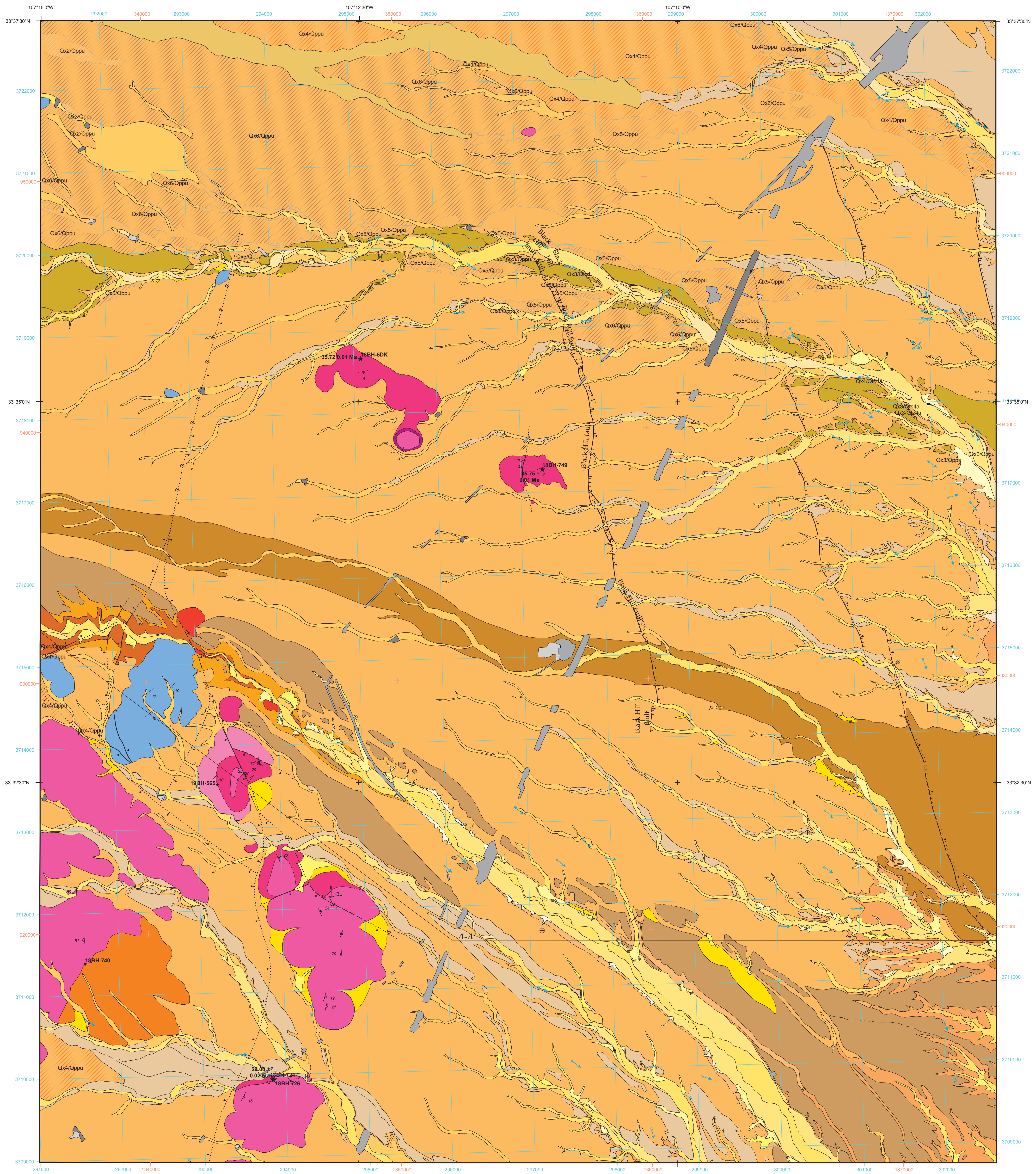
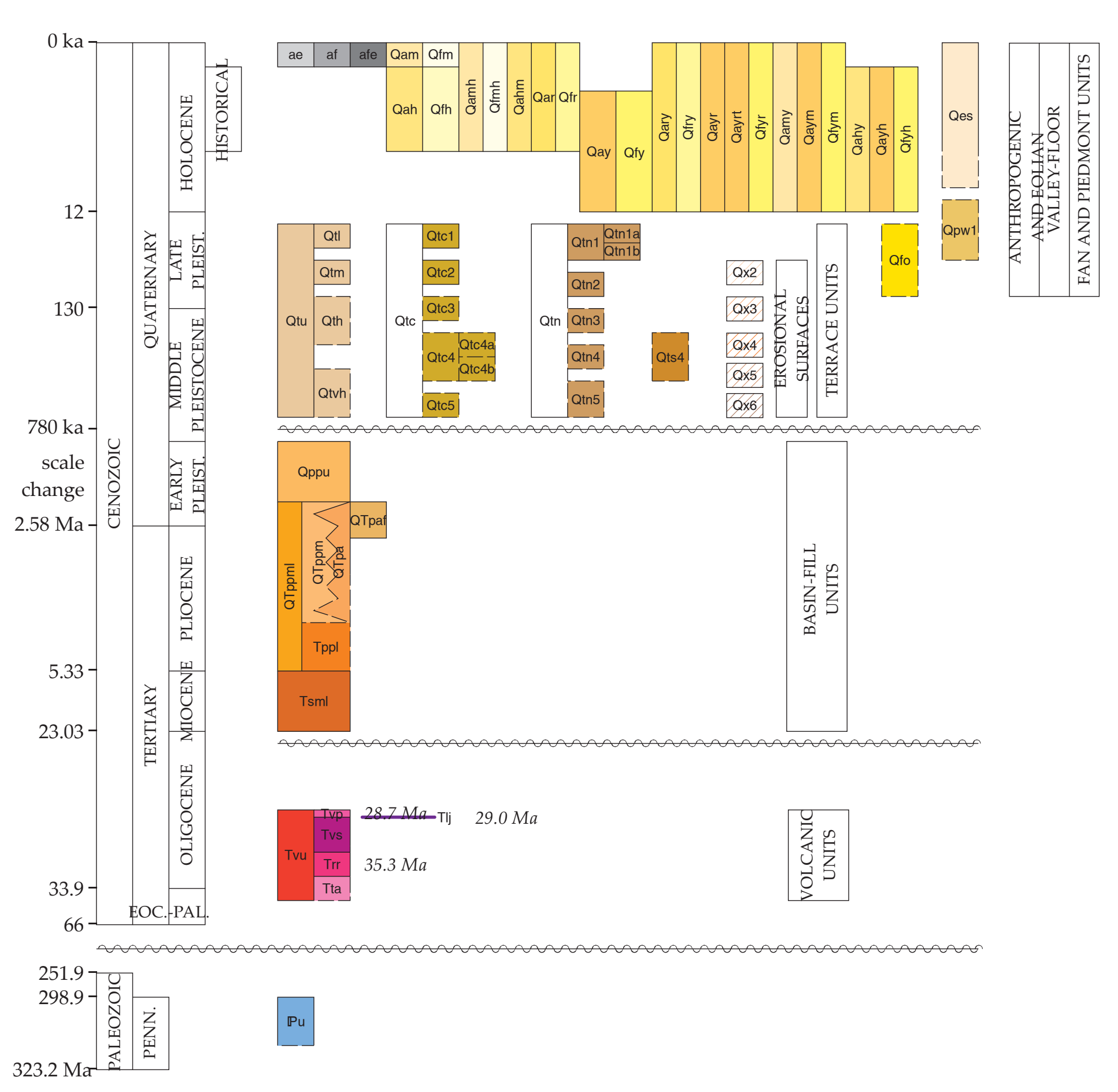
NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES A DIVISION OF NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY



Correlation of Map Units



Explanation of Map Symbols

1.1.1 Contact—Identity and existence certain, location accurate

1.1.17 Gradational contact—Identity and existence certain, location accurate

1.1.19 Gradational contact—Identity and existence certain, location approximate

1.1.2 Contact—Identity or existence questionable, location accurate

1.1.3 Contact—Identity and existence certain, location approximate

1.1.4 Contact—Identity or existence questionable, location approximate

1.2.1 La Jencia Tuff—Identity and existence certain, location accurate

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

2.12.5 Scarp on normal fault—Identity and existence certain, location accurate

2.12.6 Scarp on normal fault—Identity or existence questionable, location accurate

2.12.7 Scarp on normal fault—Identity and existence certain, location approximate

2.2.1 Normal fault—Identity and existence certain, location accurate

2.2.3 Normal fault—Identity and existence certain, location approximate

2.2.4 Normal fault—Identity or existence questionable, location approximate

2.2.7 Normal fault—Identity and existence certain, location concealed

2.2.8 Normal fault—Identity or existence questionable, location concealed

1.1.10 Geomorphic surface boundary—Identity and existence questionable, location accurate

1.1.11 Geomorphic surface boundary—Identity and existence certain, location approximate

1.1.12 Geomorphic surface boundary—Identity and existence questionable, location approximate

1.1.9 Geomorphic surface boundary—Identity and existence certain, location accurate

31.10 Cross section line

12.5 Fluvial transport direction

12.6 Sediment transport direction determined from imbrication

2.11.9 Inclined fault (2nd option)

4.3.2 Minor inclined joint (1st option)

4.3.3 Minor vertical or near-vertical joint (1st option)

4.3.4 Minor inclined (dip direction to right) joint, for multiple observations at one locality (1st option)

4.3.5 Minor inclined (dip direction to left) joint, for multiple observations at one locality (1st option)

6.1 Horizontal bedding

6.2 Inclined bedding

6.33 Apparent

8.1.2 Inclined eutaxitic (compaction) foliation—Showing strike and dip

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

★ 19.06.02 Selected locality—Location of radiometrically dated sample

● 31.21 Sample locality—Showing sample number

Description of Map Units

<Null>

01-00-00-00-00—Heading2—QUATERNARY—QUATERNARY—QUAT...

01-01-00-00-00—Heading3—AnthropogenicEolian—Anthropogenic and Eolian Units—Anthropogenic and Eolian Units

01-01-01-00-00—Unit—af—Anthropogenic Fill—Thick accumulations of sand, gravel, and clayey-silty sand from construction activities. Mapped for thick deposits of road fill along Interstate 25 and New Mexico Highway 1 as well as dams impounding stock tanks. Thickness is 1–10 m.

01-01-02-00-00—Unit—ae—Anthropogenic Excavated Ground—Excavations associated with stock tank impoundments and quarries.

01-01-03-00-00—Unit—afe—Anthropogenic Fill and Excavated Ground, undivided—Gravelly sand fill (af) and excavations (ae). See descriptions of each unit.

01-01-04-00-00—Unit—Qes—Eolian Sand and Sheetwash, undivided—Loose sand underlying sheets, coppice dunes, and small blowouts (<0.75 m deep). Sand is grayish-brown to brown (10YR 5/2–3), non-calcareous, massive to low-angle planar cross-stratified or laminated, moderately to moderately well-sorted, subrounded to well-rounded, and very fine- to medium-grained. Grains are composed of 75–80% quartz, 10–15% lithics (volcanic and ferromagnesian minerals), and 10–15% feldspar with no clay. Occasional to common (15–30%), fine to very coarse pebbles at the surface are weathered from underlying basin-fill units. Soil development is weak to non-existent. Thickness is generally less than 2–2.5 m.

01-02-00-00-00—Heading3—Valley—Valley-Floor Units—Valley-Floor Units

01-02-01-00-00—Unit—Qam—Modern Alluvium—Loose gravelly sand and gravel forming bars and underlying channels in ephemeral drainages. Sand consists of brown to grayish-brown (7.5YR 5/4 to 10YR 5/2), very poorly to poorly sorted, angular to rounded (mostly subangular), fU-vcU grains (up to 10% vfL-fL) composed of 85–90% lithics (felsic volcanic), 5–10% feldspar, and up to 5% quartz with no clay. Gravel consists of clast-supported, subangular to rounded (mostly subangular to subrounded), poorly to moderately sorted pebbles, cobbles, and subordinate boulders (up to 15–20% where stream courses run adjacent to uplands). Clast lithologies are mostly fine-grained, felsic volcanic clasts. Longitudinal and transverse bars are often underlain by up to 80% very poorly sorted, subrounded to rounded, well-graded pebbles through coarse cobbles. Topsoil is not present. Bar-and-swale topography and occasional steep-walled channels characterize the surface, exhibiting up to 0.1–0.3 m of relief. Thickness is 1–4? m.

01-02-02-00-00—Unit—Qamh—Modern and Historical Alluvium, undivided—Modern alluvium (Qam) and subordinate historical alluvium (Qah). See detailed descriptions of each unit.

01-02-03-00-00—Unit—Qamy—Modern and Younger Alluvium, undivided—Modern alluvium (Qam) and subordinate younger alluvium (Qay). See detailed descriptions of each unit.

01-02-04-00-00—Unit—Qar—Recent (Historical + Modern) Alluvium—Historical alluvium (Qah) and modern alluvium (Qam) in approximately equal proportions. See detailed descriptions of each unit.

01-02-05-00-00—Unit—Qary—Recent (Historical + Modern) and Younger Alluvium, undivided —Recent alluvium (Qah + Qam) and subordinate younger alluvium (Qay). See detailed descriptions of each unit.

01-02-06-00-00—Unit—Qah—Historical Alluvium—Loose to very weakly consolidated, gravelly sand and sandy gravel underlying low terraces along valley floors in thin to thick (3–30+ cm), mostly lenticular (occasionally tabular) beds. Sand may be pebbly and massive to horizontal-planar laminated or, less commonly, cross-laminated. Sand is brown to yellowish-brown (7.5YR 4/4 to 10YR 5/3–4), moderately to strongly calcareous, very poorly to poorly sorted, subangular to subrounded, fine- to very coarse-grained (<7% very fine sand and silt-clay), and a volcanic litharenite. Trace to 3% brownish clay films are observed in the matrix. Gravel consists of clast-supported, imbricated, poorly sorted, subangular to well-rounded pebbles and subordinate cobbles of felsic volcanics, particularly Vicks Peak Tuff. Deposit may feature 5–10% lenses of massive to vaguely low-angle cross-stratified sand similar to gravel matrix. Weak topsoil development characterized by fine peds that have experienced no or very minor clay illuviation (as bridges) and stage I carbonate accumulation. The surface exhibits bar-and-swale topography and is locally eroded, with up to 0.2 m of surface relief and no clast varnishing. Tread height is 0.3–1.5 m above modern grade. Thickness is 0.1–2.0 m.

01-02-07-00-00—Unit—Qahm—Historical and Modern Alluvium, undivided—Historical alluvium (Qah) and subordinate modern alluvium (Qam). See detailed descriptions of each unit.

01-02-08-00-00—Unit—Qahy—Historical and Younger Alluvium, undivided—Historical alluvium (Qah) and subordinate younger alluvium (Qay). See detailed descriptions of each unit.

01-02-09-00-00—Unit—Qay—Younger Alluvium—Weakly consolidated gravelly sand and sandy gravel underlying low terraces adjoining active channels or relatively inactive valley floors. Locally, the unit fines upward. Gravel are subangular to subrounded and composed of fine-grained, felsic volcanic rocks, particularly Vicks Peak Tuff, with 1–5% feldspar porphyries. Sand is reddish-brown to brown or strong brown (5YR 4/4; 7.5YR 4–5/4–6; 7.5–10YR 5/3), subangular, and very fine- to very coarse-grained with 1–10% clay-silt. Sandy gravel is clast-supported in very thin to medium, tabular to lenticular beds. Gravel consists of weakly to moderately imbricated, poorly sorted, subangular (mostly) to subrounded pebbles with 10–30% cobbles and trace to 5% boulders. Clast lithologies include fine-grained tuff and rhyolite with 1–5% feldspar porphyries. Gravel matrix consists of brown to strong brown (7.5YR 4–5/4–6; 7.5–10YR 5/3), poorly sorted, angular to subrounded (mostly subangular), very fine- to very coarse-grained sand with 1–5% silt-clay; sand is composed chiefly of lithic (volcanic) grains. Topsoil and buried soils are characterized by brown to strong brown (7.5YR 4–5/4–6), illuviated clay (Bt) horizons (faint to distinct clay films on ped faces or clast surfaces) exhibiting weak to moderate, fine to coarse, angular to subangular blocky peds. These clayey horizons may have weak calcium carbonate precipitation or overlie calcic horizons (stage I to II carbonate accumulation). Locally, deposit lacks Bt horizon and is instead characterized by a darkened A horizon with ped development. Elsewhere, soils have been removed entirely by surface erosion. Geomorphic surfaces lack bar-and-swale topography. Tread height is 1–2.2 m above modern grade. Thickness is 1–5? m.

01-02-10-00-00—Unit—Qaym—Younger and Modern Alluvium, undivided—Younger alluvium (Qay) and subordinate modern alluvium (Qam). See detailed descriptions of each unit.

01-02-11-00-00—Unit—Qayh—Younger and Historical Alluvium, undivided—Younger alluvium (Qay) and subordinate historical alluvium (Qah). See detailed descriptions of each unit.

01-02-12-00-00—Unit—Qayr—Younger and Recent (Historical + Modern) Alluvium, undivided—Younger alluvium (Qay) and subordinate recent alluvium (Qah + Qam). See detailed descriptions of each unit.

01-02-13-00-00—Unit—Qayrt—Younger and Recent Alluvium, Transitional Deposits—Younger alluvium (Qay) and subordinate recent alluvium (Qah + Qam) in non-dissected, low order drainages. Deposits are poorly exposed. See detailed descriptions of each unit.

01-03-00-00-00—Heading3—Terrace—Terrace Units—Terrace Units

01-03-01-00-00—Unit—Qtu—Terrace Gravels in Smaller Drainages, undivided—Loose to moderately consolidated, sandy gravel, and gravelly sand in very thin to thick (1–80 cm), tabular to lenticular beds underlying terraces alongside higher order stream courses. Gravel are clast-supported and well-imbricated to locally trough or planar cross-stratified (foresets 20–40 cm thick). Clasts consist of very poorly to poorly sorted, subangular to well-rounded pebbles, cobbles (10–60%), and boulders (1–25%). Clast lithologies are mostly or entirely fine-grained felsic volcanics with trace to a few percent each of feldspar porphyry, chert, and/or intermediate volcanics (visual estimate). Gravel matrix consists of yellowish red to strong brown (5YR 4–5/6; 7.5YR 5/6) to light or pale brown (7.5YR 6/3–4; 10YR 6/3), non- or weakly to strongly calcareous, very poorly to moderately sorted, subangular to rounded, vfU-vcL sand (mostly mL-vcL) composed of 80–90% lithics (volcanic) and 10–20% quartz + feldspar with 0–10% reddish-brown clay bridges and films. Compared to unit Qppu, gravel are browner, less consolidated, less commonly cross-stratified, and coarser. Gravel may be intercalated with minor lenses of thin, tabular beds of silty, very fine- to fine-grained sand or pebbly sand (very fine to very coarse) that are horizontal-planar or cross-laminated to trough cross-stratified. Soils and surface characteristics generally vary with age; moderate to strong calcic horizons (stage II–IV carbonate accumulation), illuviated clay (Bt, Btk horizons where not eroded), and various degrees of desert pavement development and clast varnishing may be observed at the surface. Deposit lacks bar-and-swale topography and buried soils. Terrace treads diverge in a downstream direction and are not necessarily correlative between drainages. Thickness is 0.3–9 m. Subdivided into four allostratigraphic subunits distinguished by tread height above valley floors:

01-03-01-01-00—Subunit—Qtl—Lower Terrace Gravel—Sandy gravel with 15–40% cobbles and 1–10% boulders. Commonly features illuviated clay (Bt) horizon in topsoil. Weak varnish on 20–30% of surface clasts. Tread generally lies 1.5–3 m above valley floors. Deposit is 0.3–1 m thick.

01-03-01-02-00—Subunit—Qtm—Middle Terrace Gravel—Sandy gravel in very thin to medium, mostly lenticular beds (minor tabular beds); thick beds and cross-stratification (up to 0.4 m thick) locally present. The deposit contains 1–10% sand or silty sand beds. Gravel is weakly to moderately consolidated, clast-supported, imbricated, subrounded, poorly sorted (locally moderately sorted within a particular bed), and comprised of pebbles with 25–50% cobbles and 2–3% boulders. Gravel are composed primarily of fine-grained felsites with <5% feldspar porphyry, 0–5% black-speckled and quartz-phyric felsite (absent south of Crawford Hollow), and 1–5% coarser-grained felsites (>3% visible quartz and feldspar crystals). Gravel matrix consists of light-brown to reddish-yellow (7.5–10YR 6/3 to 7.5YR 6/4–6), subangular to subrounded, poorly sorted, medium- to very coarse-grained sand (<25% very fine to fine sand) dominated by lithic (volcanic) grains with 1–5% free clay. Topsoil is characterized by Bt horizon development in upper 60 cm (distinct clay films on half to most of the clast surface). Highly scoured base. In Sheep Canyon west of Interstate 25, this terrace deposit correlates upstream with Qpw1. Tread lies 2–4 m above the modern drainage. Thickness is 0.5–2.7 m.

01-03-01-03-00—Subunit—Qth—Higher Terrace Gravel—Variable preservation of surface soil. Weak desert pavement and moderately strong varnish on 45–60% of surface clasts. Tread generally lies at least 4–6 m above valley floors and 1–3 m above Qtm tread.

01-03-01-04-00—Subunit—Qtvh—Highest Terrace Gravel—Strongest soil development observed is stage III+ to IV calcic soil horizons 10–100 cm thick. Weakly to well-developed desert pavement. Moderate varnish on 20–65% of surface clasts. Tread lies 7–16 m above valley floors, decreasing to 3–5 m at up-drainage positions.

01-03-02-00-00—Heading4—Erosional—Erosional Surfaces—Erosional Surfaces

01-03-02-01-00—Unit—Qx2—Qx2—Erosional surface graded to lower-to-intermediate positions in the landscape.

01-03-02-02-00—Unit—Qx3—Qx3—Erosional surface graded to intermediate positions in the landscape.

01-03-02-03-00—Unit—Qx4—Qx4—Erosional surface graded to intermediate-to-higher positions in the landscape.

01-03-02-04-00—Unit—Qx5—Qx5—Erosional surface graded to higher positions in the landscape.

01-03-02-05-00—Unit—Qx6—Qx6—Erosional surface graded to highest positions in the landscape (below aggradational surface).

01-03-03-00-00—Unit—Qtc—Terrace Gravels of Crawford Hollow, undivided—Moderately consolidated, sandy gravel in vague, thin to thick, tabular to (mostly) lenticular beds. Very weakly clay-cemented. Gravel consists of clast-supported, imbricated, poorly sorted, subangular to subrounded pebbles with subordinate cobbles and boulders (more abundant near the base). Clast lithologies include fine-grained felsites with 1–3% feldspar porphyry, 0–5% intermediate volcanics, and up to 1% black-speckled and quartz-phyric felsite observed in Qtu gravels in the northern part of the quadrangle. The matrix consists of yellowish-red to brown or strong brown (5–7.5YR 4–5/6), poorly sorted, subangular to subrounded, fine- to very coarse-grained (mostly mL-vcU) sand dominated by lithics (volcanic) and with 1–5% clay. Where not eroded, the topsoil exhibits an illuviated clay (Bt or Btk) horizon underlain by a moderate to strong calcic horizon (stage II to III carbonate accumulation). Compared to the underlying Palomas Formation, terrace deposits are browner, more poorly sorted, and slightly less consolidated. Terrace treads diverge in a downstream direction, becoming higher above the floor of Crawford Hollow. Thickness is 0.3–10 m. Subdivided into four to six allostratigraphic subunits:

01-03-03-01-00—Subunit—Qtc1—Lower Terrace Gravel of Crawford Hollow—Tread lies 2–7 m above the valley floor, decreasing upstream. May locally be subdivided into two subunits (not mapped) whose treads differ about 1 m in height. It is not known if these represent separate depositional events or if the lower is a fill-cut terrace. Deposit is 0.3–1 m thick.

01-03-03-02-00—Subunit—Qtc2—Lower-Middle Terrace Gravel of Crawford Hollow—Tread lies 3–8 m above the valley floor, decreasing upstream.

01-03-03-03-00—Subunit—Qtc3—Middle Terrace Gravel of Crawford Hollow—In general, terrace level lies 6–9 m above the valley floor, but typically 2–4 terrace treads lie in close proximity. These treads are likely developed on the same fill, and locally may lie on the same fill as Qtc4. Locally, these are subdivided into two subunits (not mapped) whose treads differ by about 1–3 m in height.

01-03-03-04-00—Subunit—Qtc4—Upper-Middle Terrace Gravel of Crawford Hollow—Sandy gravel and lesser pebbly sand that forms a notably thick fill deposit in much of the canyon. Sandy gravel is in thin to thick, lenticular to tabular beds. Gravel is clast-supported, commonly imbricated, subrounded, very poorly to poorly sorted, and comprised of very fine to very coarse pebbles with 20–40% cobbles and 5–15% boulders. Basal beds often have approximately subequal proportions of pebbles and cobbles. Clast lithologies include fine-grained felsites with 1% feldspar porphyry, 3–5% other intermediate volcanic clasts, 1–5% coarser-grained felsites (>3% visible crystals of quartz and feldspar), and trace to 2% black-speckled and quartz-phyric felsite. Pebbly sand is very thin to laminated and horizontal-planar. Sand is typically strong brown to reddish-yellow (7.5YR 4–6/6), subangular to (mostly) subrounded, poorly sorted, medium to very coarse-grained (less than 20% very fine to fine sand), and dominated by volcanic grains with 1–5% free clay (very locally up to 15% clay and reddish-brown color). Moderately consolidated and very weakly to weakly clay-cemented. Topsoil has a Bt horizon that is 50–60 cm thick and underlain by a stage III to III+ calcic horizon. Lower contact is scoured. Tread lies about 10–16 m above the valley floor, decreasing to ≈4m near the western quadrangle boundary. Two subunits, Qtc4a and Qtc4b, can be differentiated that differ 1–2 m in geomorphic height. In the central part of the canyon, the tread lies ≈2 m below the next higher geomorphic surface. Thickness is 1–10 m.

01-03-03-04-01—Subunit—Qtc4a——

01-03-03-04-02—Subunit—Qtc4b——

01-03-03-05-00—Subunit—Qtc5—Upper Terrace Gravel of Crawford Hollow—A rare gravelly deposit with a tread that lies 1–3 m above Qtc4b east of Interstate 25. Other surfaces in a similar geomorphic position are erosional. Thickness is <2–4 m.

01-03-04-00-00—Unit—Qtn—Terrace Gravels of Nogal Canyon, undivided—Loose to moderately consolidated sandy gravel and sand in thin to thick (45–120 cm), tabular to broadly lenticular beds underlying terraces along Nogal Canyon. Gravel is clast-supported and well-imbricated to trough cross-stratified. Clasts consist of very poorly to poorly sorted, subrounded to well-rounded pebbles (55–95%), cobbles (5–45%), and boulders (usually <5%). Clast lithologies are mostly or entirely felsic volcanics with trace to a few percent each of feldspar porphyry and/or intermediate volcanics (visual estimate). Gravel matrix consists of reddish-brown (5YR 5/3–4) to strong brown (7.5YR 5/6), poorly sorted, subrounded to rounded, vfL-cL sand composed of 85–90% lithics (volcanic) and 10–15% quartz + feldspar with 10–20% reddish to brownish clay bridges and films. Gravel may be intercalated with rare lenses of sand similar to gravel matrix. Underlying strata may be scoured up to 0.6 m. Soils and surface characteristics generally vary with age; moderate to strong calcic horizons (stage II–III carbonate accumulation), illuviated clay horizons (where not eroded), and various degrees of desert pavement development and clast varnishing may be observed at the surface. Deposit lacks bar-and-swale topography. Terrace treads diverge in a downstream direction. Thickness is 1.5–4 m. Subdivided into five to six allostratigraphic subunits distinguished by tread height above the canyon floor:

01-03-04-01-00—Subunit—Qtn1—Lower Terrace Gravel of Nogal Canyon—Tread lies 7–9 m above valley floors. Near the southeastern corner of the quadrangle, two subunits, Qtn1a and Qtn1b, can be differentiated by a ≈2-m-tall riser.

01-03-04-01-01—Subunit—Qtn1a——

01-03-04-01-02—Subunit—Qtn1b——

01-03-04-02-00—Subunit—Qtn2—Lower-Middle Terrace Gravel of Nogal Canyon—Tread lies 27–30 m above valley floors.

01-03-04-03-00—Subunit—Qtn3—Middle Terrace Gravel of Nogal Canyon—Tread lies 42–48 m above valley floors.

01-03-04-04-00—Subunit—Qtn4—Upper-Middle Terrace Gravel of Nogal Canyon—Strongest soil development observed is stage III+ calcic soil in upper 1.3 m of deposit. Weakly to well-developed desert pavement. Weak to moderate varnish on 25–45% of surface clasts. Tread lies 51–58 m above valley floors.

01-03-04-05-00—Subunit—Qtn5—Upper Terrace Gravel of Nogal Canyon—Strongest soil development observed is stage IV calcic soil in upper 1 m of deposit. Moderately to well-developed desert pavement. Weak to strong varnish on 15–60% of surface clasts. Tread lies 65–73 m above valley floors.

01-03-05-00-00—Unit—Qts4—Upper Terrace Gravel of Silver Canyon—Loose to weakly consolidated sandy gravel and silt-sand in thick (50–80 cm), tabular to broadly lenticular beds underlying terraces along Silver Canyon. Gravel is clast-supported and moderately well-imbricated. Clasts consist of poorly sorted, subrounded to rounded pebbles (50–100%) and cobbles (0–50%) dominated by felsic volcanics. Gravel matrix consists of brown (7.5YR 4–6/4), strongly calcareous, very poorly to poorly sorted, subrounded to rounded, vfU-cU sand composed of 80–85% lithics (volcanic) and 15–20% quartz + feldspar with <5% brownish chips. Deposit features up to 10–15% lenses of strong brown (e.g., 7.5YR 5/6), mostly tabular, internally massive to low-angle cross-stratified or laminated, slightly pebbly silt to fL or mU sand. The strongest soil development observed is stage IV calcic soil in the upper 30 cm of deposit. Moderate desert pavement development and weak to strong varnish on 10–50% of surface clasts observed. Tread lies 3–18 m above valley floors. Thickness is 1.9–12 m.

01-04-00-00-00—Heading3—FanPiedmont—Alluvial Fan and Piedmont Units—Alluvial Fan and Piedmont Units

01-04-01-00-00—Unit—Qfm—Modern Fan Alluvium—Loose gravelly sand and sandy gravel underlying fan channels, bars, and levees. Sand consists of brown to yellowish-brown (10YR 5/3–4), non- to very weakly calcareous, very poorly to poorly sorted, angular to rounded, fL-cU grains composed of 55–60% quartz, 30–35% lithics (volcanic), and 10–15% feldspar with no clay. Gravel include sandy pebble-cobble and pebble-cobble-boulder deposits; clast proportions include 55–90% pebbles, 10–45% cobbles, and 0–10% small boulders of mostly felsic lithologies reworked from Palomas Formation basin fill and terrace gravels. Soils are not observed. Bar-and-swale topography characterizes the surface, exhibiting up to 0.4–0.5 m of relief. Thickness is <2–3 m in most places.

01-04-02-00-00—Unit—Qfmh—Modern and Historical Fan Alluvium, undivided—Modern (Qfm) and subordinate historical fan alluvium (Qfh). See detailed descriptions of each unit.

01-04-03-00-00—Unit—Qfh—Historical Fan Alluvium—Loose pebble-cobble gravel in medium to thick (20–40+ cm), tabular to vaguely wedge-shaped beds. Gravel is clast- to matrix-supported and internally massive to crudely imbricated. Clasts consist of poorly sorted, angular to subrounded pebbles (65–95%) and cobbles (5–35%) of felsic lithologies; up to 15–20% of clasts may represent exotic lithologies (e.g., quartzite) derived from the axial-fluvial facies of the Palomas Formation. Gravel matrix consists of dark-brown to brown (7.5YR 3–4/4), very weakly calcareous, very poorly sorted, angular to rounded, fU-vcL sand composed of 45–50% lithic (volcanic), 40–45% quartz, and 5–15% feldspar with <5–7% light-brownish clay films. Soils are not observed; moderate to strong bioturbation by very fine to coarse roots. No clast varnish observed at the surface. Bar-and-swale topographic relief is up to 0.25–0.4 m. Thickness is <2–3 m in most places.

01-04-04-00-00—Unit—Qfr—Recent (Historical + Modern) Fan Alluvium—Historical (Qfh) and modern fan alluvium (Qfm) in approximately equal proportions. See detailed descriptions of each unit.

01-04-05-00-00—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.

01-04-06-00-00—Unit—Qfy—Younger Fan Alluvium—Loose pebble-cobble gravel in medium to thick (25–80 cm), tabular to wedge-shaped beds. Gravel is mostly clast- supported and internally massive to crudely imbricated. Clasts consist of very poorly to poorly sorted, subangular to rounded pebbles (60–90%) and cobbles (10–40%) of >95% felsic volcanic lithologies. Gravel matrix consists of brown (7.5YR 4/2–4 or 5/4), moderately to strongly calcareous, very poorly sorted, subangular to rounded, silty, fL-cU sand composed of 70–80% lithic (volcanic), 15–20% quartz, and 10–15% feldspar grains with up to 10% brownish clay films. Stage I calcic horizon with illuviated clay (Btk) observed in upper 25 cm. Weak varnish on no more than 10% of surface clasts. Bar-and-swale topographic relief up to 15–20 cm. Tread height 1.7–2.2 m above modern grade (minimum thickness).

01-04-07-00-00—Unit—Qfym—Younger and Modern Fan Alluvium, undivided—Younger (Qfy) and subordinate modern fan alluvium (Qfm). See detailed descriptions of each unit.

01-04-08-00-00—Unit—Qfyh—Younger and Historical Fan Alluvium, undivided—Younger (Qfy) and subordinate historical fan alluvium (Qfh). See detailed descriptions of each unit.

01-04-09-00-00—Unit—Qfyr—Younger and Recent (Historical + Modern) Fan Alluvium, undivided—Younger (Qfy) and subordinate recent fan alluvium (Qfh + Qfm). See detailed descriptions of each unit.

01-04-10-00-00—Unit—Qfo—Older Fan Alluvium—Loose pebble and pebble-cobble gravel in thick to very thick (75–160 cm), tabular to wedge-shaped beds. Gravel are clast- to occasionally matrix-supported and internally massive to moderately imbricated. Clasts consist of very poorly to poorly sorted, subangular to rounded pebbles (55–95%), cobbles (5–45%), and boulders (0–5%) of >95% felsic volcanic lithologies. Gravel matrix consists of brown to strong brown (7.5YR 4/4–6), moderately calcareous, poorly to moderately sorted, angular to rounded, fU-cU sand composed of 50–55% lithic (volcanic and ferromagnesian minerals), 35–40% quartz, and 5–15% feldspar grains with no clay. Stage I calcic horizon observed in upper 40 cm. Weak varnish on 25–40% of surface clasts. Tread height 2.1–3.2 m above modern grade (minimum thickness).

01-04-11-00-00—Unit—Qpw1—Lower Western Pediment Deposit—Thin lag of silt, sand, and subangular to rounded pebble-cobble and pebble-cobble-boulder gravels filling shallowly incised valleys in the north-central part of the quadrangle. Clast lithologies are felsic volcanics derived from the east-central San Mateo Mountains. Surface features an overall grayish color. Thickness is <2–3 m.

02-00-00-00-00—Heading2—QUATERNARY–TERTIARY—QUATERNA...

02-01-00-00-00—Heading3—BasinFill—Basin-Fill Units—Basin-Fill Units

02-01-01-00-00—Unit—Qppu—Upper Piedmont Facies of the Palomas Formation—Interbedded gravel bodies, pebbly silt-sand, silt, and mud. The unit consists of >80% gravels where it underlies proximal to medial positions of a Nogal Canyon paleofan extending from the southern quadrangle boundary north to Crawford Hollow. This proportion drops to 20–50% in the northern and eastern parts of the quadrangle (east of Interstate 25). Gravels occur in medium to very thick (20–110+ cm; minor very thin to thin), tabular to lenticular bodies, and are loose to moderately well-consolidated, weakly to moderately clay-cemented, weakly to strongly calcareous, and weakly to well-imbricated. Cross-stratification occurs in 1–20% of any given gravel body and includes trough to low-angle planar cross-bedding (foresets up to 1 m tall). Occasional lateral accretion sets and reverse grading. Gravel consists of mostly clast-supported (minor matrix-supported), very poorly to moderately sorted, subangular to rounded (mostly subrounded) pebbles (50–95%), cobbles (5–50%), and boulders (trace to 12%). Clast lithologies include fine-grained felsic volcanics, with 5–25% feldspar porphyries, 1–20% moderately crystal-rich felsites (>3% visible phenocrysts), and 0–15% intermediate volcanic clasts. North of Crawford Hollow, intermediate volcanics are <1% of the gravel clasts, and crystal-rich felsites are mostly limited to proximal-medial deposits of the Nogal Canyon paleofan. Gravel matrix consists of subangular to rounded, very poorly to moderately sorted, mostly medium- to coarse-grained sand (<10–20% finer and 10–25% very coarse sand to granules) composed of 70–95% lithics (felsic volcanic) and 5–30% quartz + feldspar. Clay as pore linings or bridges is estimated to compose 0.5–15% of the matrix. It imparts an array of reddish colors, including light reddish brown to reddish brown or yellowish red to reddish yellow (5YR 5–6/3–4 or 4–6/6; 7.5YR 6/6). Locally, gravel matrix may be light-gray, light-brown, or strong-brown (5–7.5YR 7/1; 7.5YR 6/4, 5/6). Fine-grained sediment is well-consolidated and occurs in thin to thick, tabular beds locally demarcated by clay-enriched zones at the top of a bed (probable paleosols). This sediment consists of a mixture of clay, silt, and very fine to fine sand with 1–30% scattered medium to very coarse sand grains and 1–10% pebbles. Beds are internally massive due to bioturbation and pedogenesis. Clay-rich zones are reddish-brown (5YR) and have angular to subangular blocky peds that are commonly coated by distinct illuviated clay films. Colors for fine-grained intervals include light-reddish-brown to pink (5YR 6/4; 7.5YR 7/3), but muddy beds locally range from light-yellowish-brown (2.5Y 6/3) to brown or pink (7.5YR 5/3 or 7/4). Buried stage I to II+ calcic horizons are locally present but minor in comparison to illuviated clay (Bt, Btk) horizons. To the south, strong calcium carbonate development is common in the upper 0.6–1.5 m of the unit, including stage III–III+ soil horizons, but buried soils are rare. Thickness is 50–85 m.

02-01-02-00-00—Unit—QTppm—Middle Piedmont Facies of the Palomas Formation—Silty to sandy mud and silt in massive to laminated or very thin to thin, mostly tabular beds; subordinate silty sand or pebbly gravel in thin to thick (<40 cm), tabular to lenticular beds. Non- to weakly calcareous. Muddy beds are moderately to well-consolidated and mostly internally massive whereas sandy to gravelly beds are loose to moderately consolidated and may be internally massive to horizontal-planar laminated. Locally, the unit consists of up to 80% mud with the remainder being a mix of silt, sand, and gravel. Mud is reddish-brown to light-reddish-brown, light-brown, or pink to very pale-brown (5YR 5–6/4; 7.5YR 7/3–4, 6/3–4; 10YR 7/3–4), often silty, and may contain trace to 5% subangular to rounded sand grains comprised of >80% lithics (volcanic). Rare to occasional buried calcic horizons (stage I–III) are up to 60 cm thick and characterized by carbonate nodules, tubules, or masses; these are sometimes associated with illuviated clay horizons (Bt or Btk). Rubbly weathering carbonate with possible root casts between Silver Canyon and Crawford Hollow near the top of the unit may represent ciénega (marsh) deposits. Sandy beds commonly consist of light-yellowish-brown or brown (10YR), well-sorted, subrounded to rounded, silty, vfU-fU grains composed of 65–70% quartz, 20–25% feldspar, and 10–15% lithics (black ferromagnesian minerals and volcanics) with little or no clay. Rare pebble gravels may be imbricated and consist of 55–60% fine-grained rhyolites and tuffs with 35–40% coarser grained felsites (>3% visible phenocrysts) and <5% intermediate volcanic lithologies. Gravels are distinctly lenticular and have a sandy matrix similar to sand beds described above that also lack clay. Where overlying Qppu contains higher proportions of finer-grained beds, QTppm may be distinguished by tanner colors (mostly 7.5YR) and greater lenticularity in channel-fill gravels that are less extensive and contain less matrix clay. Total thickness unknown but at least 45–60 m.

02-01-03-00-00—Unit—QTpaf—Axial-Fluvial Facies of the Palomas Formation, Floodplain Deposits—Reddish to pale-colored, mostly massive muds with subordinate sand lenses similar to those described for unit QTpa. Found in Crawford Hollow along the eastern quadrangle boundary and laterally gradational with distal piedmont facies of unit QTppm. Locally, the thickness is 3–7.5 m.

02-01-04-00-00—Unit—QTpa—Axial-Fluvial Facies of the Palomas Formation—Sand, lesser mud, and rare to occasional pebble gravel in laminated to thick (up to 90 cm), mostly lenticular beds. Sand is loose, non-calcareous, and internally massive to horizontal-planar or ripple cross-laminated to trough or planar cross-stratified (foresets up to 30 cm thick). Sand is composed of light-brownish-gray (10YR 6/2), poorly to moderately well-sorted, subrounded to rounded, vfL-cL grains (mostly fU-cL) composed of 60–70% quartz, 15–20% feldspar, and 15–20% lithics (volcanic, black ferromagnesian minerals, chert, and possible trace granite) with no clay. Notable brownish-red to golden flakes of mica are also found in the matrix (trace to 2%). Mud rip-up clasts up to 25 cm across are locally found in basal parts of sandy beds, particularly where scoured into mud. Mud is pale to very-pale-brown (2.5Y–10YR 8/2 and 2.5Y 7/3) or yellowish-red (5YR 4–5/6), weakly to moderately consolidated, non-calcareous, and massive to horizontal-planar laminated. It may contain whitish gypsum crusts, blades, and masses, particularly in and near Nogal and Silver Canyons. Pebble gravels (with very rare cobbles) occur in medium to thick (<20–30+ cm), lenticular beds. These are clast-supported and imbricated; clasts are poorly to moderately sorted and subrounded to well-rounded. Clast lithologies include subequal proportions of granite, chert/jasperoid, intermediate and felsic volcanics, undivided tuffs, and slightly more quartzite (15–20%). Rare pebbles of Pedernal chert are also found. Pebbles of similar lithologies are frequently concentrated at the base of individual crossbeds in sandy intervals. Gravel matrix is similar to sand but may contain trace or a few percent clay chips or bridges that impart a slightly reddish color. Basal scour by gravelly beds forms up to 0.6 m of relief along contacts with underlying sediment. Buried soils do not occur in gravels or sand, but illuviated clay (Bt) horizons are observed in muddy intervals in a few places and indicated by mottling and prismatic peds. Fragments of fossil vertebrates are occasionally found in muds and sand; a partial vertebra of the glyptodont Glyptotherium texanum recovered approximately 1 km north of Silver Canyon suggests that the uppermost axial-fluvial strata are younger than 2.7 Ma (D. Gillette and G. Morgan, pers. comm., 2019). At least 60 m thick.

02-01-05-00-00—Unit—QTppml—Lower to Middle Piedmont Facies of the Palomas Formation, undivided—Westward-thinning package of silty or sandy to gravelly sediment mapped in Nogal Canyon that includes units QTppm and Tppl. Intervals correlating to OTppm have fewer muddy beds compared to elsewhere on the quadrangle. See detailed descriptions of each unit. Thickness is <1–60 m.

02-01-06-00-00—Unit—Tppl—Lower Piedmont Facies of the Palomas Formation—Poorly exposed, weakly to well-consolidated, pebble-cobble-boulder gravel/conglomerate. Gravel/conglomerate is grayish, occasionally calcite-cemented, and massive to vaguely imbricated. Clasts consist of very poorly to poorly sorted, subangular to rounded pebbles (40–80%), cobbles (20–40%), and boulders (10–30%). Clast lithologies include 40–50% Vicks Peak Tuff, 45–50% undivided felsites (mostly fine-grained), and 0–15% greenish gray hornblende-plagioclase-phyric andesite. The unit forms an onlapping unconformity on Vicks Peak Tuff in the southwest part of the quadrangle. Thickness is unknown but likely <35–45 m.

02-01-07-00-00—Unit—Tsml—Lower and Middle Santa Fe Group, Piedmont Facies—Yellowish to reddish or reddish-brown beds of sandstone and mudstone with subordinate conglomerate exposed along Nogal Canyon. Thickness is >90 m.

03-00-00-00-00—Heading2—TERTIARY—TERTIARY—TERTIARY

03-01-00-00-00—Heading3—Volcanic—Volcanic Units—Volcanic Units

03-01-01-00-00—Unit—Tvu—Volcanic Rocks, undivided—Undivided volcanic rocks exposed along Nogal Canyon. Probably Hells Mesa Tuff or trachyandesite in most places. See the following descriptions for the individual volcanic units.

03-01-02-00-00—Unit—Tvp—Vicks Peak Tuff—Gray to light-gray (N6/ to N7/), weathering gray to reddish-brown, welded, crystal-poor, rhyolite ash-flow tuff. Phenocrysts include trace to 3% sanidine (fine to coarse, subhedral to euhedral, glassy to chatoyant), trace to 1% mafics (fine, equant), and trace quartz. Trace lithics up to 1.5 cm long are aphanitic or contain some feldspar casts. Matrix is mostly devitrified but contains trace medium glass shards (dark/opaque). Occasional eutaxitic foliation, trace to minor (15%) fiamme, and sparse to abundant spherulites. A dark-gray to black vitrophyre is observed at the base of the Vicks Peak in the southern part of the map area. This vitrophyre contains similar sanidine phenocrysts and lithic fragments as the material above it but altered to clays. The unit forms steep slopes, ledges, or cliffs. 40Ar/39Ar age of 28.72 ± 0.02 Ma (sample 18BH-726). Thickness is <180 m.

03-01-03-00-00—Unit—Tvs—Volcaniclastic Sediment Below Vicks Peak Tuff—Poorly exposed volcaniclastic sediment underlying Vicks Peak Tuff. Thickness is <6 m.

03-01-05-00-00—Unit—Trr—Tuff of Rocque Ramos Canyon—Light-gray to white (N8/; 2.5–5YR 8/1) or pinkish-gray to reddish-brown (5YR 8/1–6/2 to 4/3–4), weathering dark reddish-brown to dark-gray, moderately to densely welded ash-flow tuff. Compaction foliation is observed in places but is much more poorly developed than in the La Jencia Tuff. Phenocrysts occupy 15–40% of the surface area and are composed mainly of sanidine (fine to medium, subhedral to euhedral, glassy) with subordinate plagioclase (fine to medium, mostly subhedral) and trace to 7% biotite (fine, subhedral, commonly altered with coppery luster). The unit contains 1–5% pumice that are 1–10 cm long and relatively undeformed to highly flattened. At Black Hill, <10–15% pebble-sized lithic andesite fragments are present. South of Nogal Canyon, unit includes a reddish-brown to brown, ledge-forming, volcaniclastic facies underlying welded, sanidine-rich tuff. These facies have a mostly matrix-supported texture with subangular to subrounded, pebble-sized pumice and minor aphanitic andesite clasts. 40Ar/39Ar ages of 35.72 ± 0.01 Ma and 35.75 ± 0.01 Ma (samples 18BH-5DK and 18BH-749, respectively). Thickness is <80–100 m.

03-01-04-00-00—Unit—Tlj—La Jencia Tuff—Purplish-brown or gray, weathering dark-purplish to very dark-brown, moderately to strongly welded ash-flow tuff. Phenocrysts include 2–7% sanidine (fine to medium, subhedral to euhedral, glassy to chatoyant or altered to clay) and trace to 1% biotite (fine, subhedral, occasional coppery luster or altered to reddish, earthy mineral). Trace to 1% dusky to purplish-brown lithics up to 0.3 cm across are aphanitic or may contain tabular minerals altered to clay. Common eutaxitic foliation. Abundant fiamme and stretched vesicles and lapilli. Length:width ratios of fiamme highly variable, ranging from 3:1 to 76:1. Forms a thin ledge underlying the Vicks Peak Tuff east of New Mexico Highway 1, where it is inferred to have filled a paleotopographic low formed on the Hells Mesa Tuff. 40Ar/39Ar age of 29.00 ± 0.02 Ma (sample 18BH-724). Thickness is <7 m thick.

03-01-06-00-00—Unit—Tta—Trachyandesite—Purplish brown, weathering dark reddish or grayish brown, slightly to moderately vesicular, massive to moderately flow-foliated, aphanitic, trachyandesite lava. Vesicles are commonly coated by whitish to buff calcium carbonate or occasionally by ferromagnesian minerals. Phenocrysts include <2–3% total plagioclase, pyroxene, hornblende, and olivine; plagioclase and pyroxene are more common. Phenocrysts are very fine- to fine-grained (rare medium grains). Forms slopes and ledges. Exposed thickness is 65–70 m.

04-00-00-00-00—Heading2—PALEOZOIC—PALEOZOIC—PALEOZOIC

04-01-00-00-00—Unit—*u—Pennsylvanian Rocks, undivided—Medium to dark-gray, mostly medium-bedded, non- to occasionally cherty, generally fossiliferous mudstone, wackestone, and packstone. Chert occurs as whitish lace that weathers orange-tan. Fossils include nautiloids, bivalves up to 1.25 cm in diameter, crinoids, sponge spicules, and fusulinids. The latter are up to 3.5 mm long and often lack internal structure due to recrystallization. Some mudstones are highly bioturbated with burrows up to 0.8 cm in diameter and occurring along bedding planes. Covered intervals are inferred to be underlain by shale. The thickness of the Pennsylvanian section at Bell Hill in the adjacent Steel Hill quadrangle (sections 17 and 20, T8S, R4W) is >495 m of which the Gray Mesa and Bar B Formations comprise 460–470 m (Lucas et al., 2017).

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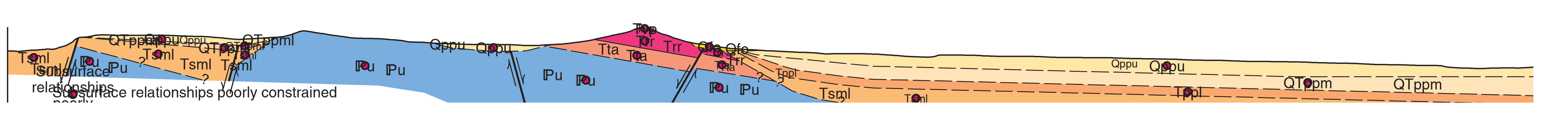
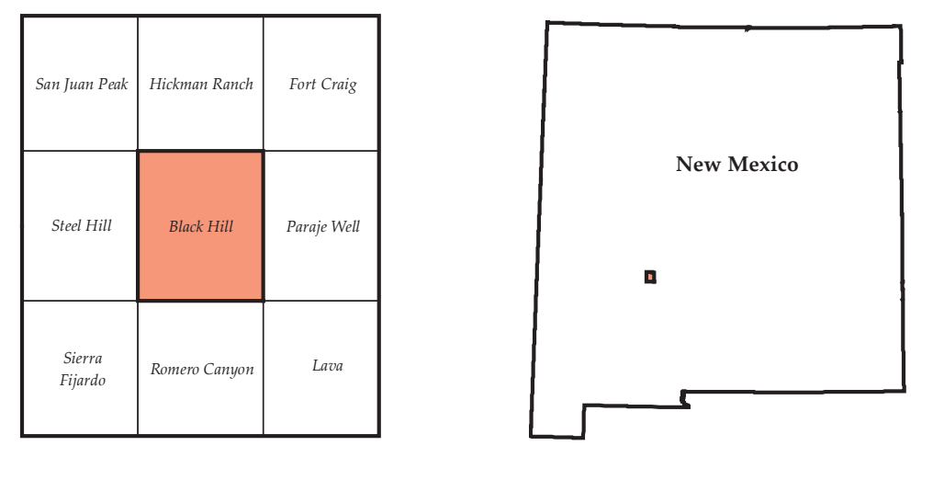
Last Modified May 2019

Geologic Cross Section A–A'

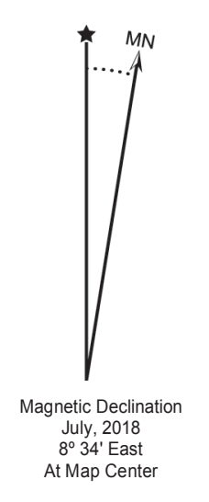


Base map from U.S. Geological Survey 2017.
North American Datum of 1983 (NAD83)
Projection and 1,000-meter grid: Universal Transverse Mercator, Zone 13S, shown in blue.
10,000-foot ticks: New Mexico Coordinate System of 1983(central zone), shown in red.

Roads....................U.S. Census Bureau, 2015-2016
Names....................GNIS, 2016
Hydrography....................National Hydrography Dataset, 2014
Contours....................IFSAR 4.5 m Digital Elevation Model, 2008
Public Land Survey System....................BLM, 2011

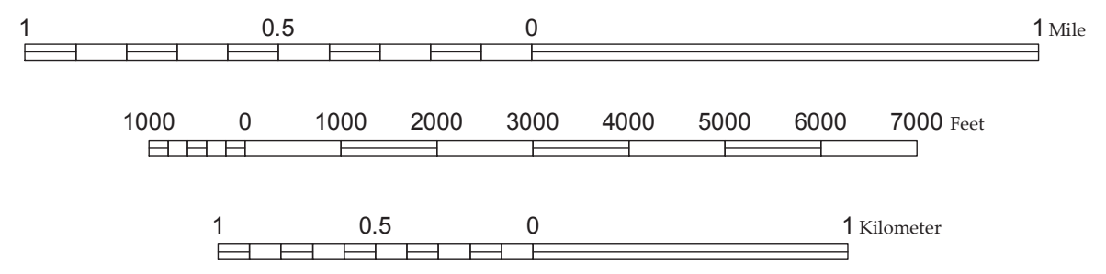


Quadrangle Location



Magnetic Declination
July, 2018
8° 34' East
At Map Center

1:24,000



Contour Interval 20 Feet

North American Vertical Datum of 1988

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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

New Mexico Bureau of Geology and Mineral Resources
Open-File Geologic Map 274

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Geologic Map of the Black Hill 7.5-Minute Quadrangle, Socorro County, New Mexico

June, 2019

by
Andrew P.Jochems and Daniel J. Koning

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Comments to Map Users

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