Goldschmidt2017 Abstract

Synthesis of layer silicate minerals by co-precipitation: a tool for systematic isotope fractionation studies

R TOSCA[1*], RS HINDSHAW[1], N TOSCA[2] AND ET TIPPER[1]

[1]University of Cambridge, Cambridge, CB2 3EQ, UK
(*correspondence: rlt46@cam.ac.uk)
[2]Universtiy of Oxford, Oxford, OX1 3AN, UK

Isotope fractionation during the process of clay mineral precipitation can provide important information about continental weathering and global element budgets. Mg and Li are among the most promising stable isotope systems currently being developed as such proxies [e.g. 1-7]. However, the quality of interpretations of the isotopic composition of clay minerals depends on knowledge of the fractionation factors in clay-water systems. Unequivocal Mg and Li fractionation factors for clay precipitation have not been established, in part, because of the challenges in replicating clay synthesis at Earth surface temperatures. Previous synthesis strategies, involving controlled heating of a gel precursor to accelerate crystal growth, have been successfully applied to Li fractionation during hectorite synthesis [6,8]. However, the effect of high temperatures on nonequilibrium isotopic fractionation during precipitation is incompletely known and, as such, warrants further study.

Here we use an approach developed in our laboratory to synthesise layer silicate minerals at low-temperature as part of a broader study to explore and quantify Li and Mg isotope fractionation during clay precipitation. Batch synthesis experiments are performed in either 1L polypropylene bottles or custom-made polycarbonate reaction vessels as a function of T, pH, and solution composition. Powder XRD and FT-IR analyses of all solids recovered indicate the production of homogenous and pure nanoparticulate Al-free (i.e., stevensite) and Al-containing (i.e., saponite) layer silicates from the smectite group. Extended syntheses were also conducted at a range of pH and temperature.

This approach offers a promising experimental platform to deconstruct the principal reactions governing layer silicate crystallisation in natural systems. In combination with Li and Mg stable isotope anlysis, this work also permits a systematic evaluation of layer silicate crystallisation on the fractionation of isotopes in natural waters [9].

[1] Wimpenny et al. (2014) *GCA* 128, 178. [2] Li et al. (2014) *EPSL* 394, 82. [3] Misra et al. (2012) *Science* 335, 818. [4] Tipper et al. (2012) *EPSL* 333, 35. [5] Georg et al. (2009) *GCA* 73, 2229. [6] Vigier et al. (2008) *GCA* 72, 780. [7] De La Rocha (2000) *GCA* 64, 2467. [8] Decarreau et al. (2012) *GCA* 85, 314. [9] Hindshaw, R. et al., *this conference*.