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Predictive Mineralogy in Mineral Exploration and Waste Rock Management

Katharina Pfaff[1], Daniel Schmidt[1], Brian Goolsby[2], Chad Ostrander[2], Nigel M. Kelly[3], Jonathan Knapp[3], Thomas Monecke[1], Aaron Noble[4], Annelie Lundström[5]
1. Center for Advanced Subsurface Earth Resource Models, Colorado School of Mines, Golden, CO, USA, 2. Hitachi High-Tech Canada, Toronto, ON, Canada, 3. Bruker Nano Analytics, Madison, WI, USA, 4. Virginia Tech, Mining and Minerals Engineering, Blacksburg, VA, USA, 5. Minalyze AB, Sävedalen, Sweden

Quantitative scanning electron microscopy (automated mineralogy) has been extensively used in the mineral processing industry to characterize ore and tailings to evaluate the efficiency of mineral extraction. However, the data-rich product of automated mineralogical analysis suggests powerful application in a predictive context to solve a range of issues throughout the mine life cycle. The ongoing study described here demonstrates that automated mineralogical analysis on exploration drill core may be useful beyond developing exploration models but may also be used to predict the potential environmental impact of future waste rock.

In this study, exploration drill core from the Idaho cobalt belt was analyzed using continuous XRF core scanning, allowing classification of the wall-rocks surrounding the ore zones into different waste rock types through cluster analysis. These different waste rock types were subsampled for automated mineralogical analysis to fully characterize their mineralogy and textural characteristics to predict their acid generating potential. This project demonstrates that such a holistic approach to rock characterization using data generated during exploration yields significant value to mining companies. By properly applying the mineralogical data, companies can thoroughly assess the environmental impact of mining early in the development cycle, allowing them to optimize their strategies for mine waste management and ultimately reduce their environmental footprint. Effluent waters derived from waste material that has a low probability of generating acid would need little or no treatment prior to release into the environment whereas waters emitted from waste materials that are producing acids would need to be mitigated.

Proactive waste management strategies, such as waste sorting and reutilization could significantly reduce operation costs, including costs associated with environmental mediation. Future research will be conducted on exploitable mineral precipitates formed from acid mine drainage to investigate whether their chemical composition (including their critical minerals potential) can be predicted.