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Development of a proxy toolbox for reconstructing polar ocean surface hydrography based on large-scale culturing of the planktic foraminifera *Neogloboquadrina pachyderma*

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Ongoing changes in the Arctic cryosphere and ocean circulation have significant implications for regional and global climate. Past records of cryosphere-ocean-climate provide invaluable context to gain insight into future climate scenarios. However, a lack of robust proxy calibrations remains a challenge in studying Arctic Ocean palaeoceanography. To this end, we have conducted culturing experiments on the polar foraminifera species *Neogloboquadrina pachyderma* to establish a proxy toolbox for freshwater dynamics and other surface ocean hydrographic conditions at high latitudes. We are exploring the potential of element ratios, including Na/Ca, B/Ca and Ba/Ca as proxies for salinity, carbonate chemistry, and barium content respectively. We are also aiming to calibrate Mg/Ca for low temperature applicable to the polar environment (<7°C).

More than 1 000 healthy, juvenile specimens of *N. pachyderma* were picked from plankton tow samples from the Greenland Sea (~74°N, ~2°E). These were placed into twelve treatments which were determined relative to (ambient) field conditions and a realistic range of past and future conditions: Salinity from 30 to 37.5 ‰, pH from 7.7 to 8.3 (total scale), temperature from 2 to 7°C, as well as variable barium concentration.

We observed calcification of new chambers and addition of crust (thick outer calcite) in all treatments. Growth rate was not linear, with extended periods without apparent calcification. Overall, we observed low mortality across all treatments prior to ending the experiments. Several specimens, initially described as dead (e.g., white cytoplasm, absent rhizopodial activity), recovered (with colourful cytoplasm, extensive rhizopodial network, feeding etc.) in subsequent weeks testifying their ability to adapt to and/or recover from stressed conditions. We also observed several events of asexual reproduction. These observations suggest that *N. pachyderma* can adapt to, and calcify at, a wide range of conditions, which has implications for the species' response to ongoing ocean warming and acidification, as well as for future studies aiming to culture *N. pachyderma*.

We are in the process of analysing elemental ratios in the culture-grown calcite of *N. pachyderma*

using Time of Flight LA-ICP-MS. The addition of crust in all our treatments potentially allow to establish separate laboratory-based calibrations for the 'crust' and 'ontogenetic calcite' components of *N. pachyderma* test. This will significantly improve the applicability of the proxy calibrations as well as our understanding of crust formation in this species.