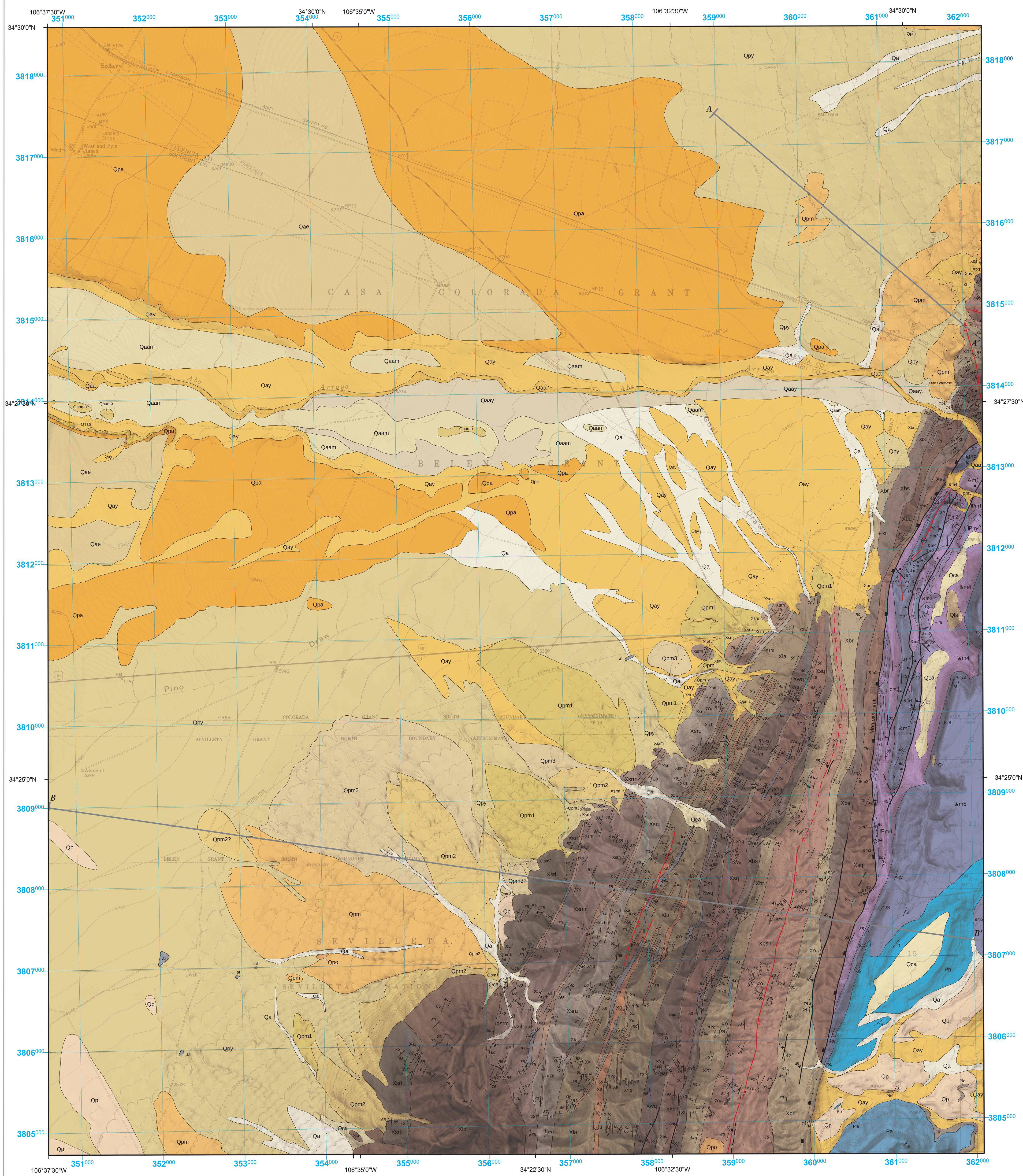
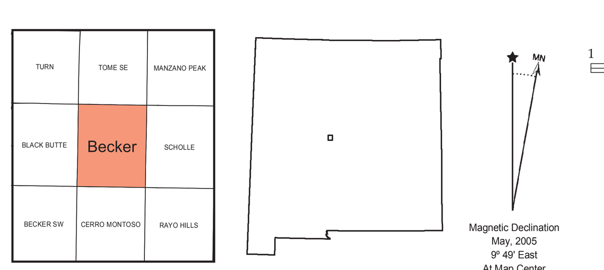
NMBGMR Open-file Geologic Map 100
Last Modified April 2012



Base map from U.S. Geological Survey 1952, from photographs taken 1947. Map edited in 1979
1927 North American datum, UTM projection -- zone 13N
1000-meter Universal Transverse Mercator grid, zone 13, shown in red



QUADRANGLE LOCATION

Magnetic Declination
May, 2005
9º 49' East
At Map Center

1:24,000

1 MILE

7000 FEET

1 KILOMETER

CONTOUR INTERVAL 20 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geologic map of the Becker 7.5- minute quadrangle, Valencia and Socorro Counties, New Mexico

May 2005
Revised October 2005

by
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New Mexico Bureau of Geology and Mineral Resources
Open-file Geologic Map 100

Mapping of this quadrangle was funded by a matching-funds grant from the STATEMAP program of the National Cooperative Geologic Mapping Act, administered by the U. S. Geological Survey, and by the New Mexico Bureau of Geology and Mineral Resources, (Dr. Peter A. Scholle, *Director and State Geologist*, Dr. J. Michael Timmons, *Geologic Mapping Program Manager*).

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This and other STATEMAP quadrangles are (or soon will be) available for free download in both PDF and ArcGIS formats at:

http://geoinfo.nmt.edu

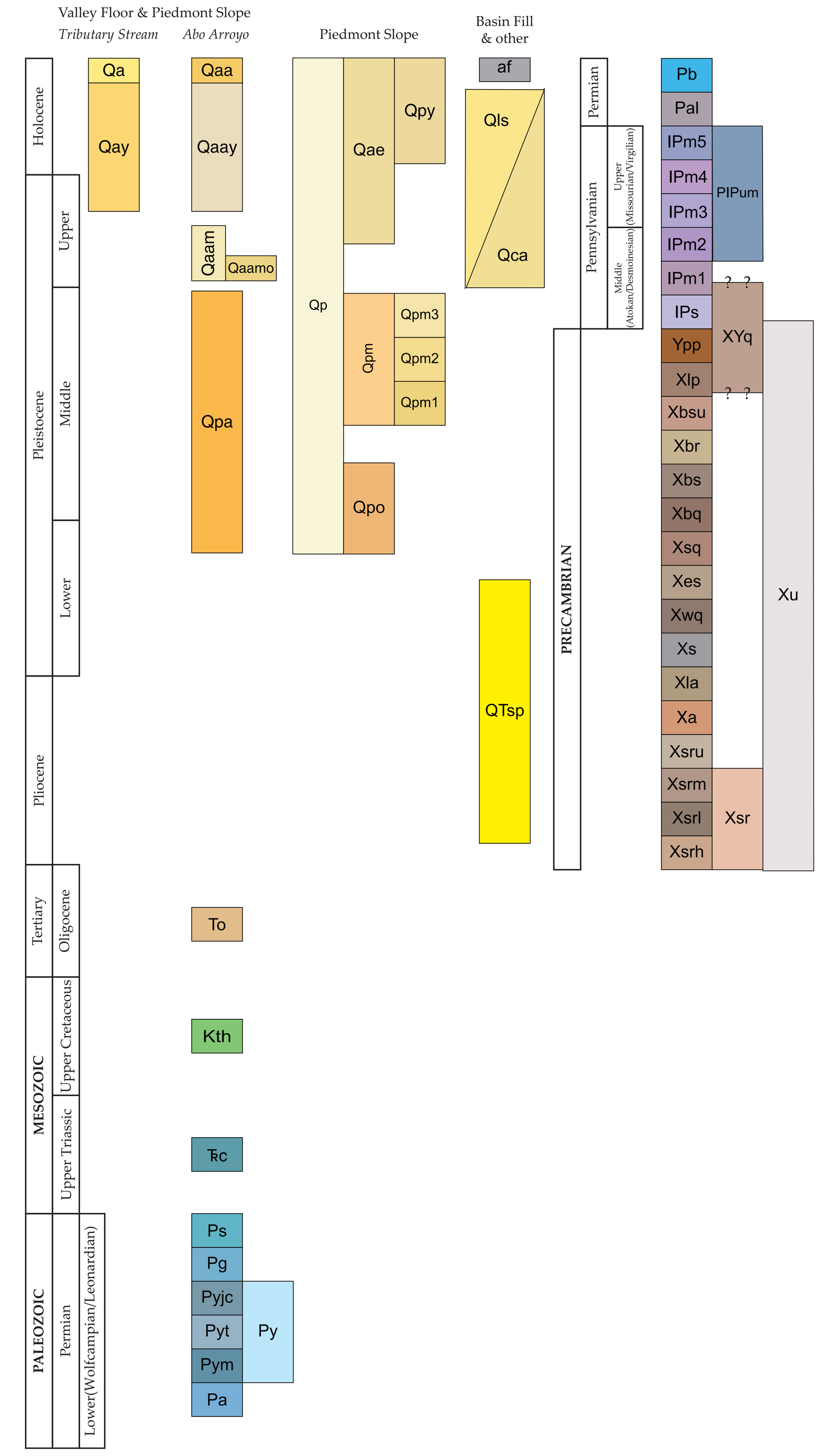
COMMENTS TO MAP USERS

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map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation.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

Correlation Chart of Map Units



Explanation of Map Symbols

Geologic Cross Section

Geologic contact–Dashed where approximately located or gradational; dotted where concealed by younger deposits.

Fault trace–Dashed where approximately located or gradational; dotted where concealed; queried where uncertain or continuity uncertain. Barb on upthrown side of Laramide reverse fault; bar and ball on downthrown side of Miocene normal fault.

Overturned Anticline–trace of axial plane showing direction of plunge.

Overturned Syncline–trace of axial plane showing direction of plunge; dashed where approximately located.

Anticline and Syncline–trace of axial plane showing plunge direction; dashed where approximately located.

Strike and Dip of bedding.

Vertical bedding.

Horizonal bedding.

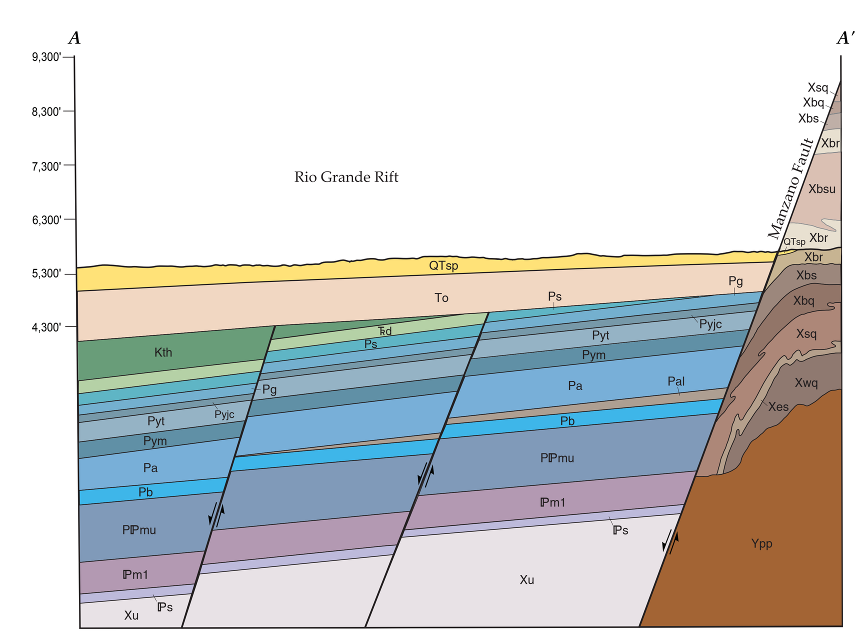
Strike and Dip of overturned bedding.

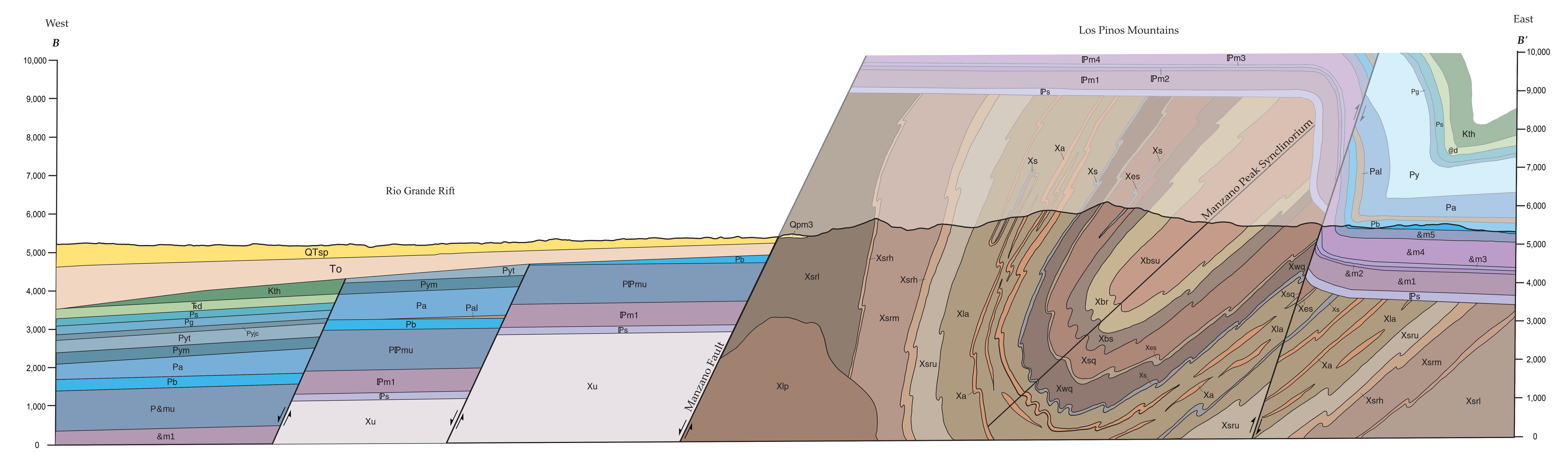
Cross bedding-Truncated foresets represent top.

S1 Compositional layering in metasediments. Arrow represents F1 minor fold axis.

S2 schistosity and crenulation cleavage. Arrow represents F2 minor fold axis.

S3 crenulation cleavage and shear bands.





Description of Units

Quaternary

Alluvium of Abo Arroyo

Qaa **Abo Arroyo alluvium, active (upper Holocene to historic)—**Brown to reddish-brown (5-7.5YR 5/4), moderately-sorted, clast-supported, pebble- to cobble-gravel. Contains cobble and boulder bars that are approximately 20 m wide and 40-50 m long. Deposit contains scattered boulders up to about 1 m maximum diameter. Gravel is predominantly subrounded quartzite and limestone with subordinate reddish-brown sandstone and minor schist Underlies active drainage of Abo Arroyo. No soil development, but deposit contains disseminated calcium carbonate. Base not observed.

Qaay **Abo Arroyo alluvium, younger terrace deposit (Holocene to latest Pleistocene(?))—**Reddish-brown (5YR 5/4-4/4), medium-bedded, fine- to medium-grained silty sand and clay with scattered lenses of pebble gravel. Lower part of unit is slightly better cemented and locally forms weak buried soil with Stage I carbonate morphology. Unit forms broad, low-lying terrace about 2 to 3 m above local base level. Very weakly developed soil with weak filamentous Stage I pedogenic carbonate morphology. Deposit base is locally exposed at mouth of Abo Canyon, where it is up to 3 m in thickness.

Qaam **Abo Arroyo alluvium, intermediate terrace deposit (late Pleistocene)—**Light-brown (7.5YR 6/4), pebble gravel and pebbly sand. Sand is poorly-sorted, fine- to very coarse-grained sand. Unit forms discontinuous, intermediate terrace about 10 m above the floor of Abo Arroyo. Weakly developed soil exhibit Stage I and II pedogenic carbonate morphology. Unit is locally subdivided into a slightly older deposits based on inset relationships. Base not exposed, but deposit is at least 1 m thick.

Qaamo **Abo Arroyo alluvium, older subunit of intermediate terrace deposit (middle Pleistocene)—**Pink to pinkish-white and reddish-brown (7.5YR 7/4-8/2 & 5YR 5/4), pebble and cobble gravel. Unit forms highest terrace in Abo Arroyo and is recognized as low-lying gravels that sit about 2 m above the top of the intermediate terrace deposit (Qaam). Soils are well developed and exhibit at least Stage III pedogenic carbonate morphology. Gravel commonly contains remnants of 1-3 mm thick carbonate coatings.

Qpa **Abo Arroyo alluvium, oldest piedmont-slope alluvium (middle or lower (?) Pleistocene)—**Low relief, fan-shaped deposit discontinuously exposed along northern and southern margins of the Abo Arroyo valley. Reddish-brown to light-brown (5YR 4/4 to 7.5YR 6/4) pebble to cobble gravel (< 25 cm diam.) containing subrounded to subangular orthoquartzite, reddish-brown sandstone, schist, and sparse granite, rounded (but deeply pitted) limestone, and yellowish-brown quartzose sandstone. Gravels commonly coated with 1-4 mm thick carbonate rinds, suggesting the presence of at least Stage III+ pedogenic carbonate morphology. Deposit surface is about 18 m above the floor of Abo Arroyo and mantled by thin (<50 cm) veneer of brown (7.5YR 5/4) fine- to medium-grained silty to clayey sand with scattered gravels. Unit is inset by terrace deposits of Abo Arroyo and tributary stream deposits derived from the southern Manzano and northern Los Pinos Mountains. Base exposed along flanks of Abo Arroyo at western margin of map area, where it is 4.5 m thick.

Piedmont-slope Alluvium

Qp **Piedmont alluvium, undivided (Holocene to Pleistocene)—**Undivided piedmont alluvium. Surface contains weakly developed soils with Stage I carbonate morphology and bury older deposits. Commonly recognized as low rounded hills. North of Abo Arroyo, deposits contain variable proportions of quartzite and granite with minor schist. To the south, they contain quartzite and metamorphic clasts. Base not exposed.

Qpy **Piedmont alluvium, younger deposits (upper Pleistocene to Holocene)—**Light-brown to brown (7.5YR 5/4-6/4), weakly consolidated, poorly sorted, pebbly to cobbly sand and gravel. Deposits commonly contain matrix-supported gravelly sand with clast-supported gravel lenses. Beds are commonly 30-50 cm in thickness and form a stack of sand and gravel that commonly have scoured basal contacts and buried, weakly developed soils exhibiting Stage I pedogenic carbonate morphology. Deposits are at least 2 m thick and typically overlie older, paler colored, alluvium containing well developed calcic soils. Forms slightly to moderately dissected surfaces. Deposits are inset against intermediate piedmont alluvium of unit Qpm. Deposits are commonly overlain by a thin, discontinuous veneer of brown eolian sand.

Qpm **Piedmont alluvium, intermediate deposits (middle Pleistocene)—**Pink (7.5YR 7/4), poorly sorted, moderately consolidated pebble to cobble conglomerate and pebbly sand. Unit forms broad alluvial fans whose toes are commonly buried by younger piedmont alluvium. Base not exposed. Commonly buried by younger piedmont and stream-valley alluvium from the Manzano and Los Pinos Mts. Deposits are locally divided into at least three subunits based on surface morphology and inset relationships.

Qpm3 **Piedmont alluvium, younger subunit (middle Pleistocene)—**Pink to brown (7.5YR 7/4-5/4), poorly sorted, moderately consolidated pebble to cobble conglomerate and pebbly sand. Unit forms broad alluvial fans that are inset against older piedmont deposits of units Qpm1 and Qpm2. Soils exhibit moderately to weakly developed Stage II to III carbonate morphology. Deposit is at least 1.5 m thick.

Qpm2 **Piedmont alluvium, intermediate subunit (middle Pleistocene)—**Strong-brown to very pale-brown (7.5YR 5/6, 10YR 8/2), poorly sorted cobble to boulder gravel. Soils exhibit moderately developed Stage II to III carbonate morphology and deposits commonly overlie older, paler-colored alluvial deposits. Deposit is at least 2-3 m thick towards the Los Pinos Mountains.

Qpm1 **Piedmont alluvium, older subunit (middle Pleistocene)—**White to pinkish-white (10YR 8/1 - 7.5YR 8/2), poorly-sorted cobble gravel. Soils are well developed and exhibit Stage III+ carbonate morphology. Schist and granite clasts are commonly weathered and split. Schist clasts are commonly rubefied. Bar-and-swale topography is subdued or not present. Gravels are commonly 5-10 cm in diameter and range up to about 50 cm in diameter. Base not exposed, but exposures near the Los Pinos Mountains indicate deposit thickness is greater than 3 m.

Qpo **Piedmont alluvium, older (lower (?) to middle Pleistocene)—**Poorly-sorted, poorly-to moderately-consolidated and calcium carbonate-cemented sand. Contains strongly developed soils with Stage III+ carbonate morphology and deposit surface is 15-20 m above Abo Arroyo. Deposit surfaces are highly dissected and are locally preserved in the Blue Springs and Abo Arroyo drainages. Unit may be correlative to uppermost Sierra Ladrones Fm. Deposits are at least 3 m thick.

Tributary Stream Valley Alluvium

Qa **Stream alluvium, undivided (upper Holocene to historic)—**Brown (7.5YR 4/4), medium- to very coarse-grained, poorly to moderately sorted, poorly consolidated pebble- to cobble gravel with local accumulations of cobbles and small boulders and gravel bars. Gravels in most drainage courses contain angular to subangular quartzite, schist, granite and sandstone. Gravels are commonly pebbles, but range to over 40 cm in diameter. Soil development is very weak with disseminated carbonate cement. Deposit underlies narrow to broad streams that are inset against low terrace deposits. Base not observed.

Qay **Stream alluvium, undivided (uppermost Pleistocene to Holocene)—**Brown (7.5YR 5/4), poorly to moderately sorted, poorly consolidated light-brown and light reddish-brown to gray-brown pebble and cobble conglomerate and sand with minor accumulations of boulders. Soil development is very weak with Stage I to II carbonate morphology. Unit forms broad valley fills that are inset against units Qpa and grade towards low-lying terraces of Abo Arroyo (Qaay). Estimated thickness is probably less than 4 m.

Artificial Fill and Mass-movement Deposits

af **Artificial fill (historic)—**Dumped fill and areas affected by human disturbances. These areas include large quarry excavations and railroad grades. Unit delineated where deposits or disturbed areas are areally extensive.

Qae **Eolian sand, alluvium, and colluvium, undivided (Holocene to upper Pleistocene)—**Brown (7.5YR 5/2-5/4), unconsolidated, poorly sorted and stratified, fine- to medium-grained sand and silty sand with scattered pebbles. Forms a thin, discontinuous veneer over older deposits. Deposits are typically less than 0.5 m thick.

Qca **Colluvium and alluvium, undivided (Holocene to upper Pleistocene)—**Brown (7.5YR 5/4), poorly consolidated, poorly sorted and stratified, fine- to coarse-grained, clast- and matrix-supported deposits derived from a variety of mass-movement hill-slope processes, including debris flow, shallow slump and creep. Clasts are typically angular and composition generally reflects local provenance. Colluvium is common on hill slopes and differentiated where areally extensive. Colluvium is commonly less than 1 m thick; on dip-slopes of Paleozoic units it is less than 0.3 m thick.

Qls **Landslide deposits (Pleistocene)—**Poorly to well consolidated and very poorly sorted, sand, and breccia. Formed by mass-movement, commonly on steep hill slopes. Arrows indicate inferred direction of movement.

Santa Fe Group

QTsp **Sierra Ladrones Formation, deposits of ancestral Abo Arroyo (middle Pleistocene to Pliocene)—**Reddish-brown (5YR 4/4) massive silty clay. Upper boundary with pebble gravel contains an eroded soil with light reddish-brown to pink (65YR 6/4-7/4) silty clay with Stage III+ pedogenic carbonate morphology. Gravels of unit Qpa may correlate to upper part of this deposit. Interpretations of deep seismic reflection profiles and gravity data suggest that low-density basin-fill may be less than 1 km thick west of the front of the Los Pinos and southern Manzano Mts (Cape et al., 1983).

Oligocene

To **Volcanic and volcaniclastic rocks, undivided—**(Shown in cross section only). White to pinkish-gray, moderately to poorly sorted, moderately consolidated, fine- to very coarse-grained sandstone with scattered volcanic pebbles and cobbles. Also contains interbedded rhyolitic tuffs and basalt and basaltic andesite flows. Correlates to the Spears Formation and Oligocene volcanic rocks of the Mogollon-Datil volcanic field. Unit is at least 350 m thick.

Mesozoic

Kth **Tres Hermanos Formation (Upper Cretaceous)—**(Shown in cross section only). Description from Myers et al. (1986). Uppermost beds are about 40 ft (12 m) pale-brown to dusky yellow shale that contains fish scales. Middle beds consist of coquinoid conglomerate containing clams, snails, and shark teeth; grayish-orange and gray shale, siltstone, and fine-grained sandstone; at top of middle sequence of beds is a 5 ft (1.5 m) thick moderate brown coquina of Crassostrea soleniscus (identified by W. A. Cobban, USGS, written commun., 1981). Lower beds are very pale orange to moderate-brown, medium-to coarse-grained sandstone and conglomerate that locally contains fossil wood. Includes probable equivalents of Dakota Sandstone and Mancos Shale. About 760 ft (230 m).

Ƭd **Dockum Formation (Upper Triassic)—**(Shown in cross section only). Description from Myers et al. (1986). Upper beds are poorly exposed red siltstone and shale; middle beds, fine-grained, moderate-red cross-bedded sandstone that forms ledges and cliffs; lower beds are grayish-red to moderate-red siltstone and fine-grained sandstone. May be equivalent to Chinle Formation. About 180 ft (54 m) thick.

Paleozoic

Ps **San Andres Limestone (Lower Permian)—**(Shown in cross section only). Description from Myers et al. (1986). Upper beds, about 26 ft (8 m) of moderate reddish-brown siltstone and fine-grained sandstone; may be equivalent to Bernal Formation of Bachman (1953). Grayish- to very pale orange, light-gray to medium-light-gray, and brownish-gray fetid limestone comprises the bulk of the San Andres; may be gypsiferous near top; lower beds are sandy. Pinkish-gray to grayish-orange well-sorted, fine-to medium-grained quartz sandstone near middle. In vicinity of Gibbs Place, upper beds are mostly gypsum. About 164 ft (50 m) thick.

Pg **Glorieta Sandstone (Lower Permian)—**(Shown in cross section only). Description from Myers et al. (1986). Reddish-brown, grayish-orange, and yellowish-orange, fine-to medium-grained, well-sorted quartz sandstone. Typically forms cliffs or very steep slopes; beds as much as 10 ft (3 m) thick. Thickness ranges between 150-190 ft (46-58 m).

Py **Undivided Yeso Formation (Lower Permian)—**(Shown in cross section only). Description from Myers et al. (1986). Orange sandstone and siltstone; white gypsum; and yellowish-gray gypsiferous limestone and sandstone.

Pyjc **Joyita Sandstone and Canas Gypson Members of the Yeso Formation (Lower Permian)—**(Shown in cross section only). Descriptions from Myers et al. (1986). Joyita Sandstone is grayish-orange to moderate-reddish-brown siltstone and fine-grained sandstone; lower part is gypsiferous and is gradational from underlying Canas Member. About 120 ft (37 m) thick. Canas Gypsum is poorly exposed grayish-white gypsum with thin beds of gypsiferous siltstone near middle of member. Because of generally poor exposures and difficulty in locating contacts in most of the map area, the Canas Member and overlying Joyita Member were mapped as one unit. The Joyita Sandstone is about 240 ft (74 m) thick.

Pyt **Torres Member of the Yeso Formation (Lower Permian or Leonardian)—**(Shown in cross section only). Poorly exposed gypsum with interbedded limestone lenses. Gypsum is bedded and weathers very light gray. Limestone lenses are up to 5 feet (1.5 m) thick and weathers light-olive gray. Base of member mapped at base of gypsum. Lower 100 feet (31 m) exposed in southeast part of quadrangle; upper beds not present in quadrangle.

Pym **Mesa Blanca Sandstone Member of the Yeso Formation (Lower Permian or Leonardian)—**(Shown in cross section only). Thin-bedded, fine-grained sandstone and siltstone. Weathers pinkish-gray, pale-red, reddish brown to white. Trace fossils observed on bedding surfaces along with ripple marks and cross bedding. Unit forms gentle slopes and undulating terrain. About 250 feet (76 m) thick.

Pa **Abo Formation, undivided (Lower Permian or Leonardian and Wolfcampian)—**Overall finer-grained than lower part of Abo Formation (Pal), and composed of thin – to thick-bedded micaceous siltstone and fine-grained sandstone. Upper portion contains sandstone and occasional granule conglomerate interbedded with siltstones and mudstones. Weathers light red and pale reddish brown, with local white and green oxidation/reduction spots. Cross laminae, ripple-marks, mudcracks and interbedded paleosols observed. Fossil plant debris and some bioturbation present. Uppermost 20-30 feet (6-9 m) interbedded with light orange-tan sandstone similar to Yeso Formation. Thickness ranges from about 420 ft (125 m) to 775 ft (235 m), but about 450 feet (137 m) in southeastern portion of quadrangle.

Pal **Abo Formation, lower unit (Lower Permian or Leonardian and Wolfcampian)—**Base of unit at top of uppermost laterally extensive marine limestone of the Bursum Fm. Basal contact is poorly exposed and disconformably overlies Bursum Formation. Unit is coarser grained and darker in color than the upper portion of the overlying Abo Formation, weathers dark purple to dark reddish brown and is coated by abundant desert varnish. Contains poorly sorted medium- to coarse-grained, cross-bedded, thick-bedded sandstones (arkosic wacke to wacke) to granule conglomerates. May contain calcite cement. Sandstone beds are more laterally continuous than those of underlying Bursum Formation. Basal sandstone may contain 10 cm limestone clasts. Rare thin lenses of thin (<20 cm thick) nodular bedded, poorly exposed, unfossiliferous (non-marine?) limestone beds at base. Unit is thin (<50 feet) and only present in the southeastern portion of the quadrangle, but is thicker and more pervasive in the Scholle quadrangle. Unit is not regionally extensive and is not present in the Lucero uplift region (Lucas and Ziegler, 2004), about 80 km to the west.

Pb **Bursum Formation of the Madera Group (Lower Permian)—**Base of unit defined at uppermost well-exposed bed of cherty limestone from IPm-5, which is typically overlain by <5 m of cover followed by 1-2 m thick coarse-grained reddish arkosic sandstone with irregular bottom contact. In northern quarter of quadrangle, basal sandstone thins and is eventually replaced by gray-white crinoid packstone. Limestone beds overlying this basal sandstone (skeletal wackestone-limey mudstone) are thin (< 2m) and contain fusulinids Triticites creekensis Thompson and Leptrotriticites sp. (Myers, 1977), finely abraded or large, intact gastropods, ramose bryozoa, crinoids, and bivalves, and rare small chert nodules (<2 cm). Middle portion of unit composed of interbedded fine-to coarse-grained cross-bedded sandstone (lithic to arkosic wacke and arkose) that may contain calcite cement, occasional granule-pebble conglomerate, red mud-shale, and micaceous siltstone; thickness of sandstone beds varies laterally. Top of unit composed of well- to poorly-exposed < 16 feet (5 m) thick light gray, thin bedded, nodular, fossiliferous limestone bed (skeletal wackestone) that contains small (1 mm thick) stringers of red sandstone, bivalves, crinoids, fenestrae, and fusulinids (Scwagerina pinosensis Thompson) sp. (Myers, 1977). Sandstone weathers reddish-brown to purplish-brown; limestone weathers olive-gray; shale and siltstone weather red. About 150 - 250 feet (46-76 m) thick.

PIPum **Upper Madera Group Formations:** Includes IPm-5 through IPm-2.

IPm5 **Middle and upper part of La Casa Member of Myers et al., 1981 (Upper Pennsylvanian -Virgilian)—**Base of unit mapped at base of first cliff-forming limestone overlying slope-forming IPm-4. Cliff- and slope-forming interval composed of three distinctive, mappable, thick (~3-8 m) limestone cliffs separated by ~10-25 m-thick slope-forming intervals. Lower limestone cliff (~4 m) composed of thick-bedded limestone (skeletal wackestone) with laterally continuous dark chert band at base (<10 cm thick) and capped by meter-scale cross-bedded limestone or cross-bedded, laterally discontinuous sandstone. Middle limestone (~3 m; skeletal wackestone) contains irregular –shaped dark chert nodules in upper 2 meters. Upper limestone (~8 m; skeletal wackestone) contains large irregular-shaped light gray chert nodules. Upper part of meters of unit contains recessed, 1-m thick limestone beds having abundant dark brown chert nodules that weather light tan. Limestone contains phylloid algae, bivalves, crinoids, brachiopods, and abundant bioturbation. Slope-forming intervals composed of interbedded green and purple micaceous siltstone, sandstone, and mudstone. Triticites creekensis Thompson? fusulinids present (Myers, 1977). Approximately 250 feet (76 m) thick.

IPm4 **Pine Shadow Member and lower La Casa Member of Myers et al., 1981 (Upper Pennsylvanian –Virgilian)—**Base of unit mapped at the top of the last limestone cliff in underlying IPm-3. Poorly exposed (slope-forming) unit composed of interbedded sandstone, siltstone, and mudstone with occasional laterally discontinuous limestone beds. A thick sandstone interval (tens of m thick) is present just north of gas pipeline road in middle of quadrangle and southern part of quadrangle. Mud-siltstones contain ripple laminations and soft sediment deformation. Plant debris and cross-bedding observed in some sandstone beds. Base of unit marked by distinctive thin (<1 m) orange dolomite bed overlain by white sandstone (quartz arenite). Approximately 560 ft (170 m) thick. Thickness varies laterally within map area by 9 m and is thinner to north (Myers, 1977).

IPm3 **Upper part of Sol se Mete Member of Myers et al., 1981 (Upper Pennsylvanian – Missourian)—**Base of unit mapped at base of first limestone cliff overlying covered interval in lower portion of Sol se Mete Member (IPm-2). Thin- to thick-bedded cliff-forming limestone (wackestone through grainstone) containing three persistent, mappable cliffs: 1) lower limestone that contains dark chert bands (0.5 m long, <20 cm thick), 2) middle limestone interbedded with orange-weathering silty limestone and sparse chert bands, and 3) thick-bedded upper limestone with distinctive orange-brown mottling in upper 2 m. Fossils include gastropods, bryozoan, rugose corals, phylloid algae, brachiopods, and abundant bioturbation. Approximately 65 ft thick (20 m).

IPm2 **Lower portion of Solse Mete Member of Myers et al., 1981 (Upper Pennsylvanian–Missourian)—**Base of unit mapped at top of upper limestone bed in underlying Los Moyos Limestone. Poorly exposed, slope-forming and interpreted to be fine-grained siliciclastic deposits (siltstone) interbedded with limestone beds (mudstone through grainstone) with marl interbeds, rip-up clasts, and plane laminations, and laterally discontinuous white and green sandstones with local granules (subarkose) (1-2 m thick). About 100 ft thick (30 m).

IPm1 **Los Moyos Limestone (Middle Pennsylvanian – Desmoinesian)—**Basal contact with underlying Sandia Formation placed at the base of the first limestone bed. Medium- to thick-bedded, cliff-forming limestone (limey mudstone to skeletal wackestones and grainstones). Individual limestone beds 1- 2 m thick. Contains dark chert in small pods (<5 cm) in lower 40 meters, middle 20 meters, and in uppermost limestone bed. Minor amounts of interbedded sandstone (quartz arenite through micaceous lithic wacke), quartz and feldspar granule conglomerate, and poorly exposed siltstone and shale. Fossils include bivalves, bryozoa, crinoids, fusulinids, chaetetids, and abundant bioturbation obscuring primary sedimentary structures. Weathers medium gray. About 560 ft thick (172 m).

IPs **Sandia Formation (Middle Pennsylvanian)—**(Shown in cross section only). Interbedded sandy, fossiliferous limestones, shales, siltstones, sandstones, and conglomerates. Fossil types include marine fossils and plant debris. Limestone in upper part weathers light- to medium-gray with dark brown chert. Basal beds are orthoquartzitic quartz-pebble conglomerates with angular pink feldspar grains. Upper contact with IPm1 is gradational and placed at last sandstone bed. Lower contact is fault contact with Proterozoic rocks. About 600 feet (183 m) thick.

Proterozoic

Ypp **Priest pluton (1427± 10 Ma, Bauer, 1993)—** (Shown in cross section only). Homogeneous porphyritic quartz monzonite intrusion (Thompson and Barnes, 1999). The pluton is dominantly composed of plagioclase, k-feldspar, quartz with secondary amounts of muscovite, chlorite, epidote, apatite, oxides, titanite, zircon and allanite (Thompson and Barnes, 1999). K-spar phenocrysts can be as large as 4 cm and plagioclase from 0.5 to 1 cm. The pluton is microscopically deformed, contains shear zones, and truncates all D2 structures in the field.

Xu **Proterozoic Undivided**

Includes units listed below.

Xlp **Los Pinos Granite—**Pink (weathers red), massive, medium- to coarse-grained, microcline + orthoclase + quartz + albite granite. Interspersed with hornblende dikes.

Xbsu **Blue Springs Upper Schist—**Green to white, chlorite + muscovite schist. The apparent uppermost unit of the Manzano Peak (F2) synclinorium, found east and northeast of the Los Pinos granite (Xlp) in the eastern region of the quadrangle. Equivalent to the Metaclastics Series pCm of Myers and McKay (1974).

Xbr **Blue Springs Rhyolite—**Black and brown to gray with lenticular quartz-feldspar pink colored stripes within darker layers. Interpreted as a metarhyolite due to the presence of potassium feldspar in the felsic lenses and a geochemical composition close to rhyolite. Equivalent to the part of pCa, the argillite of Myers and McKay (1972); Blue Springs Quartzite (bq1) of Bauer (1983).

Xbs **Blue Springs Schist—**Green to white, garnet + chlorite + quartz + muscovite schist. Crenulated with well preserved garnet. Equivalent to the part of pCa, the argillite of Myers and McKay (1972) and the Sais Quartzite (sq3) of Bauer (1983).

Xbq **Blue Springs Quartzite Member (of Blue Springs Schist)—**Thinly-bedded, medium-grained quartzites, interbedded with chlorite-muscovite schist and quartz-muscovite schist. Partly equivalent to Sais Formation and lower part of the Pine Shadow Springs of Myers and McKay (1972); mapped as Blue Springs Formation (bs1) by Bauer (1983).

Xsq **Sais Quartzite—**Thinly-bedded, reddish, schistose quartzite. Bedding planes commonly show mica concentrations. Grains size ranges from very fine to coarse sand. Primary structures include preserved cross bedding. Originally called the White Ridge and Sais quartzites of Myers and McKay (1972), called the White Ridge Quartzite 2 (wq2) of Bauer (1983).

Xes **Estadio Schist marker unit—**Coarse-grained, staurolite + garnet + biotite schist. Shows multiple episodes of deformation and contains local crenulation cleavage and at least three generations of foliation. Probably originally deposited as a mudstone layer within the sandstone. Equivalent to the Lower part of the Pine Shadow Springs of Myers and McKay (1972); called the White Ridge schist (ws1) of Bauer (1983).

Xwq **White Ridge Quartzite—**Coarse-grained, impure, orange to gray, thinly-bedded, aluminous quartzite. Fairly immature metasedimentary rock with well preserved cross bedding. Cross-bedding indicates overturned bedding. The upper part of the unit has a distinctive red, andalusite + muscovite, foliated, schistose layer. Part of the Lower part of the Pine Shadow Springs of Myers and McKay (1974); White Ridge Quartzite 2 (wq2) of Bauer (1983).

Xs **Abajo Schist—**Schistose metasedimentary rocks intruded by or interlayered with mafic metaigneous dikes and flows. The metasedimentary rocks are rich in staurolite, garnet and amphibole porphyroblasts. Possible protoliths could be siltstones. Correlated with the Lower part of the Pine Shadow Springs of Myers and McKay (1974). Equivalent to units A,B,C of Parchman (1976) and Bosque metasediments of Edwards (1976).

Xla **Abajo Lithic Arenite—**Composed of a variety of metasedimentary rocks including meta-pelites, meta-arkose and impure quartzite. The chlorite schist, and some quartzites interbedded with metarhyolite are thinly-bedded; more massive, quartzite domains are locally dominant. Locally, garnet staurolite schist and may be related to the intrusion of gabbroic dikes (now amphibolite). Compositional layering (S0) is commonly preserved and is generally at low angle to dominant schistosity (S1). Correlated with the lower metaclastic series of Reiche (1949) and the lower part of the Pine Shadow Springs and Flaggy Schist zones of Myers and McKay (1972, 1974). Equivalent to units A,B,C of Parchman (1976) and Bosque metasediments of Edwards (1976).

Xa **Amphibolite—**Black to dark green, fine-to coarse-grained amphibolites with varying amounts of macroscopic white plagioclase that ranges in texture from salt and pepper to smeared-out shear banding. Coarse-grained metadiorites are present locally. Mafic units have apparent widths up to 150 m and may thicken, thin, bifurcate or pinch out along strike. Equivalent to the pCb "basic schist" of Myers and McKay (1972). May be confused with the intrusive gabbro described above, but some units may be part of the supracrustal sequence. These were mapped as Basic Schist and Mixed Flow units by Myers and McKary (1972) and as non-rhyolitic components of the Sevilleta Formation by Bauer, 1983.

Xsr **Sevilleta Metarhyolite—**Felsic, meta-igneous rocks with quartz and feldspar phenocrysts. Generally pink to gray, blocky-fracturing, porphyritic aphanites with quartz and feldspar clasts ~1 mm in diameter. Texture ranges from thin, well developed compositional banding to massive. Planar features, such as 0.1- 5.0 cm flow bands or shear bands, are common and range considerably in thickness. Quartz veins, pegmatite and massive schistose units are present locally and generally parallel foliation. Equivalent to the Sevilletta metarhyolite of Reiche (1949) and Myers and McKay (1972). Shown in cross section only. Subdivided into four members:

Xsru **Upper metarhyolite member—**Brown to pink, finely-banded sericitic metarhyolite; 0.5-3.5 mm feldspar and quartz crystals.

Xsrm **Middle metarhyolite member—**Dark gray to black, finely-banded rhyolite; 0.5-2mm angular to rounded quartz clasts.

Xsrl **Lower metarhyolite member—**Medium gray to black, dense, finely-banded metarhyolite; speckled with 1.0-2.5 mm white feldspar crystals.

Xsrh **Hornblende schist member—**Olive to dark-green, aphanitic, vesicular, flow-banded rock. Gneissic with feldspar augen in places. Interfingers with metarhyolite members (Xsru, Xsrm, Xsrl) and merges with overlying Abajo Lithic Arenite unit (Xla).

XYq **Quartz-rich vein or pegmatite.**