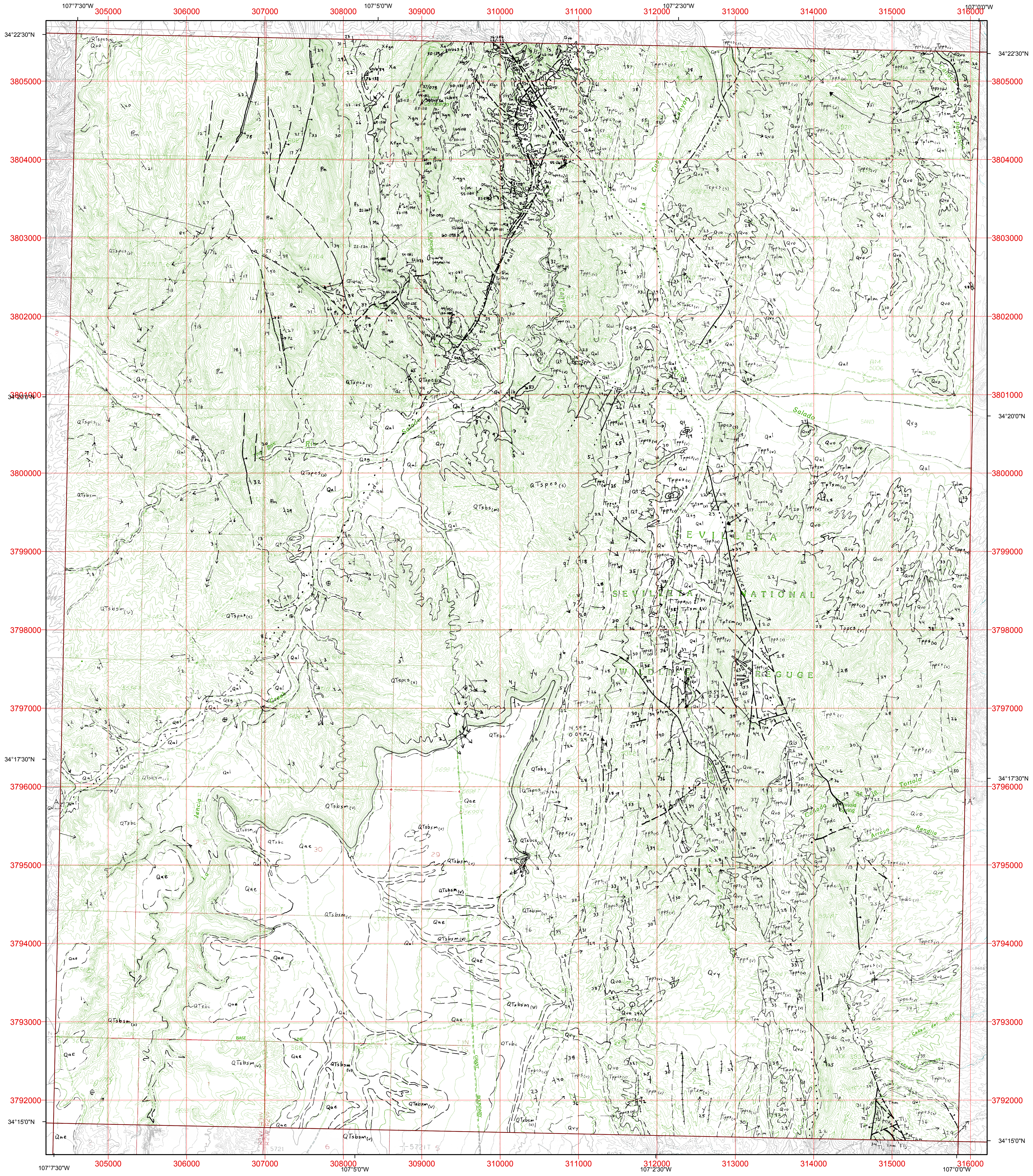
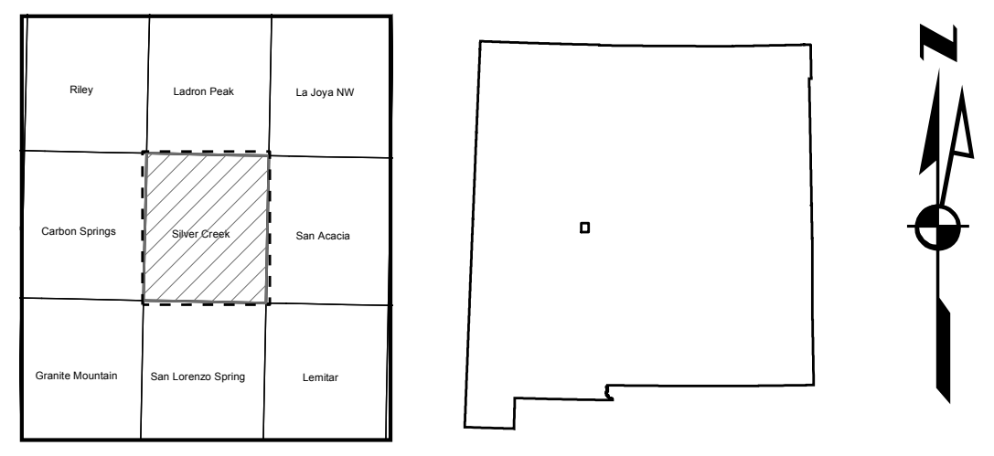


Base from U.S.Geological Survey provisional edition, 1985
1927 North American datum, Universal Transverse Mercator Projection
1000- meter UTM grid ticks, zone 13, shown in red

Geologic Map of the the Silver Creek 7.5- min quadrangle

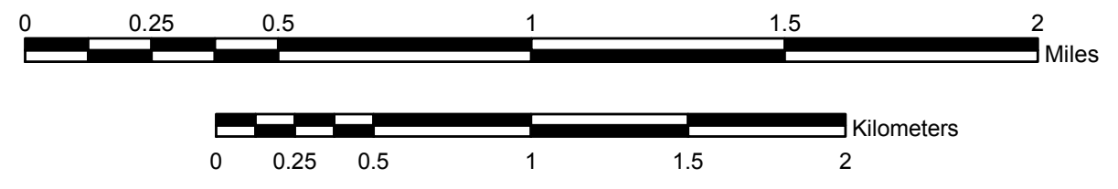
Steven M. Cather and Adam S. Read

May, 2003



Magnetic Declination
August, 2003
10º 23' East
At Map Center

1:24,017



CONTOUR INTERVAL 20 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

COMMENTS TO MAP USERS

A geologic map displays information on the distribution, nature, orientation, and age relationships of rock and deposits and the occurrence of structural features. Geologic and fault contacts are irregular surfaces that form boundaries between different types or ages of units. Data depicted on this geologic quadrangle map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation. Locations of contacts are not surveyed, but are plotted by interpretation of the position of a given contact onto a topographic base map; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologist(s). Any enlargement of this map could cause misunderstanding in the detail of mapping and may result in erroneous interpretations. Site-specific conditions should be verified by detailed surface mapping or subsurface exploration. Topographic and cultural changes associated with recent development may not be shown.

Cross sections are constructed based upon the interpretations of the author made from geologic mapping, and available geophysical, and subsurface (drillhole) data. Cross-sections should be used as an aid to understanding the general geologic framework of the map area, and not be the sole source of information for use in locating or designing wells, buildings, roads, or other man-made structures.

The map has not been reviewed according to New Mexico Bureau of Geology and Mineral Resources standards. The contents of the report and map should not be considered final and complete until reviewed and published by the New Mexico Bureau of Geology and Mineral Resources. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the State of New Mexico, or the U.S. Government.

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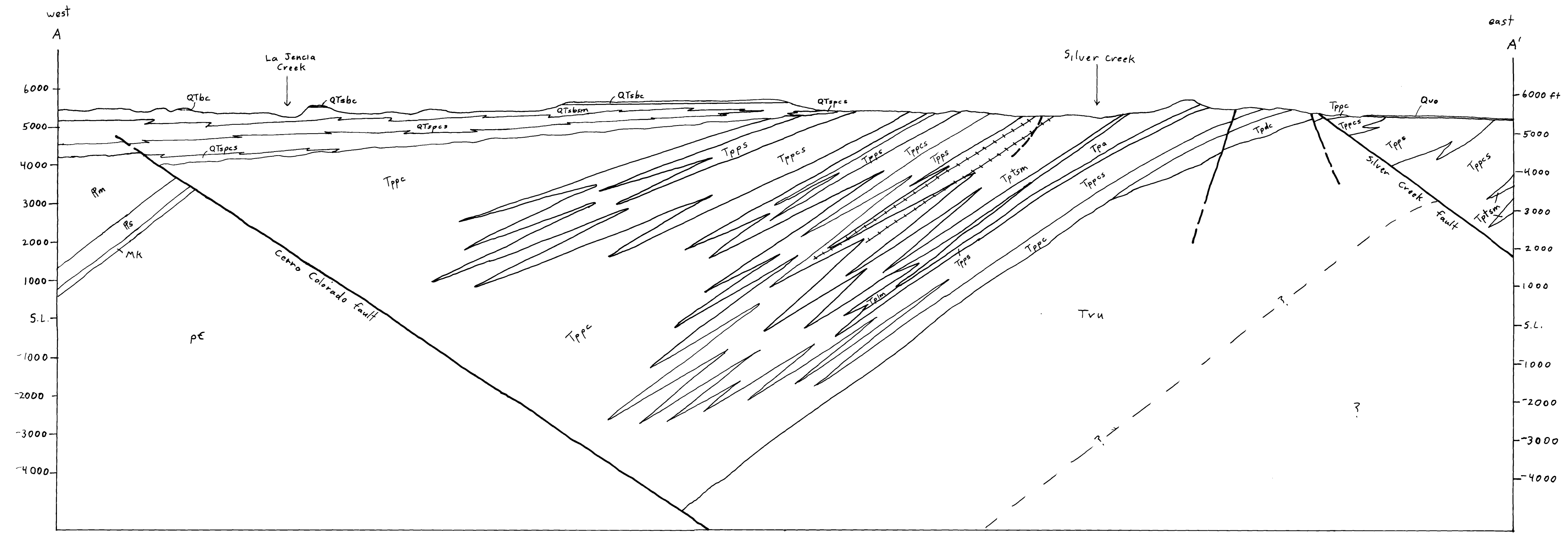
DRAFT
NMBGMR OF-GM 75

This draft geologic map was produced from scans of hand-drafted originals from the author(s). It is being distributed in this form because of the demand for current geologic mapping in this important area. The final release of this map will be made following peer review and redrafting in color using NMBGMR cartographic standards. The final product will be made available on the internet as a PDF file and in a GIS format.

Cross-section A-A', Silver Creek quadrangle



DESCRIPTION OF MAP UNITS

Surficial Deposits

Qsg **Sand and gravel (Holocene)**—Sand, gravel, and minor mud in modern active river and arroyo channels. 0–20(?) m thick.

Qal **Alluvium (Holocene)**—Sand, gravel, and mud adjacent to modern arroyo and river channels. Alluvium is typically at or near grade of modern channels, except in local areas. 0–20(?) m thick.

Qae **Eolian and alluvial deposits (upper Pleistocene–Holocene)**—Eolian sands and loessic silts locally reworked by alluvial processes. Deposits are stabilized by vegetation in most areas. Includes thin, discontinuous eolian veneers on stable upland surfaces that are intimately intertongued with alluvium. 0–2 m thick.

Qt **Terrace deposits (upper Pleistocene–Holocene)**—Fluvial gravels and sands that form strath terraces ~5–15 m above modern stream grades. 1–5 m thick.

Qvy **Younger valley-fill deposits (upper Pleistocene)**—Gravel, sand, and mud that form terraces less than about 30 m above modern stream grade. Alluvium is representative of deposition in a variety of piedmont environments, including alluvial fans, paleovalley and arroyo fills, strath terraces, fill terraces, and pediments. 0–20(?) thick.

Qvo **Older valley-fill deposits (middle Pleistocene)**—Gravel, sand, and mud that form terraces more than about 30 m above modern stream grade. Range of depositional environments is similar to Qvy. At least two aggradational episodes are represented by Qvo. 0–30(?) m thick.

Qpo **Older piedmont deposits (middle to lower(?) Pleistocene)**—Weakly cemented alluvial gravels and sands that occupy the highest post-Santa Fe Group landscape positions in the northern part of the quadrangle. 1–10 m thick.

SANTA FE GROUP

Deposits of the Santa Fe Group were subdivided based on *textural* criteria and were then further subdivided on the basis of *provenance* (Cather, 1997). Deposits containing predominantly (>50%) Paleozoic and Precambrian detritus are denoted by (s). Those consisting dominantly of volcaniclastic rocks are indicated by (v). Deposits of mixed siliciclastic, calciclastic, and volcaniclastic provenance are denoted by (m).

Sierra Ladrones Formation (Pliocene to lower Pleistocene).

QTspcs **Conglomerate-sandstone piedmont facies**—Characterized by varying, subequal proportions of conglomerate and sandstone. Conglomerate is mostly clast-supported and poorly sorted. Sandstone is typically medium to very coarse-grained, commonly pebbly, and exhibits crossbedding or horizontal stratification. Mudstone is minor unit. Consists of upper and lower tongues. The lower tongue occurs mostly east of the Cerro Colorado fault and exhibits mostly southerly paleoflow. The upper tongue buries the Cerro Colorado fault and shows mostly southerly to easterly paleoflow. Includes pediment veneer on southwest flank of Cerro Colorado that consists of poorly sorted conglomerate composed primarily of Paleozoic limestone and sandstone clasts with subordinate granite. Lower contact has considerable relief in many places and dips more steeply to the east than the constructional top which projects westward to a dissected low relief pediment cut into Proterozoic basement.

QTsbs **Sandstone-dominated basin-floor facies**—Characterized by conglomerate/sandstone ratio of less than 1/2. Conglomerate is clast-supported and occurs in tabular or lenticular units <2 m thick. Sandstone is very fine to very coarse grained and exhibits mostly of horizontal stratification. Mudstone is common and occurs as tabular units which locally compose as much as 20% of the unit. Unit was deposited by low-gradient bedload streams and associated floodplains. Paleoflow was non-systematic.

QTsbsm **Basin-floor deposits**—Consists of subequal sandstone and mudstone with subordinate conglomerate. Sandstone and pebbly sandstone is horizontally stratified or trough crossbedded and forms broad, lenticular bodies 0.5–3 m thick.

Mudstone is indistinctly bedded, forming tabular units 0.5–2 m thick and commonly contains weakly developed calcareous paleosols. Conglomerate is mostly clast supported and occurs in channel-form, commonly incised units as much as 2 m thick. Paleoflow was highly variable in direction.

QTsbc **Basin-floor travertine and related calcareous deposits**—Mesa-forming carbonate deposits interbedded with QTsbsm. To the north and east, unit consists of tabular bedded travertine deposits as much as 5–7 m thick. Ostracodes present in thin sections attest to the former presence of ponds in this area. To the south and west, unit thins and becomes more clastic-rich. Near La Jencia Creek the unit grades into carbonate-cemented sandstone, and pinches out westward against fluvial deposits of QTsbsm near the Cerro Colorado fault.

Popotosa Formation (lower Miocene–upper Miocene)

Tppc **Conglomeratic piedmont facies**—Characterized by conglomerate/sandstone ratio of greater than 2/1. In this and other facies within the Popotosa Formation, detritus was derived dominantly from mid-Tertiary volcanic rocks. Siliciclastic and calciclastic deposits in the Popotosa Formation occur locally in the stratigraphically highest part of the unit east of the Silver Creek fault near the Rio Salado. These are probably equivalent to the fanglomerate of Ladron Peak of Machette (1978). Conglomerate is mostly clast-supported, crudely imbricated, and poorly sorted. Matrix-supported debris-flow deposits are common in this facies; in areas where debris-flow deposits are voluminous, they are mapped separately as facies Tpdc. Sandstone in Tppc is medium to very coarse grained and commonly exhibits crossbedding or horizontal laminations. Mudstone is rare, occurring mostly as thin discontinuous drapes. Paleoflow was eastward.

Tpdc **Debris-flow-dominated facies**—Characterized by a dominance of very poorly sorted conglomerate that is matrix-supported and typically very well indurated. Clasts are virtually all derived from Tertiary volcanic rocks. Fills paleovalleys in the basal part of the Popotosa Formation in the Lemitar Mountains area (Chamberlin, 1982; Cather et al., 1994a).

Tppcs **Conglomerate-sandstone piedmont facies**—Characterized by conglomerate/sandstone ratio between 2/1 and 1/2. Conglomerate is mostly clast-supported and poorly sorted. Sandstone is fine to very coarse grained and commonly horizontally stratified or trough crossbedded. Mudstone is minor. Paleoflow was eastward.

Tpps **Sandstone-dominated piedmont facies**—Characterized by conglomerate/sandstone ratio less than 1/2 and sandstone/mudstone ratio greater than 2/1. Sandstone is dominantly horizontally stratified with subordinate trough crossbedding. Conglomerate is mostly clast-supported and occurs as drapes and as tabular units less than a meter thick. Paleoflow was generally eastward.

Tptsm **Transitional playa-margin facies**—Characterized by sandstone/mudstone ratio of between 2/1 and 1/2. Sandstone is horizontally laminated and forms thin tabular beds (<0.5 m). Sandstone is intimately interbedded with tabular mudstones that are structureless and dominantly red-brown in color. Conglomerate is rare. The playa-margin facies represents interfingering of distal piedmont and sand-flat deposits with playa mudstone. Near Silver Creek, paleoflow was generally northward due to deflection of regional easterly paleoflow by the Silver Creek volcano.

Tplm **Playa facies**—Characterized by a dominance of mudstone (sandstone/mudstone ratio is less than 1/2). Mudstone is mostly red-brown with uncommon greenish-gray zones that are parallel to bedding. Bedding is generally indistinct, although horizontal lamination was occasionally noted. Sandstone is medium to very fine grained and occurs as thin tabular beds (<0.3 m). Conglomerate is virtually absent. Gypsum is common. Deposited in large playa system east of the Silver Creek fault and by ponding adjacent to the Silver Creek volcano.

Tpa **Silver Creek andesite**—Pyroxene- and plagioclase-bearing basaltic andesite flows and tephra. Erupted by the Silver Creek volcano that was subsequently cut by the Silver Creek fault (Weber, 1971). Volcano consists of a shield volcano that buried an earlier tuff cone that consisted of phreatomagmatically erupted greenish basaltic glass and recycled detritus (**Tpc**) from the underlying Popotosa Formation. Radial dikes (**Tis**) are exposed in the core of the volcano. Volcano has been K/Ar dated at 16.2 ± 1.5 Ma by Weber (1971). ^{40}Ar/^{39}Ar dates of 15.33 ± 0.07 and 15.49 ± 0.20 have recently been obtained from a lava and a feeder dike, respectively, from the Silver Creek volcano (R. M. Chamberlin and W. C. McIntosh, 2003, written commun.).

UPPER EOCENE–OLIGOCENE VOLCANIC, INTRUSIVE AND VOLCANICLASTIC ROCKS

Tlp **La Jara Peak Basaltic Andesite (upper Oligocene)**—Mafic flows with associated tephra and minor eolian sandstone. Flows exhibit trachytic textures locally and phenocrysts are clinopyroxene and plagioclase ± amphibole. Individual flows are 1–5 m thick. Not dated in quadrangle; age range is ~27–24 Ma regionally.

Ti **Basaltic andesite dikes (upper Oligocene)**—Mafic dikes 0.5–1.5 m thick. Undated on quadrangle, but regionally are associated with La Jara Peak Basaltic Andesite. En echelon dikes exposed within fault slivers of the Cerro Colorado fault suggest a dextral component to this moderately dipping normal fault.

Tvp **Vicks Peak Tuff (upper Oligocene)**—Distal outflow of crystal-poor, high-silica rhyolite ignimbrite erupted from Nogal Canyon caldera in the southern San Mateo Mountains. Age is 28.6 Ma (McIntosh et al., 1991).

Thm **Hells Mesa Tuff (lower Oligocene)**—Crystal-rich ignimbrite containing crystals of biotite, quartz, plagioclase, and sanidine. Erupted from the Socorro caldera at 32.1 Ma (McIntosh et al., 1991).

Tds **Spears Group (upper Eocene–lower Oligocene)**—Grayish-purple volcaniclastic sandstone, mudstone, and conglomerate that interfinger regionally with extrusive volcanic rocks in the Mogollon–Datil (Cather et al., 1994a). Only exposed in a small fault block along Cerro Colorado fault on north side of the Rio Salado.

PALEOZOIC ROCKS

Py **Yeso Formation (Permian)**—Gray to orange sandstone, siltstone, limestone and gypsum. Exposed in fault blocks along Cerro Colorado and Silver Creek faults.

IPb **Bursum Formation (Pennsylvanian–Permian)**—Interbedded limestone and red sandstone–siltstone exposed in fault slivers along the Cerro Colorado fault.

IPm **Madera Limestone (Pennsylvanian)**—Gray to brown fossiliferous limestone and shale, and sandstone. About 600 m thick.

Mk **Kelley Limestone (lower Mississippian)**—Gray to light brown limestone (commonly crinoidal), sandstone, and shale. Paleokarst features are common. These rocks are strongly altered (oxidized iron) in places, particularly where the Cerro Colorado and Ladron faults intersect. About 30 m thick; thins to north.

PROTEROZOIC ROCKS

Ys **Mesoproterozoic(?) granite**.—Medium-grained unfoliated granite and associated granitic pegmatites. This granite appears to intrude **Xgn** and is only seen northeast of the Ladron Fault.

Xgn **Paleoproterozoic medium-grained granite gneiss**—Generally strongly foliated/lineated. Two-feldspar granite gneiss is pink due to higher proportion of K-spar to plagioclase. Biotite is often altered to chlorite. Appears to intrude **Xmgn** and older rocks. This gneiss does not appear to be a higher-strain variety of **Xmgn** because the primary grainsize is so different as is the proportion of biotite (much more in **Xmgn**) and the finite strain appears to be comparable between **Xgn** and **Xmgn**.

Xmgn **Paleoproterozoic Megacrystic grano-diorite gneiss—**Two-feldspar gneiss is very similar in composition to **Xgn** except that the proportion of biotite is much higher. Composition ranges from granite to grano-diorite probably reflecting the local composition of assimilated country rock (**Xa** and **Xfgn**). The strongly foliated/lineated gneiss is generally pink due to large K-spar crystals that are plastically deformed into ribbons 10-20 cm long. Shear sense is difficult to determine in outcrop, probably reflecting a large component of pure shear. However, K-spar porphyroclasts viewed parallel to lineation and perpendicular to foliation occasionally indicate top-west (thrust sense in present orientation) shear.

Xfgn **Paleoproterozoic fine-grained gneiss**—Felsic to intermediate gneiss of uncertain protolith. Gneiss is generally felsic, composed mostly of K-spar and quartz) and is quite fine-grained. In places, mylonite zones are present within this gneiss, however it appears that the fine grain size is primary. It is generally strongly foliated/lineated to a similar degree as **Xgn**, **Xa**, and **Xmgn** with respect to the finer grain size. This rock is intimately interbedded with amphibolite with sometimes indistinct contacts leading to more intermediate compositions. The association with amphibolite suggests that the protolith was a felsic volcanic rock or sedimentary rock derived from rhyolites in a bi-modal volcanic field. However, no primary volcanic or sedimentary features were observed in the field.

Xa **Paleoproterozoic amphibolite**—Amphibole-plagioclase mafic schist. Generally strongly foliated similar to the **Xfgn** it is interbedded with. Also appears as sometimes large screens within younger metaplutonic rocks. In places, what appear to be relict amygdules are filled with plagioclase suggesting that these rocks represent basalt flows rather than intrusive rocks.

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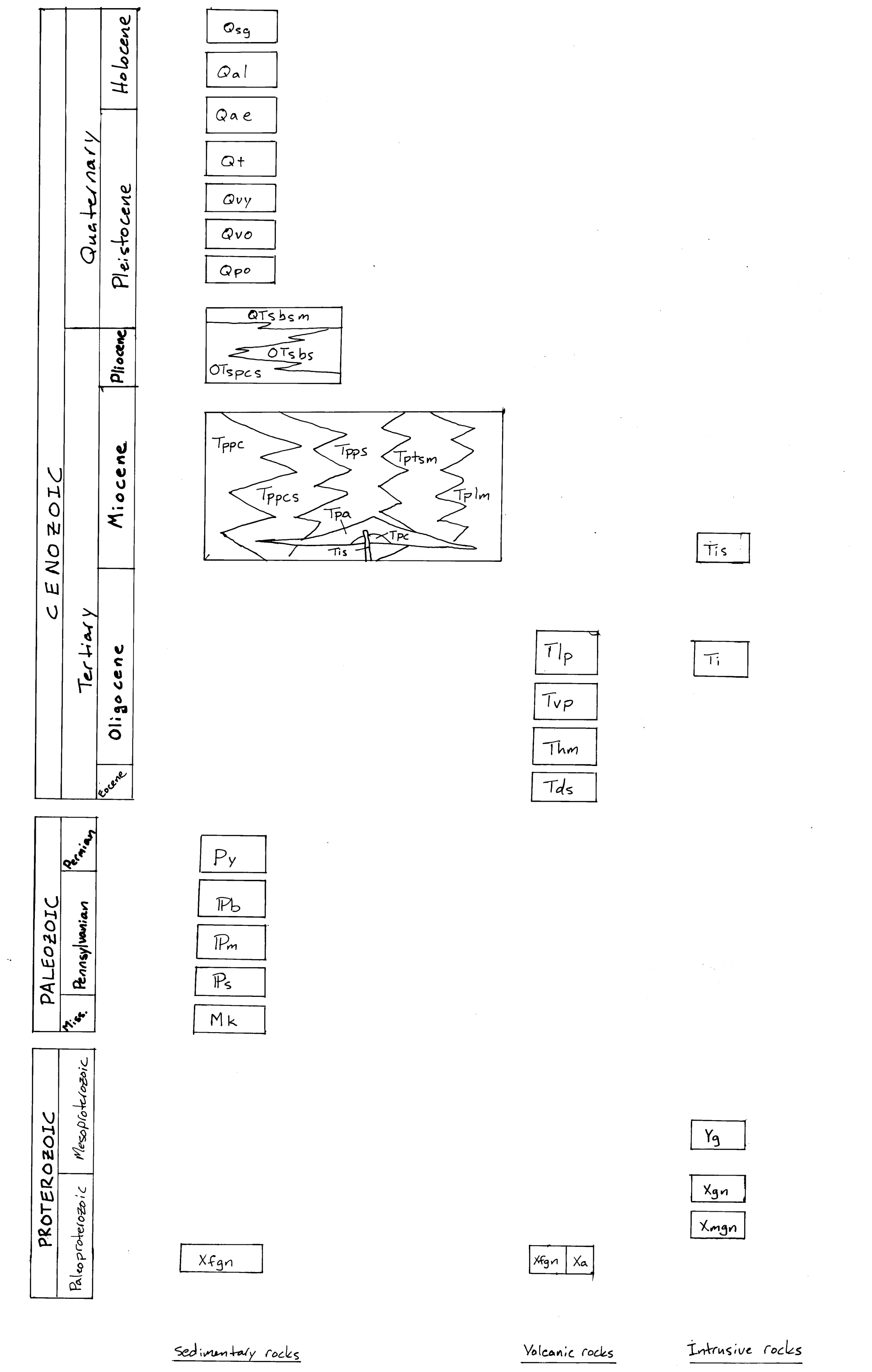
Correlation of Units
Silver Creek 7.5' quadrangle



EXPLANATION OF MAP SYMBOLS

Contact between geologic units or lithofacies within Santa Fe Group. Dashed where approximately located.

60-345 40/045 Fault showing direction and dip of fault plane and plunge and trend of slickenlines. Dashed where approximately located; dotted where oncealed. Bar and ball on downthrown block. Teeth on upper plate of reverse fault.

Anticline showing trace of hinge plane and plunge direction. Dashed where approximately located, dotted where concealed.

Syncline showing trace of hinge plane and plunge direction.

Monocline showing trace of anticlinal hinge. Dashed where approximately located, dotted where concealed.

50·135 Strike and dip of bedding (dip and dip direction shown around Cerro Colorado).

Vertical bedding.

Horizontal bedding.

45/080 D U 65·135 Strike and dip of S_1 foliation with plunge and trend of extension lineation. Sense of shear shown where determined in the field. Also indicates strike and dip of flow banding in volcanic rocks.

Mylonitic shear zone.

Paleocurrent direction based on pebble imbrication or crossbedding.

14.5 ± 0.04 Ma Tephra layer, showing radiometric age (Cather et al., 1994b).

Marker bed in Santa Fe Group.

Adit

Mine