SEG 2024 Conference: Sustainable Mineral Exploration and Development

Geometallurgical Evaluation of a Tailing Storage Facility to Address Environmental Concerns and Maximize the Extraction of Contained Resources

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A comprehensive geometallurgical evaluation of tailings material from a high-sulfidation epithermal gold deposit stored in a historic tailings storage facility (TSF) was carried out with the main objectives to (a) constrain the presence and distribution of minerals and elements of environmental concern, in particular pyrrhotite, and (b) to provide a robust estimate of the resource potential (e.g., recoverable value) of the fine particulate material in the TSF. Resource potential was considered not only for the deportment and mineralogy of remaining gold, but also for possible use of the silicate fraction for industries such as ceramics, glass, and geopolymer production.

To achieve these objectives, a drill core campaign was initiated, strategically selecting six drill holes for optimal representativity based on expected sedimentation patterns in TSFs. Drill core material was thoroughly characterized using automated mineralogy, geochemical, and hyperspectral methods. Geometallurgical domains were then defined based on 64 geochemical assays, particle size measurements, and quantitative mineralogical assessments. A hierarchical Mahalanobis distance cluster analysis was used to distinguish domains, and predictions for these domains were extended to all hyperspectral imaging samples. This comprehensive approach resulted in the delineation of four distinct domains, along meaningful spatial continuity patterns, each domain characterized by distinct modal mineralogy and geochemistry. The exercise provided valuable insight into the heterogeneity of the tailings material, laying the groundwork for targeted interventions to address environmental concerns and maximize the extraction of resources contained in the studied TSF.