Intense chemical weathering during Early Triassic revealed by Mg isotopes

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Biological recovery after the end-Permian mass extinction (EPME) was protracted as the Early Triassic was a period of reduced biodiversity, large perturbations of carbon and sulfur cycles, global temperature fluctuations, and widespread of ocean anoxia. Chemical weathering processes that convert silicate rocks into carbonates and clays would have been substantially enhanced due to increased global temperatures caused by massive CO_2 degassing from the Siberian Traps Large Igneous Province. However, only limited geochemical evidence for enhanced chemical weathering during the Early Triassic has been presented to date, and the relationship between weathering rate changes and the slow recovery of marine ecosystems is effectively unknown.

Here we present Mg-isotope ratios in siliciclastic components of shallow-marine carbonates from two well-studied Upper Permian-Lower Triassic sections in Iran and South China to test for changes in chemical weathering intensity after the EPME. We identify a distinctive positive excursion in $\delta^{26}Mg$ values (~1 ‰) from the Dienerian to the Smithian in both locations. The magnitude of the Mg-isotope excursion is comparable to those in studies of geologically young weathering profiles in which the weathering residues are isotopically heavier than the fresh parent rocks. The excursion predates the late Smithian thermal maximum, indicating that factors other than temperature may have played an important role in continental weathering. In both study sections, beds below this excursion display variable $\delta^{26}Mg$ values, whereas beds above the excursion have consistently heavier $\delta^{26}Mg$ values, suggesting that enhanced chemical weathering continued throughout the Olenekian Stage (late Early Triassic). Our data provide direct geochemical evidence for intensified chemical weathering in the aftermath of EPME. Rapid marine ecosystem recovery may have been impeded by episodes of intense chemical weathering caused by CO_2 degassing and changes in the hydrological cycle.