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PRECAMBRIAN GEOLOGY AND MINERALIZATION OF THE UPPER ROCIADA AREA, SAN MIGUEL COUNTY, NEW MEXICO

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INTRODUCTION

The Upper Rociada area lies approximately 32 km northwest of Las Vegas, New Mexico, in the eastern foothills of the Sangre de Cristo Mountains (Fig. 1). Access to the area is provided by state highways from Las Vegas to the village of Upper Rociada. Various prospects are reached by unimproved dirt roads generally passable with two-wheel-drive vehicles.

The area lies in a region of moderately rugged hills and ridges and broad alluvial valleys. Upland areas are covered by ponderosa pine, scrub oak and mountain mahogany, and valleys support rich grasslands. Elevations range from 2300 to 2600 m. Climate is typical for northern New Mexico, with cool, wet summers and moderately cold winters. The area is commonly snow-covered from December until March.

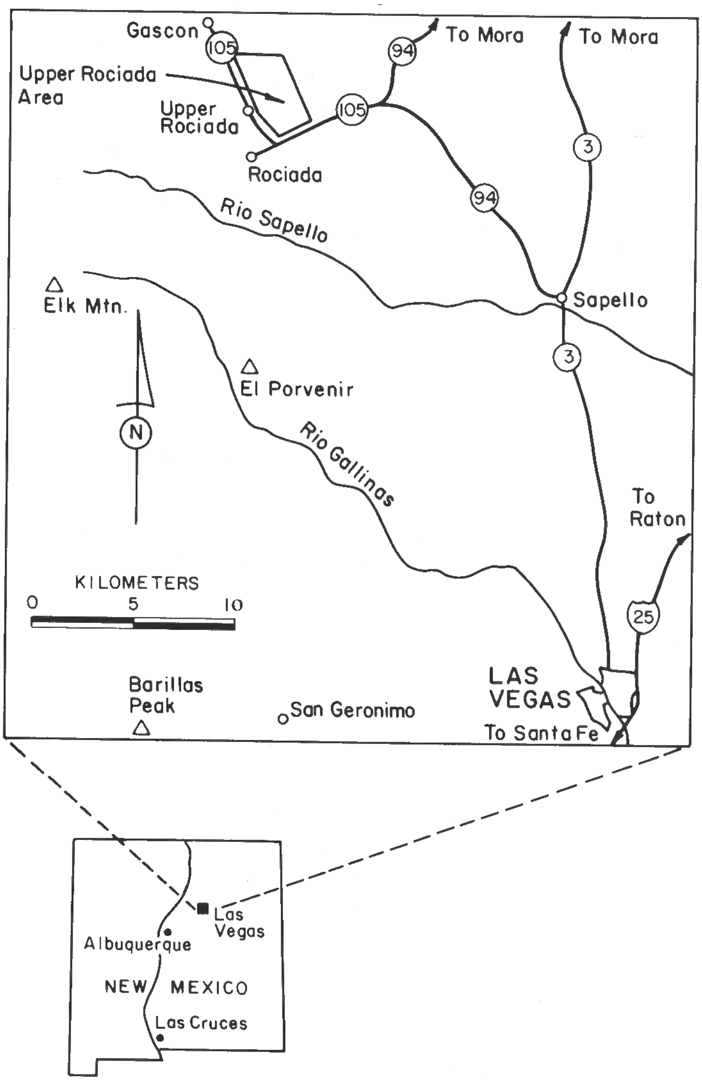

FIGURE 1. Map showing location of Upper Rociada area near Las Vegas, New Mexico.

Previous geologic work in the Rociada district has been limited to brief accounts of the mines and prospects (Lindgren et al., 1910; Harley, 1940) and reconnaissance geologic mapping (Baltz and O'Neill, 1980). In the past 10 years, the Upper Rociada area has received considerable exploration and study by major mining companies. Because this work was confidential, results have remained unpublished until now. The following paper describes the general Precambrian geology of the Upper Rociada area, locates major prospects and describes their geology and possible genesis and proposes a geologic setting and environment of deposition along with a modern-day analogue.

GEOLOGY

The Upper Rociada area consists of Proterozoic bedrock locally overlain by Mississippian and Pennsylvanian sedimentary rocks and Quaternary sediments. Since all important prospects are hosted by Proterozoic rocks, Phanerozoic rocks will not be discussed further. It should be noted, however, that minor red-bed copper prospects occur locally in Paleozoic rocks.

Proterozoic rocks consist of a sequence of amphibolite, felsite, micaceous to feldspathic quartzite, quartz–mica schist and phyllite, and minor calc-silicate gneiss, marble and quartzite. All Proterozoic rocks have undergone lower amphibolite-facies metamorphism and intense structural deformation. Two periods of isoclinal folding with transposition of layering into parallelism with foliation and a third period of broad, open folding are recognized. No radiometric-age dates are available, but it is presumed the rocks are approximate time equivalents of the Pecos greenstone belt immediately to the west (ca 1720 m.y.).

Protoliths of the supracrustal Proterozoic rocks are interpreted as follows: amphibolite was intruded as shallow plugs, dikes and sills and perhaps deposited as minor mafic flows; quartz–mica schist, phyllite and micaceous to feldspathic quartzite are broadly gradational and represent clastic sediments composed of pelites, impure to tuffaceous sandstones and minor graywackes; felsite was hypabyssal rhyolite intrusions; and calc-silicate gneiss, marble and quartzite were deposited as pelagic and exhalative chemical sediments.

MINERALIZATION

Several prospects and small mines occur in the area and are located in Figure 2. Three specific types are described in the text. In addition to prospects located in Figure 2, numerous others likely exist, but have not been visited by the author. Prospects hosted by pegmatites and Paleozoic rocks are not shown or discussed.

There is no recorded production in the area, although a small smelter was in operation in the 1900's (Lindgren et al., 1910). Additional exploration occurred in the 1930's when hand-sorted ore was transported to the Alamitos mill near Pecos. However, only small tonnages were found (A. Ramirez, oral comm. 1983). The period 1975–1985 has seen renewed interest in the area, with Noranda, Conoco, and Santa Fe Mining conducting exploration programs. Detailed mapping, soil and rock geochemistry, various geophysical surveys and considerable diamond drilling have been utilized to evaluate economic potential of the prospects and have greatly expanded knowledge of the area.

Three types of sulfide occurrences are recognized: (1) disseminated lead–zinc–silver ± copper sulfides hosted by marble, calc-silicate gneiss and/or quartzite; (2) disseminated lead–zinc–copper–iron–silver sulfides hosted by quartz–sericite phyllite and schist; and (3) quartz pods and veins carrying irregular concentrations of copper–iron sulfides with

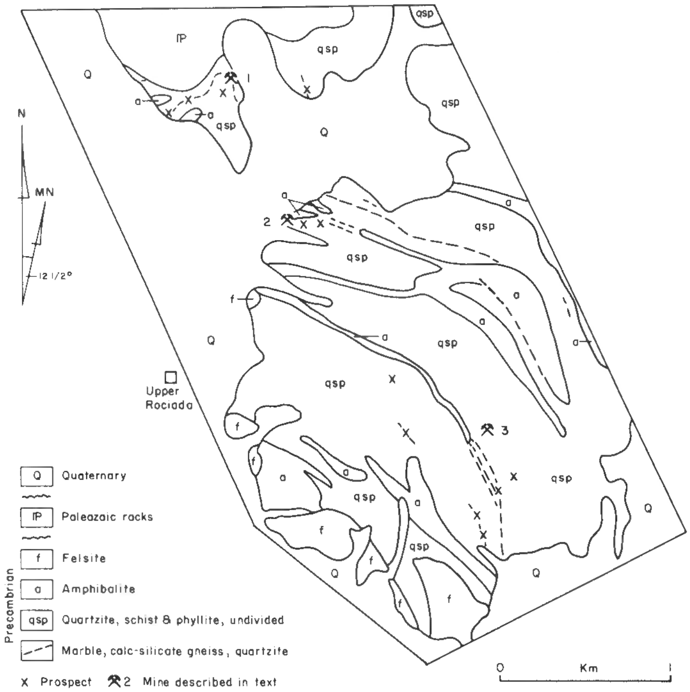

FIGURE 2. Generalized geologic map of the Upper Rociada area. Modified from Baltz and O'Neill (1980) and D. G. Armstrong's unpublished mapping. 1 = Good Hope shaft, 2 = Smith mine, 3 = Loring mine.

minor amounts of gold and/or silver. Epidote and chlorite are common accessories.

Type (1) prospects are exemplified by the Good Hope shaft (Fig. 2). Disseminated to banded sulfides and their oxidation products occur in a sequence of marbles and quartzites. Sulfides consist of galena, sphalerite and chalocopyrite and comprise up to 10% of the rock. Pyrite and tennantite(?) are minor constituents. Thick sequences of barren calc-silicate gneiss and micaceous quartzite are interlayered with the mineralized horizons. Gangue minerals include abundant talc, calcite, quartz and sericite. Accessory minerals that may be locally abundant include chlorite, tremolite–actinolite, epidote, rhodochrosite, bronze biotite, diopside, augite, wollastonite, cordierite and fluorite. The mineralization consists of narrow, stratabound lenses that collectively form a moderately plunging, rod-shaped body localized along an F_3 fold axis.

Type (2) prospects occur only at the Smith mine (Fig. 2) and the ridge to the east. At the Smith mine, an inclined shaft has explored disseminated and banded sulfides associated with concordant quartz stringers in a quartz–sericite ± tremolite schist. Intersection lineations suggest the mineralization is also rod-shaped and plunging. Sulfides include chalcopyrite, galena, sphalerite and pyrite and comprise 5–8% of the rock.

Type (3) prospects occur throughout the area and are generally of minor importance. The largest occurrence, the Loring mine, is an inclined shaft driven on a bull quartz vein in quartz–sericite–biotite schist. Little evidence of ore exists on the dump, with only minor chalcopyrite, pyrite and oxide minerals. It seems likely the ore was hand-cobbed and packed-out. Configuration of the exposed quartz vein and inclination of the shaft again suggests a plunging, rod-shaped body was explored.

GENESIS OF THE DEPOSITS

Type (1) prospects are interpreted as syngenetic deposits hosted by calcium–magneiusm-rich carbonate-silica exhalites and impure cherts. Metamorphism and structural events have deformed these horizons into plunging, rod-shaped bodies.

Type (2) prospects are interpreted as syngenetic deposits hosted by altered tuffaceous sediments. Unaltered equivalents of these hosts are believed to be the banded feldspathic quartzites immediately north of the Smith mine. Subsequent metamorphism and deformation have led to segregation of quartz stringers and sulfides and, likely, plunging, rod-shaped bodies. Prospects of this type are of minor importance in the area.

Type (3) prospects are interpreted as syntectonic quartz–sulfide veins and pods emplaced during metamorphism and deformation.

ENVIRONMENT OF DEPOSITION

Available evidence suggests the Upper Rociada sequence of rocks was deposited in a subaqueous environment dominated by clastic sedimentation and mafic volcanism. Minor pelagic sedimentation and felsic volcanism may have occurred contemporaneously. Subvolcanic and hypabyssal equivalents of the mafic and felsic extrusive rocks were intruded at shallow depths into the accumulating volcano-sedimentary pile. Heat from the upwelling magma set up hydrothermal convection cells. These hydrothermal solutions vented along faults as hot-spring deposits which leached underlying sediments and deposited carbonate, silica, talc, clays and minor sulfides at the sea-water–rock interface. Compared with proximal volcanogenic sulfide deposits of the Pecos greenstone belt, the Upper Rociada prospects are distinctly sulfide-poor.

COMPARISON WITH RECENT DEPOSITS

A modern-day analogue of the Upper Rociada area may exist in the Guaymas Basin. Compared to other modern hydrothermal vents (i.e., black smokers), deposits at this locale are carbonate- and sulfate-rich and sulfide-poor. This may be explained by the voluminous amount of sediment, both clastic and pelagic, accumulating in the restricted environment of the Guaymas Basin, through which hydrothermal solutions must travel to reach the sea floor. Basaltic magmas are prevented from reaching the surface by the thick sedimentary cover and are emplaced as sills. Shallow hydrothermal-convection cells are thus leaching metal-poor, carbonate- and silica-rich sediments rather than metal-rich mafic volcanics. Resulting exhalations ("white smokers") are currently depositing talc, carbonate, silica, smectite and minor pyrrhotite (Lonsdale et al., 1980; S. D. Scott, oral comm. 1985).

SUMMARY

The Upper Rociada area consists of several prospects and small mines hosted by deformed and metamorphosed Proterozoic marbles, calc-silicate gneisses, quartzites, and quartz veins. Two types of disseminated-sulfide prospects occur in distinct stratabound horizons that have been deformed into plunging, rod-shaped bodies by subsequent structural events. Another type hosted by quartz veins was syntectonically emplaced as plunging, rod-shaped bodies.

Evidence suggests the area was deposited in a distal, subaqueous environment dominated by sedimentation and mafic volcanism. Hot-spring exhalations were rich in carbonate, silica, talc and clays and were sulfide-poor. A modern-day analogue may exist in the Guaymas Basin.

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