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SWIR application in alteration mapping and geometallurgy at the Kyisintaung high sulfidation copper deposit, Monywa ore field, Myanmar

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The Monywa copper district is located in central-west Myanmar, approximately 600 km NNW of Yangon, and 115 km WWN of Mandalay. There are four deposits in the Monywa district. The Kyisintaung deposit contains >400 million tons of ore, including >1.2 million tons of copper resources. Hypogene chalcocite is the dominant ore-mineral in the Kyisintaung deposit, and is associated with minor covellite, digenite, and enargite. Supergene chalcocite locally occurs as discontinuous lens or blankets. In the hypogene zone, supergene chalcocite commonly coats the hypogene ore minerals. Heap leaching and the SX-EW method is used for processing due to the good leaching effect of chalcocite.

The main mineralization is closely associated with different types of high-sulfidation hydrothermal alteration minerals, including anhedral quartz, alunite, pyrophyllite, muscovite, illite, smectite, dickite, and kaolinite. Most of the alteration minerals are fine-grained and with complicated paragenetic relationships. Shortwave infrared spectroscopy (SWIR) analyses have been conducted on diamond drill cores and blast hole chips to identify the alteration minerals. The spectral absorption features between 1300 and 2500 nm have been examined in detail. The peaks of 2200nm AlOH absorption bonds are the key features to distinguish different mineral groups and subtypes of minerals in the muscovite group. We built a deposit-scale three-dimensional alteration model in the main mineralization zones, using more than 4,000 SWIR results on diamond drill core samples and 1,600 results on blast hole chips. Seven main alteration types were indentified, including massive silica, massive alunite, pyrophyllite-alunite, illite-alunite, sericite-alunite, kaolinite, and dickite zones. Mineralization is pervasive in all of the main alteration zones. But the ore and gangue mineral distribution and the mechanical properties of run of mine (ROM) is quite different. Chalcocite dominantly occur as veins and the cement of breccia in the alunite, pyrophyllite-alunite, illite-alunite, and sericite-alunite zones. Chalcocite is disseminated in the massive silica, dickite, and kaolinite zones. The covellite/chalcocite ratio is much higher in dickite zone than other alteration areas.

The differences of the ore and alteration mineral assemblages, textures, and spatial distributions will strictly affect the method and schedule of heap-leaching as well as the total leaching rate and recovery. Therefore a crusher-conveyer-stacker system is recommended to treat the ROM from the alunite, pyrophyllite-alunite, and dickite zones to reduce the boulder size to expose more free face for the ore, because the ROM in these zones are impermeable and gangue minerals are refractory to the sulfuric acid and sulfur-oxidizing bacteria processing. On the other hand, ROM in the illite-alunite, sericite-alunite, and kaolinite zones could be directly tipped by dump truck to build the leach pad in order to keep the boulder size, because the muscovite group minerals would partially alter to kaolinite or smectite in the low-pH leaching environment and destroy the primary texture and reduce the permeability of the leach pad. In conclusion, SWIR can be well applied to detailed alteration mapping in high-sulfidation deposits. Furthermore, different strategies for geometallurgy will be used based on the property of ROM in different alteration zones.