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Biological fractionations of lithium isotopes

NATHALIE VIGIER[1], FANNY THIBON[2], PACO BUSTAMANTE[3], LAURENT COUNILLON[4], MARC METIAN[5], PHILIPPE TELOUK[6] AND ISO2MET TEAM[7]

[1]LOV - CNRS - Sorbonne Université
[2]LOV- CNRS-Sorbonne Université
[3]LIENSs - CNRS-La Rochelle Université
[4]LP2M - Université Nice Cote d'Azur
[5]IAEA-REL
[6]ENS Lyon
[7]ANR ISO2MET: www.iso2met-project.fr/team

Presenting Author: nathalie.vigier@obs-vlfr.fr

Li isotopes have long been considered by geochemists as unaffected by biological processes, mainly because of the low Li concentrations in biologically-made materials. However, a large range of d^7Li values was reported in the literature for modern and coretop (recent) biogenic carbonates (e.g., Dellinger et al. 2018). Also, laboratory cultures confirmed variable Li isotope fractionations during foraminifera growth, depending on environmental parameters (Vigier et al. 2015; Roberts et al. 2018). Finally, a great range of d^7Li values (of 42 ‰) were displayed by various organs of a mammal model (Balter & Vigier, 2014).

We will show how we recently reinforced these evidence by analysing numerous soft tissues from marine organisms, including calcifiers from different trophic levels (#1). Most of them were collected in low Li marine environments and exhibit significant isotope fractionations (down to -26‰ compared to SW). An experimental study performed with mussels indicates a strong effect of the aqueous Li level on their soft tissue d^7Li value. Thus, variation of the environmental Li level appears to be a key parameter, through organism Li homeostasy and/or bioaccumulation, controling Li isotope signatures. Finally, experiments performed with cell lines expressing specific transporters demonstrate that the light ^6Li is transported much faster than ^7Li (by ~15‰) through cell membranes.

All these observations highlight the necessity to consider the impact of environmental parameters, and in particular the Li concentrations, for interpreting past d^7Li variations displayed by fossil shells. Providing precise Li isotope analyses of biological soft tissues (#2) offers a complementary way to investigate the biological isotopy of trace metals and their importance in paleoceanography.

(#1) Thibon et al., Goldschmidt 2021 (#2) Weppe et al., Goldschmidt 2021