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3D Mineralogical Analysis Using X-Ray Attenuation Computed Tomography (CT) and XRF to Determine Geoenvironmental Reactivity of Future Non-Ore Material

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Tailings from Cu-porphyry deposits typically contain pyrite (FeS_2), which may oxidise under surficial conditions to produce acid rock drainage (ARD). Evaluation of ARD potential is defined using conventional industry-standard laboratory-based static and kinetic chemical tests. These analyses do not often consider the mineralogical properties due to high analytical costs; therefore, statistics and representativity is impacted. Geometallurgical programs may sample between 0.5 and 1.0% of the ore while non-ore materials are poorly characterised in terms of mineralogy.

This research utilises computed tomography (CT) analysis of drill core samples from the Quebrada Blanca porphyry Cu-Mo deposit located in northern Chile. The Quebrada Blanca Phase 2 project (QB2) is currently under construction and is focusing on the development of the hypogene (sulphide-rich) zone. QB represents one of the world's most significant copper resources with reserves of 1.43 Bt @ 0.51% Cu.

CT is a non-destructive technique that uses high-power X-rays to image the internal 3D structure of various materials with broad applications in geoscience, particularly in the reconciliation of stereological errors generated by conventional 2D mineralogical analyses. The GeoCore X10 3D tomographic method combines X-ray attenuation and X-ray fluorescence (XRF) measurements of total or half-core samples. The sizeable 3D voxel resolution allows coarse textural analysis which, combined with elemental analyses by XRF, enables the detection of particularly high-attenuation minerals (e.g., sulphides, gold, silver). Finer sulphide textures that may drive reactivity will be analysed using SEM-based and micro-CT methods. The results of this research, combined with additional mineralogical and geochemical analyses, could generate geometallurgical indexes for ARD potential risk predictions of QB non-ore material. Robust non-ore-type domains will consequently be obtained at early stages of the life-of-mine cycle (LoM).