

AI-assisted Geological Modeling at Bingham Canyon: Integrating Machine Learning with Legacy Datasets in a Historic Porphyry System

Jen Ellis¹, Maureen Moore-Roth², Robert Slade²

¹Rio Tinto, Salt Lake , United States, ²Maptek, Denver, United States

The implementation of artificial intelligence (AI) is transforming how geologists engage with large, legacy datasets in long-lived mining districts. This study applies AI-driven geological modeling to the historic Bingham Canyon porphyry copper system, one of the world's largest and longest-operating open-pit mines with over 120 years of continuous data collection. Bingham Canyon's uniquely comprehensive dataset, more than 6,000 drill holes and over one million blast-hole samples, provided an ideal environment for testing the practical integration of AI with conventional geological workflows.

The approach uses machine-learning engine in conjunction with implicit modeling methods to evaluate how AI-assisted tools can be operationally embedded within established geological interpretation processes. The workflow establishes rapid scenario testing across decades of lithological, geochemical, and structural data, generating domain models that would be impractical to produce manually at this scale. Crucially, the system produced quantifiable confidence outputs, including confusion matrices, which highlighted both expected and unexpected areas of uncertainty. These confidence measures improved model transparency and focused geological review where needed, strengthening the partnership between AI-assisted outputs and expert interpretation.

The results demonstrate that AI and existing modeling function most effectively as complementary tools. AI excels at processing vast, complex datasets, revealing patterns, inconsistencies, and uncertainty at speeds far exceeding manual methods; existing modeling methods and geological expertise then refine and validate these insights. This integrated workflow enhanced data consistency, accelerated interpretation cycles, and improved transparency in geological modeling for a mature, highly complex deposit.

This case study shows how new computational technologies can extract fresh insight from old deposits, supporting more robust decision-making and extending geological understanding in one of the world's most iconic mines.