Experimental determination of Mg, Si and Li isotope fractionation during clay mineral formation

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Mg, Si and Li are among the most promising stable isotope proxies currently being developed with respect to providing a means of directly tracing weathering and oceanic elemental budgets. Importantly, field, experimental and theoretical data indicate that clay minerals formed during continental weathering should show appreciable isotope fractionation for all three systems, and that this may permit the weathering process to be better quantified (e.g. [1-7]). However, unequivocal Mg, Si and Li isotope fractionation factors for clay precipitation have not been established, in part, because the mechanisms that dominate in nature are not easily transferred to the laboratory. Given the challenge of replicating clay synthesis at Earth surface temperatures, previous synthesis strategies have involved controlled heating of a gel precursor to accelerate crystal growth [6] [8]. Despite the successful application of this strategy with respect to demonstrating isotopic fractionation of Li during hectorite synthesis [6] [8], the effect of high temperatures on nonequilibrium isotopic fractionation during precipitation is incompletely known and, as such, warrants further study.

Here, we synthesise clay minerals at low-temperature as part of a larger effort to determine isotope fractionation factors for Mg, Si and Li, and, ultimately, to explore potential differences in fractionation factors as a function of T, pH and clay mineral precipitated. Building on previously established methods used in our laboratory, we employ a novel approach to synthesising clay minerals at low-temperature. More specifically, our experiments are designed to explore isotope (and element) partitioning during the two stages of clay formation: nucleation and crystal growth. This experimental work will contribute to a growing mechanistic basis that will allow Mg, Si and Li isotope fractionation during clay precipitation to be explored and quantified.

[1] Wimpenny *et al*. (2014) *GCA* **128**, 178-194. [2] Li *et al*. (2014) *EPSL* **394**, 82-93. [3] Misra and Froelich (2012) *Science* **335**, 818-823. [4] Tipper *et al*. (2012) *EPSL* **333**, 35-45. [5] Georg *et al*. (2009) *GCA* **73**, 2229-2241. [6] Vigier *et al*. (2008) *GCA* **72**, 780-792. [7] De La Rocha *et al*. (2000) *GCA* **64**, 2467-2477. [8] Decarreau *et al*. (2012) *GCA* **85**, 314-325.