δ²⁶Mg record of Phanerozoic oceans

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The secular variation in the marine Mg/Ca ratio over geologic time is undisputed, however, the role of driving forces behind this phenomenon remains uncertain. A key to the discrimination of major fluxes is the quantification of the Mg oceanic cycle that in turn can be examined by using the Mg isotope compositions of low-Mg calcite brachiopod shells. Within the BASE-LiNE Earth project, a total of 95 analyses on modern and fossil (early Ordovician to Quaternary) brachiopod specimens were performed to generate an inferred δ²⁶Mg paleo-seawater record. As a prerequisite, selected modern, globally distributed species, whose average “habitat temperatures” range from about 0 to 29°C, were investigated and results revealed a weak (~0.02‰°C⁻¹) temperature-sensitivity of δ²⁶Mg in shells. This supports their suitability for paleo-seawater δ²⁶Mg reconstructions. The offset Δ²⁶Mg between modern global seawater δ²⁶Mg [1] and the average of modern brachiopods is about ~1.26 ‰, and has been applied to fossil samples. A preliminary locally weighted and smoothed δ²⁶Mg paleo-seawater trend yielded (i) short-term negative and positive anomalies during the Cenozoic, (ii) rather constant values during most of the Mesozoic, (iii) a significant positive-to-negative shift during the Permian/Carboniferous transition, and (iv) systematically negative values during the rest of the Paleozoic (relative to modern seawater). This composite δ²⁶Mg record of Phanerozoic seawater will be simulated via a coupled numerical model of oceanic elemental cycles [2], and conclusions will be made regarding the plausible driving mechanism(s) behind the observed long-term changes in the marine Mg/Ca record.