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Accelerating Geochemical Insights: In-House X-ray Absorption Spectroscopy for Arsenic Speciation in Gold Mining Workflows

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easyXAFS

In gold mining operations, the occurrence of arsenic (As) within host minerals—particularly arsenian pyrite and arsenopyrite—presents significant challenges for both mineral processing and environmental stewardship. Traditionally, determining the exact oxidation state and coordination environment of arsenic (speciation) has necessitated the use of synchrotron radiation. While providing high-quality data, the logistical bottlenecks and long lead times associated with synchrotron access often render these insights retrospective rather than proactive. This presentation explores the transformative potential of **laboratory-based X-ray Absorption Spectroscopy (XAS)** for the direct measurement of arsenic speciation within geological thin sections.

By utilizing laboratory-scale X-ray sources and optimized optics, this instrumentation allows for the collection of **X-ray Absorption Near-Edge Structure (XANES)** and **Extended X-ray Absorption Fine Structure (EXAFS)** data **either directly at the mine metallurgy lab or regional lab**. Measuring arsenic speciation in thin sections preserves the paragenetic context, facilitating a comprehensive understanding of how arsenic is hosted within the mineral matrix. This capability provides a critical bridge between bulk geochemistry and micro-mineralogical characterization.

The value proposition for integrating lab-based XAS into industrial mining workflows is twofold:

- **Process Optimization:** Real-time knowledge of arsenic speciation (e.g., $\mathbf{As^{-1}}$ vs. $\mathbf{As^{3+}}$ or $\mathbf{As^{5+}}$) allows for the dynamic adjustment of roasting or pressure oxidation parameters, directly impacting gold recovery rates in refractory ores.
- **Environmental Risk Mitigation:** Proactive characterization of arsenic mobility in tailings and waste rock enables more accurate predictive modeling of acid mine drainage and leaching behavior, ensuring compliance and reducing long-term liability.

By transitioning XAS from a specialized research tool to a standard industrial analytical asset, mining operations can achieve superior metallurgical control and environmental oversight. This talk will detail the technical feasibility of these measurements on standard thin sections and discuss the strategic advantages of decentralized, high-fidelity geochemical analysis.