Effect of Seawater Mg/Ca Ratio on Planktic Foraminifera Stable Isotope and Mg/Ca Composition

BÄRBEL HÖNISCH[1], CAROLINE BAPTIST[1], STEPHEN M. EGGINS[2], KATE HOLLAND[2], HOWARD J. SPERO[3] AND PETER SWART[4]

[1]LDEO of Columbia University, Palisades, NY 10964 (hoenisch@ldeo.columbia.edu, cbaptist@ldeo.columbia.edu)
[2]The ANU, Acton ACT 0200, Australia (Stephen.Eggins@anu.edu.au, kate.holland@anu.edu.au)
[3]US Davis, Davis CA 95616 (hjspero@ucdavis.edu)
[4]MGG/RSMAS, University of Miami, Miami Fl 33149 (pswart@rsmas.miami.edu)

Little is known about potential effects of seawater [Ca^{2+}] and [Mg^{2+}] oscillations on the trace metal and isotopic composition of calcareous foraminifers. Lacking other constraints, researchers have addressed differences in past seawater chemistry by scaling modern Mg/Ca vs. temperature (T) calibrations to past oceanic Mg/Ca. In contrast, stable isotope records have rarely been discussed in the light of changing seawater composition, but hypotheses can be posed based on existing inorganic calcite experiments. The higher vibrational energy associated with Mg incorporation in synthetic calcite is compensated by increased incorporation of ^{18}O and ^{13}C, leading to an underestimate of $\delta^{18}O$-derived Ts in high-Mg environments.

Prior to the mid Cenozoic, oceanic Mg/Ca ratios were much lower than present. Planktic foraminifers secrete low-Mg calcite and the impact of reduced seawater Mg/Ca on shell isotopic composition has never been quantified. We present results from culture experiments with planktic foraminifers, grown across a range of seawater Mg/Ca ratios, Ts and carbonate chemistry. Our results do not indicate a significant seawater-Mg/Ca effect on $\delta^{18}O$ and $\delta^{13}C$ in planktic foraminifers, but do reveal a large reduction in the T sensitivity of shell Mg/Ca when seawater Mg/Ca ratios are reduced. These data indicate that Mg/Ca vs. T calibrations derived from experiments in modern ocean chemistry cannot be applied to early Cenozoic foraminifera by scaling to paleo-seawater Mg/Ca composition, because such an approach likely underestimates climatically-controlled T variations at that time.