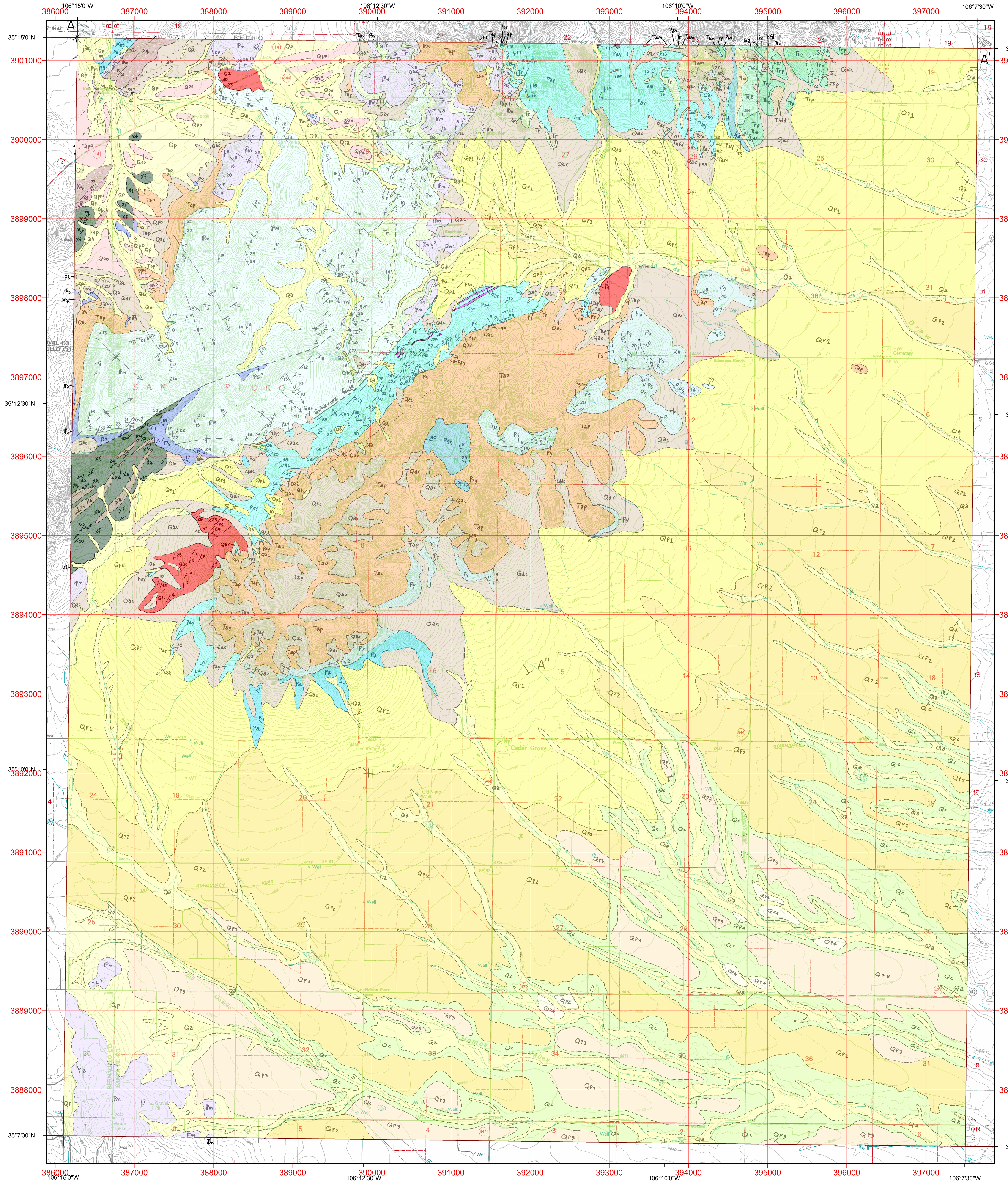
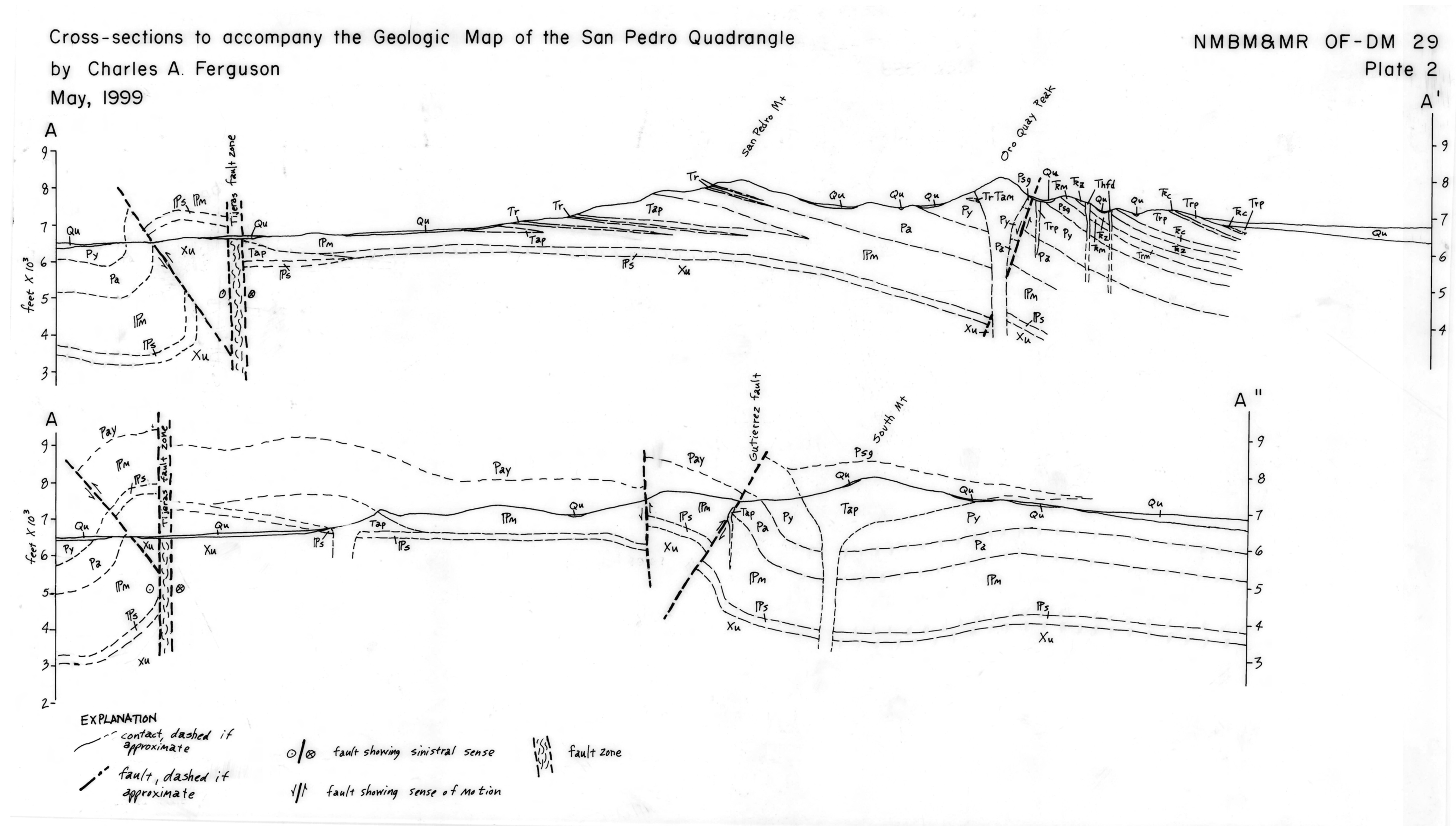


Legend

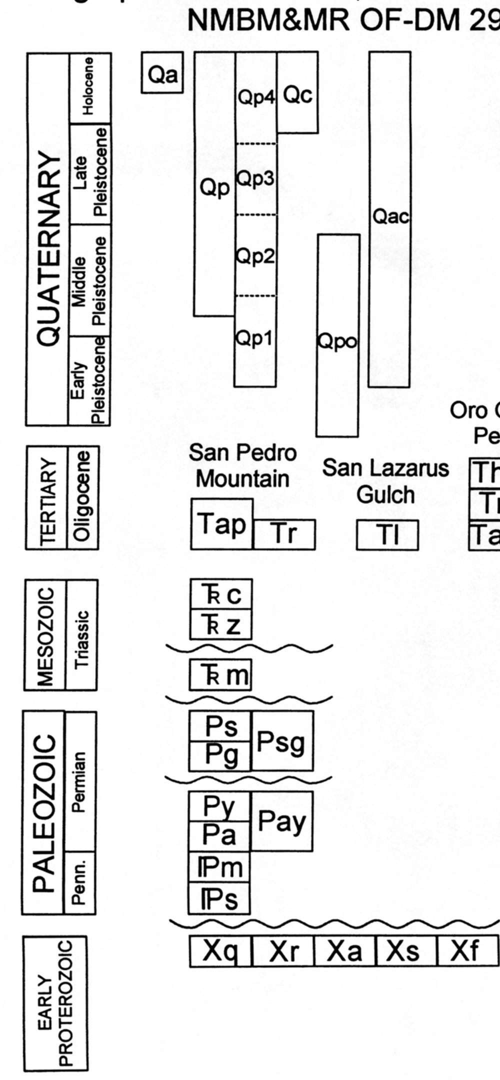
<all other values>

NAME

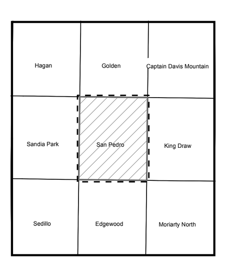
- IPm
- IPs
- IPs?
- Pa
- Pac
- Pay
- Pg
- Pg?
- Pm
- Ps
- Psg
- Py
- Qa
- Qac
- Qc
- Qca
- Qp
- Qp1
- Qp2
- Qp3
- Qp4
- Qpo
- Tam
- Tap
- Thfd
- Tr
- Trc
- Trp
- Trz
- UNKNOWN
- Xa
- Xf
- Xq
- Xs
- tl

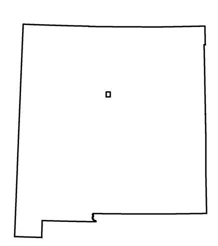


Stratigraphic Correlations, San Pedro Quadrangle
NMBM&MR OF-DM 29



Base from U.S.Geological Survey 1984, from photographs taken 1976 and field checked in 1976.
Map edited in 1984
1927 North American datum, UTM projection -- zone 13
1000- meter Universal Transverse Mercator grid, zone 13, shown in red





Geologic Map of the San Pedro 7.5 - minute quadrangle

by

Charles A. Ferguson , G. Robert Osburn , and Bruce D. Allen

May 1999

Magnetic Declination
July, 2003
10º 8' East
At Map Center

1:24,000

0 0.25 0.5 1 1.5 2 Miles

0 0.25 0.5 1 1.5 2 Kilometers

CONTOUR INTERVAL 20 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

This work was performed under the STATEMAP component of the USGS National Cooperative Geologic Mapping Program. Funding was provided by the U.S. Geological Survey and the New Mexico Bureau of Geology and Mineral Resources, a division of New Mexico Tech.

DRAFT

NMBGMR OF-GM 29

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.

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.

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Socorro, NM 87801-4796

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http://geoinfo.nmt.edu

This and other maps are available in PDF format from:
http://geoinfo.nmt.edu/statemap

or contact:
NMBGMR Publications -- [505] 835-5410
NMBGMR Geologic Information Center -- [505] 835-5145

UNIT DESCRIPTIONS
SAN PEDRO 7.5' QUADRANGLE,
SANDOVAL, BERNALILLO, AND SANTA FE COUNTIES, NEW MEXICO

To accompany NMBM&MR OF-DM 29

QUATERNARY

Qu undifferentiated: Shown only on cross-sections.

Qa Valley-floor alluvium: Holocene. Predominantly silt, sand, and clay underlying modern drainage channels and floodplains. Interfingers with colluvium towards drainage side-slopes. Includes unmapped bedrock exposures in scoured channel reaches. Generally <3 m thick.

Qc Colluvium: Deposits mantling side-slopes of drainages incised in piedmont alluvium of units Qp1-4. Holocene to late Pleistocene (?). May include unmapped, inset alluvial fills in some areas. Interfingers with valley-floor alluvium along drainage foot-slopes <5 m thick.

Qac Upland alluvium and colluvium, undivided: Holocene to early Pleistocene (?). Includes valley-floor alluvium, hillslope colluvium, talus-covered slopes, and unmapped bedrock exposures along mountain-front and in bedrock uplands. Units range from relatively thin, comparatively fine-grained, upland valley fills, to poorly sorted, clast-supported, cobble and boulder gravels mantling steep, mountain-front slopes. Estimated thickness up to 10 m.

Qp Middle and upper piedmont-slope alluvium: Holocene to middle Pleistocene (?). Includes alluvial fan and coalescent alluvial fan complex along mountain fronts, and younger, inset alluvial fills. Ranges from predominantly silt and sand to coarse units dominated by sand and cobble-gravel. Undivided unit (Qp) is mapped in the NW and SW corners of map area where piedmont alluvium in uplands forms a relatively thin mantle (generally less than 5 m) over bedrock. Four map units are differentiated on piedmont slopes of the Estancia basin, as follows:

Qp4 Piedmont alluvium, inset into unit Qp3: Holocene (?) to Late Pleistocene. Predominantly sand, silt, and gravel. Represented by relatively small, inset fills along incised, higher-order drainages. Estimated thickness 3 m.

Qp3 Piedmont alluvium, inset into unit Qp2: Late to middle (?) Pleistocene. Predominantly sand, silt, and gravel. Comparatively extensive inset fills along major drainages, extending to upper piedmont slope. Estimated thickness 3m or more.

Qp2 Piedmont alluvium: Deposits underlie highest, interfluvial summits in map area. Late to middle Pleistocene. Consists of coalescent alluvial fans along upper piedmont slopes, forming an extensive, sheet-like deposit (?) basinward over older, valley-fill/ basin-fill deposits. Unit is inset into unit Qp1 along mountain front. Predominantly sand, gravel, and silt. Tentatively mapped to include deposits inset in older, alluvial fan deposits of Canada de las Narrias.

Qp1 Older, upper piedmont slope and mountain-front alluvium: Early (?) to middle Pleistocene. Predominantly sand and gravel. Deposits generally exhibit fan morphology. Tentatively mapped to include older fan deposits in large, upland canyons (e.g. Canada de las Narrias).

Qpo Older piedmont alluvium: Deposits along west side of San Pedro and South Mountains, undivided. Early (?) to middle Pleistocene. Predominantly sand, gravel, and silt. West of map area unit underlies broad, high-level surface mapped as Qfo on the westerly adjoining quadrangle (Ferguson and others, 1996). Undivided unit also includes dissected remnants of older fan deposits and pediment gravels that are present in NW corner of map.

TERTIARY

Thfd Hornblende, pyroxene diorite: Medium- to coarse-grained pyroxene, and hornblende-rich mafic dikes occurring east of Oro Quay Peak.

Tam Augite Monzonite: Fine- to medium-grained, equigranular to plagioclase porphyritic, augite- and hornblende-bearing monzodiorite to diorite. Texture consists of strongly zoned euhedral plagioclase, euhedral to subhedral augite and hornblende with interstitial K-feldspar and rare quartz. Contains up to 10% mafic minerals including augite, hornblende, and magnetite. The unit forms a discordant stock at Oro Quay Peak in the San Pedro Mountains.

Trp Porphyritic rhyolite: White to light gray or dark gray, plagioclase (0.5 to 2.0 mm), quartz (0.5 to 1.0 mm)-phyric felsic hypabyssal sills, dikes and small stocks that invade the Permian and Triassic strata east of Oro Quay Peak. Minor amounts of hornblende, pyroxene, and opaque minerals are also present, set in a fine-grained granular matrix.

Tl Latite: Coarse-grained, K-feldspar porphyritic syenite to monzosyenite. Forms small discordant stocks in San Lazarus Gulch.

Tap Andesite porphyry: Fine- to medium-grained, equigranular to plagioclase porphyritic, hornblende monzodiorite and quartz monzodiorite. Texture consists of strongly zoned euhedral plagioclase and hornblende blades with interstitial K-feldspar and quartz. Contains up to 10 hornblende and minor to trace amounts of magnetite and/or other opaque minerals. The unit occurs primarily as sills, but also as dikes.

Tr Crystal-poor rhyolite: White to light gray, sparsely porphyritic rhyolitic sills, containing a few percent plagioclase and quartz phenocrysts in a fine-grained granular matrix. Trace amounts of opaque minerals (possibly pyrite) are also present. The unit occurs as thin sills throughout the San Pedro Mountains and northwest of South Mountain.

TRIASSIC

Tc Chinle Group: Reddish-colored silty, micaceous mudstone with subordinate thin- to medium-bedded, trough and wedge-planar cross-stratified, feldspathic sandstones. The sandstones are typically argillaceous with abundant mud chip intraclasts. Green reduction spots are common in the mudstones and argillaceous sandstones. Medium-bedded limestone-pebble conglomerates are present in some areas, particularly near the base of the unit.

Tz Agua Zarca Formation: Tan to light grayish pink, resistant, thin- to medium-bedded, cross-stratified quartz arenite and feldspathic arenite. Contact metamorphism changes the mudstones and argillaceous sandstones of this unit into a black or dark gray spotted hornfels.

Tm Moenkopi Formation: Recessive-weathering, dark red micaceous shale, silty shale and thin-bedded feldspathic sandstone. The unit also contains some gray, medium-bedded quartz arenites. Contact metamorphism changes the mudstones and argillaceous sandstones of this unit into a black or dark gray spotted hornfels.

PERMIAN

Psg San Andres-Glorieta undifferentiated: The upper two lithostratigraphic units of the Permian are complexely interleaved. The lithotypes, which may not correlate with formations of the same names, are gray limestone (San Andres) and white quartz arenite (Glorieta) These were differentiated where possible.

Ps San Andres lithotype: Light gray and less commonly tan medium- to thick-bedded limestone. The limestones are mostly micrites or skeletal wackstones, commonly with some component of quartz sand.

Pg Glorieta lithotype: White and pink (along contact with underlying Yeso lithotype) massive, or plane-bedded to low-angle planar cross-stratified quartz arenite. Locally, the sandstones are extensively bioturbated (*Macaronichnus*), and near the contact with Yeso Formation they are feldspathic. The sandstones are typically well-sorted.

Pay Abo-Yeso undifferentiated (San Pedro Mountains): the lower two lithostratigraphic units of the Permian represent a siliciclastic sequence that was mapped as a single unit in most areas because of the lack of a prominent boundary marker be, and because it is extensively contact metamorphosed in the San Pedro Mountains which changes the rocks into black or dark gray spotted hornfels.

Py Yeso Formation: Reddish to pink or tan medium- to thin-bedded, feldspathic sandstone, shale and silty shale. The sandstones are typically cross-stratified and/or cross-laminated and virtually identical to those within the underlying Abo lithotype except that, locally, salt hopper casts and molds are present. The base of the unit is marked by a continuous, plane-bedded to low-angle cross-stratified tan sandstone bed less than 10 meters thick along the southern flank of South Mountain. Elsewhere, the contact is gradational, difficult to pick consistently and is shown only cross-sections.

Pac Abo-Yeso limestone: Two massive to medium-bedded micrites or skeletal wackstones that are present in the upper Abo Formation or lower Yeso Formaion along the northwest slope of South Mountain. Each bed is less than 10 meters thick. The limestones are locally very fossiliferous, containing abundant fusilinids.

Pa Abo Formation: Red and locally tan (particularly near the base) medium- and thin-bedded arkose or feldspathic sandstone interbedded with red, micaceous siltstone and mudstone, commonly with green reduction spots. The lowermost arkoses are typically lighter colored and coarser grained than the younger feldspathic sandstones. The sandstones are cross-stratified (typically trough and wedge-planar geometries) and the finer grained rocks are commonly ripple cross-laminated. In addition, mud-chip clasts and plant debris are common. Recognized as a map unit only along the south flank of South Mountain, but shown consistently on cross-sections.

PENNSYLVANIAN

lPm Madera Formation (undifferentiated): A mixed sequence dominated by medium- to thick-bedded, light-gray, limestone and two types of siliciclastic rocks which make up <10% of the formation; greenish to tan and rarely red arkose or feldspathic sandstone, and dark-colored mudstone intervals with variable amounts of thin-bedded, black micrite and / or cherty, gray laminated to thin-bedded micrite. Contacts between the limestones and coarse siliciclastics are generally sharp, and those between the limestones and mudstones more gradational. Limestones, which vary in thickness from 20 cm to 20 meters, dominate the formation and are typically matrix-supported; micrites and skeletal wackstones. Clast-supported limestones (skeletal grainstones and packstones) are less common although locally abundant, and these tend to occur towards the top of sequences. Skeletal debris in the Madera limestones consist mostly of crinoid stems and columnals, brachiopods, corals, and bryzoans. Molluscan shell fragments are rare. The arkosic sandstones are typically coarse- to medium grained, but granules and rarely pebbles are also present. In the San Pedro Mountains where the formation is in contact with Tertiary igneous rocks, Madera Formation siliciclastics are strongly altered to black or dark gray spotted hornfels, and some of the limestones are transformed into garnet magnetite skarn with abundant copper mineralization.

lPs Sandia Formation: A sandstone-rich sequence of interbedded arkose or feldspathic sandstone, siltstone, silty mudstone and quartz-sandy limestone. Its contact with the overlying Madera Formation is chosen at the base of the oldest, light gray-colored, either massive-appearing limestone or amalgamated sequence of medium- to thick-bedded limestones. Limestones in the Sandia are typically thinner bedded, clast-supported (packstones and grainstones), greenish colored, and they contain abundant siliciclastic sand.

EARLY PROTEROZOIC

Xu undifferentiated: shown only on cross-sections.

Xq Quartzite: Light-gray, banded quartzite, locally micaceous. Bedding severely transposed. Forms resistant ridges.

Xs Sillimanite schist: A thin band of schist associated with the quartzite unit along one hill in the northwest corner.

Xa Amphibolite: Dark greenish gray and red-weathering medium- to fine-grained foliated amphibolite, locally associated with dark-colored biotite schist. Typically forms recessive, clay-rich intervals.

Xf Felsic gneiss: Light-colored, pink to gray, medium- to fine-grained feldspar, quartz, muscovite and biotite gneiss. Although interpreted as metarhyolite in the westerly adjacent Sandia Park quadrangle, some of these rocks may represent metamorphosed granitic or hypabyssal rhyolitic rocks. Typically crumbly weathering and forms subdued outcrops.

San Pedro quad Economic Geology

The San Pedro Mine produced 26.5 million pounds of copper; 26,300 troy ounces of gold; and 365,000 troy ounces of silver from 470,000 short tons of Cu-Au-Ag-bearing material in the period 1889-1992. Total production including the period prior to 1889 may exceed 600,000 short tons of material. Production from the Old Timer Mine is unknown. The Carnahan Mine (San Pedro 7.5-minute quadrangle) exploited lead-zinc-silver ore and produced 3.5 million pounds of lead, 4 million pounds of zinc, and 96,000 troy ounces of silver from 27,377 short tons of material during the period 1925-1928. Including the production during the 1880s, total material mined at the Carnahan Mine may have exceeded 100,000 short tons (Alec Sanders, personal communication, 2000).