Testing the reliability of fossil foraminifer shell geochemistry with laser ablation ICP-MS

ED HATHORNE[1], JANETT VOIGT[2], JAN FIETZKE[1], HEIKO PÄLIKE[2], AND MARTIN FRANK[1]

[1]GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany (ehathorne@geomar.de)
[2]MARUM Center for Marine Environmental Sciences, Bremen, Germany (jvoigt@marum.de)

The geochemistry of fossil planktic and benthic foraminifer shells is the foundation of the field of Paleoceanography which is responsible for much of what we know about Earth's climate beyond the ice core record. However, the vast majority of these shells are likely to have undergone post depositional diagenesis, to some extent, potentially altering the geochemical signal and biasing the interpretation of that signal. Here we utilise a quirk of biomineralization, that Sr/Ca ratios are relatively homogenous across shell walls in stark contrast to other elements such as Mg/Ca, to investigate recrystallisation diagenesis at the individual shell level. We use laser ablation ICP-MS to investigate the elemental geochemistry across the shell wall of fossil shells recovered from Miocene and Oligocene age sediments from the eastern equatorial Pacific (IODP Expeditions 320/321).

Within a single sediment sample some shells of the same species exhibit a normal homogenous Sr/Ca wall cross section while others decrease towards the inside of the shell. We attribute this decrease in Sr/Ca to recrystallization in a more open system as inorganic calcite is known to incorporate less Sr than biogenic calcite, such as foraminifer shells. It seems that elemental exchange during recrystallisation can be quite different for shells deposited next to each other. Comparison of samples from the same time interval from different sites reveals systematic changes in the proportion of shells with decreasing Sr/Ca profiles. The site previously identified as strongly recrystallised, most likely the result of a stronger geothermal gradient near a fracture zone [1], has the highest proportion of decreasing Sr/Ca profiles. Despite the open system recrystallisation, Mg/Ca ratios, which are frequently used to reconstruct past seawater temperatures, from shells with homogenous and decreasing Sr/Ca depth profiles cannot be distinguished statistically in most cases. This is strong evidence that different elements have varying sensitivities to recrystallization and that Mg/Ca ratios are mostly resilient to this type of diagenesis.

[1] Voigt et al. (2015) *GCA* 148, 360