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Exploring the weathering of continental particles in estuaries using Lithium isotopes

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Silicate weathering is one of the key processes in the earth system, because of its impact on the global carbon cycle, biogeochemical cycles, and climate change. Apart from silicate weathering on the continents, the particles transported by the global rivers could be further weathered in estuaries. Given the fact that around 30 Gt/yr of particles are transported to and deposited in estuaries, which is around 30 times the flux from the dissolved load, estuarine weathering could have a significant impact on global biogeochemical cycles. The different weathering environments compared to the continents, such as salinity, could potentially lead to rapid changes in mineral dissolution and secondary mineral formation (e.g. clays, oxides/(oxy)hydroxides) rates, which therefore modifies the fluxes of cations and alkalinity transported in the dissolved load by rivers. However, these modifications by estuarine weathering have not been investigated properly.

In this study, we have analysed the major element concentrations and Li isotopes in natural samples from two river estuaries, of the Amazon and an Icelandic basaltic river. Specifically, we have examined both the dissolved load and 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 generally show a conservative mixing of riverine dissolved Li and seawater. Particles, on the other hand, clearly take Lithium from water with isotopic fractionation, which implies secondary mineral formation. Thus, rapid silicate weathering within these estuaries can modify onland weathering and hence CO2 drawdown fluxes and behaviour.