Applications of Synchrotron Spectroscopy to Ore Discovery

NEIL R. BANERJEE[1], LISA L. VAN LOON[12]

[1]Department of Earth Sciences, Western University, London, ON (*correspondence: neil.banerjee@uwo.ca)
[2]LISA CAN Analytical Solutions Inc., Saskatoon, SK (lisacananalytical@gmail.com)

Today, the discovery of new world-class mineral deposits requires novel methodologies and approaches to deteect large-scale ore-forming systems and the vector toward their high-grade cores. Through a unque collaboration between academia industry, and synchrotrons, we are tackling this problem head on to develop novel analytical techniques for the minerals industry. Questions from across the life of mine – exploration, processing, and remediation – can be addressed using synchrotron science. Our innovative approach in harnessing synchrotron light for micron to meter analyses provides a powerful tool to address industry-relevant problems using a high-fidelity analytical technique that is both rapid and cost-effective.

Synchrotron X-ray fluorescence (SR-XRF) provides micron-scale trace element analysis and mapping of ore minerals with ppm detection limits. Synchrotron X-ray absorption near-edge structure (XANES) spectroscopy is useful for identifying the speciation of elements to improve geometallury and better understand element mobility within a geological system. Synchrotron X-ray diffraction (SR-XRD) enables the determination of the mineralogical make-up of geological materials, mineral processing residues, and mine wastes. By utilizing these techniques in combination, a richer, more complete characterization of these complex materials is being developed.

Case study:

The Yamana Gold Inc. Monument Bay Project is made up of enconomically promising Archean shear-hosted gold-tungsten deposits in northern Manitoba, Canada. SR-XRF mapping is being conducted on drill core and offcuts to identify elemental correlations between gold, arsenic, and tungsten. The spatial geochemical information obtained within the structural and mineralogical framework of the samples is providing an opportunity to develop innovative exploration vectors. SR-XRD on corresponding pulp rejects is being used to characterize mineralogy across the property. XANES spectroscopy is being conducted *in situ* on drill core samples to non-destructively probe the nature of invisible gold associated with pyrite and arsenopyrite mineral phases as either metallic Au^{0} or lattice-bound Au^{+1}.