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ELY MINING DISTRICT

Location. The Ely (Robinson, Ruth) mining district is mainly in T. 16 N., R. 62 and 63 E., in the Egan Range west of Ely (see Army Map Service, Ely topographic quadrangle map).

History and Production. The district was organized as the Robinson District in 1868. Early mining was for gold and silver. There also has been some production of lead, zinc, and manganese. Mining of the huge porphyry copper deposits began in 1907. Over 225,000,000 tons of ore averaging 1.14 percent copper has been mined from which over 4 billion pounds of copper, nearly 2 million ounces of gold, 7 million ounces of silver, and over 2 million dollars worth of molybdenum have been recovered, the total value exceeding a billion dollars at current (1960) metal prices.

This district has been the only important producer of molybdenum in Nevada. Only a few, very small shipments have been made from other areas.

Mines. The porphyry copper deposits are now mined principally by open-pit methods. In the past, block-caving and more selective underground methods were also used. Kennecott Copper Corp. owns and operates the mines, and a mill and smelter at McGill.

Previous Work. There are numerous reports on the geology of the Ely district, including those by Bateman (1935), Bauer (1960), Beal (1957), Fournier (1959), Lawson (1906), Pennebaker (1942), and Spencer (1917).

The Rocks. In the district, a sequence of generally north-striking, west-dipping Paleozoic limestone, shale, and sandstone have been intruded by Laramide (?) monzonite porphyry. These rocks have been intruded ~~and verged~~ by late Tertiary (?) intrusive and covered by extrusive rocks of sialic to intermediate composition.

The Paleozoic sequence includes the following units:

Arcturus limestone	300 feet	Permian
Rib Hill sandstone	3,250 feet	Pennsylvanian
Ely limestone	3,250 feet	Pennsylvanian
Chainman shale	500 feet	Mississippian
Joana limestone	250 feet	Mississippian
Pilot shale	200 feet	Mississippian
Nevada limestone	4,000 feet	Devonian
Eureka quartzite	150 feet	Ordovician
Pogonip limestone	1,400 feet	Ordovician

The Ordovician rocks are not exposed in the vicinity of the porphyry copper deposits.

The monzonite porphyry bodies are concentrated along an east-west zone some eight miles long. The monzonite is believed to have been intruded during a single epoch, although some bodies have been formed by multiple intrusives. The bodies commonly have very irregular shapes, and diminish in size with depth. Such bodies in the mineralized zone in outcrop vary from 200 to 3,000 feet across, and have roots extending at least 1,600 feet deep. All the monzonite is porphyritic to some degree, the principal textural variation being in the groundmass which ranges from microcrystalline to granitic. The porphyry ranges from quartz monzonite to monzonite in composition, and is composed principally of orthoclase, andesine ($Ab_{50}An_{50}$), and hornblende, varying amounts of quartz, and minor apatite, magnetite, sphene, and zircon.

<u>Structures</u>. Normal faulting is the most important structural feature in the district, the numerous faults forming an irregular pattern. Thrust faulting also has taken place in the area. Folding is prominent in the western part of the district.

The porphyry bodies, alteration, and mineralization form a prominent east-west zone. This zone apparently has little relation to the pattern of normal faulting, but was controlled by an east-west basement fault. A number of east-trending Larimide (?) basement faults have been recognized in eastern Nevada and western ~~Nevada~~ Utah; these faults provided channelways along which igneous bodies could be intruded and volcanic rocks extruded. Some of the north-trending normal faults have controlled the emplacement of the individual monzonite bodies.

Contact Metamorphism. The sedimentary rocks in contact with the monzonite have been metamorphosed. The limestone at the contact is altered to dense tactite composed of garnet, chlorite, magnetite, specularite, pyrite, and chalcopyrite. The tactite grades outward into garnet-diopside-idocrase-epidote rock, which in turn grades into bleached and recrystallized limestone containing tremolite. The shale is metamorphosed to hornfels.

Hydrothermal Alteration. Hydrothermal alteration has changed the rocks along the east-west mineralized zone. The sandstone has been silicified and its cementing material sericitized. The shales have been bleached and their fissility destroyed; where alteration has been most intense, the shale has been silicified and/or sericitized.

The intensity of alteration varies greatly in the monzonite peophyry. The alteration can be grouped into two types—argillization and silicification-sericitization—but does not occur in any distinct zonal pattern. Hornblende was altered to biotite, orthoclase to sericite, and plagioclase to sericite and/or clay minerals. Quartz, pyrite, and chalcopyrite were introduced.

Porphyry Copper Deposits. The porphyry (disseminated) copper deposits of the district occur along the same east-west zone along which the monzonite intrusive bodies, hydrothermal alteration, and contact metamorphism are concentrated. This zone is readily recognized by bleached limestone, jasperoid, leached monzonite, and limonitic staining.

The ore is mainly in altered monzonite porphyry and to a lesser extent in adjacent sedimentary rocks, seldom extending outward more than 300 feet. The rocks of ore deposits are minutely broken by intersecting fractures having no dominent trend.

Pyrite is pervasive throughout the altered monzonite as disseminated grains, veinlets, and blebs in quartz veinlets. Chalcopyrite is erratically distributed as disseminated grains and blebs in quartz veinlets. The chalcopyrite generally is more abundant where the alteration is of the argillic type. In general the ore is higher grade in the monzonite than in the sedimentary rocks. Small amounts of gold and silver occur in the ore.

The ore bodies have been oxidized and the sulfide minerals removed by leaching to a depth of 100 to over 400 feet below the surface. A zone of supergene enrichment generally occurs below the zone of oxidization; here chalcocite replaces pyrite and chalcopyrite as coatings on the sulfide grains. Chalcocite enrichment is more common where the alteration is of the quartz-sericite type. Enrichment is usually weak or absent in the sedimentary rocks.

Replacement Deposits. Small replacement deposits are scattered in the limestone along the margins of the mineralized zone. Their location is controlled by bedding planes. Copper, lead, zinc, silver, gold, and manganese have been produced from these deposits.

Molybdenum Minerals. Coatings and flakes of molybdenite are distributed erratically along fractures in the porphyry copper deposits. The molybdenite was deposited during the later stages of mineralization.

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John Schilling's notes