Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.34422

Translating Fundamental Geochemistry through Practice-Driven Partnerships

VINCENT NOËL

SLAC National Accelerator Laboratory

Addressing environmental contamination, resource sustainability, and the energy transition requires fundamental geochemical insight that can translate from molecular-scale process understanding to actionable solutions, with partnerships serving as key enablers of that translation. This presentation traces a pathway in environmental geochemistry shaped by sequential academic–industry and academic–government collaborations, progressing from impact assessment to remediation refinement and analytical innovation.

Collaboration with the nickel mining industry in New Caledonia anchored fundamental investigations of contaminant mobilization in mangrove intertidal forests—ecosystems that function as key biogeochemical filters regulating the transfer of metallic contaminants from land to marine and lagoon environments. By resolving nickel cycling and redox controls at the molecular scale, this partnership established process-based baselines that distinguish natural variability from mining- and land-use–driven perturbations. Framing fundamental biogeochemical questions within realistic industrial disturbance scenarios enabled direct relevance for land management and industrial decision-making, and demonstrated that mangrove preservation is a critical lever for limiting metal release under changing redox conditions.

Building directly on this impact-focused, molecular-scale understanding, a subsequent partnership with the U.S. Department of Energy Legacy Management program shifted the focus from impact assessment to understanding the mechanisms by which contamination persists despite active remediation. In floodplain aquifers of the Upper Colorado River Basin, uranium plumes originating from former ore-processing operations remain sustained by secondary sources and redox-driven remobilization, even after decades of intervention. Integrated field investigations and synchrotron-based characterization identified the biogeochemical controls governing uranium accumulation, stability, and release, enabling critical evaluation and refinement of remediation strategies and long-term site management.

Across both systems, a recurring limitation emerged: contaminants often move as colloidal or nanoparticulate species whose chemical forms govern transport and reactivity but are poorly resolved by conventional methods. A collaboration with an instrument manufacturer addressed this limitation by co-developing workflows that couple field- and flow-based separations with synchrotron X-ray spectroscopy while preserving redox integrity. Together, these partnerships demonstrate how fundamental geochemistry can be converted into scalable tools that connect ecosystem protection, remediation performance, and analytical innovation to sustainability and net-zero objectives.