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Lithium isotopes in hydrosystems: the game changer

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In Earth Sciences, the field of stable-isotope geochemistry of metals has greatly expanded over the past 25 years, primarily due to the recent introduction of a new generation of Multi-Collector Inductively Coupled Plasma Mass Spectrometers (MC-ICP-MS). These advanced instruments offer enhanced sensitivity and better precision, opening up new avenues of research in metal-isotope geochemistry.

Among the various stable-isotope systems studied, the geochemistry of lithium (Li) stands out for its excellent potential as a tracer of water/rock interactions. This is particularly relevant in low- to high-temperature hydrosystems, including surface waters, groundwaters, geothermal waters, rainwaters, and Li-rich brines. Lithium isotopes are highly effective tracers in many natural geosystems because they are rather commonly present in waters and rocks, and can be involved in water/rock interactions at the Earth's surface. This knowledge also refines our comprehension of the global lithium cycle.

Moreover, lithium holds strategic importance for numerous industrial applications. It is crucial in the production of Li-ion batteries for mobile devices and electric vehicles, and it is also used in pharmaceuticals for treating certain mental diseases. Understanding the behaviour of lithium and its isotopes during chemical weathering is essential for defining water/rock interactions at the Earth's surface.

Lithium is a fluid and mobile metallic element, composed of two stable isotopes: ^{6}Li ~ 7.5% and ^{7}Li ~ 92.5%. Due to the significant relative mass difference between the two isotopes, lithium undergoes substantial low-temperature mass fractionation. This fractionation provides key insights into many surface and subsurface processes. In this presentation, we will focus on the key results obtained from studying lithium isotopes in various hydrosystems, including rainwaters, surface and groundwaters, and geothermal waters over the last 20 years. The controlling parameters of lithium concentrations and distribution will be discussed along with isotopic fractionation models.

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