Applicability and reliability of Na/Ca as a direct paleo-salinity proxy in various planktonic foraminifers

JACQUELINE BERTLICH[1*], DIRK NÜRNBERG[1], ED C. HATHORNE[1], MICHAEL SICCHA[2], JEROEN GROENEVELD[2], JULIE MEILLAND[2] AND MICHAL KUCERA[2]

[1]GEOMAR Helmholtz Centre for Ocean Research Kiel, 24148 Kiel, Germany (*correspondence: jbertlich@geomar.de)
[2]MARUM - Center for Marine Environmental Sciences, Univ. of Bremen, 28359 Bremen, Germany

Foraminiferal Na/Ca in planktonic and benthic foraminifers is a new established approach to assess directly and independently from previous applied methods (e.g., paired test Mg/Ca and $\delta^{18}O$, test Ba/Ca) past seawater salinities. Recent culture and field calibration studies have shown a significant positive relationship of Na incorporation into foraminiferal calcite tests with increasing salinity [1, 2], as confirmed by our culture study of *Trilobatus sacculifer* [3].

However, we note that the sensitivity of Na/Ca in response to salinity changes is species-specific and regional dependent, albeit temperature could be excluded as a secondary influencing factor [2, 3, 5]. Na/Ca values vary from 1–3 mmol/mol for the same salinity between various planktonic and benthic foraminifera, suggesting a dominant biological control.

To further investigate possible secondary controls on foraminiferal Na/Ca, we here present new data for commonly used species for paleoreconstructions (e.g. *Globigerinoides elongatus*, *G. ruber* (pink), *Orbulina universa*, *Globigerina bulloides*, *Neogloboquadrina dutertrei*) collected by plankton tows in the eastern tropical Atlantic during RV *METEOR* cruise M140. We performed laser ablation ICP-MS measurements on individual foraminifers from locations where salinity and temperature were essentially constant while seawater pH and total alkalinity differed by ~0.5 and 100 μmol/kg, respectively. These data from field samples will provide new insights into the possible effects of natural variations in carbonate system parameters on Na incorporation into calcite tests. To further test the preservation state of Na/Ca in calcite tests over time, measurements of various planktonic species collected from core top sediments (M65-1) located in proximity to the plankton tow sample sites will strengthen our results. Preliminary results show that all measured species are within the Na/Ca range of previous studies [1-5], whereas the offset of ~2 mmol/mol between present plankton tow samples and core top samples within the same species could be related to spine loss at the end of a foraminiferal life cycle [4]. In addition, test sizes could further influence the foraminiferal Na/Ca signal. Preliminary results present, e.g., an increase of 0.5 mmol/mol within the size fraction of 212 μm to 710 μm for *T. sacculifer*, but a Na/Ca decrease of the same amount for *N. dutertrei*.

[1] Wit *et al*. (2013) *Biogeosciences* **10**, 6375-6387. [2] Mezger *et al*. (2016) *Paleoceanography* **31**, 1562-1582. [3] Bertlich et al. (2018) *Biogeosciences* **15**, 5991–6018. [4] Mezger et al. (2019) *Biogeosciences* **16**, 1147-1165, 2019. [5] Allen *et al*. (2016) *Geochim. Cosmochim. Acta* **193**, 197-221.