

Behavior of Mg isotopes during structural transformation of biotite

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Biotite, a common mineral in felsic-intermediate igneous rocks, alters to kaolinite via several pathways of structural transformation (e.g., hydrobiotite and oxidized biotite) during weathering and releases several constituent elements, such as K, Fe, and Mg, into terrestrial systems. We collected structurally transformed biotites in weathering profiles developed in the granitoid outcrops, South Korea to understand the behavior of Mg isotopes during biotite weathering. Oxidized biotite is characterized by a 10 Å peak in the XRD pattern regardless of the degree of Fe oxidation, while hydrobiotite transformation is identified by its movement to a 12.5 Å peak [1]. Mg isotopic compositions of oxidized biotites in three weathering profiles increase as a function of the Fe oxidation, yielding a 0.31‰ range of $\Delta^{26}\text{Mg}_{\text{oxidized-fresh biotite}}$, whereas those of hydrobiotites are at isotopic steady-state with an insignificant range of $\Delta^{26}\text{Mg}_{\text{oxidized-fresh biotite}}$ (0.08‰). These results suggest that light isotopes are preferentially released via diffusion through the non-expanded lattice of oxidized biotite because 10 Å basal spacing is maintained during the weathering. On the other hand, the alternating vermiculite-biotite interlayer that formed during the transformation to hydrobiotite allows all Mg isotopes to be proportionally released, therefore resulting in negligible Mg isotope fractionation. This study highlights that Mg isotope fractionation may or may not occur depending on the weathering pathway of biotite, implying controversial Mg isotopic systematics of granitoids [2, 3] may be related to such a contrasting Mg isotopic fractionation of biotite in the involved crustal assimilants.

[1] Jeong *et al.* (2006), *Geochim. Cosmochim. Acta* **70**, 4734-4749. [2] Shen *et al.* (2009), *Proceedings of the National Academy of Sciences, USA* **106**, 20652-20657. [3] Li *et al.* (2010), *Geochim. Cosmochim. Acta* **74**, 6867-6884.