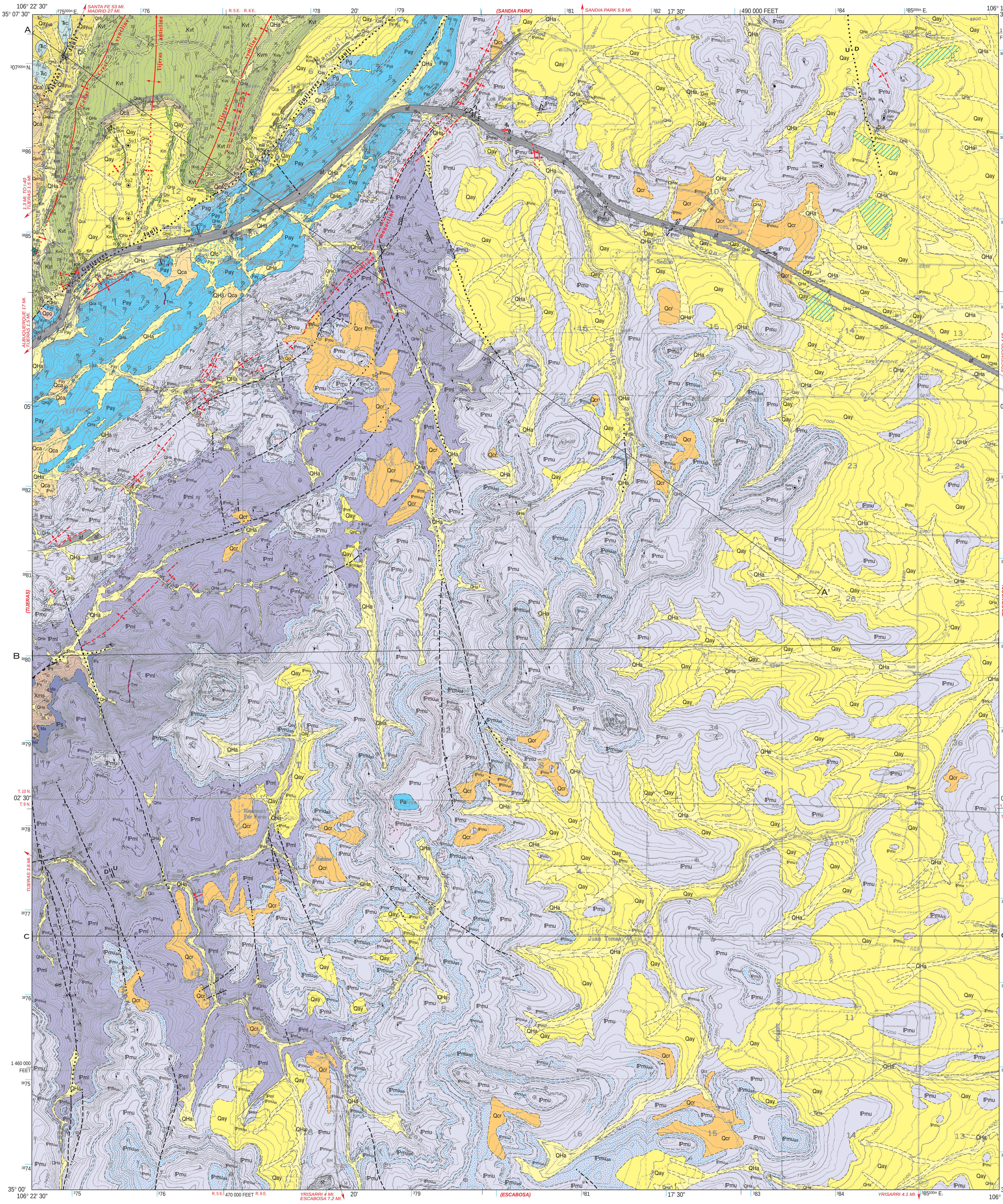
NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES
A DIVISION OF NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

Dr. Peter A. Scholle
Director and
State Geologist

Dr. Paul W. Bauer
Geologic Mapping
Program Director

NMBMMR Open File Map Series
OF–GM–20
Map last modified 14 February 2000

SEDILLO QUADRANGLE
NEW MEXICO



Base from U.S. Geological Survey 1954, photorevised 1976
Polyconic projection, 1927 North American datum, 10,000-foot grid based on New Mexico coordinate system, cental zone
1000-meter Universal Transverse Mercator grid ticks, zone 13, shown in blue

A. S. Read: mapping, map compilation, differentiation of the Madera Fm., structural cross sections B-B', C-C'; B. Allen: Quaternary mapping and unit descriptions; C. A. Ferguson: mapping, structural cross section A-A'; G. R. Osburn: Mesozoic/Permian mapping and unit descriptions; R. Chamberlin: mapping of the northeast corner of the quadrangle

D. J. McCraw: digital cartographic production

UTM GRID AND 1976 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

SCALE 1:24,000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Mapping of this quadrangle was funded by a matching-funds grant from the 1998 STATEMAP program of the National Geologic Mapping Act coordinated by the U.S. Geological Survey and the New Mexico Bureau of Mines and Mineral Resources.

QUADRANGLE LOCATION

Geology of Sedillo quadrangle, Bernalillo County, New Mexico

May 1998
14 February 2000 Revision

by
Adam S. Read[1], Bruce D. Allen[2], Glenn R. Osburn[3],
Charles A. Ferguson[4], and Richard Chamberlin[1]

[1]New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801
[2]New Mexico Bureau of Mines and Mineral Resources, Albuquerque, NM 87108
[3]Department of Earth and Planetary Sciences, Washington University, St. Louis, MO 63130
[4]Arizona Geological Survey, 416 W. Congress, #100, Tucson, AZ 85701

Unit Descriptions

Cenozoic Erathem

Surficial Units

af — **Artificial fill—**areas affected by human disturbance, including dumped fills, quarries, and areas that have been extensively modified by road construction.

Valley-Fill Alluvium

QHa — **Holocene alluvium** underlying present drainageways. Includes arroyo channel and floodplain alluvium and adjacent terrace deposits. Unit may include bedrock outcrops in scoured channel reaches. Deposits generally consist of silt and sand with varying amounts of gravel and clay. Stream and floodplain deposits range in thickness from very thin to 10 ft (3 m). Terrace deposits range in thickness from 3 to 13 ft (1 to 4 m), with treads 6 to 26 ft (2 to 8 m) above modern channel. Straths underlying terraces may be cut into older valley-fill alluvium or into bedrock.

Qay — **Holocene to middle Pleistocene (?) valley-fill alluvium and colluvium—**Predominantly silty, pebbly sand with increasing gravel content towards valley backslopes; clay content higher in valleys bounded by limestone and shale bedrock units. Ranges in thickness from a thin mantle on valley backslopes and bedrock highs to 30 ft (10 m). In western part of map area unit is graded to local base levels that predate latest Pleistocene/Holocene incision of trunk drainages. Unit forms an extensive alluvial cover in intermontane valleys in the eastern map area. Unit is locally subdivided along Arroyo San Antonio (unit Qay_{sa}), where it is locally overlain by gravely deposits of Qpm_3, and in northeastern part of map area, where remnant depositional surfaces have survived subsequent incision of valley fill.

Qay_{sa} — **Holocene to upper Pleistocene valley-fill alluvium and colluvium graded to former, higher levels of Arroyo San Antonio—**Up to 13 ft (4 m) thick. Unit is significantly disturbed in places along Highway 14 due to road and building construction.

Upper Pleistocene valley-fill alluvium and colluvium, underlying high (pre-incision) valley-fill depositional surfaces in northeastern part of map area—Younger valley-fill deposits and alluvium associated with modern drainageways are inset into surface. Soils developed on this surface exhibit stage III calcic horizons, suggesting that incision of valley fills in eastern map area and abandonment of surface occurred during latest Pleistocene time.

Qfc — **Holocene to Upper Pleistocene small alluvial fans and colluvial wedges along Arroyo San Antonio and Tijeras Arroyo—**Silty sand and gravely sand, 3 to 13 ft (1 to 4 m) thick. Unit occurs near mouths of tributaries to trunk drainages.

Qc — **Holocene to middle Pleistocene (?) hillslope colluvium—**Poorly sorted accumulations of clay, silt, sand, and gravel, up to several meters thick, deposited by mass-wasting, slope wash, and fluvial transport in steep hillslope drainages. Mapped primarily on slopes developed in clastic sedimentary rocks along I-40.

Qcr — **Holocene to middle Pleistocene (?) hillslope colluvium, residuum, and alluvium in upland interfluves and valley backslope areas—**Predominantly sandy, clayey silt with varying amounts of gravel. Ranges from <3 ft (1 m) to 10's of feet in thickness. Unit differentiated in upland areas isolated from major valleys. Derived from weathering of limestone, sandstone, and shale of the Madera Group (residuum on relatively flat-laying, limestone ledges), and from downslope movement of these materials . Mapped where accumulations cover extensive areas.

Qpm_3 — **Upper Pleistocene stream and piedmont alluvium and colluvium along Arroyo San Antonio—**Sandy gravel and silty sand, 3 to 10 ft (1 to 3 m) thick. Unit caps discontinuous bench 40 ft (~12 m) above modern floor of Arroyo San Antonio. Soils on deposit exhibit stage II calcic horizons.

Qpo — **Middle to lower (?) Pleistocene piedmont/pediment gravels—**Unconsolidated coarse gravely sand, 15 ft (~4 m) thick; caps ridges west of mouth of Arroyo San Antonio (T10N, R5E, sec.14). Larger clasts include abundant limestone cobbles. Unit is more widespread to the west (see Tijeras 7.5' quadrangle) where it is considered to overlie a former pediment developed on the eastern dip-slope of the Sandia Mountains.

Tertiary igneous intrusive rocks

Tmi — **Dike—**Generally deeply weathered mafic to intermediate dikes that strike N-S and are steeply dipping.

Mesozoic Erathem

Upper Cretaceous

Sedimentary rocks

Mesaverde Group—A complex unit of marine, marginal-marine, and fluvial sandstones, shales, and siltstones with at least two intervals of coal-bearing strata, at least 1,400 ft (430 m) thick. The sequence is divided into three mappable lithofacies, which have been given interpretive informal names: 1) marine sandstone and shale (*Kvm*); 2) fluvial and distributary-channel sandstones, which include the coal beds (*Kvt*); and 3) shoreface sandstones (*Kvs*). The sandstones of the Mesaverde Group range from feldspathic arenites to quartz arenites, and, locally, dark-colored chert grains are abundant.

Kvm — **Mesaverde Group marine sandstone and shale—**A map unit recognized only in areas where molluscan shell fragments (chiefly bivalves) are present. The unit is typically recessive weathering, and the sandstones are thin to medium bedded, dark brown to greenish, argillaceous, and variably calcareous. The unit along the west limb of the Tijeras syncline includes at least one medium-bedded calcareous sandstone containing septarian nodules and bivalve shell fragments.

Kvt — **Mesaverde Group terrestrial sandstones—**A map unit characterized by abundant woody debris and mud-chip intraclasts. It consists of two types of sandstones: 1) resistant, medium- to thick-bedded, trough and wedge-planar cross-stratified, light-colored sandstones and 2) recessive, massive or flaggy-weathering, argillaceous, greenish-brown sandstones and siltstones with abundant woody debris and mud-chip clasts. Three intervals of this map unit are recognized, each overlying marine sequences, and the upper two contain coal beds. The middle unit thins dramatically to the east, where it is represented by a 3 to 10 ft (1 to 3 m) thick, clean, cross-stratified sandstone along the east limb of the Tijeras synclinorium.

Kvs — **Mesaverde Group near shoreface sandstones—**A map unit recognized by a combination of at least two of the following features: 1) clean (nonargillaceous), well-sorted nature of the sandstone; 2) planar bedding or low-angle cross-stratification; 3) recognition of the upper-shoreface-environment restrictive trace fossil Macaronichnus (c.f. Mieras *et al.*, 1993). Molluscan shell fragments are also recognized, and at the top of the easternmost mapped outcrop, vertical, lined burrows are present. The combination of textural maturity, sedimentology, and ichnofauna are indicators of a high-energy near-shoreface environment. The map unit is discontinuous, appearing to grade laterally into marine or nonmarine sandstone units.

Km — **Mancos Shale—**Dark-gray shale, slightly calcareous shale, and septarian nodule-bearing shale with rare, thin, black micrite beds and at least two 9 to 13 ft (3 to 4) m thick, medium-bedded calcareous sandstone intervals. Entire unit is about 1,300 ft (400 m) thick. The micrites and sandstones are typically fossiliferous, yielding abundant molluscan shell fragments. A prominent noncalcareous sandstone is present in the middle of this unit that directly overlies a calcareous shale and siltstone interval containing the late Turonian ammonites *Prionocyclus novimexicanus* and *Scaphites whitfieldi*, indicating that these strata are equivalent to the late Turonian Juana Lopez Member of the Mancos Shale.

Kms — **Mancos sandstone—**Medium- to thin-bedded, noncalcareous, extensively vertical burrowed, fine- to medium-grained sandstone. The sandstone is recognized only east of Tijeras fault where it is less than 6 ft (2 m) thick. It directly overlies a calcareous siltstone–shale interval interpreted as equivalent to the Juana Lopez Member because it contains the late Turonian ammonites *Prionocyclus novimexicanus* and *Scaphites whitfieldi*. (cross section A-A' only, projected south from Sandia Park and Sandia Crest quadrangles).

Kdu — **Dakota Formation, upper map unit—**A thin unit (<100 ft – 30 m) of thin- to medium-bedded slightly calcareous sandstone, siltstone, and silty shale separated from the main body of the Dakota Formation by a covered interval. The map unit is probably correlative with the Twowells Tongue of the Dakota Formation. (cross section A-A' only, projected south from Sandia Park and Sandia Crest quadrangles).

Kd — **Dakota Formation—**Medium-bedded, pervasively silica cemented, plane-bedded to tabular cross-stratified quartz arenite, typically with abundant vertical, lined burrows, many of which are clearly Diplocraterion traces. (cross section A-A' only, projected south from Sandia Park and Sandia Crest quadrangles).

Upper Jurassic

Jm — **Morrison Formation—**Medium- to thick-bedded, light-colored, generally poorly sorted feldspathic sandstones, with green and red shaley interbeds about 500 ft (150 m) thick. Sandstones contain abundant quartz granules and greenish mud-chip clasts, and the feldspar grains typically are strongly altered to white clay minerals. The upper part of this unit in some areas is a moderately to well-sorted, moderately bioturbated feldspathic sandstone, which may be equivalent to the Jackpile Member. Abundant dark grayish-green shaly intervals with thin, dark-colored micritic limestones are present in some areas near the base of the map unit. (cross section A-A' only, projected south from Sandia Park and Sandia Crest quadrangles).

Middle Jurassic

Jet — **Entrada & Toldilto Formations, undifferentiated—**This unit, which is about 250 ft (75 m) thick, is projected south from the Sandia Park and Sandia Crest quadrangles in cross section A-A' only.

Entrada Formation—Light-green, massive (bioturbated?) sandstone. Rarely, this unit displays high-angle cross-stratification.

Todilto Formation, chiefly Luciano Mesa Member—In most areas the only part of the Todilto Formation exposed is the Luciano Mesa Member, which is a laminated, fetid, dark-gray micritic limestone. Laminations in the limestone appear to be algal in origin, and macrofossils are conspicuously absent.

Upper Triassic

Ʀc — **Chinle Group—**Dark-red, mostly medium bedded, trough and wedge-planar cross-stratified feldspathic sandstone and silty micaceous shale, about 1,300 ft (400 m) thick. Green reduction spots are common, as are limestone-pebble conglomeratic intervals, particularly near the base of the unit.

Middle and Lower Triassic

Ʀm — **Moenkopi Formation—**Recessive-weathering, dark-red micaceous shale, silty shale, and thin-bedded feldspathic sandstone, about 200 ft (60 m) thick.

Paleozoic Erathem

Upper Permian

Psg — **San Andres–Glorieta Formations, undifferentiated—**The upper two lithostratigraphic units of the Permian are complexly interleaved. The lithotypes, which may not correlate strictly with formations of the same names, are gray limestone (San Andres) and white quartz arenite (Glorieta). Combined, these units are approxinately 400 ft (120 m) thick.

Ps — **San Andres Formation—**Light-gray and less commonly tan, medium- to thick-bedded limestone, about 200 ft (60 m) thick. The limestones are mostly micrites or skeletal wackestones, commonly with some component of quartz sand.

Pg — **Glorieta Formation —**White and pink (along contact with underlying Yeso Formation), massive or plane-bedded to low-angle planar cross-stratified quartz arenite, about 200 ft (60 m) thick. Locally, the sandstones are extensively bioturbated (*Macaronichnus*), and near the contact with Yeso lithotype they are feldspathic. The sandstones are typically well sorted, but a thin, feldspathic quartz-pebble conglomerate occurs just below the base of the lowermost San Andres lithotype limestone in the Arroyo Armijo area along the boundary between Sandia Park and Sandia Crest quadrangles.

Lower Permian

Pay — **Abo–Yeso Formations, undifferentiated—**The lower two lithostratigraphic units of the Permian represent a reddish, feldspathic to quartzose siliciclastic sequence, some 1,300 ft (400 m) thick, that was mapped as a single unit throughout most of the study area.

Py — **Yeso Formation (not differentiated on map)—**Reddish to pink or tan, medium- to thin-bedded feldspathic sandstone, shale, and silty shale interbedded with massive or laminated, micritic, gray or tan limestone near the top. The sandstones are typically cross-stratified and/or cross-laminated and virtually identical to those within the underlying Abo Formation except that salt-hopper casts and molds are present.

Pys — **Yeso sandstone lithotype—**Red to light-red and tan, medium- to fine-grained feldspathic sandstone and red siltstone or shale. Sandstones are typically thin to medium bedded and wedge planar to trough cross-stratified; ripple cross-laminations are common in the finer-grained intervals. Yeso lithotype siliciclastics are virtually indistinguishable from those of the Abo Formation, and these sequences were usually mapped together. Yeso siliciclastics were differentiated only in areas directly adjacent to Yeso limestones or where salt-hopper casts/molds are abundant. Salt-hopper casts and molds are usually present in the upper part of the Abo–Yeso formation siliciclastic sequence, but because of the generally poor exposure and the small size of float material, the presence or absence of these structures was not considered a reliable criterion for picking the Abo–Yeso contact.

Pa — **Abo Formation—**Red and locally tan (particularly near the base), medium- and thin-bedded arkose and feldspathic sandstone interbedded with red micaceous siltstone and shale, commonly with green reduction spots. The lowermost arkoses are typically lighter colored and coarser grained than the younger feldspathic sandstones, and at least one of them is strongly bioturbated (*Macaronichnus*). The sandstones are cross-stratified (typically trough and wedge-planar geometries), and the finer-grained rocks are commonly ripple cross-laminated. Mud-chip clasts and plant debris are common. It is differentiated on the map only southeast of Cedro Peak where about 30 ft (9 m) of basal red arkosic sandstones are present.

Pac — **Abo limestone lithotype—**Rare, less than 1-m-thick, thin- to medium-bedded, gray to tan limestones, typically containing abundant bivalve fragments and/or echinoid spines.

Upper and Middle Pennsylvanian

Madera Formation, undifferentiated—A mixed sequence dominated by medium- to thick-bedded, light-gray limestone interbedded with subordinate orange to reddish arkose and tan sandstone as well as siltstones (which are less common and can be greenish to tan and micaceous), about 1,600 ft (490 m) thick. Dark-colored mudstone intervals with variable amounts of thinly bedded black micrites are also present, particularly at the base of the formation. This formation is informally divided into two members: *IPml*–dominated by massive limestone, shale, and thin discontinuous siliciclastic beds near the top of the unit, and *IPmu*–a cyclically interbedded sequence of limestone and thinner siliciclastic and mudstone beds. The upper member is defined by the first occurrence of a thick and relatively continuous siliciclastic bed. Due to poor exposure and the difficulty in tracing thin beds through the folded and likely faulted Chamisoso monocline south of Tijeras Canyon, the distinction between *IPmu* and *IPml* is not always clear. Within both members, contacts between the limestones and coarse-grained siliciclastics are generally sharp although occasionally both coarse clastic material is seen within limestone as well as limestone clasts within siliciclastic units. These often arkosic sandstones are typically coarse- to medium-grained, but granules and rarely pebbles also are present. These pebbles can be up to 1.5 in (4 cm) in diameter and consist principally of Precambrian quartzite with minor micaceous felsic schists that look very similar to rocks presently exposed in the basement-cored uplifts of north-central New Mexico. Siliciclastic rocks generally have a well developed planar or cross stratification. Contacts between the limestones and mudstones are generally gradational. Limestones, which vary in thickness from 8 in to 65 ft (20 cm to 20 m) (amalgamated beds), dominate the formation, and these are typically matrix-supported (micrites and skeletal wackestones). Clast-supported limestones (skeletal grainstones and packstones) are less common, although locally abundant, and these tend to be toward the top of sequences. Skeletal debris in the Madera Formation limestones consist mostly of crinoid stems and columnals, brachiopods, corals, bryzoans, and sometimes abundant fusilinids. Molluscan shell fragments are rare. The lower member (*IPml*) is generally more fossiliferous.

IPmu — **Madera Formation upper member (comprises all members of the Wild Cow Formation of Myers and Mckay, 1976, which were defined on the basis of fusilinid biostratigraphy)—**a sequence of alternating limestones and siliciclastic rocks that are often arkosic and generally medium to coarse grained, about 850 ft (260 m) thick. The base of this member is defined as the first occurrence of a thick and relatively continuous siliciclastic bed. Petrified wood is seen locally throughout this member.

IPml — **Madera Formation lower member (Los Moyos Limestone of Myers and Mckay, 1976, which they defined on the basis of fusilinid biostratigraphy)—**a sequence of often fossiliferous and massively bedded cliff-forming wavy laminated and cherty micritic limestone interbedded with shales, about 750 ft (230 m) thick. Shale is particularly abundant near the base of this member where it grades into the Sandia Formation.

Lithotypes within *IPm*, *IPmu*, and *IPml*:

IPml and *IPmu* are subdivided into several common lithotypes denoted by two lower case letters. The principal lithologic distinction is between siliciclastic rocks and limestone/shale. For brevity and clarity, where a lithotype is not specified and siliciclastic units bound either contact, the Madera lithotype is considered to be dominantly a mixture of limestone and subordinate shale. Otherwise, the Madera lithotypes remain undifferentiated. Where lithotypes are differentiated, the limestone is generally well exposed forming ledges and benches, but the shale is only seen to outcrop rarely and in roadcuts.

$IPmu_{as}$, $IPml_{as}$ — Madera Formation siliciclastics undifferentiated including siltstone, sandstone, and arkose. Most clastic rocks are usually medium to coarse grained. Less common are siltstones and fine- to medium-grained sandstones that are often micaceous. Pebble conglomerates are locally seen but often grade into coarse sandstones. These rocks are generally well stratified from planar to cross bedded (to varying degrees). Individual beds are often tabular extending up to several kilometers but may be lenticular as well.

$IPmu_{ak}$ — Madera Formation arkose–orange to pale red, medium- to coarse-grained arkosic to sandstones (10-25% feldspar) that are locally conglomeratic.

$IPmu_{cc}$, $IPml_{cc}$ — Madera Formation ledge forming limestones that are distinct and particularly thick.

$IPmu_{ms}$ — Madera Formation mudstone/shale–generally does not outcrop except in roadcuts. Mudstones locally grade laterally into limy mudtsones and nodular limestones or micaceous sandstones. Some maroon mudstones grade laterally and vertically into arkosic sandstones.

IPs — **Sandia Formation—**Sandstone-rich sequence of interbedded arkoses and feldspathic sandstones, siltstones, silty shales, and limestones, about 150 ft (45 m) thick. This unit is commonly present between the Madera Formation and the Proterozoic basement (or the Arroyo Peñasco Group, where present). Its contact with the overlying Madera Formation is chosen at the base of the oldest, light-gray either massive-appearing limestone or amalgamated sequence of medium- to thick-bedded limestones. The Madera Formation limestones are typically micrites or skeletal wackestones, whereas limestones in the Sandia Formation are typically thinner bedded, clast supported (packstones and grainstones), and greenish, and they contain abundant siliciclastic sand.

Mississippian

Ma — **Arroyo Peñasco Group—**(seen only as blocky float) The locally thin and discontinuous sedimentary quartzite that comprises the basal Del Padre Sandstone Member of the Espiritu Santo Formation sits directly on the unconformity over Proterozoic basement. This very white and extremely well lithified unit is easily mistaken for a metamorphic quartzite but has no apparent foliation, has visible rounded grains on weathered or broken surfaces, and is only seen along the Great Unconformity between Proterozoic basement and the Pennsylvanian Sandia Formation, where it is less than 10 ft (3 m) thick. No other members or formations within the Arroyo Peñasco Group have been recognized in the map area.

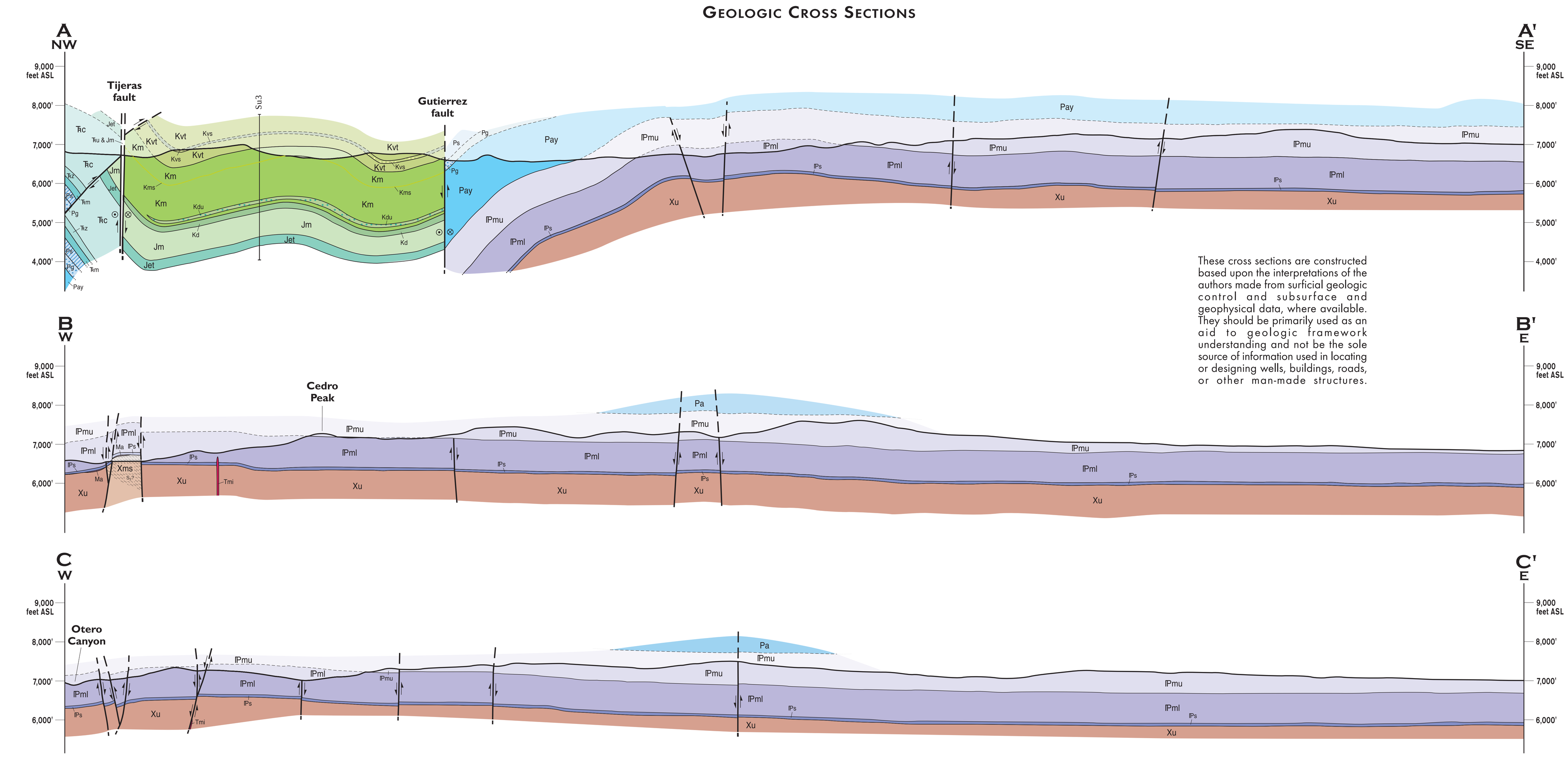
Proterozoic Erathem

Paleoproterozoic rocks

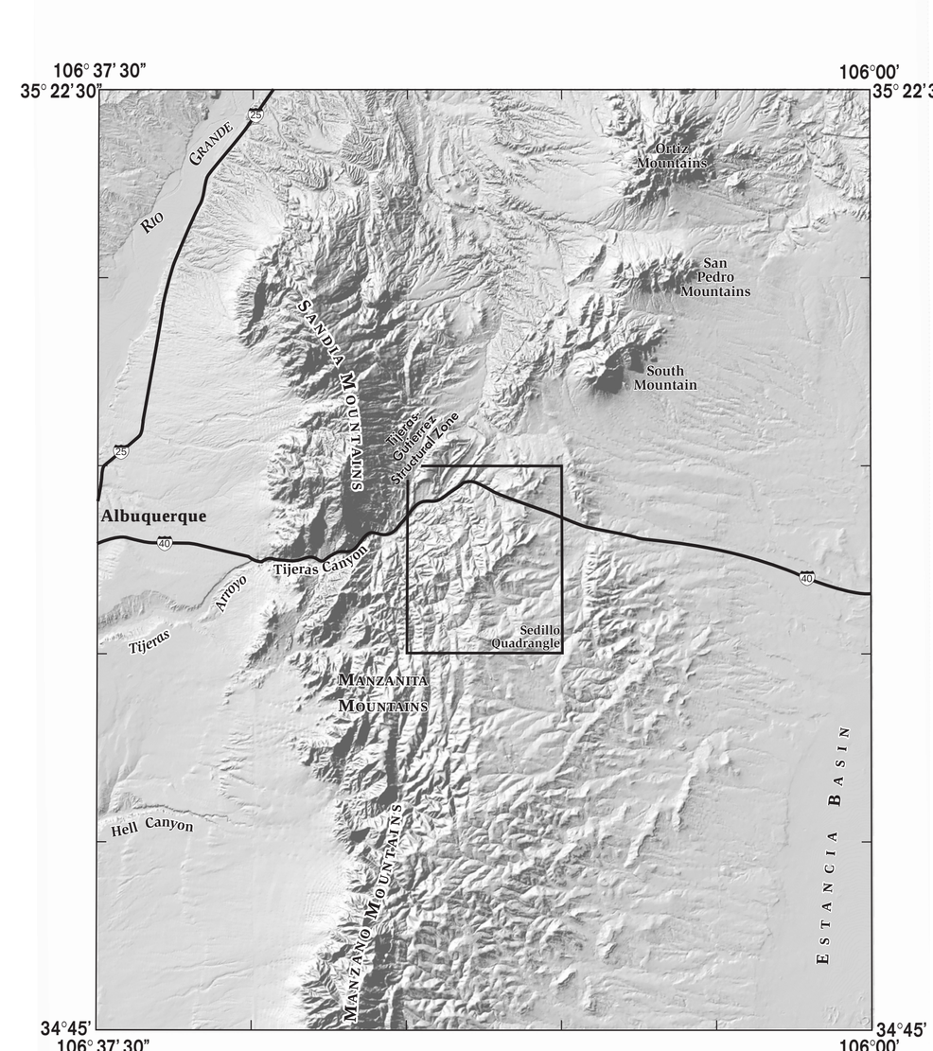
Xms — **Pelitic and semi-pelitic schist—**gray quartz-rich pelitic and semi-pelitic schist with gradational changes in mica content between micaceous quartzite and quartz-muscovite schist. containing multiple tectonic fabrics defined by fine-grained micas. Porphyroblasts have not been seen in hand sample.

Xu — **Paleoproterozoic (?) rocks undifferentiated** (on cross section).

Geologic Cross Sections



These cross sections are constructed based upon the interpretations of the authors made from surficial geologic control and subsurface and geophysical data, where available. They should be primarily used as an aid to geologic framework understanding and not be the sole source of information used in locating or designing wells, buildings, roads, or other man-made structures.

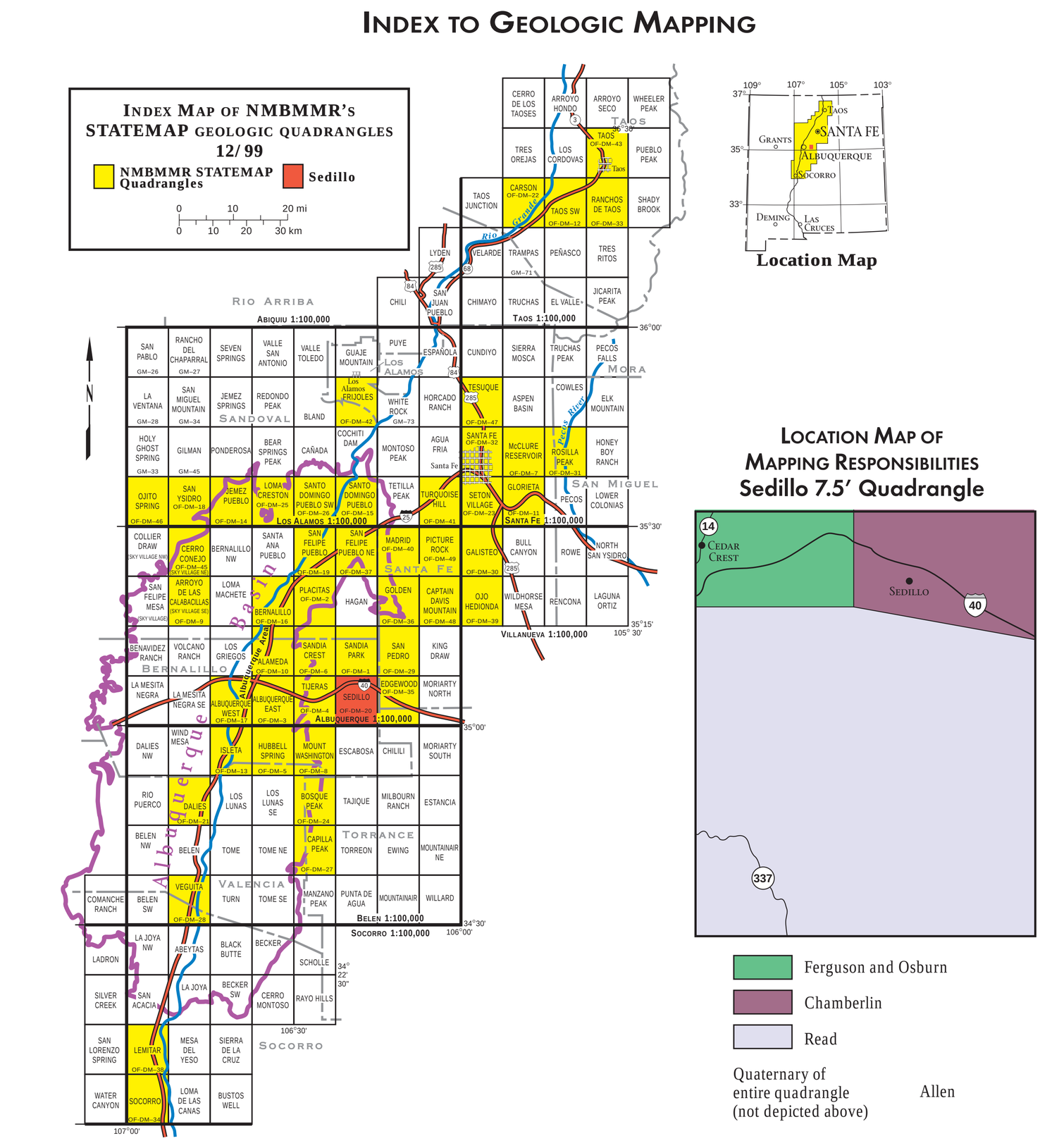


Physiography of the Sedillo quadrangle and surrounding area. Base derived from USGS 10-m DEM data.

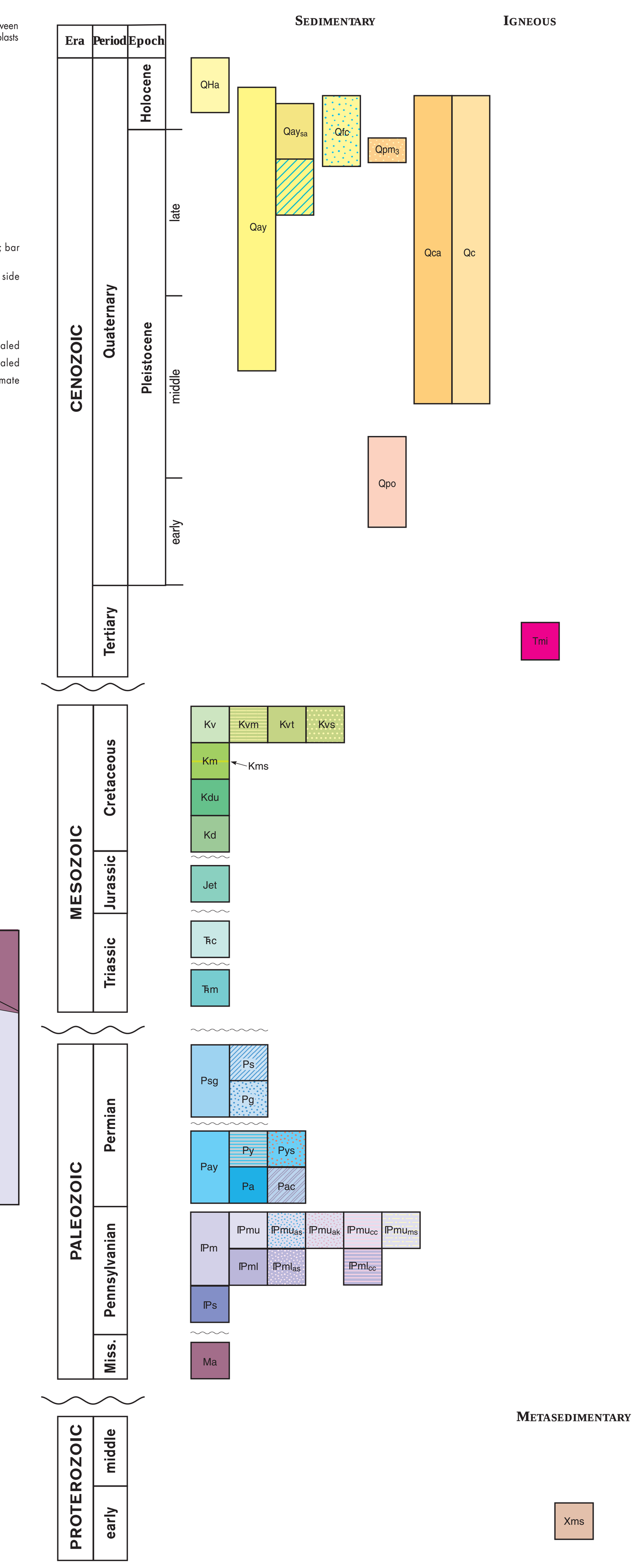
Explanation of Map Symbols

- Exposed contact
- Approximate or inferred contact
- Fault–Movement unknown; tick shows dip if known
- Normal fault–Solid where exposed, dashed where approximately located or inferred, dotted where concealed; bar and ball on downthrown side; tick shows dip
- Reverse fault–Dashed as it is approximately located or inferred, or dotted where concealed; teeth on upthrown side
- Mesoscopic fault showing separation
- Slickenlines on fault
- Breccia or gouge zones
- Trace of axial plane of anticline, with fold plunge, dashed where approximate or inferred, dotted where concealed
- Trace of axial plane of syncline, with fold plunge, dashed where approximate or inferred, dotted where concealed
- Trace of axial plane of a monocline with an anticlinal bend; short arrow on steeper beds, dashed where approximate or inferred, dotted where concealed
- Strike and dip of bedding, horizontal bedding
- S_1 schistosity–S_1 is commonly subparallel to S_0 (bedding)
- Joint, vertical joint
- Mineral lineation defined by aligned elongate minerals and stretched grains
- Mine / Quarry
- Spring
- Water well and storage tank
- Pebbly conglomerate with siliclastic units
- Slump block, dash depicts upslope failure area, arrows depicts direction of failure movement

Index to Geologic Mapping



Correlation of Units



Comments to Map Users

A geologic map graphically displays information on the distribution, nature, orientation and age relationships of rock and surficial units and the occurrence of structural features. These data are derived from geologic field mapping, compilation of published and unpublished work, and photogeologic interpretation. Locations of geologic unit contacts are not surveyed; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologist. The study area was mapped at scales of 1:12,000 and 1:24,000; therefore, the user should be aware of significant variations in map detail. Any enlargement of this map beyond a scale of 1:12,000 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.

This quadrangle map has been Open-filed in order to make it available as soon as possible. The map has not been reviewed according to New Mexico Bureau of Mines and Mineral Resources standards, and due to the ongoing nature of work in this area, revision of this map is likely. As such, dates of revision will be listed in the upper right corner of the map and on the accompanying report. ***The contents of the report and map should not be considered final and complete until it is published by the NMBMMR.***