

## Geologic map of the Silver City quadrangle, Grant County, New Mexico.

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by

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map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation.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

### DESCRIPTION OF MAP UNITS

#### CENOZOIC

- Qy** — **Younger alluvium (Recent to late Pleistocene)** — Alluvium in active channels, flood plains, and terraces incised less than 3 m.
- Qc** — **Colluvium and talus (Recent to late Pleistocene)** — Slope deposits, mostly shown in areas where bedrock relationships are uncertain.
- Qm** — **Terraced alluvium (Late Pleistocene)** — Alluvium in terraces incised between 3-10 m. This unit appears to be correlative with sand and gravel deposits in piedmont ridges and meadows north of Silver City along Silva and Little Walnut creeks.
- Qo** — **Older alluvium (Early to Late Pleistocene)** — Older alluvium in high-standing terraces, and piedmont deposits.
- Tgy** — **Conglomerate (Miocene to Pliocene)** — Conglomerate, pebbly sandstone, and sandstone. Clasts in the conglomerate distinguish this unit from the volcaniclastic sandstone and conglomerate (Tvc). On L.S. Mesa in the northwest corner of the map, clasts of the Bear Mountain intrusive complex, which intrudes Tvc, are abundant. Northwest of Silver City, this unit contains abundant quartz-phyric felsic volcanic clasts, which are notably absent in the older Tvc unit. The Tgy conglomerate also contains clasts of the phenocryst-poor rhyolite (Trt) which is unconformably overlies and which intrudes the volcaniclastic conglomerate (0 to >150 m thick).
- Tt** — **Nonwelded lithic tuff (Cenozoic)** — Nonwelded lithic-rich ash-flow tuff containing clasts of quartz feldspar phenocryst-rich, welded ash-flow tuff (0-30 m thick).
- Ta** — **Andesite lava (Cenozoic)** — Andesitic lava containing 20-35% 1-4 mm plagioclase and 2-4% 1-2 mm altered mafics (0-120 m thick).
- Tw** — **Welded ash-flow tuff (Cenozoic)** — Contains subhedral to euhedral quartz, sanidine, and biotite, in a tan to light pink and gray aphanitic matrix. Each mineral comprises up to about 5% of the rock. Altogether, the rock is relatively crystal-rich, containing between 15 and 20% phenocrysts. Biotite is slightly altered and has a silvery sheen. Quartz is clear. Both quartz and biotite are between 1-5 mm across. Clear crystals of sanidine range up to 5 mm. On weathered surfaces quartz and sanidine appear as slightly darker spots. Euxenitic foliation is visible locally, but most exposures are not ideal. Large rounded boulders of this unit up to 2 m across are contained within Tgy immediately adjacent to the contact. They are so numerous that they resemble bedrock, but eutaxitic foliation in these clasts is random.
- Td** — **Bear Mountain intrusive complex (Cenozoic)** — Dacitic porphyry containing 10-15% 1-3 mm euhedral plagioclase (An 28-34), up to 2% -2 mm biotite, and sparse magnetite phenocrysts. The groundmass is cryptoperthitic and contains abundant microclitic cavities according to Petersen (1979). Mostly sheets and lenticles. Similar rocks (Tb'), but rhyodacitic in composition and slightly older than the Td occur at Mt. Stewart and in the extreme northwestern part of the map area.
- Tri** — **Phenocryst-poor rhyolite (Cenozoic)** — Very phenocryst-poor, light-colored felsite porphyry dikes, sills, and intrusions, characteristically strongly lined and containing sparse, euhedral biotite up to 5 mm.
- Tvc** — **Volcaniclastic sandstone and conglomerate (Cenozoic)** — Red sandy matrix conglomerate and sandstone. In the north-central part of the map, the unit consists of monotonous, very thick-bedded to massive clast-supported conglomerate, and clasts are dominated by andesite lava (TKa) and K-feldspar porphyritic monzonite (TKc). Elsewhere the unit is dominantly a thin- to medium-bedded conglomerate and pebbly sandstone with cross-stratified sandstone and sparse siltstone and mudstone beds. Intervals of felsic pumiceous sandstone are locally important. In the northwest, the unit is dominated by sandstone with subordinate mudstone and includes several phenocryst-poor andesite lavas (0 to >150 m thick).
- Tvt** — **Ash-flow tuffs within volcaniclastic rocks (Cenozoic)** — A series of at least two and as many as four nonwelded to poorly welded felsic ash-flow tuffs ranging from 0-5m thick within the volcaniclastic sandstone and conglomerate unit. The tuffs are typically pumice-rich and the lower ones contain biotite phenocrysts up to 4mm. Other phenocrysts include biotite, sanidine, plagioclase and quartz.
- Tbo** — **Older andesite lavas within volcaniclastic rocks (Cenozoic)** — Phenocryst-poor andesite lavas intercalated with Tvc.

#### CENOZOIC-MESOZOIC

- TKc** — **Eighty Mountain intrusion** — K-feldspar porphyritic monzonitic intrusion containing 5-10% hornblende and biotite.
- TKm** — **Mafic intrusion** — A highly variably textured complex of mafic intrusions in the vicinity of Pinos Altos Mountain. Varieties include hornblende-porphritic andesite, porphyritic andesite similar to the TKa unit, plagioclase-porphritic gabbroic bodies, and medium-grained equigranular diorite to monzodiorite with 20-30% hornblende and biotite.
- TKh** — **Hornblende porphyry dikes and sills** — Dark, fine-grained crystalline matrix andesite porphyry dikes and sills with abundant 4-15 mm hornblende phenocrysts. This unit is also labeled Td due to space limitations. Hundreds of dominantly NNE-trending dikes and sills of TKh intrude Kc north and northeast of Silver City. We have not mapped these in detail as the area is mainly covered by housing developments. Those interested in the pre-development outcrop pattern of the intrusions in that area are referred to Cunningham (1974).
- TKmz** — **Fine-grained monzonite** — Two small intrusions of fine-grained monzonite containing 10-30% mafics (biotite and hornblende). Locally the intrusions contain sparse phenocrysts of K-feldspar and hornblende up to 1cm.
- TKa** — **Andesite** — Andesitic lava containing up to 30% phenocrysts of plagioclase (1-5 mm) and altered mafics (up to 4mm). On the slopes of Pinos Altos Mountain in the northeast corner of the map area, the unit is intimately associated with mafic intrusions (TKm). In these areas, the andesite lava is distinguished from intrusive rocks with certainty only in areas where auto-brecciated texture is present (0-200 m thick).
- TKac** — **Quartz pebble conglomerate** — Pebble conglomerate containing well-rounded quartz pebbles and rounded to sub-angular argillite and arkosic sandstone pebbles in a dark, argillaceous sandy matrix. The unit is poorly preserved, its outcrop pattern based entirely on float, where it occurs along the unconformity between the Colorado Formation (Kc) and the volcaniclastic conglomerate (Cv) in the center of section 20, T14W, R17E. The unit is probably correlative with the Kac map unit of Skotnicki and Ferguson (2007) in the easterly adjacent Bayard 7.5' quadrangle.

#### MESOZOIC

- Kc** — **Colorado Formation (Cretaceous)** — Arkosic lithic sandstone, siltstone, and shale with sparse oyster-rich skeletal packstone beds up to 20 cm thick. Sandstone beds, typically cross-stratified, range up to 10 m thick and constitute approximately 20% of the formation. Dinosaur tracks occur within some thin-bedded siltstone units (0 to >300 m thick).
- Kb** — **Bearfoot Quartzite (Cretaceous)** — A complex succession of quartz sandstone, siltstone, silty shale, and pebble conglomerate. The unit typically consists of a basal silty shale up to 10m thick overlain by quartz sandstone interbedded with subordinate siltstone and shale. Pebble to granule conglomerate and pebbly quartz sandstone, if present, occur near the base, but no where, apparently at the base of the unit. Pebble conglomerate and sandstone beds are commonly cross-stratified in tabular-planar to wedge-planar sets and rarely troughs. Clasts within the conglomerates are sedimentary rock, presumably from the underlying Paleozoic section. A gradational upper contact with the Colorado Formation is defined at the top of the highest quartz sandstone (10-40 m thick).

#### PALEOZOIC

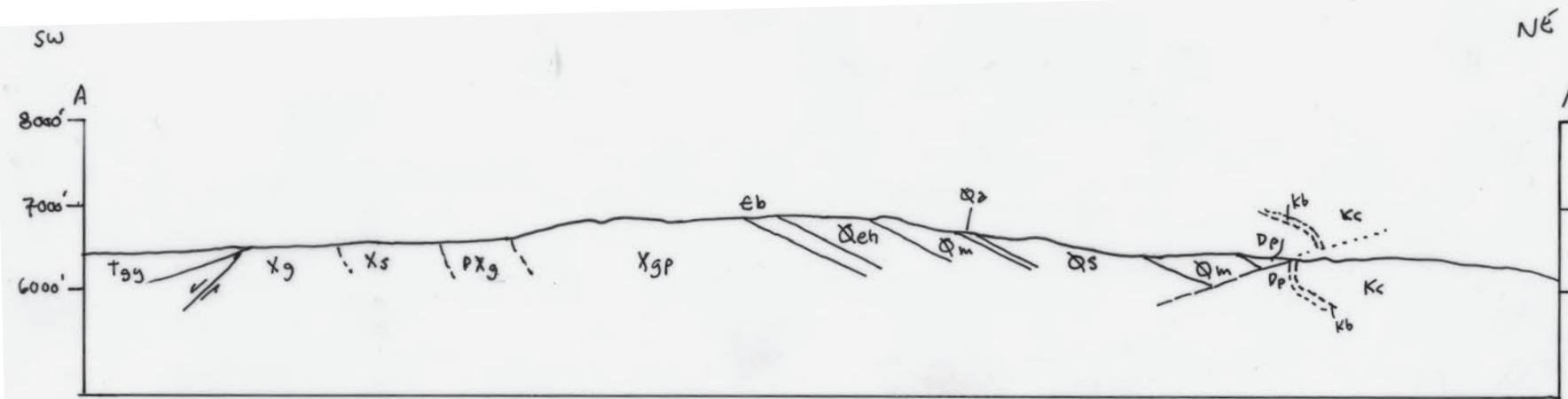
- MP** — **Lake Valley and Oswaldo Limestone (Mississippian - Pennsylvanian)** — Medium- to thick-bedded limestone, typically cherty with sparse interbeds up to 5 m thick of dark shale and rare, fine-grained, cross-stratified, pink quartz sandstone. Limestone consists mostly of skeletal packstone and grainstone with abundant crinoid columnals, and locally abundant fusulinids. Red chert characterizes the middle portion of this unit throughout the map area (200-240 m).
- Dp** — **Percha Shale (Devonian)** — Dark green gray shale with sparse silty laminae near the base. The upper 10-15 m contains sparse lenticular micritic limestone beds that is locally differentiated as a separate unit (the Box Member). The main unit, known as the Ready Pyg Member constitutes most of the formation in this area (120 m thick).
- OS** — **Stratigraphic nomenclature of Silurian and Ordovician units follow that of Clemens (1991) which is slightly modified from Hayes (1975) based on recommendations from the American Commission on Stratigraphic Nomenclature (1961) and the North American Commission on Stratigraphic Nomenclature (1983).**
- Oa** — **Cutter Member of the Montoya Formation and Fusselman Formation (Ordovician and Silurian)** — A pair of mostly massive micritic carbonate units with sparse skeletal remains. The lower unit (Cutter) contains large beds of colonial tabulate and rugose coral, and locally includes a basal skeletal packstone containing abundant large brachiopods. The upper unit (Fusselman) is thinner, typically darker, and commonly vuggy with a widespread skeletal waxstone containing large pentamerid brachiopods whose identification yields an Early to Middle Silurian age (Harbour, 1972). The units are combined because the contact is very difficult to pick consistently, especially on the east-facing dip-slopes of the Silver City Range.
- Orne** — **Aleman Member of the Montoya Formation (Ordovician)** — Thin-bedded light brown micritic dolostone with abundant (30-50%) bed-parallel ribbon chert (10-20 m).
- Oeh** — **Upham Member of the Montoya Formation and McKelligam and Jose members of the El Paso Formation (Ordovician)** — A three part map unit spanning the Montoya and El Paso formation boundary. The formations, easily distinguished in areas of structural simplicity and good exposure are very difficult to consistently map on the heavily vegetated east-facing dip slope of the Silver City Range. Both formations include a basal unit containing abundant quartz sand. The oldest unit, the Jose Member, thin and poorly represented in the Silver City (0-5 m thick), is a low-angle, cross-stratified, sandy dolostone that grades up into the McKelligam Member, which is dominated by thick, amalgamated sequences of algal laminated massive carbonate (mostly limestone) that displays trepce structures, intralaminar breccia and conglomerate, and well-developed columnar stromatolites. Chert is rare to absent in the Jose and McKelligam members. The McKelligam is unconformably overlain by the Upham Member of the Montoya Formation (25-30 m thick), characterized in its basal portion by abundant granule to medium-grained well-rounded quartz sand in chaotic intralaminar breccia and conglomeratic carbonate, chiefly of dolostone. Dolomite of the Upham Member is chiefly cherty skeletal packstone and grainstone. The upper contact of the Upham Member is a pronounced unconformity that is commonly strongly silicified and hematite stained (combined thickness of 60-80 m).
- Cb** — **Hitt Canyon Member, El Paso Formation (Ordovician)** — Thin- to medium-bedded, tabular-planar sets of strongly bioturbated gray and tan carbonate. Carbonates are typically dolomitic, variably cherty skeletal waxstone and packstone, and the gray and tan color variation defines a characteristic "chicken-wire" texture giving the unit a mottled appearance (75-90 m).

#### PROTEROZOIC

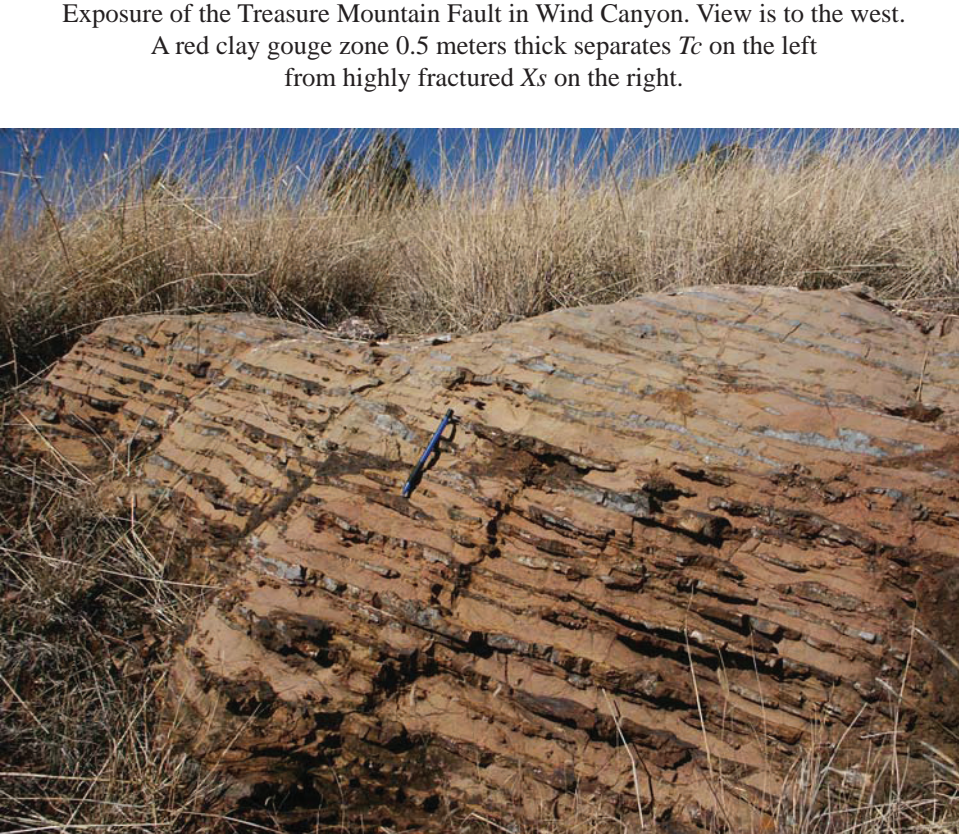
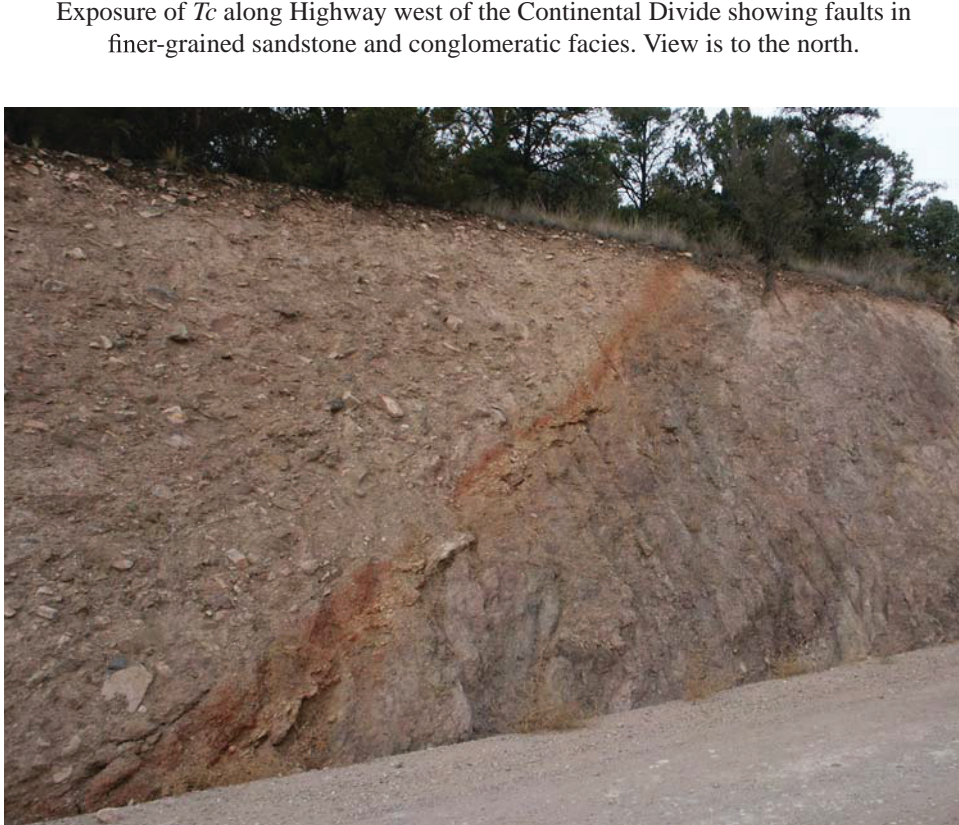
- YXgp** — **Granite porphyry (Middle Proterozoic)** — Contains about 10% subhedral light gray phenocrysts of K-feldspar and sparse smaller quartz, both 2-4 mm wide and locally slightly larger, in a finely granular orange-tan matrix of quartz and feldspar. Subhedral K-feldspar (exhibiting Carlsbad twinning) is locally light tan and stands out in contrast to the darker orange matrix. In other areas, K-feldspar is nearly the same color as the matrix and is difficult to see. In these areas quartz appears as darker gray spots on weathered surfaces. Biotite is less than 1% of the rock and occurs as small anhedral clumps less than 2 mm wide. In most areas, however, biotite is almost completely weathered and nearly unrecognizable. Nearly all exposures exhibit the same texture, though locally the matrix is slightly coarser grained. Weathering into a distinctive light gray orange color and typically breaks and weathers into angular fragments, compared to the more rounded outcrops of Xg. The mineralogy of both YXgp and Xg are very similar, suggesting they may be related.
- Xg** — **Granite (Early Proterozoic)** — Medium- to marginally coarse-grained and equigranular. This characteristically light orange-colored granite is almost everywhere texturally similar. It is composed of relatively equant crystals of K-feldspar, plagioclase, and quartz. Plagioclase appears altered (sericitized?). Biotite is almost completely altered to hematite and most outcrops appear isocratic. As such, it is difficult to estimate the original percentage of the mineral. The exposures farthest south are the most strongly foliated, with foliation defined by quartz crystals strung out into long lenses, and aligned mica. In hand lens, these quartz lenses appear to be recrystallized into individual crystals. Feldspars are broken and elongated. A little farther north foliation is weaker and defined only by aligned biotite. Foliation fades out northwest. Rare fine-grained granite dikes cut the granite. Of the three observed, all are near-vertical and trend approximately N110°E. One occurred in the south and was also foliated.
- Xa** — **Amphibolite** — Mostly medium-grained. Composed of interlocking crystals of dark amphibole and light gray plagioclase and minor quartz. Exposures are commonly dark grayish green. This unit is both foliated and non-foliated.
- Xq** — **Quartz-muscovite schist** — This unit characteristically contains quartz and coarse-grained muscovite. It is mostly strongly foliated and forms resistant ridges. In many areas muscovite is a minor component and the rock can be classified as a quartzite. The quartzite is mostly muscovite-free and lightest gray in a band about 20 m wide immediately adjacent to the granite along the southern contact of the unit. It is possible that this band represents an original stratigraphic horizon that acted as a barrier to granite intrusion.
- Xs** — **Quartz-biotite schist** — This rock is composed mostly of fine-grained quartz, and less abundant fine-grained biotite ± muscovite. The rock is characteristically light tan with a wispy, locally undulating foliation. The rock is mostly forms slopes that are covered with dark brown soil, so exposures are poor. Although most exposures contain biotite as the dominant mica, muscovite is abundant locally, and in some areas the rock can be difficult to distinguish from the quartz-muscovite schist (Xq). In a few eastern outcrops, the rock contains red garnet between 2-6 mm in diameter. The protolith for this rock was probably fine-grained silty sandstone.

#### REFERENCES

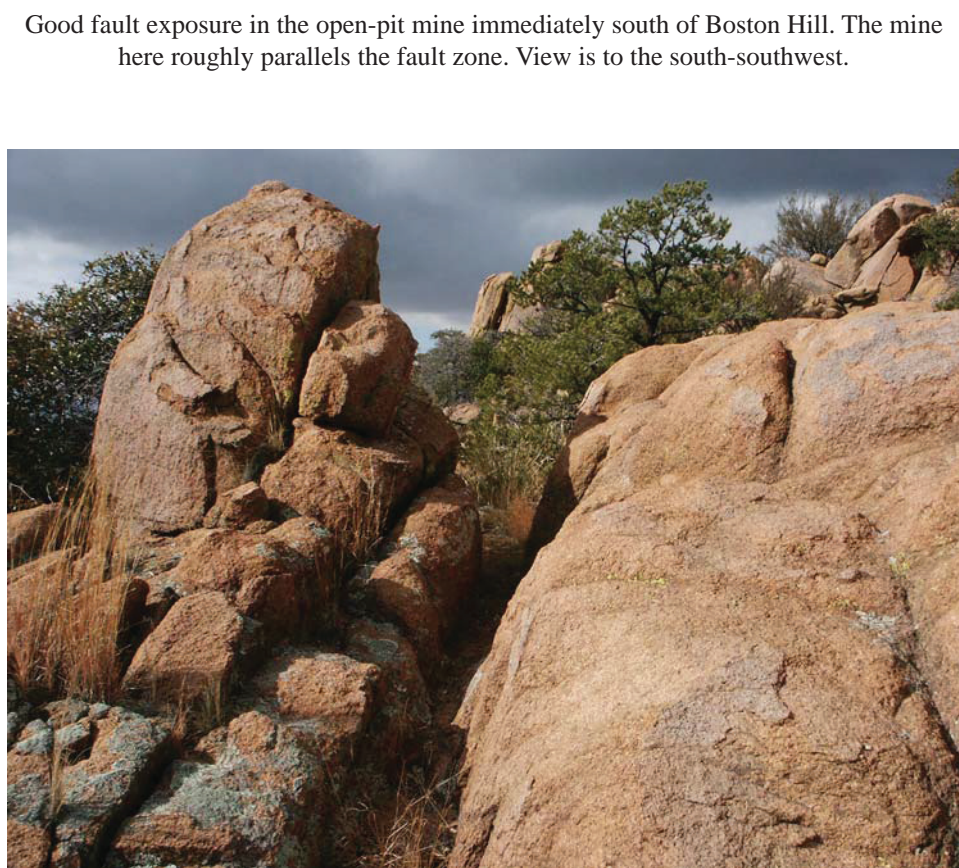
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A nice view of Silver City looking northeast from Boston Hill.



Exposure of foliated and contorted amphibolite (Xa).



Typical bouldery exposure of Xg about one mile northwest of Fleming Canyon.

Base map from U.S. Geological Survey, 1962, from photographs taken 1961; field checked in 1962, edited in 1962. 1927 North American datum, New Mexico Coordinate System, west zone (Transverse Mercator). 1000-meter Universal Transverse Mercator grid, zone 12, shown in red.

CORNER MARKS	SECTION NUMBER	TOWN SECTION
CIRCLE MARK	Yellow City	POPE BARRETT
1962 REGISTRATION	THIRTEEN	HARLEY WEST

#### QUADRANGLE LOCATION

This draft geologic map is preliminary and will undergo revision. It was produced from either scans of hand-drafted originals or from digitally drafted original maps and figures using a wide variety of software, and is currently in cartographic production. It is being distributed in this draft form as part of the bureau's Open-file map series (OFGM), due to high demand for cartologic map data in these areas where STATEMAP quadrangles are located, and it is the bureau's policy to disseminate geologic data to the public as soon as possible.

After this map has undergone scientific peer review, editing, and final cartographic production adhering to bureau map standards, it will be released in our Geologic Map (GM) series. This final version will receive a new GM number and will supersede this preliminary open-file geologic map.

# DRAFT



New Mexico Bureau of Geology and Mineral Resources  
Open-file Map Series  
**OFGM 164**

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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/publications/maps/geologic/ofgm/home.html>