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Multisource rock characterisation at microscale for a better understanding of processing characteristics

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ABSTRACT

One of the main challenges for current and future mining and processing methodologies is to deal with the variability of rock characteristics. This variability affects how the rock behaves in the processing plant, as well as the economic feasibility of the project. Until now, there has not been a detailed understanding of how intrinsic rock properties, such as mineralogy or texture, impact the processing of an ore type. For example, the rock characteristics that control the energy required to break the rock in each comminution stage are still not completely understood. Knowledge of how these intrinsic rock properties affect processing could lead to the development of transformative technologies or targeted processing methodologies aimed at achieving more efficient processing.

With advances in imaging and computing in recent years, it is now feasible to analyse thousands of images of rock texture from a wide range of sources such as an optical microscope, scanning electron microscope (SEM)-based automated mineralogy systems and X-ray micro-tomography. The SEM-based systems are commonly used for rock characterisation in mining, and deliver an outstanding identification of major minerals. However, this technology is not capable of detecting mineral grain boundaries which may be important features in terms of how a rock breaks. However, advances in optical microscopy imaging allow us to identify grain boundaries and thereby complement SEM-based systems. Alongside these tools which measure rock characteristics in polished sections as 2D data, the integration of X-ray micro-tomography systems as a tool for rock characterisation allows characterisation of intact rock in 3D. This provides useful information on important characteristics such as porosity and 3D orientations of mineral grains, which have been identified as potential major influences in the processability of ores.

This study focuses on the integrated use of these characterisation techniques to quantify the mineralogy and texture of rocks from ore deposits at the microscale, which provides key data for predicting how each rock type responds in mineral processing operations. Four rock types with a range of textures were analysed with these three techniques and different information was extracted from each measurement, demonstrating that these systems provide complementary data. The identification of the essential characteristics for processing at microscale is a key step forward for the adoption of the newest rock characterisation technologies into the mining industry and for the development of future processing technologies based on understanding the properties of the rock being processed.