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Tracing silicate weathering in estuaries using lithium isotopes

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Silicate weathering plays a significant role in stabilising the Earth's climate over long time scales. Silicate weathering occurs not only on continents but also in estuaries, where continent-derived silicates are further weathered. However, estuarine weathering has not been investigated properly. Every year, global rivers transport ~30 Gt of particles from continents to estuaries which is around 30 times the flux from the dissolved load [1]. In estuaries, the different salinity means that the weathering environment is different than that on the continents, potentially resulting in rapid changes in dissolution and secondary mineral formation (e.g. clays, oxides/(oxy)hydroxides) rates. Through these processes, estuarine weathering can modify the fluxes of cations and alkalinity transported in the dissolved load by rivers.

In this study, we use lithium isotopes to investigate weathering processes in estuarine mixing zones from Iceland and the Amazon plume. Li isotopes are a tracer of silicate weathering congruency and intensity [2]. Specifically, we have examined not only the dissolved load but also multiple selective leachates of the suspended and bedloads, to separate out the exchangeable and oxide, as well as clay fractions.

The Li concentrations in the dissolved loads show generally conservative mixing of riverine dissolved Li and seawater, except in the low salinity zones. Particles, on the other hand, clearly show isotopic fractionation that does not represent mixing, instead is caused by estuarine weathering processes. In other words, rapid silicate weathering within these estuaries is clearly modifying not only Li behaviour but also silicate weathering and hence CO_2 drawdown fluxes and behaviour.

[1] Oelkers *et al.* (2012) *Comptes Rendus Geoscience* **344**, 646–651. [2] Pogge von Strandmann *et al.* (2020) *Elements* **16**, 253–258.