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Abstract from SME Annual Meeting 2002

Browne, Q.J., and Miller, M.A., 2002, Use of geologic parameters for development of low-grade copper reserves, Silver Bell mine, Arizona

Silver Bell produces about 21,000T of fine copper annually from low-grade chalcocite and oxide copper ores with current mineable reserves of 146 million tons averaging 0.39% Cu. Silver Bell geologists integrate various geologic parameters to optimize mine production and search for additional reserves. Geologic parameters are fundamental aspects of ore and waste rock that influence mine operations, Porphyry copper mineralization is hosted in a complex suite of Laramide-age intrusive rocks which have been enriched through supergene processes. Ore is mined by two methods; conventional blast and haul for leach and in-situ leaching of rubblized material. Copper is recovered by sulfuric acid leaching and SXEW processing.

Notes from talk taken February 28, 2002 by Keith R. Long, Economist, Geologist, USGS – Tucson

Originally mined Oxide and El Tiro open-pits for supergene enriched ore (~1 percent Cu) which was processed by flotation. In 1997, an SXEW plant was built adjacent to the old flotation mill next to the Oxide open pit. Mining resumed in the Oxide and El Tiro pits, and the North Silver Bell and West Oxide pits were opened.

Ore is overlain by a leached capping of hematite-limonite-goethite-jarosite some 100 feet thick. Contact with the underlying enriched zone is horizontal and sharp. Mineralization in the enriched zone consists of disseminated and vein chalcocite and oxide copper (malachite-chrysocolla-azurite, with lesser cuprite and native copper) in skarn. Protore below the enriched zone has a grade of 0.2 to 0.25 percent copper.

Currently mining chalcocite and oxide copper ore with a cut-off grade of 0.15 percent copper. Ore is mined in 40 foot benches with a blast-hole spacing of 22 to 35 feet, depending on rock type and alteration. Ore is neither blended or crushed. Run-of-mine ore is stacked on 20 foot lifts and leached 60 days.

Material less than 0.15 percent copper but more than 0.1 percent copper is rubblized in-place, terraced with bulldozers, and leached in-situ. Rubblizing is accomplished with 9-inch diameter blast holes up to 240 feet deep. Material does not move when rubblized. Adjustments to explosive loading practices has optimized mineral fragment size. This is a very inexpensive mining method, but only 30 percent of the copper in rock rubblized is recovered as cathode.

The SXEW plant produced 62 tpd cathode copper. PLS grade is 1.47 grams copper per liter. Some 8,000 gallons of solution are treated per hour. The plant achieves 92 percent solution extraction efficiency and 92 percent current efficiency.

Significant (350 Mt ?) reserves have been added from recent exploration drilling.