

An exploration into ancient fluid chemistry in the Canadian Shield at the Lupin orogenic gold deposit, Nunavut, Canada

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The objectives of this senior thesis are to: (i) characterize the volatile chemistry and origin of hydrocarbon-carbon-dioxide-nitrogen-rich fluid inclusions occurring in the Lupin deposit, an Archean orogenic gold system hosted within banded iron formation in Nunavut, Canada, (ii) compare the fluid chemistry and origin of these Archean volatiles to those in modern petroleum-natural gas systems as well as other orogenic gold systems, in order to discern whether volatile compositions are diagnostic of their formation via abiogenic vs. biogenic processes, and (iii) develop exploration criteria that can be used to locate Archean gold systems under buried cover.

An extensive analytical study of the chemistry of the fluid inclusion gases in the Lupin deposit was undertaken by using in-line crushing gas-chromatography, laser Raman microscopy, microthermometry, and N-S-C-H isotope systematics of inclusion fluids and associated altered host rocks. These analytical tests constrained the temperature-pressure window of entrapment of these phases. Comparison to gas chemistry in conventional hydrocarbon systems was done to establish petrochemical criteria as to the diagnostic aliphatic hydrocarbon species that allow differentiation between biogenic (bacterial reduction, thermal maturation) vs. abiogenic (polymerization, Fischer-Tropsch) synthesis, and differentiation between barren and mineralized metamorphic rock suites in Archean greenstone belts.

Specific questions at Lupin that the research is addressing include: (1) What fluids transported gold and what physiochemical mechanisms caused its precipitation? (2) Does the fluid inclusion record support key elements of the genetic model for the deposit? – timing of ore fluid formation and migration with peak metamorphism? – coincident with the emplacement of Archean granitoid batholiths (3) Do the chemical characteristics of fluids provide any indication of their source (and therefore, gold source)? (4) Can deposit-scale variations in the gold grade associated with the quartz veining be rationalized with the local fluid characteristics? [Poster]