Geologic Map of the

Ladron Peak Quadrangle, Socorro County, New Mexico

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Scale 1:24,000

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Map Unit Descriptions
Ladron Peak 7.5-minute quadrangle

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Cenozoic

Quaternary

Quaternary geologic units were mapped in the field and using color digital orthophotographs and stereopair aerial photographs. Colors are denoted using Munsell notation (Kollmorgen, 1994). Pedogenic carbonate morphologic stages after Machette (1985).

Anthropogenic and Surficial Deposits

Thin surficial deposits derived from wind and mass-movement processes, or areas disturbed by human activities.

af	**Artificial fill and disturbed land** (modern) — dumped fill associated with construction of small dams.
Qca	**Colluvium and alluvium, undivided** (Holocene-Pleistocene) — poorly consolidated, poorly sorted and stratified, fine- to coarse-grained, clast- and matrix-supported, transport-limited deposits derived from a variety of mass-movement hillslope processes, including rock-fall, debris flow, shallow slump and creep. Gravels are typically angular and composition generally reflects local upslope provenance. Differentiated where areally extensive, thick, or obscures geologic contacts. Variable thickness, ranging from 0-20 m.

Stream-valley Alluvium

Tributary stream-valley alluvium associated with modern and Pleistocene entrenched tributary valleys. Deposits typically contain poorly to well sorted, poorly to well stratified, clast- and matrix-supported sediment that is inset against the Santa Fe Group and older rocks.

Qa	**Active alluvium, modern deposits** (modern-Holocene) — light-brown (7.5YR 6/4), unconsolidated, poorly to moderately sorted, medium- to coarse-grained sand and pebbly to bouldery sand occupying modern arroyos that grade to the floor of the Rio Puerco and Rio Grande valleys. No pedogenic development or carbonate cement. Base is not exposed, but deposit is estimated to range from 1 to 3 m in thickness.

Qvy	**Younger alluvium, undivided** (Holocene-uppermost Pleistocene) — brown (7.5YR 4/4) pebble gravel associated with broad valley fill units within modern stream valleys and valley border fans that grade to the Rio Puerco floodplain. Weak soil development with Stage I pedogenic carbonate morphology.
Qvm	**Intermediate alluvium, undivided** (middle Pleistocene) — brown to strong-brown (7.5YR 5/4-5/6) pebble gravel and pebbly sand with stage II+ to III pedogenic carbonate morphology. Inset by younger stream-valley alluvium (***Qvy***). Locally divided into three subunits based on inset relationships and surface morphology.
Qvm3	**Intermediate alluvium, intermediate subunit** (middle Pleistocene) — strong-brown, weakly to moderately consolidated pebbly sand and medium- to coarse-grained sand with Stage III pedogenic carbonate morphology; poorly exposed. Thickness ranges from 1 m to over 3 m thick.
Qvm2	**Intermediate alluvium, older subunit** (middle Pleistocene) — strong-brown, moderately consolidated pebbly sand and medium- to coarse-grained sand with Stage III pedogenic carbonate morphology; poorly exposed. Thickness ranges from 1 m to over 3 m thick.
Qvm1	**Intermediate alluvium, oldest subunit** (middle Pleistocene) — brown, weakly consolidated pebbly sand and medium- to coarse-grained sand with Stage III pedogenic carbonate morphology; poorly exposed and strongly modified by erosion. Thickness ranges from 1 m to over 3 m thick.
Qvo	**Older stream-valley deposits, undivided** (middle Pleistocene) — poorly exposed pebble to cobble gravel on high ridge-tops. Unconformably overlies moderately to slightly tilted strata of the Popotosa and Sierra Ladrones formations. Locally exhibits stripped soils with Stage III+ pedogenic carbonate morphology. Unit is inset by intermediate alluvium (***Qvm***). Gravels are dominated by 10-20% boulders of quartz and light-colored granite, with locally abundant schist. Gravels up to 60 cm in maximum diameter. Deposit top about 70-115 m above local base level. On the southwest side of the range, Qvo appears to grade to the Riley Travertine (not present in map area; see Barker, 1983). Approximately 15 m thick.
QTp	**Older piedmont deposits, undivided** (upper Pliocene-lower Pleistocene) — Subhorizontally bedded cobble to boulder gravel and gravelly sand. Poorly exposed and overlies Popotosa Formation and older rocks in angular unconformity. Probably correlative to upper part of Sierra Ladrones Formation. Locally divided into older subunit (***QTpo***) based on inset relationships. Thickness variable, but generally less than 24 m.
QTpo	**Older piedmont deposits, upper subunit** (upper Pliocene-lower Pleistocene) — poorly exposed cobble and boulder gravel along the northeast flank of Ladron Peak; inset by older piedmont deposits (***QTp***).

Tertiary

Lower Santa Fe Group

Deposits of the Santa Fe Group were subdivided based on *textural* criteria and were then further subdivided on the basis of *provenance* (Cather, 1997). Deposits containing predominantly (>50%) Precambrian detritus are denoted by **(g)**. Those consisting dominantly of volcaniclastic rocks are indicated by **(v)**. The Popotosa Formation records unroofing of the Ladron Mountains with the lower part of the formation being dominantly volcaniclastic and the upper part mostly consisting of granitic detritus. No upper Santa Fe Group equivalents are present on the quadrangle except possibly unit **QTp** (see above).

Popotosa Formation (lower Miocene–upper Miocene)

Tpx	**Probable high-elevation erosion surface** (Miocene?)— Probable high-elevation erosion surface inferred along eastern flank of Monte Negro (cross-hatch pattern on map).
Tppc	**Conglomeratic piedmont facies—**Characterized by conglomerate/sandstone ratio of greater than 2/1. Conglomerate is mostly clast-supported, crudely imbricated, and poorly sorted. Matrix-supported debris-flow deposits are common in this facies; in areas where debris-flow deposits are voluminous, they are mapped separately as facies Tpdc. Sandstone in Tppc is medium to very coarse grained and commonly exhibits crossbedding or horizontal laminations. Mudstone is rare, occurring mostly as thin discontinuous drapes. Paleoflow was eastward or southeastward.
Tpdc	**Debris-flow-dominated facies**—Characterized by a dominance of very poorly sorted conglomerate that is matrix-supported and typically very well indurated. Exposed northeast of Ladron Peak. Clasts are virtually all derived from Tertiary volcanic rocks, mostly the La Jara Peak Basaltic Andesite.
Tppcs	**Conglomerate-sandstone piedmont facies—**Characterized by conglomerate/ sandstone ratio between 2/1 and 1/2. Conglomerate is mostly clast-supported and poorly sorted. Sandstone is fine to very coarse grained and commonly horizontally stratified or trough crossbedded. Mudstone is minor. Paleoflow ranged from northeastward to southeastward.
Tpps	**Sandstone-dominated piedmont facies—**Characterized by conglomerate/ sandstone ratio less than 1/2 and sandstone/mudstone ratio greater than 2/1. Sandstone is dominantly horizontally stratified with subordinate trough crossbedding. Conglomerate is mostly clast-supported and occurs as scour-fills and as tabular units less than a meter thick.
Tptsm	**Transitional playa-margin facies—**Characterized by sandstone/mudstone ratio of between 2/1 and 1/2. Sandstone is horizontally laminated and forms thin tabular beds (<0.5 m). Sandstone is intimately interbedded with tabular mudstones that are structureless and dominantly red-brown in color. Conglomerate is rare. The playa-margin facies represents interfingering of distal

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

Middle Tertiary Rocks Of The Mogollon-Datil Volcanic Field

Tv	**Tertiary Volcanic Rocks, undifferentiated —** Altered and brecciated volcanic rocks of uncertain affinity exposed in a fault sliver east of the ranch house (formerly Brown Ranch) and south of the Jeter Mine.
Tlp	**La Jara Peak Basaltic Andesite, medial to upper tongues undifferentiated** (upper Oligocene)— Mostly medium gray to purplish gray, massive and platy to vesicular basaltic andesite lavas characterized by moderately abundant (5–10%) fine- to medium-grained phenocrysts of olivine, usually altered to reddish brown iddingsite. Black fine-grained nearly aphyric basalt locally occurs at the base of this unit where it overlies the La Jencia Tuff. Mafic lavas locally appear to fill a paleovalley as much as 100m deep that truncated the older La Jencia and Hells Mesa tuffs. Tlp lavas unconformably overlie Spears conglomerates near the bottom of this paleovalley. Phenocrystic plagioclase is typically absent. Thin flows (3-6m) locally exhibit vesicular tops and reddish basal zones. Maximum thickness is approximately 250 m.
Tj	**La Jencia Tuff** (upper Oligocene)—Light gray, pale red and grayish red, phenocryst poor, dense to moderately welded, pumiceous rhyolite ignimbrite. Contains sparse (3-5%) phenocrysts of sanidine and quartz with traces of plagioclase and biotite. Outflow sheet erupted from the composite Sawmill Canyon caldera in the west-central and eastern Magdalena Mountains (Osburn and Chapin, 1983). Mean ^{40}Ar/^{39}Ar age from bulk sanidine separate is 28.85 ± 0.04 Ma (McIntosh and others, 1991). Correlation here based on distinctive lithology and relative stratigraphic position. Locally appears to fill a 10 m deep paleovalley cut into the upper Hells Mesa Tuff. Thickness range is 0-50 m.
Th	**Hells Mesa Tuff** (lower Oligocene)**—**Pale reddish to purplish gray and light gray, densely welded, slightly pumiceous, moderately phenocryst-rich (20-30 %), rhyolite ignimbrite; contains moderately abundant fine- to medium-grained (1–3 mm) phenocrysts of sanidine, plagioclase, biotite and quartz. This distal section is less crystal-rich and more biotite rich than relatively proximal sections in the Lemitar Mountains, which suggests winnowing of heavier large crystals during lateral transport. Mean ^{40}Ar/ ^{39}Ar age (bulk sanidine) is 32.06 ± 0.1 Ma (McIntosh et al. 1991). Large volume ignimbrite (1200 km^3) erupted from

	Socorro caldera (Chamberlin et. al, 2004: McIntosh et. al., 1991). Correlation is based on distinctive lithology and relative stratigraphic position. Thickness range is 0-30 m.
Ts	**Spears Formation** (upper Eocene)— Purplish gray, dusky purplish gray, light brownish gray and light gray volcanic-rich conglomerates and sandstones derived from intermediate composition volcanic highlands. Dark gray subrounded hornblende andestite porphyry clasts range from boulders to pebbles; they are common in lenticular to tabular conglomeratic beds, usually 1-3m thick. Regionally dated at about 39-33 Ma (Osburn and Chapin, 1983). Correlation based on lithology and relative stratigraphic position. Contains numerous malachite (copper carbonate) occurrences in moderately dipping to steeply dipping (25-75º) shear zones immediately underlying the moderately dipping Silver Creek fault. Thickness uncertain due to faulting and folding; minimum thickness is about 200m.

Tertiary Intrusive Rocks

Ti	**Mafic dikes** (probably Oligocene) — Dark gray, phenocryst-poor, mafic dikes about 50-60 cm wide. Sparse iddingsite suggests a basaltic composition. Dikes cut Eocene Baca Formation and dip steeply to SSW.

Synorogenic Laramide Conglomerates

Tb	**Baca Formation** (middle to upper Eocene)— Consists primarily of crudely bedded, reddish brown to dusky red, coarse-grained arkosic sandstone and conglomeratic sandstones. Limestone cobble conglomerates are common near the base of the formation. Subangular granitic and quartzite clasts are also common. Usually moderately well cemented and crudely bedded. Poorly cemented basal conglomerates are locally exposed as limestone-clast lag zones on a reddish arkosic soil. Coarse-grained grus-like character in altered (yellowish brown) outcrops can give poorly bedded zones the appearance of a granite outcrop. A few observations of pebble imbrications indicate southerly to southwesterly paleocurrents. North of Red Tank, the Baca Formation lies in angular unconformity on tightly folded beds of the Abo Formation and is conformably overlain by the Spears Formation. Southeast of Red Tank the Baca Formation unconformably overlies the Tres Hermanos Formation and also locally rests unconformably on the lower Mancos Shale. The Spears-Baca contact is gradational and intertonguing, over as much as 10-20m. The base of the Spears Formation (top of the Baca) is placed at the first up-section appearance of purplish gray volcaniclastic sandstone or conglomerate, which is often locally intimately mixed with purplish arkosic sandstone. Baca and Spears beds are commonly altered (initially reduced and recently oxidized) to gray and yellowish brown colors along Laramide strike-slip faults, thrust faults, and sheared axial planes of folds (see Alteration and Mineralization). Thickness appears to be highly variable, approximately 10-60m.

Mesozoic

Cretaceous

Kt	**Tres Hermanos Formation, Atarque Sandstone member** (middle Turonian) — Dark brown, well-cemented, fine-grained sandstone beds (20-30 cm thick) capped by thin oyster coquinas (1-2 cm thick) are common at the base of the Atarque member. Oyster beds usually grade upwards into yellowish brown, fine- to medium-grained, finely laminated sandstone beds and minor beds of gray shale. In the Red Tank area, Atarque Sandstone beds are anomalously reddened within an early Tertiary weathering zone unconformably overlain by the Eocene Baca Formation (see Alteration and Mineralization section). Atarque Sandstone beds immediately under the Baca Formation (or under the Red Tank thrust) are commonly pale red, reddish brown or lavender colored. In some localities reddish colored sandstone beds abruptly change color along strike into yellowish brown sandstones (Table1, S88). These sharp color boundaries that cut across bedding are interpreted as ancient redox boundaries. Note that yellowish brown colored Cretaceous sandstones typically represent recent oxidation of gray reduced sandstones in the modern weathering zone. The Carthage and Fite Ranch members of the Tres Hermanos Formation are apparently absent here, probably due to early Tertiary erosion prior to Baca Deposition. Maximum exposed thickness is about 20-30 m.
Km	**Mancos Shale, lower tongue** (lower to middle Turonian) — Consists normally of medium to dark gray marine shales with scattered limy concretions that are conformably overlain by oyster beds of the basal Tres Hermanos Formation. Thin white bentonite ash beds are locally present within dark gray shale beds (UTM 13s, NAD27 313292E, 3807665N). Gray shale beds are commonly mantled by scattered crystals of clear selenite. The lower 2/3 of Km is calcareous (i.e. disseminated calcite) and the upper 1/3 is non-calcareous. Key middle Turonian fossils collected from limy concretions in the shale beds include Collignoniceras Woollgari woollgari (Mantell) and Collignoniceras Woollgari regulare (Haas) as identified by Dr. Steve Hook. Lower Turonian Mytiloides mytiloides (Mantell) was also collected from a light brown calcarentite bed (Bridge Creek limestone bed) near the axis of an anticline about 700m SE of Red tank. Km exposed here is temporally and lithologically equivalent to the Rio Salado tongue of the Mancos Shale. Fossil data are summarized in Table 2. Mancos shale beds are anomalously reddened within an early Tertiary weathering zone unconformably overlain by the Eocene Baca Formation (see Alteration and Mineralization). Large exposures of mottled reddish brown and bluish gray calcareous shale are attributed to early Tertiary oxidation in an unsaturated (vadose) weathering zone. Nimick, 1986, miscorrelated these reddened Mancos shale beds with the Triassic Chinle Formation. The thickness of the Rio Salado tongue of the Mancos Shale is normally about 75-90m. The thickness of Km here is uncertain due to complex folding and faulting. The basal section of the lower

	Mancos Shale is apparently truncated by the Red Tank thrust fault; exposed thickness is probably about 60m.

Triassic

T_r	**Triassic rocks undifferentiated** — Chinle Group (and/or Moenkopi Formation): Gray limestone pebble conglomerate along the base with overlying red thinly bedded siltstone. Weathered red clay units interbedded with siltstones. Local thickness unknown.

PALEOZOIC

A thick section of Paleozoic rocks is exposed on the west side of the range where they are folded adjacent to the Ladron Fault and the west-tilted Ladron block. Esposure is essentially continuous from the Great Unconformity where Missippian rocks overly Proterozoic basement to the Abo formation (just off the quadrangle boundary) and perhaps higher. On the east side of the range, Paleozoic and younger rocks are exposed as small and often brecciated and/or altered fault slivers adjacent to Proterozoic basement along the Jeter and Silver Creek Faults.

Permian

Py	**Yeso Formation** (Permian) — Red to orange siltstones and mudstones, tan to orange sandstones, and dark-gray unfossiliferous limestones. Mudstones and siltstones commonly have light-gray reduction spots. May include minor exposures of Abo Formation. Thick to thin bedded. Local thickness unknown.
Pa	**Abo Formation** (Permian) — Mostly moderate red to reddish brown mudstones that are poorly indurated and well indurated beds of red to pale red sandstone, siltstone and occasional meter-thick light gray limestone beds. Sandstones are fine- to coarse-grained and often exhibit small low-angle cross beds. Overturned beds of cross-bedded sandstone and chert-pebble conglomerate locally define the toe of the Red Tank thrust fault about 450m SE of Red Tank. The normally red colored sandstones and mudstones were locally altered to dark gray and yellow brown colors by reducing fluids that circulated along high-angle reverse faults, thrust faults, and axial surfaces of tight folds of Laramide ancestry (see Alteration and Mineralization). Sandstone beds are often highly sheared and tightly folded in the area northeast of Red Tank. May include some brown sandstone and orangish gray limestone beds of the lower Yeso Formation. However, gypsum beds typical of the Yeso Formation have not been observed in the Red Tank area. Tight folding of beds and variable dip domains make estimates of thickness virtually impossible in the Red Tank area. Correlation of this "red bed" map unit is presently tentative. Red-brown, cross-bedded sandstones and red shales are the dominant lithology in the upper Abo Formation of the nearby Lucero uplift, but chert-pebble conglomerates have not been reported there (Kelly and Wood, 1949). Minimum thickness is probably 200 m

Pennsylvanian

Mapping of the Pennsylvanian and Mississippian rocks in the Apache Gap area was modified from Hammond (1987). However, Hammond's Pennsylvanian nomenclature was discarded in favor of the simpler Kelley and Wood (1946) nomenclature used in Sierra Ladrones and nearby Lucero uplift (see Kues, 2001).

IPm	**Madera Group undifferentiated** (middle to upper Pennsylvanian, Desmoinsean to Missourian) — Grey Mesa and Atrasado Formations combined, used where fault-bounded slivers of Madera Group rocks are exposed along the Jeter fault.
IPma	**Atrasado Formation of the Madera Group** (Missourian to Virgilian) — Characterized by interbedded limestones, sandstones and thicker shales with limestones that are less consistently thick and cliff-forming than the underlying Gray Mesa Formation. 271 m thick (see Hammond, 1987).
IPmg	**Gray Mesa Formation of the Madera Group** (Desmoinesian) — Dominantly thick-bedded fossiliferous and often cherty limestones interbedded with coarse sandstones and shales. Contact with underlying Sandia Formation is gradational and is considered to be the base of the first cliff-forming limestone. The top of the formation is considered to be the above the prominent tan-colored limestone cliff that marks a transition to the thinner-bedded overlying Atrasado Formation (see Kelley and Wood, 1946; Hammond, 1987). 224 m thick.
IPs	**Sandia Formation** (middle Pennsylvanian, Atokan) — Brown, orange-brown, and brownish-purple, fine to coarse-grained sandstone and conglomeratic sandstone: gray carbonate mudstone; and shale. Sandstones typically contain <10% feldspar grains and show large-scale, wedge- and trough-shaped cross-beds and planar parallel bedding; conglomerates contain quartz pebbles or chert cobbles; fauna include solitary rugose corals and brachiopods. Overlies Mississipian rocks with a slight angular unconformity in places. 78.5m thick (see Hammond, 1987).

Mississippian

M	Caloso and Kelly Formations undifferentiated — Brownish-white, thick-bedded, medium-grained quartzose sandstone and brown and gray, medium-bedded, arenaceous carbonate mudstone. Basal sandstone shows small-scale, low-angle, wedge- and trough-shaped cross-beds; limestone contains <5% coarse-grained sand; fauna include crinoid columnals and small brachiopods. 10 m thick. (see Armstrong, 1958).

Proterozoic

Plutonic Rocks

Mapping of the plutonic rocks in the interior of the range and descriptions are largely from Condie (1976) with significant revision in the vicinity of the Jeter fault.

XY	**Meso- and Paleoproterozoic rocks, undifferentiated** — includes plutonic and metamorphic rocks.
XYg	**Proterozoic plutonic rocks, undifferentiated** — Altered and brecciated granitic rocks within fault slivers along the Jeter Fault.
Yapl	**Aplite dikes** (Mesoproterozoic) — Light-yellow, fine grained granular, intrusive dikes that crosscut all Proterozoic lithologies and appear to be related to be a late phase of the Ladron quartz monzonite.
Yg	**Ladron quartz monzonite** (Mesoproterozoic)— (Condie, 1976; Black, 1964)): Buff to white, well-exposed quartz monzonite, commonly coarse-grained. Foliation is usually absent except in mylonite zones. Some mylonites proximal to the Jeter Fault are parallel to that structure and appear to be related to early extension. The Ladron quartz monzonite is distinguished from the Capirote granite gneiss by its lighter color, lack of easily discernable foliation, and the presence of two micas (biotite and muscovite). Yg clearly intrudes Xcg and all other Proterozoic rocks and is assumed to be Mesoproterozoic based on the similarity in texture and field relationships to 1.4 Ga granites in the region.
Xcg	**Capirote granite gneiss** (Paleoproterozoic) — (Noble, 1950) : Red-brown, highly weathered biotite-bearing granitic gneiss; commonly well-foliated. Grain boundaries are stained by iron oxides. Foliation is variable, but almost always discernable. Discrete mylonite zones are common throughout the gneiss, but mylonite zones proximal to the Jeter Fault are parallel to it and appear to be related to early extension on the fault. Alteration is also common proximal to the footwall of the Jeter fault in the granite and in rocks of any age. Grain size varies from coarse to medium and is typically coarser than the Ladron quartz monzonite. This granite clearly intrudes the supracrustal rocks. The Capirote granite gneiss often contains screens of mostly amphibolite, especially in the low hills on the eastern side of the range. Assumed to be Paleoproterozoic based on the strong foliation and the similarity of field relationships to other 1.6 Ga gneisses in the region.
Xcg_{alt}	**Capirote granite gniess altered to a white chalky appearance** (Paleoproterozoic) — Also used for strongly brecciated Capriote granite gneiss that has been stained yellow, red, or brown by oxides proximal to the Jeter Fault.

Supracrustal Rocks

Mapping and descriptions are largely based on work by Taylor (1986). All supracrustal rocks are presumed to be Paleoproterozoic based on the probable age of the Capirote granite gneiss and similarity to rocks exposed in the nearby Manzano and Sandia mountains.

Xq	**Quartzite —** White, buff, or gray, medium- to fine-grained quartzite; thin pelitic and metaconglomerate interbeds are common (split where mappable). Primary sedimentary structures include cross bedding and tabular bedding. Up to 500 m thick.
Xqp	**Quartzite interbedded with pelitic rocks —** Used where mapping separate interbeds are is practicable.
Xp	**Pelitic rocks —** Brown to gray quartz-muscovite pelitic schist and phyllite, locally porphyroblastic; amphibolite interlayers common. About 95 m thick.
Xma	**Meta-arkose** — (see Taylor, 1986): Pink to buff, coarse- to medium-grained meta arkose often interbedded with metaconglomerate and phyllite. Faint low-angle planar cross bed and tabular bedding are the only primary structures recognized, but primary textures include sub-angular grains and lithic fragments.. Contact with overlying quartzite is gradational. Minimum of 450 m thick.
Xmc	**Meta-conglomerate** — Gray to brown well-foliated and lineated metaconglomerate, with minor quartzite interbeds. Clasts are dominantly felsic volcanic rocks with quartzite, granitoid and minor chert and mafic rocks. Up to 120 m thick.8
Xgp	**Granophyre —** Distinctive massive rock exposed east of Ladron Peak that contains amphibolite screens. Fault bounded on the west and intruded by the Ladron quartz monzonite on the east. Contains partially resorbed sodic plagioclase phenocrysts in a groundmass of micrographic intergrowths of quartz and K-spar. Interpreted as a shallow intrusive related to the siliceous metavolcanic rocks (Condie, 1976).
Xvbf	**Thin layers of buff biotite-rich felsite inter-layered with amphibolite** (Xa) — Probably represents intermediate volcanic rocks interbedded with basaltic lavas.
Xvf	**Pink to white, banded, fine-grained felsite —** May represent rhyolitic lavas or tuffs. Up to 45 m thick
Xmv	**Massive metavolcanic rocks —** Thick package (1800 m) of purplish-brown and brownish-black, folitated, siliceous volcanics: minor black and green amphibolite in thin layers. Primary textures including rock fragments, phenocrysts, and flow banding are common. Texture and composition suggests that the protoliths of this package were largely ash-flow tuffs interbedded with air-fall tuffs, rhyolite, and basaltic lavas. (Condie, 1976).

Xa	**Green to black amphibolite and hornblende schist —** contains biotite-rich felsite interlayers (differentiated as Xvbf where possible). Common as screens within plutonic rocks, particularly low on the east side of the range.

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