GEOLOGIC ASSESSMENT OF ACID CONSUMPTION FROM LEACHING OF OXIDE COPPER ORES OF THE EXOTIC EL TESORO COPPER DEPOSIT, NORTHERN CHILE

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Northern Chile hosts some of the world’s largest copper ore deposits, including copper oxide systems of exotic derivation. The El Tesoro exotic copper deposit is located in Region II of northern Chile, approximately 160 kilometers NE of the port city of Antofagasta. Estimated reserves comprise 185 million tonnes of ore containing 0.88% Cu as atacamite and chrysocolla. An SX/EW operation, El Tesoro produces 70,000 tons of 99.99% cathode copper annually. With current open pit mining methods and rate, the expected life of the deposit is twenty-one years.

El Tesoro copper oxides are hosted within a sequence of fanglomerates comprising unconsolidated to poorly consolidated gravels and channel sands. These sediments show little or no alteration; copper, iron, and manganese oxides form part of the sediment matrix. The mineralized fanglomerate sequence strikes approximately N50E and dips 15°NW, and extends over an area of 10 km$^2$. Clasts making up the host gravels and sands are predominantly andesite and granitic rock fragments, including formerly mineralized porphyry clasts that may show pre-erosion alteration consisting of white phyllosilicate and/or chlorite replacement of groundmass and phenocryst sites. Ores are hosted by two tabular mineralized horizons having a combined thickness of about 80 meters, with 10 to 15 meters of essentially barren gravels separating the two mineralized gravel sequences. A regional, basin-bounding fault forms the eastern limit of the gravel sequence; early Eocene age andesite flows occur adjacent to this structure and contain minor copper mineralization. The mineralized gravels are thought to be younger than early Miocene age (no older than about 23.7 Ma), and are definitely older than a 10.2 Ma volcanic ash horizon that overlies the El Tesoro fanglomerate sequence.

Because all copper at El Tesoro is recovered using SX-EW methods, this study was initiated to ascertain the significance of fanglomerate mineralogy with respect to acid consumption, leaching effectiveness, and copper production. Petrographic study of the clasts comprising the ore-host fanglomerates suggests that aluminum, manganese, and iron are likely released during acid leaching of the copper ores. Such release of cations from aluminosilicates results in both increased acid consumption and formation of phyllosilicates within the leach-recovery circuit; however, our study also indicates that moderation of pH during leaching would result in limited dissolution of aluminosilicates and concomitant improvement in copper recovery and acid consumption.