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SÉMINAIRE D'AVANCEMENT DES TRAVAUX DE MAÎTRISE

Maîtrise interuniversitaire en sciences de la Terre (M.Sc.), Université Laval et INRS-ETE
Mardi, le 16 mai 2023 à 09h30 via la plateforme en ligne Zoom :
https://ulaval.zoom.us/j/67499151945?pwd=aUVKR2liTmdaeTdVVGNTb0V2STRRdz09

The role of fluid-rock reactions on gold-endowment at the Meliadine gold district, Nunavut, Canada: a sulfur isotope study

by Philippe Mongeau

Orogenic gold deposits are the main source of gold in Canada, but the source of the auriferous hydrothermal fluids in such deposits remains equivocal. Further, fluid-rock reactions play an important role in gold precipitation at these deposits and influence the chemical composition of sulfides. This project aims to document the multiple sulfur isotope signature ($\delta^{34}S$, $\Delta^{33}S$ and $\Delta^{36}S$) of gold-associated sulfides in orogenic gold veins, in order to track the source and evolution of auriferous fluids and to better understand near-mine controls on gold precipitation.

The Meliadine gold district, located in the Western Churchill Province in Nunavut, hosts close to 10 Moz of gold, occurring as a series of deposits hosted in Archean host rocks of the Rankin Inlet greenstone belt. These deposits are spatially associated with the Pyke fault, forming sub-parallel quartz-carbonate vein corridors through iron formation, clastic metasedimentary and metavolcanic rocks, where replacement-style mineralization occurs in iron-rich lithologies as gold associated with sulfides.

Two generations of sulfides are recognized based on textural and chemical evidence and relationship to gold. Generation 1 corresponds to early, barren, pyrrhotite±(pyrite-chalcopyrite), while generation 2 consists of gold-associated arsenopyrite-pyrrhotite±(pyrite–galena-chalcopyrite), subdivided into 2a and 2b based on textural relationships. Multiple sulfur isotope analyses were completed in-bulk (SF_6^+-line IRMS) and in-situ (SIMS), allowing to test the efficiency of the vectoring and to better understand the role host rocks have in controlling fluid redox. Results show that the $\delta^{34}S$ sees little variation at the sample, drillhole and deposit scale with an average of $\delta^{34}S$=3.1‰±2.8 (2SD; n=238) and indicates no correlation to gold grade. Sulfur mass-independent fractionation (S-MIF) is present in all samples, yielding average values of $\Delta^{33}S$=0.3‰±0.2 (2SD; n=129) and $\Delta^{36}S$=-0.7‰±0.6 (2SD; n=58), which indicates an Archean metasedimentary input of sulfur to the auriferous fluids responsible for the formation of a Paleoproterozoic deposit. In-situ analyses show that the $\delta^{34}S$ and $\Delta^{33}S$ remain homogeneous within sulfide grains.

This new dataset shows that, here, the source of these auriferous fluids is clearly associated with fluid-rock interactions with the host-rock, and that the devolatilization of deep-seated metasedimentary and metavolcanic units during prograde metamorphism may play an important role in sourcing sulfur, key to the transportation of gold at the crustal scale.

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