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Mg/Ca heterogeneity across individual foraminifera tests in relation to seawater temperature, test structure and growth processes

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Mg in foraminifera tests indicates potential as a palaeoenvironmental indicator of past seawater conditions. The high spatial resolution of secondary ion mass spectrometry (SIMS, up to 10 μm) allows multiple analyses (e.g. 50-100) to be made across individual foraminifera tests. Such high resolution records have several applications in palaeoenvironmental reconstructions. Time series records across individual tests may indicate seasonal variations in seawater temperature and composition, particularly in shallow and shelf seas. High resolution records may also provide information on other processes affecting test chemistry e.g. gametogenesis. We used SIMS to study Mg/Ca variations across specimens of the benthic foraminifera *Hyalinea balthica*, which had been collected 'live' (i.e. Rose Bengal stained) from a range of sites in the Celtic Sea at different stages of the annual cycle. Temperature and salinity profiles have been well characterised at the sites. Mg varied significantly between chambers of individual foraminifera but the seasonal geochemical trends were not as expected. We observed a significant decrease in Mg as we analysed across the outermost chambers of one test, from older to more recently deposited material, although we anticipate that this material was deposited during a period of increasing bottom water temperatures. *Hyalinea balthica* tests have a bilamellar wall structure and calcification is not confined to the final chamber of the test. Instead as each new chamber is added a layer of calcite is also deposited over the outside of the previously formed test resulting in progressive thickening of the chamber walls. We observed an increase in Mg concentration in the outer thickened parts of the chamber walls and we hypothesise that kinetic effects, reflecting complex disequilibrium processes during crystal precipitation affect the geochemistry of the different parts of the test.