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Constraining the Seawater Mass and Isotope Budget of Lithium: Results from IODP Leg 339 and Leg 379

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Silicate weathering consumes CO_2 and controls cation fluxes to the ocean, thus playing a critical role in modulating long-term seawater chemistry and climate. There are very few markers of seawater chemistry whose value has changed over time as a function of the uplift – weathering – subduction cycle. Lithium being one such proxy has been extensively utilised as a geochemical tracer whose long-term evolution of isotopic composition in seawater is a function of Urey's tectonic cycle. Marine pore-waters are an excellent archive utilized here to study the sedimentary processes affecting seawater chemistry.

Utilizing a method developed inhouse to separate Li from matrix and measure Li isotopes, I analysed porewater samples from IODP Leg 339 and Leg 379. At the porewater-sediment interface of continental margins, authigenic aluminosilicate clay (smectite) formation also termed as Reverse Weathering, removes Li from seawater/porewater. The process of reverse weathering preferentially uptakes ^{6}Li over ^{7}Li. Thus, porewaters are expected to be depleted in [Li] compared to seawater ($[Li]_{PW} < [Li]_{SW}$), and the porewater Li isotopic composition is more enriched in ^{7}Li than seawater ($\delta^7Li_{PW} > \delta^7Li_{SW}$). This process occurs in shallow sediment depths where smectite is the dominant clay and illitization has not commenced. However, most porewater profiles exhibit higher Li concentrations and lighter isotopic compositions, indicating clay transformation processes. During clay transformation caused by high pressure and temperature during burial, isotopically light Li is released from the clays. This release of isotopically light Li increases the porewater Li concentration while driving it isotopically light. During sediment subduction, a significant fraction of this clay bound isotopically light Li is released as a part of clay dewatering. Our study of **Leg 339 porewater samples with clay dewatering evidence** and **Leg 379 porewater samples in silica-rich environment** helps us to further constrain Li seawater mass budget by constraining the mass flux and isotopic composition of recycled Li from sediments to seawater. I have also developed a set of equations to extrapolate my present findings to a global scale. This study of Li isotopic systematics of marine porewater helps constrain the complex dynamics of Li in seawater.