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Why and how lithium isotopes can help tracing Li contamination and Li transfer to living species

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The global demand for lithium has surged due to the exponential growth of Li-ion batteries for electronics and EVs. With less than 10% of industrial lithium being recycled, concerns about environmental contamination have intensified. In this context, Li isotopes (δ^7Li) emerges as a powerful tool to distinguish natural from anthropogenic sources and quantify Li transfer to living species.

In this study, compilation of published (1,2) and new data reveals that the anthropogenic endmember exhibits a low average δ^7Li value (10.1‰ ± 5.7‰), distinct from fresh waters (21‰ ± 7‰) and oceanic values (31‰ ± 0.5‰). This low δ^7Li value aligns with measurements in resource rocks (0-13‰, brines, pegmatites) (3,4). Among anthropogenic materials, Li-batteries show the lowest δ^7Li values (8.6‰ ± 4.5‰), while detergents (15.4‰ ± 6‰) and drugs (12.8‰ ± 1‰) are higher. Wastewaters display a wide range of values (7‰ to 16‰), reflecting a mix of natural and anthropogenic sources. A significant isotopic contrast exists between natural sources (depleted in ^{6}Li by silicate weathering) and anthropogenic sources. Coupled with the conservative behavior of Li^+ in water, largely independent of pH, redox conditions, and adsorption, this isotopic dichotomy proves useful for assessing contamination levels (1).

From environment to the biosphere, the proportions of ^{7}Li and ^{6}Li vary due to biological kinetic processes (5). Cells, plankton, and bivalves exhibit high Li bioaccumulation capacity, with lower δ^7Li values due to active transporters regulating Na and pH in cells and specific organs (5). Li isotopes can thus be used to model evolution of Li biological fluxes in organisms. Our findings show that heavy δ^7Li values in soft tissues of bivalves cultured in Li-rich seawater can be explained by their ability to rapidly increase their Li excretion within a few hours.

By integrating field observations, experiments and modeling, we demonstrate that Li isotopes provide critical insights for assessing environmental and health risks.

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4. Teng et al. (2006) *EPSL* 243, 701-710
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