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NMBGMR Open-file Map Series
OFGM 120
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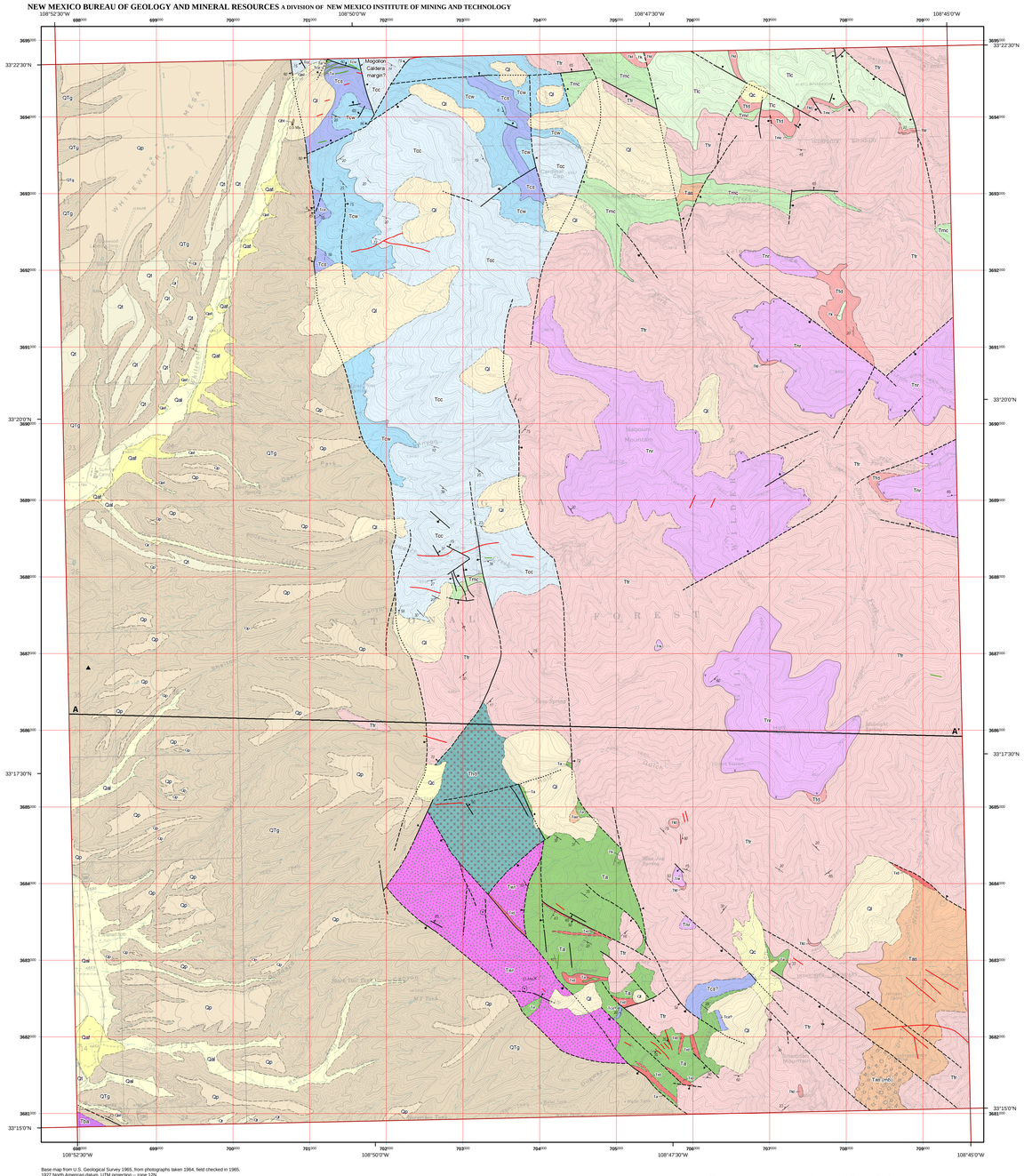
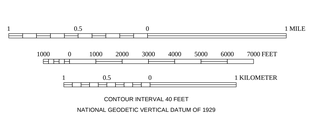


Base map from U.S. Geological Survey 1965, from photographs taken 1964, field checked in 1965.
1927 North American datum. UTM projection – zone 12N
1000-meter Universal Transverse Mercator grid, zone 12, shown in red

QUADRANGLE LOCATION



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DRAFT

Geologic map of the Holt Mountain quadrangle, Catron County, New Mexico.

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by
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Description of Map Units

Qal **Valley alluvium (Holocene)** - Stratified silt, sand, gravel, and boulders along Whitewater Creek and major tributaries, and tributaries to the San Francisco River in the southeast corner of the quadrangle; a few meters thick.

Qaf **Alluvial fan deposits (Holocene)** - Stratified silt, sand, gravel and boulders at the mouth of major, and some minor tributaries of Whitewater Creek; as much as several meters thick.

Qc **Colluvium (Holocene)** - Coarse talus and unsorted gravel deposits that mantle bedrock on steep slopes and some valley interfluves; variable thickness.

Qp **Piedmont slope deposits (Holocene(?)and Pleistocene)** - Gravel deposits that cap low-dipping pediment surfaces on Gila conglomerate along the Mogollon Mountains front. The subhorizontal surface of Whitewater Mesa may be best described as a conformable surface on Gila conglomerate covered by a thin accumulation of weathered eluvium.

Ql **Landslide deposits (Holocene? and Pleistocene)** - Extensive areas of slumped and rotated bedrock along the west-facing slopes of the Mogollon Range, and north and south facing slopes of the east-west trending canyon of Whitewater Creek.

Qt **Stream terrace deposits (Pleistocene)** - Mapped from air photos; a lower terrace about 65 meters above Whitewater Creek and an older terrace about 80 higher; thickness uncertain.

Qbt **Bishop Tuff (?) (Pleistocene)** - A single outcropping of light gray, glassy tuff is present east of Whitewater Creek about 1/4 mile (0.4 km) south of the creek crossing below the Whitewater Picnic Ground (shown as a campground, now abandoned!, on map) (Brenda B. Houser, U.S.Geological Survey, personal commun.,1984). The glassy, bubble-wall, tuff is 3-5 meters thick, and has been tentatively identified by argon/argon radiometric age of 0.84 +/- 0.12 Ma and trace element chemistry (William McIntosh and Nelia Dunbar, respectively; New Mexico Bureau of Geology and Mineral Resources, personal communication, (1994)) as Bishop Tuff from the Long Valley caldera near Mammoth California. The thickness of the tuff , this far from its source, is maybe best explained as a reworked deposit from a more widespread and much thinner original air-fall deposit that was inset in valley alluvium of Whitewater Creek, though its purity is remarkable in that case. The deposit lies about 100 feet above the Catwalk road, where it has been excavated by shallow pits for unknown purposes.

QTg **Gila Group, undivided (Pleistocene to Miocene)** - Volcaniclastic sedimentary rocks, informally referred to as "Gila conglomerate" west of the Rio Grande; comparable to the Santa Fe Group east of the Rio Grande. Consists mainly of coalescing alluvial fans at the west facing front of the Mogollon Mountains. Equivalent rocks in the adjoining Alma quadrangle, to the northwest, have been subdivided into bedded sequences, and described in detail (Houser, 1987). Maximum thickness in the Holt Mountain quadrangle about 1500 feet.

Tlc **Last Chance Andesite (Oligocene)** - Thick sequence of gray to reddish gray andesite lava flows and flow breccia; named originally for exposures in the Mogollon quadrangle to the north. Last Chance flows are part of the moat-fill sequence around the resurgent dome of the Bursum caldera, which probably accounts for their thickness. They seem to be more dike- related in contrast to the many small to moderate sized shield volcanoes that characterize the Bearwallow Mountain Andesite of similar age that are distributed throughout much of the Mogollon-Datil volcanic field. Maximum thickness of the Last Chance is about 500 feet.

Tbo **Bearwallow Mountain Andesite (Oligocene)** - Patches of andesite rubble representing remnants of andesite lava flows overlie rhyolite of Nabours Mountain along the crest of the Mogollon Range between Nabours Mountain and Holt Mountain. Probably correlates with Last Chance Andesite of the Mogollon Quadrangle (Ratté, 1981). Also present in southwest corner of quadrangle where it is probably derived from the Black Mountain or Sundial Mountain eruptive centers to the south.

Tnv **Nabours Mountain Rhyolite (Oligocene)** - Light-gray, reddish gray, and dark-gray lava flows of porphyritic rhyolite along the ring fracture zone of the Bursum caldera between Nabours Mountain and Holt Mountain contain about 10 percent small phenocrysts, mainly plagioclase, biotite, hornblende and minor sanidine and rare quartz. Black obsidian vitrophyre a few meters thick locally separates these flows from underlying Fanney Rhyolite along the Whitewater trail at the west end of Nabours Mountain. Elsewhere, as along the Holt Mountain pack trail, a zone of distinctive reddish-brown agglutinate a few meters thick is present at the base of the Nabours Mountain flows. Maximum thickness of flows about 1000 feet.

Tsl **Deadwood Gulch pyroclastic member of Fanney Rhyolite (Oligocene)** - Bedded pyroclastic fall deposits unconformably overlie Fanney Rhyolite lavas north of the main fork Whitewater Creek, where erosional remnants of Mineral Creek Andesite locally separates the two. The fall deposits are overlain by Last Chance Andesite north of Whitewater Creek Elsewhere the pyroclastic rocks locally separate Fanney Rhyolite and overlying Nabours Mountain Rhyolite as at the southeast corner of Holt Mountain and north of South Fork of Whitewater Creek. Similar rocks along the crest of Skeleton Ridge are capped locally by Last Chance Andesite, and seem to underlie Nabours Mountain Rhyolite toward the west end of Skeleton Ridge, but there is some uncertainty about the contact relations there, and there is a possibility that the pyroclastic breccias on Skeleton Ridge could be related to a post-Nabours Mountain Rhyolite dacitic eruptive center to the east at Grouse Mountain in the Grouse mountain quadrangle. North of Whitewater Creek, the pyroclastic beds range between 0 and 400 feet thick; south of South Fork Whitewater Creek 0 to 200 feet, and on Skeleton Ridge about 300 feet.

Tnd **Fanney Rhyolite dikes (Oligocene)** - Large and small dikes radiate off the Fanney Rhyolite domes, particularly between Wilcox Peak and Sheridan Mountain and across Big Dry and North Fork of Big Dry, where dikes also cut megabreccias of Apache Spring Tuff; see photos.

Tfr **Fanney Rhyolite (Oligocene)** - Light-gray to reddish-gray, flow-banded, rhyolite flows and intrusive-extrusive domes that define the broad, 3-4 mile wide, ring-fracture zone of the Bursum caldera. Typically aphanitic(fine-grained) flows contain less than 1 percent tiny (1 mm or smaller) phenocrysts, mainly plagioclase and quartz, with minor sanidine and biotite, in a sperulitic matrix. More coarsely porphyritic facies are widespread, particularly south of Little Whitewater Creek, but have not been amenable to mapping separately at the map scale, and seem to be mixed with the aphanitic flows without consistent age relationships. The more porphyritic flows contain about 5 to 15 percent feldspar, quartz, and black biotite in an aphanitic to spherulitic matrix. Apparent maximum thickness on the south side of Holt Mountain about 2200 feet.

Tmc **Mineral Creek Andesite (Oligocene)** - Reddish-brown to dark-gray lava flows and flow breccia; ranges from very fine-grained to porphyritic; locally is coarsely porphyritic with a distinctive "turkey track" texture of plagioclase laths commonly 1 to 2 cm long, with or without small pyroxene phenocrysts. Crops out mainly in canyons along Whitewater Creek and South Fork of same; also south side of Little Whitewater Creek, opposite Huckleberry flourspar mine, and from Holt Gulch to Sheridan Gulch; interpreted as representing moat deposits of the Bursum caldera formed by volcanic activity that preceded and accompanied resurgent uplift within the caldera. Bedded volcaniclastic rocks, interlayered locally with the Mineral Creek andesite lava flows in Little Whitewater Creek, and south from Holt Gulch to Goat Canyon, are partly, at least, of pyroclastic origin like the fall-out deposits described interlayered in the Cooney Canyon Member of the Cooney Tuff, as indicated by the presence of at least one light-colored, 1-2 cm thick ash bed in Goat Canyon. Maximum thickness, in Goat canyon about 1200 feet.

Tas **Apache Spring Tuff (Oligocene)** - Rhyolite ash-flow tuff (ignimbrite); intracaldera fill of Bursum caldera; exposed only in the canyon of Whitewater Creek, about two miles above the junction with the South Fork, and along Big Dry Creek and its North Fork in the southeast corner of the quadrangle. Typical Apache Spring Tuff in Whitewater Creek is dark purplish-gray to reddish-gray densely welded tuff that contains as much as 50 percent phenocrysts (1 mm to 5 mm), including rounded, commonly partly resorbed quartz, blocky feldspar (sanidine and oligoclase-andesine), black biotite, opaque oxides (magnetite-ilmenite), and honey- yellow sphene in a streaky (eutaxitic) matrix of devitrified glassy shards and pumice. In Dry Creek, Apache Spring Tuff consists mainly of meso- and mega-breccia, mb, of older rocks (mainly andesitic and silicic lava flows) from the Bursum caldera wall, in a light- to dark- gray Apache Spring Tuff matrix. Maximum exposed thickness, about 1200 feet.

Ta **Andesite lava flows and interlayered volcaniclastic sandstone beds (Eocene and/or Oligocene)** - Andesite flows are commonly porphyritic with plagioclase and pyroxene phenocrysts. Sandstone beds are subordinate and mainly on the ridge NNW of Chipmunk Spring at about 6600 feet elevation and south side of Little Whitewater Creek. Thickness of unit varies from about 200 feet (65 m) on the south side of Little Whitewater Creek to about 1400 feet (450 m) along Goat Corral Canyon. Correlation and stratigraphic position are uncertain. Some rocks mapped as Ta may be correlative to Mineral Creek Andesite or with mafic lava flows interlayered with South Fork Member of the Cooney Tuff.

Cooney Tuff (lowermost Oligocene and/or uppermost Eocene) - Ferguson (1927) described Whitewater Creek Rhyolite and Cooney quartz latite as lava flows and tuff beds in the Mogollon mining district. Since then these units have been recognized as members of a thick, cauldron-related, ash-flow tuff (ignimbrite) sequence. A third, recently recognized lower member, (Ratté and others, 2004) is included below. Total thickness of Cooney Tuff, about 800 to 1000 meters. Source for the ~ 34 Ma Cooney Tuff (McIntosh, 199-) is believed to be the Mogollon caldera, most of which was destroyed by subsequent subsidence of younger calderas in the Mogollon Range caldera complex. However a fragment of the structural wall of the Mogollon caldera is believed to be present east of lower Whitewater Canyon in the northwest corner of the Holt Mountain quadrangle (Ratté and others, 2004) (photo and detailed map).

Tcc **Cooney Canyon Member** - Multiple, multi-colored, ash-flow tuff cooling units, a few tens of meters to 100 to 200 meters thick. Individual units generally thicker toward top of member. Tuff units vary from densely-welded to poorly welded, and typically contain 10 to 30 percent small(1-3 mm) phenocrysts (crystals) of sodic plagioclase, black to bronze colored biotite, and opaque oxide. Lithic fragments are common and vary in abundance from unit to unit, with dimensions generally a few cm or less. Lower half of member is characterized by at least 5 discontinuous, dark-colored, bedded, volcaniclastic sandstone and conglomerate layers, 0-10 meters thick. These consist mainly of mafic lithic fragments and feldspar crystals, but locally contain pumice fragments, as much as several cm long, in a matrix of crystals and fine pumice. Altered glass shards, in which delicately thin, unbroken bubble walls are present(see photo), indicate lack of appreciable surface transport, as by running water. These volcaniclastic layers are interpreted as fall deposits from minor plinian eruptions that punctuated the more massive ignimbrite accumulations. Base of member is arbitrarily defined as the occurrence of the first of the dark, volcaniclastic sandstone layers above the underlying ignimbrites of the Whitewater Creek Member. Total thickness of member about 500 meters.

Tcw **Whitewater Creek Member** - A single, simple cooling unit of gray to reddish-gray, densely-welded tuff that grades upward to light-gray, partially welded tuff at top. Member generally has less than 1 percent tiny quartz and feldspar phenocrysts and a few small lithic fragments, but some lithics up to a few tens of cm. Lower part of member is silicified, lithophysal (stone bubbles), zone of densely welded tuff, in which the streaky (eutaxitic) structure approaches rheomorphic (secondary) flow, after initial deposition as a pyroclastic flow. Lithophysal zone grades upward into a columnar-jointed zone that in turn grades into a planar, foliated zone. These zones help to identify the Whitewater Creek Member elsewhere, but are best delineated along the lower end of the Catwalk National Recreation Trail, in the northwest corner of the Holt Mountain quadrangle and southeast corner of the Mogollon quadrangle to the north (Rattè, 1981). Total thickness of member, 150 to 200 meters.

Tcs **South Fork Member** - Includes at least 5, partially- to densely -welded, ash-flow tuff (ignimbrite) cooling units from about 10 to 200 meters thick. Tuffs vary in color and phenocryst content similar to those in Cooney Canyon Member. Tuffs are separated by 5 mafic lava flow sequences, 10 to 65 meters thick. The South Fork Member is recognized only at and below the junction of the South Fork of Whitewater creek and along the Mogollon Range front from the mouth of Whitewater Canyon. Total thickness of lower Member is 400-500 meters; (ignimbrites 300-400 meters; mafic lava flows 100-150 meters).

Tbr **Rhyolite of Wilcox Peak (Eocene)** - Fine-grained rhyolite intrusive center in south-central part of quadrangle. Includes numerous rhyolite to dacitic dikes and small plutons that intrude the dacite of Holt Gulch and other highly altered rocks. Intrusive rhyolite and intruded rocks are widely altered to advanced argillic stage. Alteration minerals include alunite and dickite. Isotopic analysis of alunite indicates an alteration age of 33 Ma (Marvin and others, 1987, p.36, analysis no. 53). Exploration for molybdenum and precious metals in late 70's was curtailed by worldwide glut of molybdenum, but mineral resource potential remains.

Tnd **Dacite of Holt Gulch (Eocene?)** - Gray to greenish-gray, fine-grained, granitic textured intrusion, or extrusive-intrusive dome; contains sparse hornblende needles and small plagioclase phenocrysts; extensive propylitic alteration; locally cut by thin apilitic veinlets and somewhat larger apilitic dikes, which may be amenable to dating. Dacite forms an isolated elliptical body, about 2-3 square kilometers, as exposed across Holt Gulch. Associated quartz veins, in and adjacent to Holt Gulch have been prospected for base and precious metals (Ratté and others, 1979).

Geology Notes

The Holt Mountain quadrangle is critical to the interpretation of the volcanic history of the Mogollon Mountains caldera complex. It contains the most complete exposures of the Cooney Tuff, the oldest of the major caldera-forming ignimbrite sequences in the Mogollon Range at ~34 Ma. The Cooney Tuff consists of three mappable ash-flow tuff members that have an aggregate thickness on the order of 1000 meters, indicative of a volume sufficient to require major caldera-forming eruptions in Late Eocene time. These partially to densely welded ignimbrites are exposed intermittently along the approximately 30 mile (50km) southwestern front of the Mogollon Range, from the Mogollon mining district, north of the quadrangle, to the mouth of the Gila River canyon upstream from the town of Cliff (Ratté and Gaskill, 1975. Cooney Tuff outcrops in the Holt Mountain quadrangle are interpreted to be largely intracaldera deposits; the only known outflow Cooney Tuff being located in the Big Lue Mountains and Clifton 15 minute quadrangles toward the Arizona border to the west (Ratté and Brooks, 1995).

The caldera source for the Cooney Tuff, the proposed Mogollon caldera, is believed to have been centered beneath the Mogollon Range where its presence has been largely obscured by continued volcanism and the formation of the younger Gila Cliff Dwellings and Bursum calderas, 28 Ma. However, a possible segment of the structural wall of the Mogollon caldera is represented by a fault in the cliffs on the east side of Whitewater Canyon above the Catwalk Trail, fig~, This NNW trending fault extends into the Holt Mountain quadrangle about ½ mile east of the Whitewater Picnic Ground, but is cut off by a NE trending fault that presumably moves the proposed structural wall to the west, beneath the Gila conglomerate in the alluvial fans along the Mogollon range-front fault.

The eastern half of the Holt Mountain quadrangle consists largely of intrusive-extrusive rhyolite domes and flows, Fanney and Nabours Mountain rhyolites, which mark the ring-fracture zone of the Bursum caldera. The Bursum caldera collapsed in response to the eruption of the Bloodgood Canyon Tuff (not exposed in the Holt Mountain quadrangle) and was subsequently filled by the Apache Spring Tuff, which is exposed mainly on the resurgent dome of the caldera, along the crest of the Mogollon Range. However, Apache Spring Tuff also is exposed in the bottom of Whitewater Creek and along the Whitewater Pack Trail in the northeastern part of the Holt Mountain quadrangle, and in spectacular cliffs on both sides of Big Dry Creek in the southeastern corner of the quadrangle.There, much of the Apache Spring Tuff consists of crudely layered, intracaldera meso-and megabreccia from the caldera walls in a matrix of Apache Spring Tuff, fig-This caldera-fill is cut by a swarm of rhyolite dikes as much as tens of meters thick, which are best exposed in the east wall of the canyon of Big Dry Creek, fig~.

Mineralized rocks are present along the Mogollon Range front from the Mogollon mining district in the Mogollon quadrangle, north of the Holt Mountain quadrangle, to the Gila fluorspar district at the mouth of the Gila River canyon above Cliff (Ratté and others, 1979). Silver, gold, and base metals (lead and copper) were mined at Mogollon, mainly before WW II. The mineralization there has been dated at about 17 Ma. Numerous prospects for both base and precious metals occur elsewhere in the Holt Mountain quadrangle(references), and fluorspar was mined in Little Whitewater Creek. The most important prospects in the quadrangle are a lead-zinc deposit at the Uncle John mine above the forks of Big Dry Creek, near the eastern edge of the quadrangle, and precious and base metal occurrences in the Wilcox mining district in the south-central part of the quadrangle, along the Mogollon range front, mainly from Holt Gulch to the Chipmunk Spring area. The alteration and mineralization in the Wilcox district appears to be related to the dacitic intrusion of Holt Gulch and the rhyolite of Wilcox Peak, which intrudes it. The dacite of Holt Gulch is pervasively propylitized and the rhyolite dikes and small plutons of the Wilcox Peak rhyolite and associated wall rocks (mainly dacite of Holt Gulch?) are altered to an argillic or advanced argillic stage over a large area. Dickite and alunite are common on hill 6881, west of Chipmunk Spring in Goat Corral Canyon, and the alunite has been dated at about 33Ma (Marvin, and others, 1987, entry 53, p.36). Most recently (1970's), major exploration for molybdenum had advanced to the drilling stage by a major mineral exploration company, but was curtailed by a worldwide glut in the supply of that metal.

References cited:

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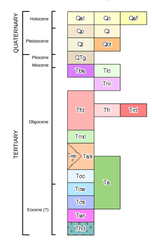
Figure 1 A, B, C, and D. 1A) East side of Whitewater Canyon above teh Catwalk National Recreation Trail showing proposed structural wall of proposed Mogollon caldera. Tcs, South Fork member of Cooney Tuff. b, interlayered basaltic lava flows. Tcw, Whitewater Creek Member of Cooney Tuff. Tcc, Cooney Canyon Member of Cooney Tuff. 1B) Same as 1A from a different angle with Catwalk Trail visible in lower right. 1C) Southeast wall of Whitewater Canyon viewed from Gold Dust Trail showing multiple cooling units in Cooney Canyon Member of Cooney Tuff separated locally by thin, dark colored, volcaniclastic sandstone layers. 1D) View of east wall of Big Dry Creek showing rhyolitic dikes

Explanation of Map Symbols

- Drill hole for mineral exploration
- Basal vitrophyre of Nabours Mountain Rhyolite
- Vertebrate fossil locality
- 0.8 Ma — Age
- 20 — Strike and dip of bedding
- 17 — Strike and dip of foliation
- Vertical foliation
- Contact; dashed where approximate
- Normal fault; dashed where approximate, dotted where concealed. Ball on downthrown side, dip shown where measured
- Rhyolite dike
- Andesite dike
- A A' — Line of cross section
- Silicic and argillic alteration

Correlation of Map Units



Cross Section A-A'