THE EUREKA MINING DISTRICT, NEVADA

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INTRODUCTION

The Eureka Mining district is in Eureka County in the east-central part of Nevada; the county seat, Eureka, with a population of less than 500, is about 250 mi (400 km) east of Reno, Nev., and 325 mi (520 km) west of Salt Lake City, Utah.

HISTORY AND PRODUCTION

Ore was discovered in the district in 1864 during the wave of prospecting in what is now the State of Nevada. This prospecting followed the discovery and development of the bonanza ores of the Comstock Lode. The rich ores found in Eureka, as well as those in other districts, such as Austin, Hamilton, and Pioche, were major factors in the opening of the intermountain west through railroad and communication construction and the settlement of such mining camps as Eureka (which at one time in the early 1800's is reported to have had a population of some 10,000 people).

The initial discovery of ore was made south of the present town of Eureka; like most of the ore discovered subsequently, it was oxidized gold-silver-lead ore rich in iron. Initially the ore was not amenable to the benefication methods then current, and it was not until 1869, when smelting techniques were improved and the large rich ore bodies of Ruby Hill were discovered, that the district became highly productive. The greater part of the district's production took place in the 20 years from 1870 to 1890 and came mostly from the mines on Ruby Hill. Two large smelters, the Richmond, south of Eureka, and the Eureka Consolidated, on the north, produced large quantities of gold, silver, and lead, and slag piles are still prominent features of the landscape. In addition, several smaller smelters were active during the period.

The production from the Ruby Hill mines decreased after about 1890, but a smaller continuing output was made by lessees from Ruby Hill and from new discoveries in other parts of the district. In 1905, the two major Ruby Hill mines were consolidated as the Richmond–Eureka mine, and considerable amounts of lower grade ore and stope fillings were shipped to Salt Lake Valley smelters.

Beginning in 1919, extensive exploratory drilling was undertaken in search of extensions of the Ruby Hill ore bodies that had been cut off by the northwest-striking Ruby Hill fault. Several drill holes struck ore of good grade, and a new shaft (the Fad) was sunk in 1941–1946 to a depth of 2,500 feet. In crosscutting to the ore intersections from the shaft, however, a large flow of water was tapped, and the shaft was flooded to within several hundred feet of the surface. Considerable study of methods to accomplish dewatering of the mine to permit access to the ore bodies has been made, but, as yet, no satisfactory economical solution to the problem has been reached.

In recent years, there has been some significant production from the Diamond mine of the Consolidated Eureka Mining Co., and from the T.L. shaft of the Eureka Corp., Ltd. (now the Ruby Hill Mining Co.) and the Windfall mine.

Records of production from the Eureka district for the years prior to about 1900 are fragmentary, and in many places conflicting. When such information as appears to be dependable is pieced together, it suggests that in the neighborhood of 2 million tons of ore was mined, containing about 1,650,000 ounces of gold, 3,900,000 ounces of silver, and 625 million pounds of lead. These metals had a value (at prices existing at the time of production) of somewhat in excess of $120 million. At present-day metal prices, the total value would, of course, be much greater.

In addition to the contribution that the production made to the national economy, the Eureka district significantly advanced mineral technology in several respects. Perhaps the most notable was the development of new and improved smelting methods for the oxidized ores of the district; the district has been characterized as the "cradle of modern lead blast furnace smelting." Less well known is the fact that some of the earliest experiments in geochemical and geophysical prospecting were carried out on Ruby Hill. Finally, the Ruby Hill mines constituted one of, if not the earliest district in which the leasing or "tribute" system was utilized in mining the ore. Less notable at the time, perhaps, but of major importance to subsequent mining in the United States was litigation to apply mining law to the irregular "limestone replacement" deposits of the district. The dispute between the Richmond and the Eureka Consolidated mines on Ruby Hill resulted in protracted litigation, finally settled in the U.S. Supreme Court.

GEOLOGY

The Eureka district was one of the first in the Great Basin to be given detailed geologic study by the newly established U.S. Geological Survey, and the reports on this work by Hague, Walcott, Iddings, and Curtis were the basis for future work not only in the district but also in adjoining areas in Nevada.

The stratigraphic section established at that time has, with relatively minor modifications, continued in use to the present time. It includes representatives of all the Paleozoic systems and has a total thickness of about 30,000 ft (9,000 m); Cambrian formations, having a total thickness of about 7,500 ft (2,300 m), Devonian units (largely dolomite) having a total thickness of about 5,000 ft (1,500 m) and Carboniferous and Permian beds having a

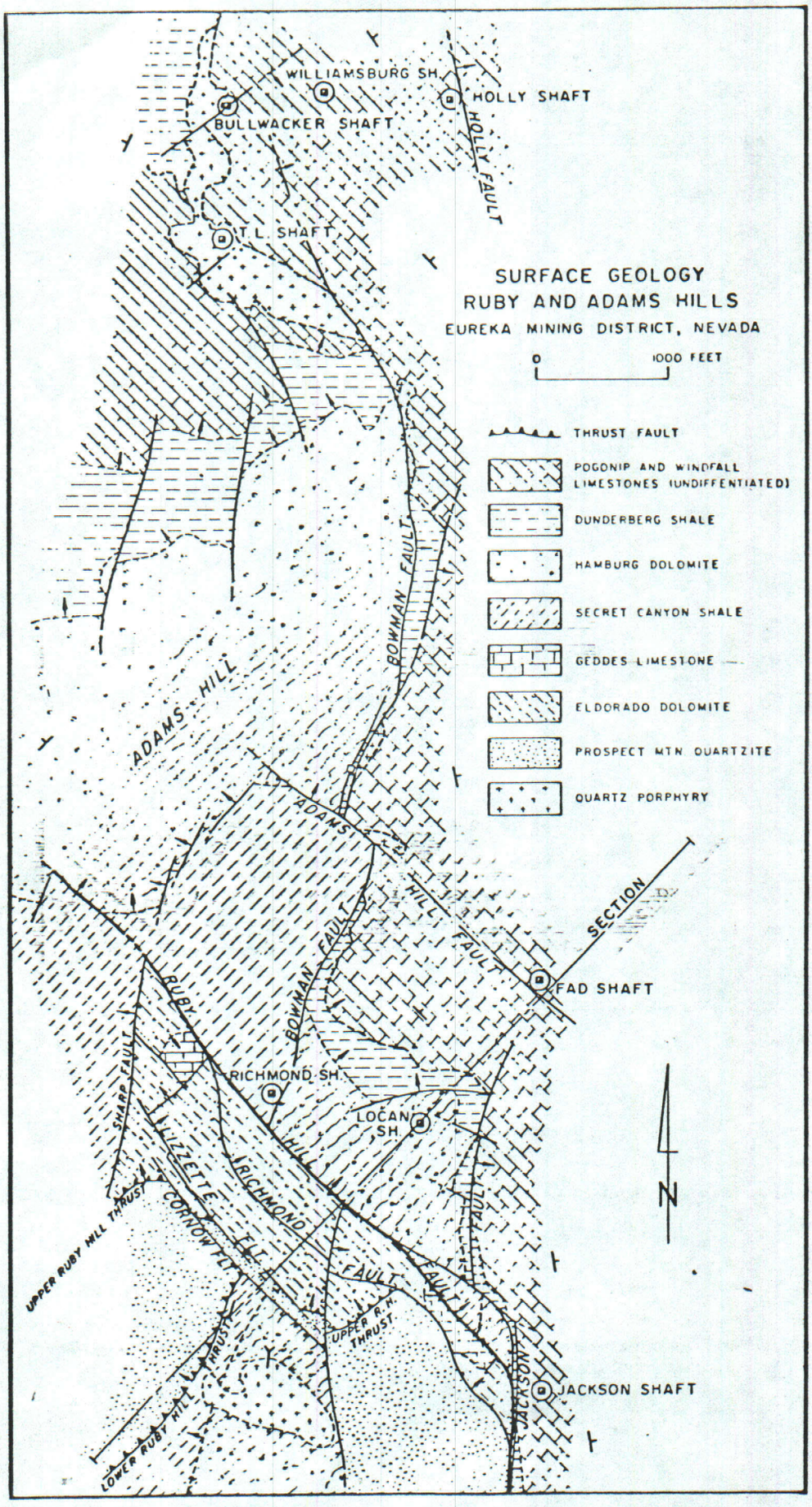

FIGURE 1. Surface geology of Ruby and Adams Hills, Eureka district, Nevada. Modified from Nolan and Hunt (1968, fig. 2).

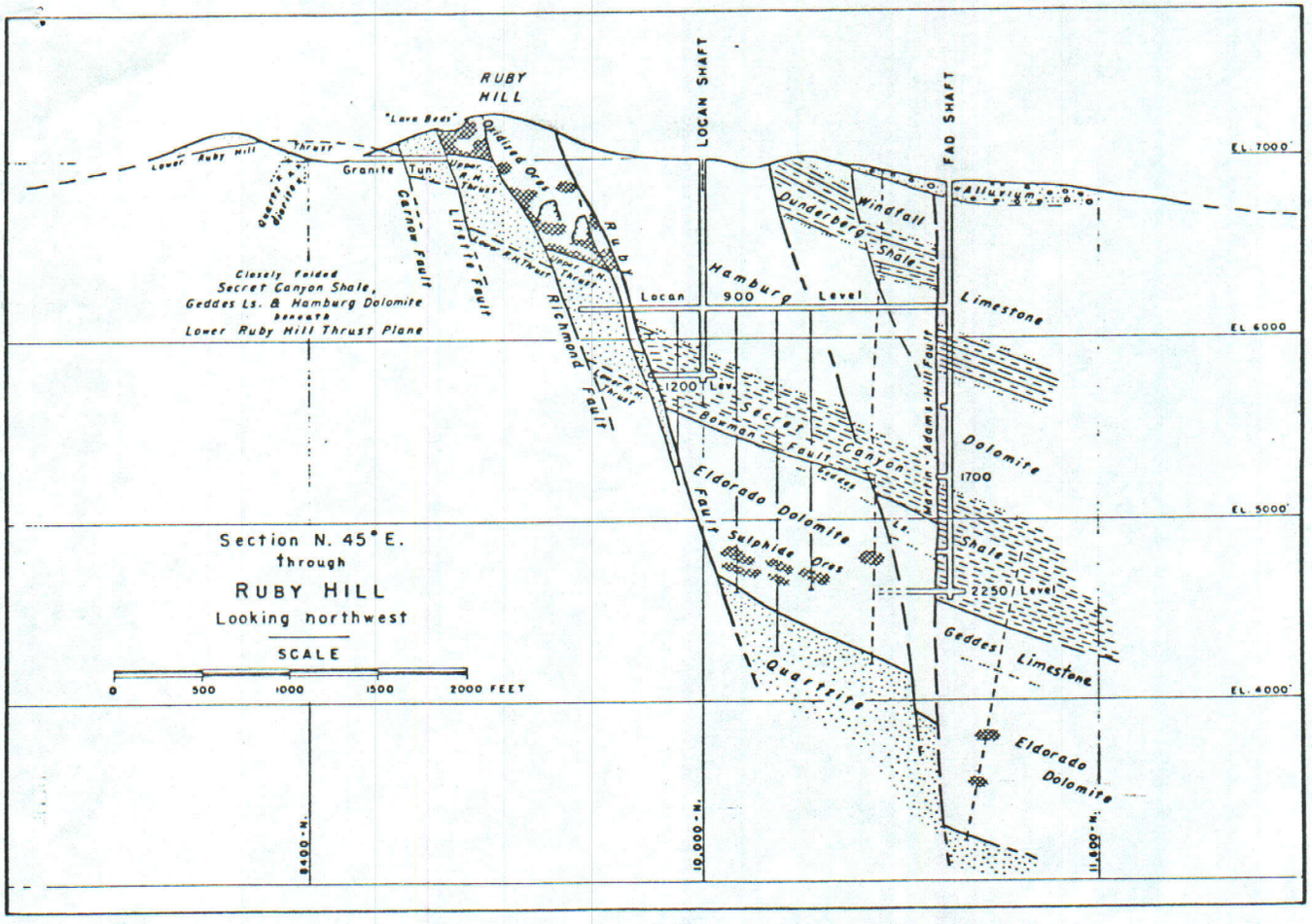

FIGURE 2. Geologic cross section N45° E through Ruby Hill. Modified from Nolan and Hunt (1968, fig. 3).

total thickness of about 10,000 ft (3,000 m) constitute the major part of the section.

Unconformably above these rocks, a sequence of about 1,000 ft (300 m) of freshwater sediments was deposited in Early Cretaceous time. The Cretaceous sediments were overlapped before lithification by sheets of megabreccias. A small exposure of quartz diorite that crops out a short distance south of Ruby Hill is of mid-Cretaceous age; it is the surface expression of a more extensive mass known from deep drill holes and magnetic anomalies.

Younger rocks include a group of Oligocene intrusive rhyolite plugs, ash-flow and air-fall tuffs, and flows; Miocene ash-flow tuffs and alkalic basalt; gravel ranging in age from late Tertiary to Holocene; and Pleistocene lakebeds.

The Eureka district lies just east of a major structural feature of central Nevada, the Roberts Mountains thrust. This thrust, which was formed in Late Devonian and Early Mississippian time, has brought "western facies" sedimentary rocks tens of miles eastward over lithologically dissimilar "eastern facies" Paleozoic rocks. The rocks east of this thrust have been deformed and cut by thrust faults; these latter thrust faults have been folded into a series of north-trending antiforms and synforms. Like the Roberts Mountains thrust, these structurally lower thrust plates have brought into juxtaposition lithologically different facies of contemporaneous rocks, although the degree of difference in the facies is far less than that involved in the major thrust. Unlike the Roberts Mountains thrust, however, these thrust plates involve rocks of Carboniferous and Permian age; hence, the thrusting in this area must have continued for some time after the main movement on the Roberts Mountains thrust.

Both the Cretaceous sedimentary rocks and the Oligocene volcanic rocks are localized in the synforms and were apparently emplaced within them after the folding that formed the antiforms and synforms. Locally, at least, deposition of the younger rocks took place shortly after the antiforms were relatively elevated along steep "normal" faults that formed along the boundaries of the folded belts.

Basin-range faults causing elevation of the present mountain areas appear to have followed in part the older faults that separate antiforms and synforms. Other faults, however, transgress the older structures at considerable angles; they branch and die out, and locally a few have curved traces.

ORE DEPOSITS

Essentially all of the mineralized rocks, and the small plug of Cretaceous intrusive rock, are restricted to the antiforms. Probably more than three-quarters of the total production of the Eureka district has come from the mines

of Ruby Hill, the summit of which is 2 miles west-southwest of the town of Eureka.

The Ruby Hill ore bodies were found in a northwest-trending wedge-shaped mass of Eldorado Dolomite (Middle Cambrian). The dolomite mass was limited downwards and to the southwest by a branching thrust zone that had been folded into a north-plunging anticline. To the northeast, the dolomite and the ores were both cut off by the more steeply dipping Ruby Hill normal faults; westward, the ore zone was terminated by a branch of the basin-range fault that forms the west boundary of Prospect Ridge (figs. 1 and 2).

Individual ore bodies were replacement masses in the dolomite; their location for the most part was controlled by fractures or faults; the nearly complete oxidation of the original sulfide ores, however, has obscured the important lithologic or structural features. Although some of the ore shoots have been characterized as "mantos," most of the Ruby Hill ore was found in irregular replacement bodies, some pipelike in form, others more tabular or veinlike. These bodies varied greatly in size, ranging from small podlike bodies a few feet across to chambers several hundred feet in extent. Many of the larger shoots were associated with open caves, which are thought to have formed during the oxidation of the ore.

Although most of the ore mined was nearly completely oxidized, sulfide ore from the T.L. mine north of Ruby Hill, and from drill-hole intersections, is probably similar to the original or primary mineralized material. It is made up of pyrite, arsenopyrite, galena, sphalerite, and minor quartz. The oxidized ore contains considerable, though varying, amounts of iron oxide, anglesite, cerussite, mimetite, plumbojarosite (and probably the arsenic analog, beudantite), bindheimite, and some quartz, halloysite, and calcite. Cerargyrite and native gold were probably present also. Bulk analyses of early day ore suggest that plumbojarosite (and/or beudantite) may have been abundant constituents.

Exploration in recent years, cited previously, has demonstrated the presence of relatively unoxidized sulfide ore in the Eldorado Dolomite in the hanging wall of the Ruby Hill fault. This ore contains substantial amounts of gold, silver, lead, and zinc, but it has not as yet been economically feasible to mine because of the problems presented by the large quantities of water. Drilling marginal to the lead-silver ore has indicated a considerable area of iron-zinc mineralization that suggests a possible zonal arrangement of the ores relative to the quartz diorite intrusive body.

Other mines productive in the past in the Eureka district include the T.L., Bullwhacker, and Holly to the north, and the Diamond, Silver Connor, Dunderberg, Croesus, Hamburg, and Windfall to the south. Except for the Windfall mine, which is now active, most of these mines produced oxidized gold-silver-lead ore from replacement bodies in dolomite, although the host dolomite in some of them was the younger Hamburg Dolomite rather than the Eldorado Dolomite.

SELECTED BIBLIOGRAPHY

Curtis, J. S., (1884) Silver-lead deposits of Eureka, Nevada: U.S. Geol. Survey Mon. 7, 200 p.

Hague, A. (1892) Geology of the Eureka district, Nevada: U.S. Geol. Survey Mon. 20, 419 p.

Nolan, T. B. (1962) The Eureka district, Nevada: U.S. Geol. Survey Prof. Paper 406, 78 p.

Nolan, T. B., and Hunt, R. N. (1968) The Eureka Mining district, Nevada, *in* Ridge, J. D., ed., Ore Deposits of the United States 1933–1967, Graton-Sales volume: New York, Am. Inst. Mining, Metallurgical, and Petroleum Engineers, v. 1, p. 966–991.