Geology of the Santa Rita area

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remarks regarding the processes follow.

Garnetization and epidotization may have recurred as indicated or may have been active processes only after solidification and fracturing of the granodiorite dikes. The evidence is clear that these processes followed intrusion and probably solidification of the hoods of stocks.

Biotitization is apparently restricted to the area of disseminated copper mineralization. It affects granodiorite stock rock and the younger granodiorite dikes, but so far as known does not affect the next-younger quartz monzonite dikes.

Representation of magnetite deposition, at least in volume, is subject to the same uncertainties as representation of garnetization.

Bleaching alteration is parallel with and closely associated in space and probably in time with pyritization.

Zinc mineralization is shown by two alternatives, both of which show large-scale introduction of zinc after reopening of the granodiorite dikes. The subjective element in such interpretation is large. Zinc mineralization is shown in this manner because zinc ore is in many places clearly related to reopening along and in granodiorite dikes; but so far as known, it is not related to reopening along and in the next-younger quartz monzonite porphyry dikes.

Copper mineralization is shown by two of several possible alternatives. Both show large-scale copper mineralization after intrusion of quartz monzonite porphyry, because the quartz monzonite porphyry contains about as much of the primary mineral, chalcopyrite, as does granodiorite where the two rocks are about equally shattered. Both alternatives show the main copper mineralization after the main zinc mineralization because of described relations (not decisively interpretable) to quartz monzonite porphyry, the paragenetic relations of chalcopyrite and sphalerite in veins, and the absence of zinc so far as known in the rocks intensely mineralized by disseminated chalcopyrite.

GEOLOGY OF THE SANTA RITA AREA

by
G. J. Ballmer*

Introduction

The distribution of the rocks at Santa Rita presents a rather complex picture. Sediments, ranging in age from the late Paleozoic through the Upper Cretaceous, have been faulted, intruded, altered and generally "discombobulated" to such an extent that the present picture is somewhat formidable. This sedimentary-igneous complex later was further complicated by intrusion of dikes, faulting, and final covering of all of the area by Tertiary flows.

Geologic History

Following the deposition of the sediments several thick and numerous thin sills of quartz diorite porphyry of two ages were intruded into the limestones and shales and sandstones of the Upper Paleozoic and Upper Cretaceous. Considerable faulting followed and may have accompanied these intrusions. The sills in the Paleozoic limestones, in general, are much thinner than those in the upper Cretaceous which may attain thicknesses of several hundred feet. The former also are most persistent in their horizons and one, occurring about 90 feet above the base of the Pennsylvanian, has locally been termed the "marker sill" because of its remarkable persistence.

Subsequent to the intrusion of the sills, the sedimentary and igneous rocks were intruded by a large granodiorite porphyry stock which was forcibly pushed through the sediments causing rather steep dips at the contacts. This stock sent out dike-like fingers or apophyses, at various points, and was itself intruded by granodiorite porphyry dikes of a slightly later age. Mineralogically, not a great difference exists between the rock of the stock and that of the sills. One difference, however, is the coarseness of the stock rock and the comparatively fine-grained texture of the sill rocks, particularly the thinner ones. The stock and dikes intruded planes of weakness, as faults, that originated shortly after intrusion of the sills. Movement along these various faults has taken place at several intervals up until very recently.

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Mineralization

A period of mineralization probably accompanied or followed closely the intrusion of the large granodiorite porphyry stock. This mineralization was largely a part of the widespread hydrothermal alteration which was the final stage of the intrusion. The primary ore mineral chalcopyrite was precipitated from hot aqueous solutions, and due to the varying character and the broken nature of the host-rock both disseminated and vein deposits were formed.

Enrichment

Ore deposits of commercial grade were formed by secondary enrichment processes. Chalcocite, the principal ore mineral, occurs as truly disseminated blebs and also in small veinlets and stringers. The abundant pyrite it replaces may be merely coated with a thin film or be partly to almost completely destroyed. Other copper minerals occurring in minor quantities are native copper, cuprite, malachite, azurite and chrysocolla. Quartz, sericite, halloysite, and other clay minerals are common gangue constituents.

Alteration

Patterson and Kerr (1947, p. 1-3), Columbia University, who made a study of the alteration at Santa Rita divided granodiorite porphyry of the stock into four stages. They say, "... The granodiorite porphyry containing vitreous black biotite and glassy feldspar phenocrysts was designated Stage One of alteration. Stage Two was characterized by dull-gray-black chloritized biotite and altered feldspars. Stage Three included all granodiorite porphyry showing hydromica pseudomorphs after biotite. The final stage of alteration, Stage Four, showed no relicts of the original biotite and only widely scattered feldspar phenocrysts. The most highly altered granodiorite porphyry of Stage Four is essentially a quartz-sericite rock lacking phenocryst relicts . . . ". They state further, " . . . A striking correlation between the ore values and the alteration stages was evident. Generally, the highest ore values occurred in zones of Stage Three alteration. Stage Four was of secondary importance. Although Stage Two had not figured prominently in recent operations, assay values obtainable indicated poor production . . . ".

The Ore Body

The ore body is very roughly tabular, and is circular in plan. The largest segment by far is in the south and southwest parts of the stock and adjacent rock. The ore body was buried under oxidized capping ranging in thickness from nothing to four hundred feet. It is very irregular in thickness and in a few isolated places reaches a maximum thickness of six hundred feet. Chalcocite has been noted to a depth of approximately one thousand feet in prospect drill holes and in one instance, native copper and oxidized copper minerals have been identified at a depth of approximately twelve hundred feet.

THE TYRONE DISTRICT

Abstracted by
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This information on the Tyrone district was taken from U. S. Geological Survey Professional Paper 122 (Paige, 1922).

The Tyrone district was discovered by Robert and John Metcalf about 1871. Previous to that, Indians mined turquoise from shallow pits. In 1904 the Phelps Dodge Corporation bought a third interest in the Burro Mountain Copper Company and later, in 1913, purchased most of the claims in the district. After extensive exploration and development, the Phelps Dodge Corporation began mining. Operations were continued during World War I and for a few years thereafter. Since about 1921, production has come mainly from leaching operations, which reached a peak during World War II. The Tyrone district lies 10 miles southwest of Silver City. Its principal settlement is the town of Tyrone, now nearly abandoned. Leopold, an abandoned town, lies about a mile southwest of Tyrone. The Continental Divide passes diagonally through the area from the southwest to the northeast corner.

All the dominant topographic features of the district are primarily the result of erosion of rocks of varying hardness under special topographic conditions in a semiarid climate. The Little Burro Mountains is a homoclinal fault block with a precipitous southwest-facing scarp and a gently sloping, partly gravel-covered northeastern slope. The Big Burro Mountains is an erosion remnant bordered by a rock-cut surface that merges into a gravel plain along its

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