Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30615

Using lithium isotopes to model biological processes impacted by contamination

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Lithium consumption has surged dramatically since 2010, primarily driven by the boost of high-tech devices like mobile phones and laptops, as well as Li-ion batteries for electric vehicles and energy storage systems. Current Li consumption surpasses the natural river flux to the ocean (70 kt/yr), while recycling rates remain notably low. Recent studies document instances of lithium pollution in riverine systems [1], raising concerns about potential contamination of soils and littoral zones, which serve as the ultimate sink for various pollutants released on land.

Littoral environments provide critical ecosystem services and their natural biodiversity is exceptional. While microplastics, organic pollutants and several trace metals have been widely monitored and investigated in ecotoxicological studies, lithium has received little attention yet. To address this emerging issue, we investigate the biogeochemical cycling of lithium and assess its potential risks for ecosystems using its isotopic ratio (delta^{7}Li).

For this, we develop optimized and automated geochemical and isotopic techniques for measuring Li levels and Li isotopes in environmental and in biological samples using respectively last generation TQ-ICP-MS (iCap MTX) and MC-ICP-MS (Neoma^{TM}) (*ThermoFischer Sci.*).

Lithium contamination and its recent evolution is being determined for various parts of France and the European continent through the study of river waters sampled at their outlets and through the study of sentinel species bioaccumulating lithium. The transfer of lithium from the environment to aquatic organisms is being investigated experimentally [2], and cell cultures targeting ionic transporters of interest are employed to quantify kinetics effects [3].

Using sentinel species, we find that some of the large rivers display an increase of Li levels since 1990's while others not. Lab experiments and related Li isotope variations demonstrate that the excretion rate is rapid and depends on the Li environmental level and on the organism metabolism. These first results open new questions concerning the impact of anthropogenic lithium on its global cycle and its fate in the critical zone.

[1] Choi et al. (2019) Nature Communications 10, 5371. [2] Thibon et al. (2021) ACS Earth & Space Chem. 5, 6, 1407-1417. [3] Poet, Vigier, Bouret et al. (2023) iScience 26, 106887