Geoenvironmental Properties of the Quebrada Blanca Deposit Waste Rock Using Hyperspectral Mineralogy

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Chile produced 5.73 Mt of copper by 2020, primarily resulting from the exploitation of porphyry copper-type deposits. Considering cut-off grades averaging 0.5% it is estimated that 99% of the mined materials are non-ore materials (e.g., waste rock, spent heap leach, tailings, etc.). Chilean mine sites produce 530 Mt of tailings per year, with approximately 1.5 Mt deposited every day. Recent calculations confirm that ~11.0 kMt of tailings are distributed in 757 tailings storage facilities. Commonly, these non-ore materials can contain pyrite (FeS_2), which under surficial conditions, can oxidize to produce acid and metalliferous drainage (AMD). However, non-ore materials can also represent vital sources of supplementary metal commodities (primary and critical metals) that can be recovered after mineral reprocessing of tailings or directly from waste rock.

Traditionally, the environmental characteristics of future waste materials are defined using established chemical tests (e.g., static and kinetic tests). However, these do not routinely consider the measurement of mineralogical properties in detail. To address this gap, the study aims to develop a 'predictive environmental reactivity assessment toolkit'. The approach is being developed using drill core materials at the Quebrada Blanca Cu-Mo porphyry hypogene deposit located in Northern Chile to predict the properties of future non-ore materials. The research program will evaluate the mineralogy of samples across different lithologies and alteration zones, including environmental forecasting as well as potential source for supplemental extraction, using the combination of: (1) clustering analysis of available raw hyperspectral data; (2) industry-standard chemical tests; and (3) mineralogical and geochemical quantification. The expectation is to generate geoenvironmental domains based on hyperspectral mineralogy, environmental reactivity in a more selective way and assist with future non-ore materials management at early life-of-mine stages.