "recent" deposit) and subordinate younger alluvium (**Qfay**) deposited on alluvial fans. See descriptions of **Qfah**, **Qfam**, and **Qfay**. Up to ~5(?) m thick.

Qfay — **Younger alluvium on alluvial fans**—Alluvial fan sediment composed of interbedded sandy gravel with minor to subequal fine-dominated sand; gravely sand to sandy gravel at the mouths of small steep gullies. Surface is generally eroded and lacks a notable soil (no more than stage I moprhology). Surface exhibits subdued to no bar and swale topography (=20 cm relief), weak clast varnish, and a weak desert pavement. Up to ~6 m thick.

Qfaym — **Younger alluvium and modern alluvium on alluvial fans**—Younger alluvium (**Qfay**) and subordinate modern alluvium (**Qam**) deposited on alluvial fans. See descriptions of **Qfay** and **Qfam**. Up to ~6 m thick.

Qfayh — **Younger alluvium and historic alluvium on alluvial fans**—Younger alluvium (**Qfay**) and subordinate historic alluvium (**Qah**) deposited on alluvial fans. See descriptions of **Qfay** and **Qfah**. Up to ~6 m thick.

Qfayr — **Younger alluvium and recent (modern + historic) alluvium on alluvial fans**—Younger alluvium (**Qfay**) and subordinate recent alluvium (grouped modern and historical alluvium, **Qam** and **Qah**) deposited on alluvial fans. See descriptions of **Qfay**, **Qfah**, and **Qfam**. Up to ~6 m thick.

Qfao — **Older alluvium on alluvial fans, undivided**—Alluvial fan with sandy gravel and sand. Gravel is subrounded (mostly) to rounded, very poorly sorted, and consists of pebbles, cobbles, and ~25% boulders. Surface clasts are moderately to well varnished. 1-10(?) m thick.

Qfap1 — **Older alluvial fan deposits whose surfaces grade to the treads of terrace deposits Qtp1 and Qta1**—Alluvial fan sandy gravel and gravelly sand that have prograded over the treads of the lowest terraces in Animas and Percha Creeks (**Qtp1** and **Qta1**). 1-4 m thick.

Qfap2 — **Older alluvial fan deposits whose surfaces grade to the treads of terrace deposits Qta2 and Qtp2**—Alluvial fan sandy gravel (minor pebbly sand) in vague, thin- to medium-, lenticular to tabular beds. Gravel comprised of pebbles with 35-45% cobbles 10-15% fine boulders. Matrix consists of brown (7.5YR 5/4), very fine- to very coarse-grained sand with 5-7% clay-silt. Subequal matrix vs. clast-supported (and imbricated) beds. Moderately consolidated. Surface is commonly eroded. 1-3 m thick.

Qfp3 — **Older alluvial fan deposits whose surfaces grade to the treads of terrace deposits Qtp3**—Sandy gravel (minor-pebbly sand) in vague, thin- to medium-, lenticular to tabular beds. Gravel comprised of pebbles with 35-45% cobbles and 10-15% fine boulders. Matrix consists of brown (7.5YR 5/4), very fine- to very coarse-grained sand with 5-7% clay-silt. Subequal matrix vs. clast-supported (and imbricated) beds. Moderately consolidated. Surface is commonly eroded. 1-3m thick.

Qfa3 — **Older alluvial fan deposits whose surfaces grade to the treads of terrace deposit Qta3**—Sandy gravel that was not exposed. A few meters thick.

Qfa4 — **Older alluvial fan deposits whose surfaces grade to the treads of terrace deposit Qta4**—Widespread, high-level alluvial fan deposit along Animas Creek that consists of sandy gravel and pebbly sand, commonly coarsening upward; also characterized by a paleosol developed on lower, finer strata (with illuviated clay and stage I to III+ calcic horizons). Sand is mostly medium- to very coarse-grained. Surface gravel are moderately varnished and locally spallated. 2-6 m thick.

Qfp4 — **Older alluvial fan deposits whose surfaces grade to the treads of terrace deposit Qtp4**—Sandy-gravel and pebbly sand of an alluvial fan deposit that has prograded over terrace **Qtp4** in Percha Creek. ~4 m thick.

Qft4 — **Older alluvial fan deposits whose surfaces grade to the treads of terrace deposit Qtt4**—Sandy gravel and pebbly sand of an alluvial fan deposit that has prograded over terrace **Qtt4** in Trujillo Canyon. 2-3 m thick.

Terrace Deposits (Quaternary)

Terrace Deposits Associated with Las Animas Creek.

Qtau — **Undifferentiated Las Animas Creek terrace deposit**—Sandy-gravel-terrace deposit that was not correlated. 1-2 m thick.

Qta1 — **Lowest Las Animas Creek terrace deposit**—Basal 80 cm has abundant cobbles and boulders that are very poorly sorted, subrounded, and volcanic. Overlying sediment is a brownish, pebbly sand. Tread lies 7 m above the valley floor. 2 m thick.

Qta2 — **Lower middle Las Animas Creek terrace deposit, undivided**—Surface gravel are moderately to well varnished. Locally divided into three subunits: **Qta2a**, **Qta2b**, **Qta2c** (lower to highest), which are described separately below. Mostly 1-2 m thick.

Qta2a — **Lower middle Las Animas Creek terrace deposit, lower subunit**—Sandy-gravel in vague, medium to thick beds. Clast-supported, subrounded to rounded, poorly to very poorly sorted, and comprised of 30-40% pebbles, 30-40% cobbles, and 15-30% boulders. Sand medium- to very coarse-grained, subrounded, and moderately sorted. Topsoil has some clay illuvation but no strong calcic horizon. Treads are ~13 m above the valley floor. ~ 1 m thick.

Qta2b — **Lower middle Las Animas Creek terrace deposit, middle subunit**—Sandy gravel consisting of well-graded pebbles to cobbles and 15-30% boulders. Beds are thin to thick (mostly thin and medium) and lenticular to tabular. Matrix consists of fine- to very coarse-grained sand (mostly coarse to very coarse); <0.5% clay and no obvious clay argillans. Tread lies 18-21 m above the valley floor. 1-3 m thick.

Qta2c — **Lower middle Las Animas Creek terrace deposit, upper subunit**—Sandy gravel in thin- to thick-lenticular beds and very thin- to medium-tabular beds. Lower 1 m has abundant boulders. Sand is mostly medium- to very coarse-grained; 3-5% clay in the matrix. Very minor-interbeds of fine-grained, pinkish-gray (7.5YR 7/2), fine-grained sediment dominated by silt and very fine- to fine-grained sand. Tread lies 23-27 m above the valley floor. 1-8 m thick.

Qta3 — **Middle Las Animas Creek terrace deposit, undivided**—Sandy gravel and gravelly sand, mostly clast-supported in thin- to thick-lenticular beds. Gravel includes 30-50% pebbles, 30-40% cobbles, and 15-35% boulders. Sand is mostly medium- to very coarse-grained. 1-5% clay in sand matrix. Surface clasts are moderately to well-varnished and cobbly to bouldery. Includes 3 subunits whose treads lie 29-31 m above the valley floor; each is 1-3 m thick.

Qta4 — **Upper middle Las Animas Creek terrace deposit**—Sandy gravel containing 35-50% pebbles, 30-40% cobbles, and 15-35% boulders, commonly coarsest at its base. Locally in middle of deposit is a thick bed of tan, silty very fine- to fine-grained sand that is bioturbated and massive (overprinted by a mottled, stage II to III+ calcic horizon). Tread lies 42-35 m above the valley floor, decreasing in height downstream. 1-4 m thick (mostly ~2 m).

Qta5 — **Upper Las Animas Creek terrace deposit**—Sandy gravel in vague, medium to thick beds with local intervals that are about 1 m thick, dominated by bioturbated silt and very fine- to fine-grained sand. Surface is commonly covered by slopewash. Topsoil commonly has a stage III+ to IV calcic soil horizon. Lower contact is scoured (50-60 cm of relief). Tread lies 52-44 m above the valley floor, decreasing in height downstream. 0.5-3 m thick.

Terrace Deposits Associated with Percha Creek.

Qtp1 — **Lower Percha Creek terrace deposit**—Sandy, clast-supported gravel that includes 40-45% pebbles, 35-45% cobbles, and 15% boulders. Deposit constitutes a fill terrace with no base observed in the western part of the quad; basal strath is up to 3 m above modern grade downstream. Varnish is observed on 45% of clasts at the surface. No significant soil formation. Unconsolidated and 2 to 8 m thick.

Qtp2 — **Lower middle Percha Creek terrace deposit, undivided**—Sandy gravel that includes 55-60% pebbles, 35% cobbles, and 5-10% boulders. Fine to very coarse sand in matrix. Overbank sediments and soils typically not preserved, though calcic soil horizons with stage I carbonate morphology are locally observed. Varnish is observed on 10-15% of surface clasts. Locally subdivided into two deposits: **Qtp2a** and **Qtp2b**. Unconsolidated and 2-6 m thick.

Qtp2a — **Lower middle Percha Creek terrace deposit, lower subunit**—Basal strath lies 5-8 m above modern grade. It is inset 4-6 m into unit **Qtp2b**.

Qtp2b — **Lower middle Percha Creek terrace deposit, upper subunit**—Basal strath lies 11-12 m above modern grade.

Qtp3 — **Middle Percha Creek terrace deposit**—Sandy-pebble-cobble-gravel-terrace deposits. Matrix has very fine- to very coarse-grained sand. Varnish observed on 70% of surface clasts. Discontinuous preservation of weak topsoils (with stage I+ calcic horizons). In the eastern most part of quad, the treads of **Qtp3** and **Qtp4** converge, with **Qtp3** inset 6-8 m into **Qtp4**. Basal strath lies 14-21 m above modern grade. Unconsolidated and 1-4 m thick.

Qtp4 — **Upper middle Percha Creek terrace deposit, undivided**—Sandy to bouldery, pebble-cobble gravel that locally forms fill terraces. Deposit commonly capped by continuous stage II carbonate horizons and discontinuous Btk horizons up to 35 cm thick. In the easternmost part of the quad, the treads of **Qtp3** and **Qtp4** converge, with **Qtp3** inset 6-8 m into **Qtp4**. Locally subdivided into two inset deposits: **Qtp4a** and **Qtp4b**. Unconsolidated and 2-9 m thick.

Qtp4a — **Upper middle Percha Creek terrace deposit, lower subunit**—Basal strath lies 19-21 m above modern grade. It is inset 3-4 m into **Qtp4b**.

Qtp4b — **Upper middle Percha Creek terrace deposit, upper subunit**—Basal strath lies 25-29 m above modern grade.

Qtp5 — **Upper Percha Creek terrace deposit, undivided**—Sandy gravel that includes ~50% pebbles, ~40% cobbles, and ~10% boulders. Varnish observed on 75-90% of surface clasts. Overbank sediments typically not preserved. Cambic horizons may be observed in the upper 20 cm, whereas the lower 1 m of the deposit may feature stage III carbonate development. Locally subdivided into two inset deposits: **Qtp5a** and **Qtp5b**. Weakly consolidated and 2-8 m thick.

Qtp5a — **Upper Percha Creek terrace deposit, lower subunit**—Basal strath lies 32-34 m above modern grade. It is inset 4-14 m into **Qtp5b**.

Qtp5b — **Upper Percha Creek terrace deposit, upper subunit**—Basal strath lies 35-47 m above modern grade.

Terrace Deposits Associated with Trujillo Canyon.

Qtt1 — **Lower Trujillo Creek terrace deposit**—Sandy gravel. Tread is about 5 m above the valley floor. Probably 1-3 m thick.

Qtt2 — **Lower middle Trujillo Creek terrace deposit**—Cobble-rich sandy gravel that locally fines upward from boulder-dominated to pebble-dominated. Gravel is rounded to subrounded, poorly sorted, and composed of relatively dark volcanic rocks. Clasts on tread are well-varnished. Tread lies 11-12 m above the valley floor.

Qtt3 — **Middle Trujillo Creek terrace deposit**—Clast-supported, sandy gravel that includes 40% pebbles, 35-45% cobbles, and 15-25% boulders and where Preserved top soil exhibits stage III calcic horizon(s). To the west, a lower 1.0-1.2 m-thick gravel layer is overlain by 1.5 m of pink (7.5YR 7/3), massive, silt containing calcium carbonate nodules. Tread is 20-27 m above the valley floor, increasing in height downstream. 5-6 m thick.

Qtt4 — **Upper middle Trujillo Creek terrace deposit**—Sandy gravel that includes very fine to very coarse pebbles, 30-40% cobbles, and 15-30% boulders. Sand in matrix is medium- to very coarse-grained. Particularly large boulders are found near the western quadrangle border (b axis of 30-60 cm). Where not covered by slopewash, surface clasts are strongly varnished. Tread lies 21-30 m above the valley floor, increasing in height downstream. 1-3 m thick.

Qtt5 — **Upper Trujillo Creek terrace deposit**—Sandy gravel with 25-35% pebbly sand. Gravel is generally clast supported and comprised of pebbles, 30-40% cobbles, and 3-30% boulders. Matrix sand is mostly medium to very coarse grained. Surface clasts are strongly varnished except where overlain by thick slopewash deposits. Tread lies 35-40 m above the valley floor, increasing away from the drainage axis due to southward slope. 1-6 m thick.

Terrace Deposits Associated with Smaller Canyons.

Qtg1 — **Lower terrace deposit associated with smaller canyons**—Sandy gravel and lesser pebbly sand. Gravel includes pebble, cobbles, and sparse to abundant boulders. Sand in matrix is mostly medium to very coarse grained. Where observed, topsoil has notable illuviated clay horizon(s) but only weak calcium carbonate accumulation (stage I morphology). Strath lies 0-2 m above the modern stream. Inset into both **Qtg2** and **Qtguh**. Up to 2 m thick.

Qtg2 — **Middle terrace deposit associated with smaller canyons**—Sandy gravel, mainly pebbles and cobbles with a matrix that consists of slightly clayey, fine- to coarse -grained sands. Bedding ranges from massive to very thin to medium, tabular to lenticular; local cross-stratification, 30 cm thick. Base of deposit is channelized. Strath heights are 2-5 m above the modern channel; tread heights are 3-8 m above the channel and inset into **Qtguh** treads. 0.5 to 4 meters thick.

Qtguh — **High-level terrace deposit associated with smaller canyons, undivided**—Sandy gravels with sparse interbedded sandy silts and clays, the latter increasing towards valley margins. Matrix material is reddish-brown clayey fine to coarse sand. Maximum calcic soil horizon morphology of stage II. Correlation of terraces is uncertain. Strath heights lie over 5 m above the local channel; tread heights are 5-12 m above the channel. Deposits are 0.75 to 1.5 meters thick.

Qtgu — **Terrace deposit associated with smaller canyons, undivided**—Poorly sorted, sandy gravels. Commonly used on map in upstream reaches of small tributary drainages, where terrace tread and strath heights converge and the above map units become indistinguishable. Also applied to what appears to be erosion-related, thin gravel deposits in the southeastern corner of the quadrangle (which commonly have a concave-up profile).

Santa Fe Group Basin-Fill of Palomas Basin, Western Piedmont Facies (EarlyMiocene–Early Pleistocene)

Palomas Formation

QTpuc — **Palomas Formation, upper coarse unit**—Coarse sediment where gravelly channel-fills dominate (<35% reddish-brown, finer-grained, extra-channel sediment). Gravel matrix has 1-20% clay that imparts an orangish color. Overlies and interfingers eastwards with **QTpu** strata. Onlaps older Santa Fe Group to the west. Upper 2-6 m of unit contains paleosols (stage III to IV calcic horizons). 1-90 m thick.

QTpu — **Palomas Formation, upper unit**—Light-reddish-brown, extra-channel sediment interbedded with laterally extensive, gravelly channel-fill complexes. Coarse channel-fills are 60% of unit volume and composed of sandy gravel and subordinate pebbly sand. Extra-channel sediment consists of medium- to thick-tabular beds composed of very fine- to medium-grained sand, clayey-silty fine sand, or silt. 15-41 m thick, pinching out to west.

QTpui — **Palomas Formation, fine-grained tongue of the upper unit within the upper coarse unit**—Light-reddish-brown, extra-channel sediment interbedded with minor gravelly channel-fill complexes 1-3 m thick, as described in unit **QTpu**. Forms a mappable tongue in the upper coarse unit (**QTpuc**) in lower Greenhorn Arroyo. 4-25 m thick.

QTput — **Palomas Formation, transitional zone at base of upper unit**—A transitional interval between the upper and middle units, becoming less red down-section. Sediment consists of interbedded: 1) reddish-brown to light-brown to pink, extra-channel sand/silt and 2) brown to pinkish-gray channel-fill gravel, the latter constituting 35-65% of unit volume. Lowest part of this unit in Trujillo Canyon likely correlates with **QTpm**. 9-35 m thick, pinching out to west.

QTpm — **Palomas Formation, middle unit**—Light-colored silt and very fine- to fine-grained sandstone; 10-20% interbedded gravelly channel-fills near eastern quad border, increasing to 30-50% in the middle of the quad. Fine-grained beds are thin to thick, tabular, and internally massive. Coarse channel-fills are typically ribbon-like forms, with 5-15% thick, extensive coarse channel-fill complexes. 5-35 m thick, pinching out to the west.

QTpl — **Palomas Formation, lower unit**—Sandy gravel and pebbly sand interbedded with minor silt and fine sand beds. Gravel fraction includes trace to 2% dark gray basalt. In Trujillo Canyon, this unit has a well-developed calcic soil in its upper 1-12 m (stage III to V carbonate morphology, mostly III+), increasing in thickness (becoming cumulic?) to the west. Non- to weakly cemented. 1-155 m thick, pinching out to the west.

QTplt — **Palomas Formation, transitional zone at base of lower unit**—Reddish, transitional base of the lower unit of the Palomas Formation that is composed of pebbly sandstone and subordinate sandy gravel (locally occurring as 2-10 m-thick intervals) containing trace to 1% dark-gray, vesicular basalt clasts. Correlated to 520-712 ft depths in the Percha well (pebbly sand with interbeds of sandy-gravelly clay or silt). 1-60 m thick, thinning to west.

Santa Fe Group Basin-Fill That Underlies the Palomas Formation

Tsu — **Santa Fe Group, upper unit of pre-Palomas Formation basin-fill**—Reddish pebbly sandstone interbedded with minor sandy pebbles that tends to form slopes. Estimated 10-15% coarse intervals where sandy gravel is subequal to gravelly sandstone. Gravel fraction lacks very dark-gray basalt clasts. Correlated to a fine-grained, reddish interval in the lower Percha well (712-1000 ft depths). Probably equivalent to the Rincon Valley Formation.

Tsut — **Santa Fe Group, transitional zone at base of upper unit of pre-Palomas Formation basin fill**—Transitional zone between the upper and middle units of pre-Palomas Formation basin fill that is moderately to strongly cemented but still reddish in color. Strata consist of pebbly sandstone with 5-25% thin to medium, lenticular sandy pebble-cobble beds. Subsumed into the lowest part of unit **Tsu** in Percha Creek. Generally 10-30 m thick.

Tsm — **Santa Fe Group, middle unit of pre-Palomas Formation basin fill**—Well-cemented, light-reddish-brown, sandy conglomerate, conglomeratic sandstone, and subordinate sandy siltstone. Forms local ledges and cliffs that are not as prominent as those associated with **Tslc**. Sand is mostly medium- to very coarse-grained. Differentiated only in western Percha Creek. Cemented by silica and calcium carbonate. 50-60 m thick.

Tsml — **Santa Fe Group, middle-lower units of pre-Palomas Formation basin fill, undivided**—Pinkish-white to pinkish-gray, conglomeratic sandstone coarsening westward or down-section to sandy conglomerate. Well-cemented by silica and calcium carbonate. Forms ledges and cliffs, particularly towards the west. Matrix clay decreases down-section from 3% to <1%. Mapped south of Percha Creek. Mostly correlative to Hayner Ranch Formation. 550-1100 m thick.

Tslc — **Santa Fe Group, lower unit of pre-Palomas Formation basin fill**—Strongly silica-cemented sandy conglomerate and pebbly sandstone comprising the base of the Santa Fe Group; forms prominent ledges. Mapped only in western Percha Creek. Gravel composition is dominated by basaltic andesite and other volcanic types (=5% each of chert and volcaniclastic lithologies). Unit is likely correlative to Hayner Ranch Formation of Seager et al. (1971). 75-300 m thick.

Basalt Flows (Neogene)

Tb — **Basalt flows**—Aphanitic basalt that is ledge-forming, dense and mostly non-vesicular. Phenocrysts include 1-4% total olivine and pyroxene (0.25-1 mm), but up to 10% olivine in southernmost unit. Abundant plagioclase in groundmass. North of Hwy NM-152, flow package is 30 m thick. South of Co Rd B027, the basalt fills paleovalleys and <2 m thick. Non-basaltic gravel does not overlie the flows.

Tbu — **Basalt flow, upper subunit north of Greyback Arroyo**—Upper flow subunit of **Tb** north of Greyback Arroyo. Grades upward into slightly vesicular basalt. See unit **Tb** description.

Tbl — **Basalt flow, lower subunit north of Greyback Arroyo**—Lower flow subunit of **Tb** south of Greyback Arroyo. Dated at 4.5 ± 0.10 Ma using K/Ar methods (Seager et al., 1984). See unit **Tb** description.

Tmi — **Mafic intrusions (dikes)**—Dense to vesicular, aphanitic to aphanitic-porphyritic basalt intrusions occurring as dikes east of Wicks Gulch. Phenocrysts include 2-8% olivine, trace to 4% pyroxene, and 1-2% plagioclase. Locally, mafic rocks rest on, or intrudes, hydromagmatic deposits (subsumed into unit) that are 0.4-2.1 m thick. Dikes inferred to have fed **Tb** flows and to be of similarage (4.5 Ma).

Subsurface Units (cross section only)

Tv — **Tertiary volcanic rocks, undivided**—Includes upper and lower andesites of Trujillo Peak, which are a dark-gray to purplish-brown, aphanitic to aphanitic-porphyritic, fine- to medium-grained andesite (Jochems et al., 2014). Other rocks may include rhyolites, andesites, basaltic andesites, tuffs (i.e., Kneeling Nun and Sugarlump Tuffs), and volcaniclastic sediment (including the Rubio Peak Fm). Poorly constrained thickness of ~180 m.

Pz — **Paleozoic rocks, undivided**—Paleozoic strata dominated by limestones and dolomites, with lesser shales and sandstones. Jochems et al. (2014) describes these strata in detail. Poorly constrained thickness of 600-650 m.

XYu — **Proterozoic rocks, undivided**—Includes granite, gneiss, and schist.

Mapping Responsibilities

Author(s) Mapping

- Jochems
- Koning
- Cikoski and Koning
- Koning and Jochems
- Koning and Jochems – no land access granted

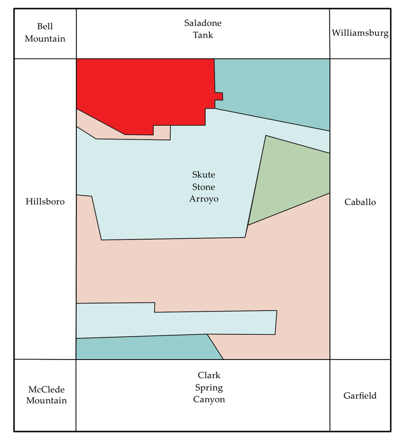


Figure 1—Contact (denoted by arrows) between the Palomas Formation and underlying, orangish Santa Fe Group strata (map unit Tsu). Both are composed of sand and gravel, but unit Tsu is redder and finer-grained (i.e., finer gravel and slightly more clay). The uppermost part of Tsu lacks dark gray basaltic gravel (presumably the 4.5 Ma basalt found near the western quadrangle border), but this gravel type does occur in the overlying Palomas Formation ~6-10 m above its base. Unit Tsu likely correlates with the Rincon Valley Formation (defined by Seager et al., 1971). This contact is conformable in the eastern quadrangle and unconformable to the west. Pink ruler in the photo is 15 cm long.

Figure 2—Lower Palomas Formation sandy gravel, as exposed on the northern slopes of Trujillo Canyon. This unit is correlated to a coarse unit in the newly drilled Percha well (at 35-520 ft depths) that is inferred to make a good aquifer (Wichter and Associates, unpublished consultant report to Hatch, N.M.). In both outcrop and in the Percha well, this unit has relatively clean sand and shows evidence of basaltic detritus. Six units were differentiated in the Palomas Formation, all of which pinch out to the west (away from the major basin-bounding fault zone at the foot of the western Caballo Mountains). The uppermost and coarsest unit of the Palomas Formation extends furthest west and onlaps older Santa Fe Group basin fill.

Geologic Cross Section

No vertical exaggeration