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Copper Resources in Secondary Enrichment Blankets at Tanamá, Puerto Rico

by

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Introduction

The purpose of this report is to make available drill-hole data and other information on the secondary enrichment ores at Tanamá, Puerto Rico. The Tanamá porphyry copper deposit is located in west-central Puerto Rico (lat. 18° 15' 30" N., long. 66° 49' 29" W) (pl. 1, inset). It was discovered by geologists of the Kennecott Copper Corp. in 1960. In 1965, after Kennecott had completed 155 drill holes aggregating 44,000 m, a reserve of 139 million tonnes of ore averaging 0.64 percent copper was proven (all references to copper grades in this report are in weight percent). During succeeding years, attempts by Kennecott and the Puerto Rico Commonwealth Government to reach agreement on terms of a mining lease were unsuccessful and in 1990, Kennecott relinquished its interest in the property. In the past decade various mining companies have applied for exploration permits in Puerto Rico and there has been renewed interest in the Tanamá deposit.

In 1970, a cooperative study of the Tanamá deposit by the U.S.Geological Survey (USGS) and the Commonwealth Department of Natural Resources was begun and geologic and assay logs of drill holes were provided by Gregorio Chavez, resident manager for Kennecott in Lares, Puerto Rico. These logs were an important basis for the study and were included in generalized form, at 1:5,000 scale, in the resulting report (Cox, 1985). The logs contain information on the extent, thickness and grade of the secondary enrichment blanket. As a result of recent technological advances including development of low-cost solvent extraction and electrowinning processes, secondary-enrichment ore at Tanamá has become economically attractive.

Geology of the deposit

The Tanamá deposit is a stockwork of quartz-chalcopyrite veinlets associated with a tonalite porphyry intrusion (pl. 1) of Eocene age that intrudes Cretaceous metavolcanic rocks (Cox, 1985). Most of the copper mineralization is in the porphyry, but, locally, metavolcanic rocks are mineralized near the porphyry contact. The deposit contains two orebodies separated by a narrow zone of weakly mineralized metavolcanic rocks. The north orebody contains magnetite in the stockwork veinlets and exhibits feldspar-stable alteration. The ore zone forms a shell around a low-grade core of altered porphyry centered around diamond drill hole (DDH) T-136 (pl. 1; pl. 2, section C-C'). The south orebody is rich in pyrite, and feldspar is completely destroyed by phyllic-argillic alteration. Cox (1985) defined the zonal arrangement of feldspar-stable and feldspar destructive alteration and proposed that the south orebody was originally the top of the system and was down-dropped on a west-northwest-striking normal fault to its present position adjacent to the north orebody.

Parts of the ore bodies remain undefined by the 1965 drilling. In the north orebody, the copper-ore shell was assumed by Cox (1985) to completely surround the low-grade core. Following this assumption, most of DDH T-63 (pl. 1) can be interpreted as pentrating the core. The ore-grade intercept in the uppermost part of this hole, however, can be interpreted as the top of the ore shell that extends around the southeast side of the porphyry intrusion and is continuous with the ore intercept in DDH T-124. In the south orebody, there has not been sufficient drilling to define the extent of ore in the tonalite porphyry stock west of DDH T-71.

The orebodies are cut by numerous mafic dikes with low copper content that were probably emplaced after the copper deposit was formed. These are abundant near DDH T-66 (pl. 2, sections A-A' and C-C'; Cox, 1985, fig. 11A).

Secondary enrichment

The orebodies are exposed on an erosion surface of low relief that is inclined 6°-7° north and descends under Oligocene fluvial-lacustrine strata (Nelson and Tobisch, 1968). This pre-Oligocene surface is dissected by the Río Tanamá and other streams belonging to the present drainage system. Weathering and secondary copper enrichment probably occurred during both the early Tertiary and Quaternary Periods.

Weathering of the abundant pyrite in the south orebody resulted in acid leaching of copper and its nearly complete removal from the upper 20 to 70 m of soil (pl. 2, sections A-A' and B-B'). This copper was redeposited below the water table as secondary copper sulfides replacing pyrite and chalcopyrite in a blanket that has an average thickness of about 40 m. The lower limit of this blanket is defined by the lowest observation of secondary copper minerals recorded in the drill core logs. Other occurrences of chalcocite are shown by symbol (pl. 2, section A-A'). Copper grades are highest over mineralized porphyry and range from 0.9 to 4.5 percent. Lower grades (0.2 to 0.6 percent) where the blanket intercepts metavolcanic wall rocks reflect the lower protore grades in these rocks.

The preponderance of magnetite over pyrite in the north orebody limited the amount of leaching there so that the blanket is only about 20 m thick (pl. 2, section C-C'). The presence of numerous post-ore dikes near DDH T-66 and T-137, and the low-grade core, which reaches the surface near DDH T-136, results in lower grades of enriched ore in this blanket.

X-ray examination of secondary ores from the drill holes T-108 and T-109 in the south orebody by R.W. Potter II (written commun., 1976) identified abundant covellite and minor digenite in the central part and djurleite and minor chalcocite in the lower part. Secondary ore examined in DDH T-137 in the north orebody blanket contains malachite, chrysocolla, and minor chalcocite (Cox, 1985, p. 35).

Conclusions

Plate 1 shows the outline of the greater-than-one-percent-copper secondary enrichment blanket at a scale of 1:2,500. This outline is based on the coincidence of (1) copper mineralization in porphyry and nearby metavolcanic wallrock, (2) pyritic feldspar-destructive alteration and (3) copper grades of greater than 0.4 percent in drill hole intercepts below the blanket at the 430 m elevation (Cox, 1985, fig. 11B). The west boundary of the blanket is poorly constrained by lack of drill holes, and the presence of a post mineral dike in DDH T-71 makes it difficult to estimate ore grade in tonalite porphyry in this area. Given these uncertainties, the area of this blanket is estimated to be 78,000 sq. m; its average thickness is 41 m; and the rock density is assumed to be 2.5 tonnes per cu. m. These data indicate that approximately 8 million tonnes of ore with a copper grade of one percent or higher is present over the south Tanamá deposit. Extensions of the blanket may be found near and west of DDH T-71 and T-91, and small pockets of secondary ore probably overlie the north orebody.near DDH T-137. In addition, the southeast side of the north orebody (southeast of a line between DDH T-63 and the collar of T-124) is undefined by drilling, and secondary ore may be present in this area. A deep extension of secondary ore may be present near DDH T-93, where scattered chalcocite occurrences suggest that the thickness.of the blanket is as much as 160 m.

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