SEG 2017 Conference

Answers at the speed of light: Synchrotron solutions for mineral exploration, production, and remediation

Neil Banerjee*, Lisa Van Loon

*Western University, London, Canada, ON, Email: neil.banerjee@uwo.ca

Synchrotron solutions for life of mine (mineral exploration, production, and remediation) studies is a novel niche presently under-utilized in our field. Harnessing synchrotron light for micron- to millimeter-scale analysis provides a powerful tool that addresses industry relevant problems using a rapid, high-resolution analytical technique. Through a unique collaboration between academia, industry, and synchrotrons we are tackling this problem head on to develop techniques for the geoscience community and mining industry.

Synchrotron micro X-ray fluorescence (µXRF) provides rapid and cost-effective micron- to millimeter-scale trace element analysis and mapping of ore minerals, rock slabs, and core with ppm detection limits. Speciation of trace elements important for understanding element mobility can be probed using X-ray absorption near-edge structure (XANES) spectroscopy. Large-scale (tens of cm) µXRF mapping and XANES analysis of half core samples associated with gold deposits in Canadian greenstone belts have revealed detailedmineralization histories and novel trace element exploration vectors. Gold in these deposits is commonly intimately associated with pyrite mineralization but is present both as free and/or “invisible gold”, bound in the pyrite crystal lattice. The high flux and energy of a synchrotron allows for in situ and non-destructive detection of invisible gold by uXRF and can probe its nature (metallic Au0 vs. lattice bound Au+1) using XANES spectroscopy.

For regulatory compliance, it is important to determine which minerals are present in any tailings management facility and how they evolve over time. XANES spectroscopy is an excellent tool for determining element speciation. Mineral phases can be accurately identified as well as relative amounts determined. With this information the oxidation-reduction of deleterious-element bearing compounds (e.g., As, Se, Mo, Cr, etc.) can be monitored and effective management practices implemented to ensure long-term capture of toxic phases.