# THE GEOLOGY OF THE SAN XAVIER NORTH PORPHYRY COPPER DEPOSIT, PIMA MINING DISTRICT, ARIZONA

by

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## Abstract

The San Xavier North porphyry copper deposit is located on the Papago Indian Reservation, about 15 miles south of the city of Tucson. Events that led to its development began in 1955 when Asarco geologists discovered two small altered and mineralized outcrops surrounded by alluvium. Exploration drilling began in mid-1957 after successful competitive bidding with the Papago Indians. By 1967 over 60 holes averaging between 600 and 700 feet deep were drilled in the deposit. Initial production began in 1968 with the mining of copper-bearing silica flux for use at Asarco smelters. Production of copper oxide ore began in 1973 at an approximate rate of 4,000 tons per day.

The San Xavier North porphyry copper deposit consists of oxide copper zones, supergene chalcocite, and hypogene sulfides all contained within Cretaceous clastic rocks and Laramide quartz monzonite porphyry intrusions. The clastic rocks are an intimately interbedded sequence of arkosic sandstones, siltstones, and mudstones and are part of the Cretaceous Bisbee Group probably equivalent to the Amole Arkose. The sedimentary rocks were asymmetrically folded prior to the intrusion of the quartz monzonite porphyry.

The quartz monzonite porphyry exists as dikes and a single stocklike(?) mass which lies immediately to the south of the pit. The porphyry intrusions at San Xavier North are identical to the quartz monzonite porphyries at Mission and similar to the quartz monzonite porphyry described at Twin Buttes.

The only major fault delineated to date is the low-angle, mid-Tertiary San Xavier fault. The depth to this structure is slightly over 2,000 feet and it forms the boundary between the overlying mineralized rocks and underlying unmineralized Precambrian granite.

Hydrothermal mineralization and alteration at San Xavier North are spatially interrelated and formed as part of a continuing chemical process that resulted in a zonal distribution of both sulfide and alteration minerals. Hypogene ore-grade (approximately 0.5% Cu) mineralization is confined to the clastic wall rocks in such a manner as to form an arcuate zone adjacent to the main porphyry mass. This ore zone mineralization is characterized by 1-3 percent by volume sulfides with a pyrite-chalcopyrite ratio that ranges from 1:1 to 1:3. Stratigraphy exerts an important control on the distribution of chalcopyrite in that the finer grained the sedimentary host is the greater the chalcopyrite content. Molybdenum and silver mineralization is concentrated within this ore zone and in the central porphyry mass.

Surrounding the ore zone is an area of pyrite mineralization that is characterized by a sulfide content of 2-4 percent and a pyrite-chalcopyrite ratio that ranges from 10:1 to 3:1. The area of change from the ore zone to the pyrite zone is transitional over a distance of nearly 100 feet.

Associated with both of the above-mentioned mineral zones is a phyllic alteration which in itself is internally zoned in a manner sympathetic to the described mineral zones. The strength of phyllic alteration is greatest in the pyrite shell at or near its interface with the chalcopyrite zone. Quartz veining is most abundant in the ore zone.

Supergene mineralization at San Xavier North consists of leached capping, two different oxide copper zones, and an ore-grade chalcocite blanket. An upper zone of oxide copper is contained within the capping and represents oxidation of a chalcocite zone that hung up dur-

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ing leaching of other sulfides. A lower zone of oxide copper exists at the base of the capping and is a product of partial oxidation of the main chalcocite blanket. The chalcocite blanket does not conform to bedrock topography and the eastern part of the enriched zone is partially oxidized and eroded. The chalcocite blanket ranges from 30 to 100 feet in thickness and is the result of approximate twofold enrichment. Copper grades in the blanket average between 0.6 and 1.0% Cu. The copper oxide zones consist of a mixture of chrysocolla, malachite, neotocite, melaconite, and minor azurite. The oxide copper grade is approximately 0.8% Cu.

Current interpretations are that the formation of the supergene deposit occurred prior to or during the formation of the mid-Tertiary Helmet Fanglomerate. Erosion and partial oxidation occurred after initial movement on the San Xavier fault and prior to deposition of the alluvial gravels that to a great extent preserved the deposit.