

Technological Innovations in Exploration and Mining – Success Stories from a Copper Miner

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Technological advances applicable to the mining industry have expanded, and with increased demand for data, Freeport-McMoran Exploration looks at advances in analytical geochemistry, mineralogy, geometallurgy, geomechanics, core scanning, software, data analytics, and AI/ML, and has successfully applied them to exploration efforts, ore characterization, and downstream products for mine planning, blasting, and geometallurgy.

We built a centralized core processing facility and mineralogy lab capable of processing up to 10,000 samples/month, collecting trace element and quantitative mineralogy data with XRF, XRD and SWIR on 10-foot/3-meter drillholes samples. The data complements assay and trace element geochemistry from the analytical results for over 50 elements and analytes, also on every sample. Combined with high-resolution photography, core scanning, data analytics and machine learning, application of these technologies enables us to perform auto-RQD measurements and detail logging with more accuracy, consistency, and efficiency, improve the identification and differentiation of lithology and alteration, leading to better targeting/discoveries. We added items in our resource models that help predict downstream processing issues, e.g., calcite for acid consumption or pyrite for acid generation on leach pads, feldspars and quartz affecting hardness for blasting and comminution, clays affecting milling and blending/routing, and deleterious elements that affect flotation.

To handle the significant increase in data, we expanded our GIS capabilities for compiling and viewing geologic mapping, surface geochemistry, geophysics, drillholes, and land status. We are merging data from multiple sites into a unified database to improve consistency and efficiency in logging and oretype characterization. Data accessibility is enhanced by innovative platforms such as Power BI and web-based viewing platforms for our database software. With these developments, we continue to enhance the orebody knowledge of our mineral deposits, which improves targeting, routing, and processing decisions, and positions us well for strategic growth opportunities.