How do marine carbonate Mg/Ca and Sr/Ca proxies constrain Cenozoic ocean history

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The role of biologically-induced biomineralisation versus biologically-controlled mineralization [1] is controversial and is a key issue in the role of minor elements and isotopes of marine calcium carbonate minerals as proxies of ocean composition. Trace element partition coefficients in corals, foraminifera and coccolithophores are intermediate between inorganic values and unity and seem to reflect the extent to which calcium carbonate is precipitated under tight biological control by the organisms [2,3]. It has been proposed [4] that Mg incorporation in foraminifera involves initial precipitation of high-Mg calcite, perhaps of evolutionary significance [5], followed by Mg removal leading to the observed temperature-dependency of Mg/Ca. We propose that carbonate ion exerts a significant control on Mg incorporation in benthic foraminifera [6]; temperature and carbonate ion scale linearly in the modern oceans and calibrations can mislead. Palaeoceanographic records show an inverse relationship between coccolith Mg/Ca and Sr/Ca [7]. Extensive palaeoceanographic records of coupled Mg/Ca, Sr/Ca, $\delta^{18}O$ and $\delta^{13}C$ in planktonic and benthic foraminifera from a range of oceanographic settings will be presented as part of a discussion on the respective roles of temperature and carbonate system chemistry on proxies and thus on the information proxies may hold on the evolution of ocean geochemistry.

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