Investigating Silver Nanoparticle Transport in Soil via Synchrotron X-Ray Microtomography

IAN L. MOLNAR[1*], DENIS M. O'CARROLL[1], JASON I. GERHARD[1] AND CLINTON S. WILLSON[2]

[1]University of Western Ontario, London, Canada, imolnar@uwo.ca (*presenting author)

[2] Louisiana State University, Baton Rouge, U.S.A., cwillson@lsu.edu

The rapidly increasing production and use of nanoparticles carries with it a risk of their release into the subsurface environment, contaminating aquifers that are either used for municipal drinking water or discharge into surface water bodies. To consider their risk, it is necessary to understand nanoparticles' fate in the subsurface. However, nanoparticle transport in the subsurface environment remains poorly understood and developed relationships are specific to the imposed experimental conditions and particle type. This research aims to improve our ability to non-destructively measure pore-level concentrations and distribution of nanoparticles in an effort to better understand the soil - nanoparticle interactions and role of pore geometry.

Synchrotron x-ray computed microtomography (SXCMT) is widely used for imaging soil and rock cores and fluids occupying their pore space. The high resolution, three-dimensional, quasi-real time datasets output by SXCMT are capable of accurately quantifying silver nanoparticle concentrations within a porous media. These datasets can provide valuable information about silver nanoparticle distribution throughout the pore-network and even within each individual pore. This presentation will: outline an SXCMT method for imaging and quantifying aqueous silver nanoparticle solutions in porous media, present and analyze and number of time-lapse images of silver nanoparticles invading and evacuating a variety of water saturated soil types and examine the role of intra and inter-pore geometry on nanoparticle transport and deposition.

Targeting sites for exploration for precious metal mineralization in the Guanajuato district, Mexico using petrography and fluid inclusions

D. MONCADA* AND R.J. BODNAR

Department of Geosciences, Virginia Tech, Blacksburg, VA 24061 USA, moncada@vt.edu (*presenting author)

The search for mineral deposits is a time consuming, risky and very expensive process. Any technique that can help the explorationist to quickly and inexpensively discriminate between areas with high potential for economic mineralization and those with lower potential provides a competitive advantage to those applying the technology. In this study, we describe a technique based on petrography of gangue minerals and fluid inclusion characteristics that may be applied in exploration for precious metal deposits to identify targets from surface, drill holes and underground workings.

The Guanajuato mining district in Mexico was discovered 1548. This initial discovery was in the la Luz area with major northwest trending vein systems. The mining in the area has been continuous and recent exploration programs to search for new targets have been successful. Mineralization in veins show variability, from gold-rich to silver-rich, in going from west to east. Ore textures also vary and include void space that formed during multiple fissuring events, banded quartz veins, vuggy quartz, lattice bladed calcite, lattice bladed calcite replaced by quartz, massive quartz veins and stockworks with adularia and sericite/illite. More than 200 samples from nine veins representing all different styles of mineralization were collected from the La Luz system, and the mineral textures and fluid inclusion characteristics of each sample have been defined. In addition, each sample was assayed for Au, Ag, Cu, Pb, Zn, As and Sb. Some drill holes were assayed for 34 elements.

Samples from the La Luz system show a wide range in silica textures. The veins that have been studied show a range in textures, including colloform, plumose and jigsaw texture, quartz that are all indicative of rapid precipitation, such as occurs when fluids boil. Other mineral phases, including illite, adularia and bladed calcite are also indicative of rapid growth in a hydrothermal system and are characteristic of boiling systems. Because boiling is an effective mechanism for precipitating gold and silver from hydrothermal fluids, the presence of mineral textures indicative of boiling is a desirable feature in exploration. In many samples, textural evidence for boiling is supported by coexisting liquid-rich and vapor-rich fluid inclusions, or Fluid Inclusion Assemblages consisting of only vapor-rich inclusions, suggesting “flashing” of the hydrothermal fluids. Several traverses along outcrop on the surface and perpendicular to the veins show that samples collected from within 25 m of the main veins show increasing precious metal abundances that correlate with an increase in features that indicate boiling. Drill core samples show the same behavior, with evidence of boiling increasing within 0 to 5 m of where precious metal abundances increase. This approach helps to establish new targets for detail exploration. Importantly, textural and fluid inclusion evidence for boiling has been observed in the deepest levels of the La Luz system, suggesting that additional precious metal resources may occur beneath these levels.