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Lithium bioaccumulation in bivalves: biological controls and isotope perspective

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Lithium (Li) consumption has increased rapidly over the past decade with the expansion of Li-ion batteries and energy storage technologies, raising concerns about emerging Li inputs to coastal environments. In European coastal systems and beyond, *Mytilus* mussels are widely used as sentinel organisms to monitor long-term environmental contamination. However, the interpretation of Li concentrations and Li isotope compositions (δ^7Li) in biomonitoring remains limited by an incomplete understanding of biological controls. Laboratory exposure experiments were conducted to quantify Li bioaccumulation, depuration, and isotope fractionation in *Mytilus* mussels. Under controlled conditions, rapid Li uptake and depuration occur within hours to days, accompanied by substantial Li isotope fractionation ($\Delta^7Li_{mussel-seawater}$) under elevated Li levels, indicating strong physiological regulation of Li fluxes. To investigate genetic and metabolic influence on long-term lithium bioaccumulation in bivalves, genetically characterized *Mytilus* progenies, including parental species (*M. edulis* and *M. galloprovincialis*) and two hybrid lineages, were transplanted for one year under identical environmental exposure. All genetic groups exhibit coherent temporal trajectories in Li concentration and δ^7Li, yet the magnitude of these variations differs among genotypes. The δ^7Li–Li relationship reveals a two-stage pattern, characterized by an initial decrease in δ^7Li during Li accumulation, followed by a marked δ^7Li increase as Li concentrations decline in all mussel groups. Together, these results demonstrate that Li systematics in mussels are strongly influenced by physiological regulation, with genetic background exerting a secondary effect. These results demonstrate the potential of *Mytilus* mussels for coastal Li assessment and contribute to improving biomonitoring frameworks such as “Mussel Watch Programs”.