# Varied Mg isotope responses to distinct climate conditions during granite weathering

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Three granite weathering profiles at Beijing (BJ1), Hubei (HB), and Guangdong (GD) from China were studied for mineralogy, major element concentrations and Mg isotope composition. These weathering profiles were developed under distinct climate conditions (temperate, subtropical, and tropical). In the BJ1 profile, $\delta^{26}$Mg values of saprolites are slightly higher than those of their parent rocks and negatively correlated with $\tau_{MgO}$. The variation of $\delta^{26}$Mg in the profile can be explained by the preferential remove of $^{24}$Mg during the dissolution of biotite at the incipient stage of weathering. In the HB profile, the $\delta^{26}$Mg values of bulk saprolites are variable and successively decrease towards surface, correlating with the abundance of kaolinite. This profile can be explained by a two-step process: 1) $^{26}$Mg is first incorporated into kaolinite, and 2) the intensive weathering may result in an increasing removal of kaolinite towards surface resulting in the lower section more enriched in kaolinite and $^{26}$Mg. As for the GD profile formed under tropical weathering, the $\delta^{26}$Mg values of saprolites decrease toward surface, correlating with the abundance of sericite and $\tau_{MgO}$, having lower $\delta^{26}$Mg values than the parent rock above ~ –250 cm, but higher $\delta^{26}$Mg values than the parent rock below ~ –250 cm. This profile can be explained by a three-step process: 1) $^{26}$Mg is first incorporated into crystal structures of secondary sericites; 2) the further weathering results in sericites converted into kaolinites, which is coupled with a significant loss of Mg; and 3) the combination of atmospheric input and possibly chromatographic effect lowers $\delta^{26}$Mg of the saprolites close to surface. Compilation of our and previously published Mg isotopic data of several typical weathering profiles reveals the potential applications of Mg isotopes as great tracers of mineral reaction pathway, weathering intensity, and climate conditions.