

Domaining Acid Rock Drainage Risk Using Automated Mineralogy and Geometallurgical Tools

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Sulfide oxidation and resultant acid rock drainage (ARD) formation depends on numerous variables, including chemical and physical properties of sulfide minerals, and the occurrence and distribution of potential neutralizing minerals (e.g., carbonates). Consequently, mineralogical characteristics of ore and waste units need to be understood to predict their likelihood of acid formation. However, most mineralogical techniques require careful sample preparation (e.g., X-Ray diffractometry) and often, only a few samples can be analyzed due to expense (e.g., electron microprobe analysis) or dedicated expertise required to interpret the output data (e.g., laser ablation ICPMS). Consequently, the mining industry prefers geochemical techniques (e.g., static tests) to predict ARD risks, despite the fact that such an approach has serious limitations. Clearly, new domaining and prediction methodologies that rely on mineralogical and textural data are required. However, such datasets must be acquired in a rapid and cost-effective manner and generate statistically valid data that can be used to support waste classification schemes ultimately leading to accurate ARD prediction. We have addressed this need by developing environmental geometallurgy indicators, and the computed acid rock drainage (CARD) risk grade tool.

These new methodologies were tested using in a pilot study using drill core samples (n = 70) obtained from the Comstock Chert, a new prospect being explored near Mt. Lyell, Western Tasmania, Australia. Two lithologies with differing ARD characteristics were sampled, the Tyndall Group Lynchford member recognized as a carbonate breccia, and the pyrite-bearing Lyell schist. These samples were subjected to a range of mineralogical analyses, routine ARD geochemical tests (e.g., paste pH; acid base accounting, ABA; net acid generation, NAG), field-based techniques (e.g., portable X-ray fluorescence, pXRF; short-wave infrared spectrometry, SWIR), and geometallurgical analyses (e.g., hyperspectral logging, Equotip). This study demonstrated the following: (1) hyperspectral data allows identification of acid-neutralising carbonate minerals when used alongside paste pH and total sulfur values; (2) Equotip hardness data provide a conservative indication of lag-time to acid formation when used with total sulfur values; (3) CARD risk grading accurately identified high and low risk ARD domains; and (4) pXRF data provides a sound indication of the abundance of environmentally significant elements. Collectively, these tools can be used to perform ARD risk domaining at the early stages of mining operations.