Rapid and long-lasting increase in global weathering during the early Toarcian Oceanic Anoxic Event

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The chemical weathering of silicates represents a major feedback mechanism in the Earth's climate system, helping to stabilize atmospheric CO_2 and thus temperature on geological timescales. In this work, we present a high-resolution osmium-isotope record of global chemical weathering from a stratigraphically thick record of the early Toarcian oceanic anoxic event (T-OAE, ~182 Ma). Organic-rich mudrocks in the studied succession were deposited in a nearshore marine environment on the margin of the Panthalassa Ocean, and are now exposed in Yamaguchi Prefecture in southwest Japan. A pronounced excursion in the carbon-isotope composition of organic matter through this succession, which has been replicated globally, is diagnostic of the T-OAE and has been linked to the large-scale release of ^{12}C-enriched carbon. We show that the trend to minimum carbon isotope values in the succession is mirrored by an abrupt increase in radiogenic osmium indicative of a marked increase in global silicate weathering rates. The magnitude of this change in weathering and the absolute values of the osmium isotope data are similar to those recorded recently from another succession on the opposite side of the Panthalassa Ocean. Together, the available data suggest that weathering rates abruptly increased by up to 500% during the T-OAE, and that this increase occurred in direct response to climate warming caused by large-scale carbon effusion. We also find that weathering rates remained elevated for at least ~1 million years after carbon release, emphasizing the protracted impact that the Toarcian event had on the Earth's climate system.