



Magnesium Stable Isotope Compositions in biogenic CaCO_3

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Mass-dependent variations in the Mg isotope compositions of modern biogenic marine carbonates were analyzed to investigate Mg isotope fractionation during CaCO_3 precipitation and to explore the potential of Mg isotopes as proxies in paleoceanography. Analytical procedures are outlined in Wombacher et al. (this meeting). Below, all data are reported as $\Delta^{26}\text{Mg}$ in per mil relative to the seawater Mg isotope composition. The long term reproducibility of ± 0.2 is estimated from 37 analyses of the JCP-1 coral standard. All stated uncertainties refer to 2 standard deviations.

Aragonite samples (corals and sclerosponges) display negative and uniform $\Delta^{26}\text{Mg}$ values of -0.9 ± 0.3 relative to seawater despite a temperature range of almost 20°C , thus no relationship between Mg isotope fractionation and temperature can be resolved. Also, the uniform high-Mg calcite data (sclerosponges, a calcitic coral and a red alga; -2.5 ± 0.2) that spans a temperature range of more than 20°C displays no correlation with temperature. Compared to aragonite, the calcite data exhibit a much larger enrichment in the light Mg isotopes. These results are in accordance with data from speleothems (Galy et al. *EPSL* 2002) and corals (Chang et al., *Biochem. Biophys. Res. Comm.* 2004). In contrast, data for an echinoid high Mg-calcite (-1.6), a brachiopod low-Mg calcite (-1.3) and coccoliths (-0.2 to -2.2) display Mg isotope fractionations that are significantly smaller than those defined by the sclerosponge, coral and red alga high-Mg calcite data. Low-Mg calcites of tropical (27.4°C) planktonic

foraminifera display variable and much larger Mg isotope fractionations (*N. dutertrei* (-4.6); *G. menardii* (-4.1); *G. ruber pink* (-4.7); *G. sacculifer* (-5.5)) that do not correlate with their Mg/Ca ratios. Miliolid, benthic foraminifera scatter significantly, but yield values rather typical for high-Mg calcites (-2.3 ± 0.8).

While the consistency of the aragonite and most high-Mg calcite data suggests the absence of significant metabolic influences on Mg isotope fractionation, such effects are obvious in the echinoid, brachiopod, coccolith and planktonic foraminifera data. It appears that the aragonite and high-Mg calcite of sclerosponges and corals have little potential as paleotemperature proxies. If Mg isotopes in biogenic carbonates contain paleotemperature information at all, this is most likely recorded by metabolic effects, e.g. in some planktonic foraminifera species.

The absence of a resolvable dependence of Mg isotope fractionation on temperature contrasts with the temperature dependence observed for Ca isotopes (e.g. Gussone et al., *GCA* 2005). Lemarchand et al. (*GCA* 2004) argued that the Ca isotope fractionation principally results from equilibrium isotope partitioning between Ca in solution and close to the crystal-solution interface. They further suggest that the equilibration of Ca between crystal and solution is hindered at elevated temperatures, because of the temperature related increase in $[\text{CO}_3^{2-}]$ and precipitation rates, such that the Ca isotope fractionation is attenuated. If this model is correct, it implies that, in contrast to Ca, equilibrium partitioning of Mg can be maintained between solution and CaCO_3 crystal surfaces at high precipitation rates.