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Trace Elements Investigations Report 602

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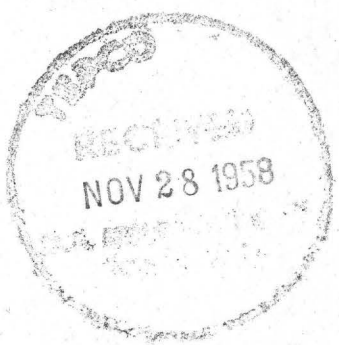

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ABSTRACT

The Little Cone quadrangle includes an area of about 59 square miles in eastern San Miguel County in southwestern Colorado. It lies within and adjacent to the northeastern boundary of the Colorado Plateau physiographic province. The precipitous front of the San Juan Mountains lies a few miles to the east and northeast, and an outlier of the San Juans, the San Miguel Mountains, lies about a mile to the south. The quadrangle contains features characteristic of both the plateaus and the mountains, and has been affected by geologic events and processes of two different geologic environments.

Within the Little Cone quadrangle and in the Placerville quadrangle to the north and the Gray Head quadrangle to the east, the Entrada sandstone of Late Jurassic age contains vanadium deposits with which are associated large but low-grade amounts of uranium. These deposits form one essentially continuous layer about 10 miles long and 1 to 1-1/2 miles wide, and possibly a second layer of smaller dimensions.

The sedimentary rocks exposed in the Little Cone quadrangle range in age from Permian to Cretaceous; they have been gently warped and broken by many normal faults, and are cut by numerous igneous rocks of Tertiary age. Several thousand feet of Paleozoic rocks probably underlie the quadrangle; these rocks are known only from points of observation (deep oil wells and exposures) that are some miles from

the quadrangle. A few thousand feet of Upper Cretaceous and Tertiary sedimentary rocks and Tertiary volcanic rocks formerly were present in the quadrangle; they were removed during extensive periods of erosion following the end of the Cretaceous and at the end of the Tertiary. Pleistocene deposits include a basalt flow and glacial drift on the upland surfaces, and valley fill and terrace gravels in the valleys of the major drainages. Alluvium, colluvium, talus, torrential fans, landslides and spring deposits, all of Recent age, are also present.

The continental sedimentary rocks of the Cutler formation of Permian age are the oldest rocks exposed in the quadrangle. Deposition of the Cutler was followed by a long period of erosion and peneplanation. There is no marked angular discordance between the Cutler and the overlying Dolores formation in the Little Cone quadrangle, but there is in areas some tens of miles east and west of the quadrangle where some crustal warping took place.

The continental sedimentary rocks of the Dolores formation of Late Triassic age are red beds, like those of the Cutler in gross lithology. They are subdivided into five general units which persist throughout the quadrangle and for some tens of miles to the north, south, and east. A second long period of erosion followed deposition of the Dolores.

The Entrada sandstone of Late Jurassic age overlies the Dolores formation, and is in turn overlain by the Wanakah formation, also of Late Jurassic age. The Wanakah consists of the Pony Express limestone member at the base, the Bilk Creek sandstone member near the center, and a "marl" member at the top. The Morrison formation overlies the Wanakah; it consists of the Salt Wash sandstone member below and the Brushy Basin

shale member above. A period of erosion, probably of relatively short duration, followed deposition of the Brushy Basin member.

The Burro Canyon formation of Early Cretaceous age is the oldest rock unit that overlies the Morrison formation in the Little Cone quadrangle. The Burro Canyon occurs as discontinuous bodies that fill channels cut in the top of the Morrison formation. Deposition of the Burro Canyon formation was followed by another period of erosion, which in turn ended with deposition of the Dakota sandstone of Early(?) and Late Cretaceous age. The Dakota sandstone grades upward into the Mancos shale of Late Cretaceous age.

The Paleozoic and Mesozoic formations were broadly folded during Laramide time as part of an orogeny of regional extent, and the San Juan Mountains area was uplifted as a broad dome. Extensive erosion followed deformation, and the Cretaceous rocks in the area of the Little Cone quadrangle and the Mesozoic and Paleozoic rocks eastward from the quadrangle were successively bevelled. The Telluride conglomerate of Oligocene(?) age was laid down on this surface. In the Little Cone quadrangle several hundred feet of the Telluride was deposited upon a considerable thickness (probably 3,000 feet or more) of the Mancos shale. At Telluride, about 12 miles east of the quadrangle, the Telluride conglomerate lies upon the Dolores formation. Volcanic rocks of Miocene(?) and Miocene age were deposited widely upon the Telluride conglomerate; at one time they had a thickness of probably 1,000 feet or more in the quadrangle. They gave been eroded completely from the quadrangle, but are present in the San Miguel Mountains a few miles to the south and southeast.

During the mid-Tertiary, probably during the Miocene, the sedimentary rocks were cut by numerous igneous bodies. Four major rock types are represented, in decreasing order of abundance they are granogabbro, granodiorite, rhyolite(?), and microgabbro. The granogabbro is by far the most abundant, and forms the Flat Top Peak plug, the Little Cone laccolith, numerous sills in the Mancos shale and Dakota sandstone, and a few dikes. The granodiorite forms sills in the Mancos shale and the Dakota sandstone, and the rhyolite(?) forms a single major sill in the Dakota. The microgabbro forms dikes that cut rocks as young as the Mancos shale. Metamorphic effects adjacent to the intrusives generally are restricted to baking that extends only a few feet out into the enclosing rocks; in many places no metamorphic effects are evident.

The rocks in the Little Cone quadrangle were displaced along faults in the mid-Tertiary time, probably after the igneous rocks were injected. All of the faults are normal, with vertical or very steep dips. In part, the faults form two long and narrow north- and northwest-trending grabens that extend into the adjoining Placerville quadrangle to the north. The graben faults form two systems, one trending northward to north-northwestward, and the other trending norhtwestward, that are essentially contemporaneous. Other faults trend eastward to northeastward; some of these appear to be related to the intrusion of the igneous rocks.

At the end of the Tertiary, probably in the early Pleistocene, the general area was again uplifted and subjected to extensive erosion. The Mancos shale was stripped from the northern part of the Little Cone quadrangle, and in this part of the area, the upland surfaces formed on top of the Dakota sandstone were largely controlled by the geologic structure.

On Specie Mesa a basalt flow of Quaternary age was erupted on a surface that cuts both the Mancos and the Dakota. The surface preserved beneath the flow has essentially the same position and slope as the adjacent present-day surfaces.

Within the quadrangle at least two stages of glaciation can be distinguished. High-level drift, unrelated to the present drainage systems, is correlated with the Cerro (early Pleistocene) glacial stage. Younger drift, occurring within the valleys of the present drainages, is correlated with the Durango or Wisconsin glacial stages, and may represent both.

Mineral deposits within the Little Cone quadrangle include tabular vanadium-uranium deposits in the Entrada sandstone, and placer gold deposits in terrace gravels and valley fill of Pleistocene age and in alluvium of Recent age.