Geometallurgical analysis using computed tomographic core scanning

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The breakage parameters of all rocks are inherently controlled by physical characteristics, with the broad concept of texture being a key variable. Here we consider texture to encompass a range of rock characteristics including the composition, size, shape and distribution of each mineral phase and the interconnectivity and boundary association of each phase observed at a range of geologically significant scales. Whilst such features can be extracted from 2D and 3D analytical methods (e.g., SEM microscopy and micro-CT scanning), representative sampling of geological variability and heterogeneity is rarely achieved. Geometallurgical studies attempt to maximise deposit knowledge through integration of multidimensional datasets to evaluate geological heterogeneity at a range of scales across a deposit.

Here we present the use of a new computed tomographic core scanner, the Orexplore GeoCore X10, that can analyse full geological drill cores. The GeoCore X10 generates a 3D attenuation map where selectable colour intensities correspond to X-ray attenuation of the material. An XRF spectrometer simultaneously generates multielement geochemical data from the core. The system uses minerals as building blocks; weighs the sample; calculates the volume from tomography; and assesses concentration values for the elements from stoichiometry. In the tomographs, ore minerals e.g., gold, galena and scheelite can be discriminated from gangue phases including quartz, carbonate and pyrite at voxel resolutions between 75 and 200 μm.

This study reports the 3D characterisation of ores from Au and Cu deposits using the GeoCore X10 to extract textural information relating to gold size, shape and mineral association. Significantly, the GeoCore X10 can resolve relationships with meso-textural features which generate anisotropy within the rock volume. This includes veins, bands and clustering of minerals which are here described in relation to their predicted behaviour (liberation, size distribution) during rock breakage.

This study highlights the potential of non-destructive, in situ CT-scanning to determine textural relationships at geological-scales relevant to geometallurgical and geoenvironmental modelling of ore systems.