INTERPRETING THE MARINE OSMIUM ISOTOPE RECORD

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The osmium isotopic composition of sea water has increased throughout the Cenozoic from an Os-187/Os-188 of ~0.2 at the Cretaceous-Tertiary boundary to a ratio of 1.06 at present. To first order this increase resembles the Cenozoic increase in the marine strontium isotope record. It is therefore tempting to interpret both records as to reflect increasing input of radiogenic continental material due to changes in the continental weathering intensity, regulated by climatic/tectonic forcing. However, the sources of radiogenic osmium differ markedly from those dominating the marine strontium isotope system. Whereas the marine strontium isotope system is conventionally interpreted using multi-component isotope mass balances, variations in the marine osmium isotope record can be interpreted differently. First, large impacts are capable of “resetting” the marine osmium isotope value to unradiogenic values characteristic of undifferentiated planetary matter. Second, the Re/Os of organic-rich sediments is sufficiently large that weathering of organic-rich sediments at a constant rate can lead to a steady increase in the osmium isotopic composition of sea water with time. In such a scenario trends towards more radiogenic osmium isotope sea water values (e.g., from 15 to 2 million years) are unrelated to increases in continental weathering intensity. Thirdly, the marine residence time of osmium is short enough to capture short-periodic (glacial-interglacial) fluctuations in the system that are inaccessible to the buffered marine strontium isotope system. This offers not only the opportunity to discriminate between high-frequency (climatic) and low-frequency (tectonic) forcing, but also increases the likelihood of the system reaching steady-state.