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Mg/Ca and 18O in the calcite of benthic foraminifera: does size matter?

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Mg/Ca and del-18O are popular proxies for past sea water temperatures, ice volume and, together, salinity. The biological control that foraminifera have over calcification results in precipitation of calcium carbonate that has an isotope and element composition that is very different from those of inorganically precipitated calcium carbonates. Indications for an effect of ontogeny (i.e. size of a specimen) on the fractionation of oxygen isotopes are contradictory, while for the incorporation of most (trace) elements, data are lacking. The causes of size-based variability in element incorporation and isotope fractionation need to be understood and quantified in order to reliably use them as paleoproxies.

In this study, we present Mg/Ca and oxygen isotope data from cultured specimens of the benthic foraminifer Ammonia tepida. When asexual reproduction takes place in this species, 50-300 genetically identical juveniles (i.e. clones) are produced. These juveniles are cultured at constant temperature, carbonate chemistry, salinity, etc to determine inter- and intra-specimen variability in Mg/Ca, Ba/Ca and Sr/Ca. From the same groups of clones, del-18O was determined from specimens with different sizes. Results show that the variability differs greatly between the analysed elements (e.g. relatively constant for Sr and Ba, variable for Mg) and isotopes, underscoring the need for a biological understanding of foraminiferal calcification pathways.