Theme: * Looking to the Future: Whats Next?

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Title of Abstract: * **Numerical Modeling of Hydrothermal Ore-Forming Processes and the Link to Lithogeochemical Vectors for Exploration**

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Hydrothermal ore deposits involve complex fluid-rock interactions, where alteration zones yield information on physicochemical conditions of ore-forming processes and fluid pathways. Lithogeochemical vectors can be used to delineate alteration zones and potentially yield information for targeting ore zones for the exploration of mineral deposits. To be able to recognize these geochemical and mineralogical signatures, it is imperative to understand the underlying ore-forming processes and link them to geochemical vectors. Numerical modeling permits tracking changes in rock chemistry and metal precipitation mechanisms by simulating various alteration and fluid evolution scenarios such as boiling, fluid mixing, fluid-rock interaction, and changes in redox, pH, and temperature. The open-access MINES thermodynamic database (http://tdb.mines.edu) has been recently launched for modeling fluid-rock interaction and the chemical changes related to ore-forming processes, using the program GEM-Selektor (http://gems.web.psi.ch). The philosophy behind the MINES database is to focus on testing a series of numerical modeling projects used to simulate various ore deposits. We present a number of case studies where GEM-Selektor has been successfully applied to simulate ore-forming processes. These include Cu transport and mineralization at the Kansanshi Cu-Au deposit hosted in metasedimentary rocks, and the metasomatism of pegmatites and mobilization of rare earth elements (REEs) in the Strange Lake REE-Zr-Nb mineral deposit. We also use this method to demonstrate the coupling of complex chemical equilibria with reactive mass transport along a fluid flow path for simulating the deposition of Pb and Zn in a Mississippi Valley-type (MVT) deposit and the alteration associated with volcanogenic massive sulfide (VMS) deposits. The long-term goal of this project is the generation of a geochemical vectors database for interpreting field data, using knowledge gained from numerical simulations combined with field observations. This link between fundamental and applied research is expected to significantly advance ore vectoring for the exploration industry.

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