Preliminary Geologic Map of the Iron Mountain Quadrangle, Sierra County, New Mexico (Year 1 of 1-Year)

By
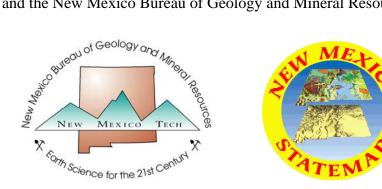
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Scale 1:24,000

PRELIMINARY GEOLOGY OF THE IRON MOUNTAIN QUADRANGLE, SIERRA, SOCORRO, AND CATRON COUNTIES, NEW MEXICO

Cover photo: View of Iron Mountain (left) and Reilly Peak (right), from the south. Iron Mountain is underlain by Paleozoic limestones and sandstones. Reilly Peak is underlain by a rhyolitic intrusion, the Rhyolite of Reilly Peak. Hills in front of the mountains are underlain by Santa Fe Group sediments, mostly derived from the highland in the background, but in part also derived from the Black Range, off photo to the left. Houses belong to the town of Winston, and dark outcrops at bottom of photo are of the andesite of the Winston graben.

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INTRODUCTION

The Iron Mountain quadrangle lay along the east flank of the Black Range and west flank of the northern tip of the Sierra Cuchillo. It includes the geographic features Iron Mountain and Reilly Peak of the northern Sierra Cuchillo, the small mining prospect town of Grafton in the northern Black Range, and Poverty Creek, an axial stream that drains both the northern Black Range and Sierra Cuchillo into Cuchillo Negro Creek, which passes through the Sierra Cuchillo toward the Rio Grande further south. The area is almost exclusively ranching land, split between three large ranches and several much smaller parcels. A thin strip of National Forest Service land lay along the western edge of the quadrangle. Access is provided by NM-52 and several small unimproved dirt ranch roads.

Geologically, the Iron Mountain quadrangle lay along the western flank of the Rio Grande rift, where the rift is superimposed upon the older Mogollon-Datil volcanic field. Tertiary volcanics associated with the volcanic field dominate the Black Range, with large intrusions in the northern Sierra Cuchillo likely form this period as well. The center of the quadrangle, lying along Poverty Creek and its tributaries, is dominated by an extensional basin, the Winston graben, in which gravels derived from the uplifted Sierra Cuchillo and Black Range have accumulated since the late Oligocene (Cikoski and Harrison, in press). This rift basin fill, up to and including the maximum level of aggradation, correlates to the Santa Fe Group of Baldwin (1963; redefined by Hawley et al., 1969). Post-Santa Fe Group alluvium is also present as terrace deposits along current streams.

Much of the geologic history of this area is discussed in detail elsewhere, and the interested reader is referred to Jahns et al. (1978), Harrison (1990, 1994), and Cikoski and Harrison (in press) for more detail. Please note that ^{40}Ar/^{39}Ar ages from McIntosh et al. (1991), used throughout this report, have been scaled upwards by 1.3% to reflect changes to the accepted Fish Canyon Tuff sanidine monitor age, which has increased from 27.84 Ma to 28.201 Ma (Kuiper et al., 2008).

ACKNOWLEDGEMENTS

PALEOZOIC AND MESOZOIC ROCKS

The Sierra Cuchillo is underlain by a nearly complete section of Paleozoic strata (Jahns et al., 1978, 2006). Unfortunately, while this section is apparent under detailed stratigraphic examination (Jahns et al., 1978), the rocks are highly altered by Tertiary intrusive activity and highly faulted by extensional tectonics, such that not all individual units not readily mapped separately (Jahns, 1943). Here, we did not add to the existing mapping of R.H. Jahns, though his stratigraphic data is reproduced here for reference.

The base of the Paleozoic section (Ϲmϴe) consists of several quartz-rich sandstones (38 m of Cambrian Bliss Sandstone and 2 m of Cable Canyon Sandstone of the Ordovician Montoya Formation) with interbedded limestones (54 m of Ordovician El

Paso Limestone, which lay between the two sandstone units; Jahns et al., 1978). Despite heavy alteration, this unit is readily separable from the overlying limestone-dominated units and hence is mapped separately.

Above the basal quartz sandstones lay a very thick section of Paleozoic limestones (Om₽m). In detailed section, these can be divided into 37 m of Montoya Formation, 1 m of Fusselman Formation, 2 m of Oñate Formation, 2.5 m of Percha Formation, 31 m of Lake Valley Formation, 13 m of Kelly Limestone, 53 m of Sandia Formation, and at least 275 m of Madera Limestone (Jahns et al., 1978).

Above the thick section of limestones lay a transitional unit of interbedded limestones and red siltstones, followed by the distinctive red siltstones of the Abo Formation (Pa). The lowermost Abo beds and uppermost transitional beds may correlate to the Bursum Formation, which typically lay between the Abo and Madera Formations, but fossil evidence is inconclusive (Jahns et al., 1978). The transitional interval is 30 m thick, and Abo Formation is 285 m thick.

The Permian Yeso and San Andreas Formations (Pys) were not mapped separately by Jahns (1943) nor here. These units consist of a thick section of limestones, siltstones, and sandstones of varying proportions, with rare gypsiferous siltstone in the lower Yeso Formation (Jahns et al., 1978). The unit has a combined thickness of at least 446 m (Jahns et al., 1978).

A thin section (64 m total) of quartz-rich sandstones, shales, limestones and conglomerates caps the Paleozoic section (Jahns et al., 1978). Jahns et al. tentatively correlated this section to the Dakota Formation, but were uncertain.

EOCENE-OLIGOCENE IGNEOUS ACTIVITY

The northern Black Range is dominated by Eocene to Oligocene volcanic rocks (Harrison, 1990), while the Sierra Cuchillo is intruded and highly altered by two large intrusions that are likely of comparable age (Jahns, 1943; Davis, 1986). The volcanic rocks in the Black Range represent only a fraction of the Eocene to Oligocene units present in the range (cf., Harrison, 1990; Harrison and Cikoski, in prep.), but include some of the oldest and youngest of the section.

The oldest volcanic unit is the Rubio Peak Formation, divisible into a lower debris flow-dominated unit (Trp) which surrounds map-scale exotic blocks of Pennsylvanian limestone (₽me), and is overlain by lavas of various textures (Trpa, Trph, Taba). The general sequence of debris flows under lavas is continuous to the south onto the Winston quadrangle, but individual lava units are not necessarily continuous. Harrison (1989) interpreted the exotic blocks as gravity-slide blocks, possibly derived from the southwest. These blocks can be observed to be surrounded by debris flows both laterally and statigraphically, with drill core and mines both exposing the bottoms of these blocks, confirming that they are not in place Pennsylvanian limestone (Harrison, 1989).

Toward the top of the Rubio Peak Formation is a lithic-rich tuff unit, the tuff of Victoria Tank (Tvt). McIntosh et al. (1991) correlated this unit to the tuff of Luna Park and the tuff of Farr Ranch, but Harrison (1990) disagrees, contending it is more likely a local unit. Age data does not exist for this tuff, inhibiting accurate correlation. This unit does not extend to the south onto the Winston quadrangle.

Overlying the tuff of Victoria Tank is an interbedded sequence of Cliff Canyon Sandstone (Tcc) and tuff of Rocque Ramos Canyon (Trrc). The former is a sequence of

arkosic to quartzose sandstones with rare siltstones and a basal conglomerate. Lucas (1986) recovered mammal fossils from the unit, which he interpreted to be of early Chadronian age (~36 Ma). The later is a regional moderately crystal-rich ash-flow tuff, correlated to the Bell Top 4 tuff by $^{40}Ar/^{40}Ar$ and paleomagnetic data (McIntosh et al., 1991), either sourced from the Emory caldera (Harrison, 1990) or from the northern Cedar Hills (Clemons, 1975). The tuff has an average $^{40}Ar/^{39}Ar$ age of 35.41±0.08 Ma (McIntosh et al., 1991). Both units continue to the south onto the Winston quadrangle, where the tuff exclusively overlies the sandstone and the units do not interbed (Harrison and Cikoski, in prep.).

Overlying the Cliff Canyon Sandstone and tuff of Rocque Ramos Canyon is the Kneeling Nun Tuff (Tkn), a regionally-extensive crystal-rich ignimbrite that erupted from the Emory caldera at 35.34±0.10 Ma, based on single-crystal $^{40}Ar/^{39}Ar$ ages (McIntosh et al., 1991). This tuff forms a regional stratigraphic marker, present in much of the Mogollon-Datil volcanic field.

Following the Kneeling Nun Tuff and associated lavas, the later of which are not present on this quadrangle, there followed a regional hiatus in volcanism (Harrison, 1990), which Cather et al. (1994) used to divide the older Datil Group from the younger Mogollon Group. During this time, Harrison (1990) suggested the area was a stable volcanic plateau, onto which the basaltic andesite of Poverty Creek (Tpc) erupted. This basaltic andesite is the local expression of the SCORBA suite of Cameron et al. (1989), an extensive suite of basaltic andesites that buried much of western New Mexico in the late Oligocene, and is interpreted by some workers to reflect the initiation of extensional tectonics (Cameron et al., 1989; Harrison, 1990). Two K-Ar ages exist for the basaltic andesite of Poverty Creek from the northern Black Range, one at 28.3 ±0.6 Ma (Woodard, 1982) and another at 28.8±0.6 Ma from Chapin (pers. comm., cited in Harrison, 1990). However, on the Winston quadrangle, the andesite is overlain by the 29.39±0.20 Ma tuff of Little Mineral Creek ($^{40}Ar/^{39}Ar$ age from McIntosh et al., 1991; map data from Harrison and Cikoski, in prep.), indicating the andesite is at least some places as old as about 30 Ma.

The basaltic andesite is overlain on the Iron Mountain quadrangle by the rhyolite of Sawmill Peak, a sequence of thick, moderately crystal-rich flows bearing conspicuously large (0.7 to 1.5 cm across) sanidine phenocrysts. The rhyolite has not been dated, but is bracketed by the 29.47±0.22 Ma tuff of Mud Hole and the 29.23±0.08 Ma La Jencia Tuff (both ages are single-crystal $^{40}Ar/^{39}Ar$ ages from McIntosh et al., 1991), tightly constraining the age of the rhyolite to ~29.3 Ma.

In fault contact with this sequence is a narrow fault sliver of the 28.93±0.14 Ma Vicks Peak Tuff, a regional pale brown ignimbrite with conspicuously large pumice often bearing crystalline rims resulting from vapor-phase crystallization (Harrison, 1990; $^{40}Ar/^{39}Ar$ age from McIntosh et al., 1991). To the south on the Winston quadrangle, the Vicks Peak Tuff lay upon the older volcanic strata with slight angular unconformity, which Cikoski and Harrison (in press) interpreted to record initial development of the Winston graben. Unfortunately, the base of the tuff is not exposed on this quadrangle.

Not yet radiometrically dated, but certain from this same period of igneous activity, are two large intrusive masses in the Sierra Cuchillo. At the surface, the larger is the white to light gray, fine-grained and commonly spherulitic rhyolite of Reilly Peak (Jahns, 1943; Davis, 1986). Several rhyolitic dikes around the Peak are possibly

extensions of this body. The smaller is a light gray to tan quartz-orthoclase-biotite granite here informally called the granite of Iron Mountain. This stock is associated with abundant tactite mineralization found in the northern Sierra Cuchillo (Jahns, 1943, 1945), and is likely a source of rhyolite porphyry dikes in the area.

SANTA FE GROUP

The Santa Fe Group of the Winston graben is discussed in detail by Cikoski and Harrison (in press) and Koning (in press). On the Iron Mountain quadrangle, only their upper Santa Fe Group unit (Tsfu) is present. The age of the unit is constrained by the underlying 18.3±0.4 Ma andesite of the Winston graben (K-Ar age from Seager et al., 1984) and overlying 4.5-5.0 Ma basalt of Tabletop Mountain (age range from ^{40}Ar/^{39}Ar ages of McLemore et al., in press), which are exposed on the Winston and Chise quadrangles (Jahns et al., 2006; Harrison and Cikoski, in prep.). In addition, Jahns (1955) reported collecting Quaternary invertebrate fauna from this unit on this quadrangle, but this is not in agreement with the radiometric age range, and in fact the outcrop from which he collected the strata includes both Santa Fe Group and post-Santa Fe Group alluvium, so the accuracy of this age constraint is uncertain. We choose to accept the radiometric ages as the bounds for the upper Santa Fe Group.

The upper Santa Fe Group here is composed of two distinct facies, a western piedmont derived from the Black Range and an eastern piedmont derived from the Sierra Cuchillo. Unfortunately, access was not granted to the northern and southern portions of the quadrangle during the period field work was conducted, and hence the contact is only well located in the center of the map. In addition, a complete lack of subsurface data inhibits understanding the true extent of either unit. Because of these restrictions, the two facies are not mapped separately here. The contact at the surface, where well constrained, appears to lie along the Deep Well fault.

The western piedmont (Figure 1) consists of poorly cemented gravels and sandy gravels of almost exclusively volcanic composition, dominantly andesitic, with sparse limestone, most likely from the exotic blocks of Pennsylvanian limestone found in the Rubio Peak Formation. Beds are generally either planar bedded, matrix-poor, largely uncemented fine pebbles and sands, or cross-bedded and channel-shaped, silty sand-matrix-rich fine pebbles to cobbles. These two deposit types may represent deposition by sheetflood and channelized processes, respectively. Along the section that was examined in detail, the channel deposits increase in abundance to the east, but it is unknown if this occurs throughout the quadrangle. Beds have gentle (<10°) eastward dips that decrease to the east, which suggests the attitudes are primary and not structural.

The eastern piedmont (Figure 2), in contrast, consists of generally matrix-rich, massive pebble to cobble deposits. Gravel compositions are still dominantly andesitic, but with abundant limestone and rhyolite porphyry, and rare granitic clasts and red siltstones that are not found in the western piedmont on the Iron Mountain quadrangle. White $CaCO_3$ cement, most likely reworked from the common limestone clasts, is locally common. To the west, down paleoflow direction, gravel sizes generally fine and channels of coarser material can be distinguished. Beds typically dip shallowly (<10°) to the west, descreasing in dip magnitude to the west, again suggesting the dips are primary in nature.

Local southward drainage found along the contact between the two facies suggests that the two met at a south-flowing axial drainage, similar to today.

Figure 1 - Upper Santa Fe Group, derived from the Black Range. Note the relative lack of matrix material, and only local lightening of the gravels by carbonate accumulation. Upper part is moderately bioturbated by Holocene biota.

Figure 2 - Upper Santa Fe Group derived from the Sierra Cuchillo. Note abundance of matrix material and light color, possibly from the presence of carbonate in the matrix. Photo is looking south, and beds dip slightly to the west.

Exploration drilling in Sections 3 and 10, T10S R8W, penetrated as much as 660 m of Santa Fe Group gravels (P. Willard, pers. comm., cited in Harrison, 1990), giving a minimum thickness for the Santa Fe Group on this quadrangle.

POST-SANTA FE GROUP ALLUVIUM

To the south, on the Winston quadrangle, the upper Santa Fe Group is capped by a Pliocene pediment deposit, locally capped on the Chise quadrangle by the basalt of Tabletop Mountain (Harrison and Cikoski, in prep.; Jahns et al., 2006). This unit has not been recognized on the Iron Mountain quadrangle. It is likely that the Iron Mountain basin fill was also beveled during this same time period, however, as the highest surface capping the basin fill on this quadrangle appears to be correlative to the pediment described by Koning (in press) for the area to the north. Pediment gravels, if present, are simply too similar to the underlying Santa Fe Group deposits to be distinguishable.

Three ages of pre-historic alluvium are recognized on the Iron Mountain quadrangle (Qao3, Qao2, Qao1, in order of increasing age). These units are distinguished from the underlying Santa Fe Group by morphology and surface color, in that the terrace alluvium is typically capped by a planar tread with a noticeably redder surface color on aerial imagery. The units are distinguished from each other based on the relative heights of the treads capping each unit. Exposure of these deposits is very rare, but suggests that at least the older two have Stage III or greater carbonate horizons. Qao2 is by far the most prevalent post-Santa Fe Group unit, and this observation was used to correlate deposits from along Poverty Creek to those along Wildhorse Canyon. Most post-Santa Fe group deposits are very thin, less than 3 m thick, though locally Qao2 and Qao1 form up to 8 m thick fill deposits.

STRUCTURE

Faults and folds associated with Laramide compression and Rio Grande rift extension are present on the quadrangle. Harrison attributed north-northeast-striking dextral strike-slip faults in the Black Range to Laramide compressional tectonics. The folding of the Paleozoic system in the Sierra Cuchillo may also be a product of Laramide compression, though the ancestral Rocky Mountain orogeny may have also contributed to folding. Compressional deformation affects rocks as young as the Eocene Rubio Peak Formation. Harrison (1989) used some of the larger exotic blocks of limestone in the Black Range to determine that at least 3140 m of dextral offset has occurred along the strike-slip faults.

Normal faults associated with Rio Grande rift extension offset all units but the inset post-Santa Fe Group alluvial deposits. Two of the largest faults bound the Winston graben, though their exact amounts of offset is unknown. Normal faults dominantly strike north-northwest to northeast, with both eastward and westward dips. Rake angles of lineations are typically steeper than 74°, indicating dominantly dip-slip with minor strike-slip components.

Exposure of faults in the Santa Fe Group is very rare, but locally small offset normal faults (<0.5 m of offset) are found in outcrop (Figure 3), and some continuous scarps are here interpreted to be fault-controlled. The Red Paint Canyon fault of McLemore (2010), which bounds the west flank of the Sierra Cuchillo on the Montoya Butte quadrangle to the northeast, is projected onto this quadrangle and is interpreted to cross under the Santa Fe Group in the Havil embayment to bound the Sierra Cuchillo on the Iron Mountain quadrangle at the north end. From here, the Red Paint Canyon fault may extend further southwest into the basin fill, or may merge with the fault that bounds the west flank of the Sierra Cuchillo.

No deformation is apparent in the post-Santa Fe Group alluvium, and the Winston graben appears to have been tectonically inactive since the Pliocene (Cikoski and Harrison, in press; Koning, in press;).

Figure 3 - Small faults are locally found in outcrop. Fault is just right of hammer, dipping to the right.

UNIT DESCRIPTIONS

Quaternary

af   **Artificial fill** - Compacted sand, silt, and gravel, mainly of earthen dams. 0-2 m thick.

Qca   **Colluvium and alluvium, undivided** - Gravel, sand, and silt burying geologic features in the interior of the Black Range. Includes gravity-, slopewash-, and minor channel-transported material. 0-2 m thick.

Qsa   **Slopewash alluvium** - Silt and lesser sand forming low-gradient aprons that conceal underlying geologic features. Includes small fine-grained fans and slopewash and minor gully-transported material. 0-1 m thick.

Qah   **Historic alluvium** (0-500 years BP) - Gravel, sand, and silt associated with historic flows of active channels. Includes low terraces up to 1 m above the channel floor, with no soil development. 0-2 m thick.

Qagf   **Gully-mouth fans** - Gravel, sand, and silt associated with current gully-mouth fans. Locates the ends of active gullies and arroyos. No soil development. 0-1 m thick.

Qay **Younger alluvium** - Interbedded pebbly silty sands and pebbly channels, with weak soil development. Gravels are poorly sorted and angular to subrounded, with rare cobbles, with matrix material of medium to coarse sand. Pebbly silty fine sands are massive (bioturbated). Weak buried soils are common, and distinguished by darkened A horizons. Carbonate horizon development up to Stage I+ in active and buried soils. Colors of 10YR 4/2 to 6/3 common, locally 7.5YR hues. Underlies terrace treads up to 3 m above local channels. 0-4? m thick.

Qayh **Younger and historic alluvium, undivided** - Combination of Historic and Holocene material. See individual descriptions for more detail.

Qao3 **Older alluvium, youngest subunit** - Very poorly exposed gravels underlying terrace treads inset upon treads of Qao2. Surfaces dominated by pebbles, with rare carbonate coats. Tread heights are 3-10 m above local channel floors, decreasing upstream. 0-2 m thick.

Qao2 **Older alluvium, intermediate subunit** - Pebbles and cobbles with well developed soils underlying terrace treads 6 to 25 m above local channels. Tread height increases downstream from mountain fronts. Dominantly medium pebbles, with a few percent cobbles, of poorly sorted angular to subrounded clasts. Carbonate horizon development up to Stage III, with local small clay films on gravels above the carbonate horizon. Rare buried soils with carbonate development up to Stage II. Colors as red as 5YR 5/4, typically 7.5YR 7/2 to 7/3. 3 to 8 m thick.

Qao1 **Older alluvium, oldest subunit** - Poorly exposed gravels underlying terrace treads inset upon by those of Qao2. Pebbles and cobbles underlying treads 25 to 40 m above local channels, decreasing upstream. 0 to 8? m thick.

Qao **Older alluvium, undivided** - Used where specific unit correlation is not clear or feasible. 0-3 m thick.

Tertiary
Santa Fe Group

Tsfu **Upper Santa Fe Group** - Pebbles to cobbles and silty sands filling the Winston graben. Distinctly different eastern and western sediments, controlled by the lithologic differences between the Black Range and Sierra Cuchillo. Western gravels are volcaniclastic, matrix-poor, and in thin to medium cross-bedded channels or thin planar bedded sheets. Generally poorly cemented, but with local carbonate accumulations up to Stage III as buried soils. Gravels are mainly andesite porphyries, with lesser rhyolites, aphyric lavas, and sparse limestone. Eastern gravels contain far more matrix material and cement, as well as more abundant limestone, felsic phaneritic and porphyritic rocks, and red siltstones. Gravel beds are typically massive, though locally occur as channels in dominantly fine-grained outcrops. At the surface, the eastern and western facies meet at the Deep Well fault, a continuous scarp that may be an erosional feature. Local southward pebble imbrications along this trend suggest a southward axial drainage. Thickness of

at least 660 m based on exploration drilling in T10S R8W Sections 3 and 10 (Harrison, 1990).

Mogollon Group

Tvp **Vicks Peak Tuff** - Light gray to light brown, massive, moderately to densely welded, crystal-poor ash-flow tuff. Phenocrysts of sanidine (1-3%) and sparse quartz. Bears conspicuous large, elongate pumices, most of which bear a granular texture from vapor-phase mineralization and recrystallization.

Tsp **Rhyolite of Sawmill Peak** - Dark red-brown porphyritic alkali rhyolite lavas. 10% phenocrysts of large sanidine up to 1.5 cm across. Trace biotite and quartz. Includes local, discontinuous pyroclastic rocks.

Tpc **Basaltic andesite of Poverty Creek** - Gray to dark gray, aphanitic to sparsely porphyritic basaltic andesites. As much as 10% phenocrysts of plagioclase, pyroxene, and rare biotite, generally under 1 mm across. Belongs to the widespread SCORBA suite of Cameron et al. (1989). Includes rare interbedded volcaniclastic rocks.

Datil Group

Tkn **Kneeling Nun Tuff** - Light gray to gray to tan to pink, poorly to moderately welded, crystal-rich ash-flow tuff. 20-45% phenocrysts of quartz, sanidine, plagioclase, and biotite. Normally zoned, with more abudant quartz and sanidine at the base, and more abundant biotite toward the top. Erupted form the Emory caldera, SSW of the quadrangle.

Tcc **Cliff Canyon Sandstone** - Purplish to white, fine-grained and well-sorted arkosic to quartzose volcaniclastic sandstones. Grains are typically subrounded to rounded and of quartz, sanidine, plagioclase, and minor biotite. Includes purple to blue-gray siltstones, and a basal conglomerate. Poorly consolidated and exposed.

Trrc **Tuff of Rocque Ramos Canyon** - Moderately to poorly welded, moderately crystal-rich ash-flow tuff. 10-20% phenocrysts of subequal sanidine and plagioclase, and 1-2% biotite. Common small (1.5-2 cm across) devitrified pumice. Rare andesitic lithic fragments. Correlated to the Bell Top 4 tuff by Ar/Ar age and paleomagnetic data (McIntosh et al., 1991).

Tvt **Tuff of Victoria Tank** - Moderately to densely welded, lithic-rich, pumice-rich, crystal-poor ash-flow tuff. Up to 10% phenocrysts of plagioclase, sanidine, and biotite. 20-40% subangular lithic fragments of red and gray-black aphaneitic lavas, up to 6 cm across. May correlate to the tuff of Luna Park and the tuff of Farr Ranch (McIntosh et al., 1991), or may be a local unit (Harrison, 1990). As much as 100 m thick.

Trpa **Rubio Peak Formation, andesitic lavas** - Plagioclase $\pm$ horneblende $\pm$ pyroxene andesitic porphyry lavas. Multiple flows overlying the debris flows of the lower Rubio Peak Fm.

Trph **Rubio Peak Formation, hornblende phyric lavas -** Plagioclase + horneblende $\pm$ pyroxene andesitic porphyry lavas. Multiple flows overlying debris flows of the lower Rubio Peak Fm.

Taba   **Basaltic andesites, undivided** - Dark, aphanitic, intermediate lavas. Multiple flows overlying the debris flows of the lower Rubio Peak Fm. Uncertain correlation on this quadrangle, but likely a part of the upper Rubio Peak Fm.

Trp   **Rubio Peak Formation, debris flow-dominated unit** - Lower, volcaniclastic-dominated Rubio Peak Fm. Dominantly massive, heterolithic, matrix-supported debris flow deposits, with pebbles to boulders of aphanitic and porphyritic intermediate volcanic rocks. Interbeds with sandstones to the south. Surrounds landslide blocks of limestone (ℙme).

ℙme   **Exotic blocks of Madera Limestone** - Exotic blocks of Pennsylvanian limestone surrounded by debris-flows of the lower Rubio Peak Fm.

Pre-volcanic

Ku   **Cretaceous, undivided** - Interbedded quartzose sandstone, shale, limestone, and local conglomerate. Measured thickness of 64 m (Jahns et al., 1978).

Pys   **Yeso and San Andreas Formations** - Interbedded variegated yellowish, greenish, and reddish sandstone and siltstone, and medium to dark gray fossiliferous limestone. Measured thicknesses of 233 m for the Yeso, at least 213 m for the San Andreas (Jahns et al., 1978).

Pa   **Abo Formation** - Red, maroon, and yellowish to reddish brown siltstones, mudstones, and sandstones, with thin interbeds of fossiliferous gray silty limestone in the lower 30 m ("transition beds" of Jahns et al., 1978). Measured thicknesses of 315 m by Jahns et al. (1978).

Omℙm   **Paleozoic limestones, undivided** – Interbedded light to medium gray limestones and medium to dark gray siltstones. Commonly highly altered and faulted. Dominantly Madera Limestone, with a set of much thinner older units apparent in measured section. Includes 37 m of Montoya Formation, 1 m of Fusselman Formation, 2 m of Onate Formation, 2.5 m of Percha Formation, 31 m of Lake Valley Formation, 13 m of Kelly Limestone, 53 m of Sandia Formation, and at least 275 m of Madera Limestone (Jahns et al., 1978).

€mOe   **Paleozoic quartzose sandstones** - Interbedded light gray to dark brownish gray pebbly quartz-rich sandstones and light to medium gray limestones, with a basal section of oolitic hematite. Composite of several thin, commonly highly altered units, separable in measured section. Includes 38 m of Bliss Sandstone, 54 m of El Paso Limestone, 2 m of Cable Canyon Sandstone (Jahns et al., 1978).

p€   **Precambrian, undivided** – Cross-section only. Medium- to coarse-grained amphibolite and fine-grained to porphyritic meta-rhyolite where exposed further south on the Chise quadrangle.

Intrusive rocks

Tgim   **Granite of Iron Mountain** - Light gray to tan, fine-grained phaneritic quartz-orthoclase-biotite granitic stock. Even-grained, intergrown quartz and feldspar, subordinate biotite. Coarsest at north end, with crystals just over 1 mm across.

Trrp   **Rhyolite of Reilly Peak** - White to gray, fine-grained high silica rhyolite stock. Davis (1986) described thin sections with spherulitc to trachytic textures, with plagioclase as the main microphenocryst and accessory biotite, titanite, epidote, muscovite, hematite, amphibole, apatite, and magnetite.

Tir   **Rhyolitic dikes** - Dark gray to greenish-gray, largely aphanitic dikes. Sparse, fine quartz phenocrysts.

Tirp   **Rhyolite porphyry dikes** - Dark gray to greenish-gray, weathering pink and reddish-brown, quartz±orthoclase porphyries. Thicker dikes are coarser and contain more phenocrysts.

Tia   **Andesitic dikes** - Dark green to dark gray to black, aphanitic to porphyritic, intermediate dikes. Phenocrysts of plagioclase and horneblende.

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