Applications of Automated Quantitative Mineralogy in Geometallurgy

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Most deposits display a high degree of geological and mineralogical complexity that can have serious consequences in metallurgical processing. Therefore, the proper characterization of the ore and gangue minerals requires a multi disciplinary approach combining geology, mineralogy, geochemistry and processing. However, mineralogy to a large extent informs the metallurgical process and SGS has pioneered the application of automated mineralogy as a practical tool for this purpose, using QEMSCAN and other methods, throughout the mining chain from advanced exploration through to production. In this presentation we discuss actual case histories where automated mineralogy has been applied in a geometallurgical framework at a pre-feasibility to feasibility level. We will discuss examples from a magmatic Cu-Ni, a strongly serpentinized magmatic Ni, and a REE deposit.

Mineral speciation and ratios, e.g., chalcopyrite, cubanite, and pentlandite/pyrrhotite are critical to model the Cu-Ni magmatic deposit. The ratio of the Cu-sulfides and that of pentlandite/pyrrhotite are used to delineate the distribution of high Cu grade and Ni zones. The Cu-sulfide ratio can impact the Cu grade because of the presence of two Cu sulfides with different Cu concentration. The pyrrhotite variation can impact the nickel circuit performance and decrease the nickel concentrate grade. Therefore, such features are critical when modelling the deposit.

In the serpentinized Ni ore, automated mineralogy is used to speciation the Ni minerals into sulfides, alloys and refractory Ni in the silicate matrix. The mineralogical results are linked to the metallurgical test work in order to model the geometallurgical domains. Thus, the understanding of the spatial variability of the Ni distribution as recoverable and non-recoverable is key to understanding the metallurgical performance.

Quantification and speciation of the rare earth minerals, coupled with geological and geochemical data, can help delineate REE zones. The liberation and association of the REM and gangue minerals is critical for selecting the proper beneficiation method (i.e., flotation, gravity). Furthermore, metallurgical balances using only REE (e.g., Ce, Y) are not adequate to understand the high or low recovery of certain minerals. Mineral balances are necessary in order to optimize the process. The data can then be used to populate the geological and mining models in order to at least optimize the REE recovery.

These case studies will illustrate how mineral quantification and improved understanding of inherent mineralogical parameters in relation to metallurgy reduce technical risk in both exploration and flowsheet development.