

**Unravelling sources and behaviour of lithium in the Salar de Atacama:
Halogen isotopes, Noble gases and brine-mineral element partitioning.**

Université du Québec à Montréal and McGill University, Canada



Lithium is critical for the green energy technologies that underpin the transition to a sustainable society. It enables the electrification of transportation owing to its unrivaled energy storage per unit weight. Brines in salt flats are a primary source of lithium, and South America's two main salt flats, the Atacama Desert in Chile and the Uyuni Salt Flat in Bolivia, account for 75% of the world's Lithium supply. In this research program, the Universities of Concepción and Mayor in Chile, McGill and UQAM in Canada, and the company IT2 Isotope Tracer Technologies Inc. collaborate to gain a comprehensive understanding of the hydrogeological cycle of Li in these environments, as well as its sources and enrichment processes.

We invite applications for two fully-funded graduate student opportunities hosted by the Geotop research centre (www.geotop.ca) at McGill University and UQAM in Montréal, Canada:

1. **MSc:** Halogen and noble gas isotopes as tracers for fluid and lithium sources and their fractionation during transport and precipitation.

The origin of brines and lithium in the Atacama Salars is still debated. They originated possibly during the harsh, arid conditions of the Miocene, characterized by intense evaporation, but no direct dating has ever been attempted. This study will focus on the use of Cl and Br isotopes to unravel the origin of these brines. Noble gas helium and its isotopes will be analyzed in salt inclusions to determine whether a paleo-fluid has been preserved and can provide clues to the origin of fluids, as well as a rough estimate of residence time, using U-Th/⁴He dating techniques.

We invite applicants with a proficient interest and background in geochemistry. The candidate will work in the field and the noble gas laboratory of UQAM, and possibly with a short stay at the IT2 Isotope Tracer Technologies Inc. (Waterloo, Ontario) to learn about Cl and Br analytical methodologies. This is a fully funded 2-year (MSc) position with a start date of early 2026. For questions, please contact Dr. Daniele L. Pinti (pinti.daniele@uqam.ca) and Dr. Vincent van Hinsberg (hinsberg@eps.mcgill.ca).

2. **PhD:** Brine-mineral partitioning of halogens, noble gases, and trace metals

Brines carry a fingerprint in their trace elemental and isotopic signatures of the reservoirs from which they sourced their elements and the processes that acted upon them. This is primarily controlled by the exchange of elements and isotopes between minerals and fluids. This exchange is highly systematic, and knowing the relevant partition coefficient enables understanding of brine compositions and the forward modeling of their formation and evolution. In this project, you will experimentally determine partition coefficients for Li and associated elements, noble gases, and

selected isotopes between minerals and fluids, focusing on how this partitioning is affected as the fluids evolve from dilute waters to concentrated brines. You will apply the resulting understanding of partitioning behaviour to brines of the Salar de Atacama to determine the potential involvement of magma-derived Li, the role of magmatic-hydrothermal fluids in Li-transport, and the progressive enrichment of Li in the brines. The project involves analyses of rocks, minerals, brines and salts from the Salar de Atacama region by bulk and in-situ analytical methods for major and trace elements, halogens and isotopes; mineral-fluid partitioning experiments in batch and flow-through autoclaves and pressure vessels; and geochemical modelling of water-rock interaction.

We invite applicants with an MSc degree in the geosciences and relevant research experience in geochemistry and/or experimental petrology, as well as a keen interest in critical metals, brines, and volcanic-hydrothermal systems. This is a fully funded 3-year PhD position with a start date of early 2026. For questions, please contact Dr. Vincent van Hinsberg (hinsberg@eps.mcgill.ca) and Dr. Daniele L. Pinti (pinti.daniele@uqam.ca).