

SEG 2024 Conference: Sustainable Mineral Exploration and Development

Insights into Enhanced Brownfield Exploration Techniques at Morenci for Improved Ore Characterization and Mineral Reserve and Resource Addition

Paul Albers¹, William Stavast¹, Logan Hill²

1. Freeport-McMoRan Exploration Corporation, Tucson, AZ, USA, 2. Freeport-McMoRan Morenci Operations, Morenci, AZ, USA

The mineral deposits of the Morenci district consist of copper oxide, secondary sulfide, and primary sulfide mineralization associated with a large porphyry copper system. Geologic studies indicate that a complex series of Tertiary igneous intrusive rocks were emplaced within Precambrian-age granite and overlying Paleozoic and Mesozoic sedimentary rocks. Several cycles of leaching and enrichment of the primary sulfides formed the secondary sulfide enrichment blanket and copper oxide zones currently being mined.

Morenci has had a long history of exploration, development, and production that dates back to the first records of copper mineralization identified in 1863. 43.9 billion pounds of copper have been produced since 1906, including 13.9 billion pounds of copper since 2007. World-class mining and production rates have been coupled with systematic brownfield exploration drilling programs to replenish and expand mineral reserves and resources, extend the mine life, and optimize the mine plan. Nearly 3 million feet in 2,000 drill holes of core and reverse circulation methods were drilled over the last two decades. Improved core logging workflows at a Tucson-based centralized location, coupled with technological advances, are key for enhanced orebody knowledge and characterization. The exploration drilling also serves as a valuable input to ore characterization, geometallurgical/geomechanical studies, and leaching initiatives. Detailed geological logging with the support of predictive lithology from geochemistry and geotechnical logging via high-resolution imagery has improved workflows and consistency. Drill samples include a multi-element suite analytical package coupled with mineralogy and geochemistry from XRD and XRF, which has provided significant improvements for material characterization. Enhancements in geologic resource modeling methods have been important components of this process. This presentation for enhanced brownfield exploration, including approaches taken and value gained, positions Morenci well for continual production.