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Mg isotope compositions of siliciclastic sediments on the East Asian continental margin: New constraints on silicate weathering and Mg cycle

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In the last decade, much attention has been devoted to Mg isotopic behavior during various weathering processes. Nonetheless, whether Mg isotopes in terrigenous siliciclastic sediments in modern oceans can reflect continental weathering regimes remains unresolved. Understanding the major controls of Mg isotope fractionation in siliciclastic sediments is thus a prerequisite to decode past Mg isotope records for tracing continental weathering history. In this study, we present mineralogical, elemental and Mg isotopic compositions of terrigenous siliciclastic sediments in the Changjiang (Yangtze River) estuary and the adjacent continental shelf of the East China Sea. δ^{26}Mg values of the clay-sized sediments vary -0.15 ‰ to 0 ‰ and display no correlation with the proportion of different clay minerals. Our results suggest that early to intermediate weathering processes is characterised by the progressive leaching of isotopically light Mg from silicates, leading to the enrichment of ^{26}Mg in secondary clay minerals. Therefore, Mg isotopic variability of clay-sized sediments is primarily determined by catchment weathering, rather than by provenance lithology or mixture of clay minerals. An isotopic mass balance calculation indicates that the δ^{26}Mg value of silicate weathering flux on continental scale is ca. -0.6‰ to -0.4‰. The new constraint on δ^{26}Mg value of silicate weathering flux provide a new opportunity to better understand the Mg cycle. A further calculation indicated that the Mg flux from silicate weathering in the Changjiang catchment is as ~9.5-11×10^{10} mole/yr, accounting for nearly 30% to 40% of the total Mg influx of Changjiang River into the ocean. In addition, a numerical modelling with the up-to-date flux and isotope fractionation data indicated that a slight enhancement of silicate weathering can potentially drive the rapid rise of Mg/Ca in seawater since late Cenozoic, but maintain the constancy of seawater δ^{26}Mg as reported by literatures. Our study demonstrates that Mg isotopes of marine clay-sized sediments have the potential to trace the evolution of continental weathering and Mg cycle on Earth surface.