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The effect of salinity on Na/Ca in cultured shells of the foraminifer *Operculina ammonoides*

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Na is incorporated into marine carbonate minerals and was recently proposed as a proxy for paleo-salinity. However we demonstrated that Na/Ca ratio in foraminiferal shells ($\text{Na}/\text{Ca}_{\text{shell}}$) is actually a novel proxy for past ocean Ca concentrations (Ca_{sw}) in benthic foraminifera (Hauzer et al., 2018). In the present study, we determined the extent to which foraminiferal Na/Ca (and other elements) change with salinity for the high-Mg large benthic foraminifer *Operculina ammonoides*. This laboratory culture experiment was conducted under four different salinities 32.9, 36.1, 40.65 and 43.0 PSU, at a constant temperature of 25 °C and pH of ~8.17. *O. ammonoides* specimens were labeled with the fluorescent dye Calcein (40 μM) for five days prior to the experiment. Experimental seawater was prepared from filtered Gulf of Eilat seawater (40.65 PSU) and the salinity was modified by the addition of deionized water or by the evaporation to the desired value at room temperature. All experimental seawater were spiked with ^{135}Ba in order to unambiguously determine newly grown CaCO_3 during spatially-resolved analysis of the shell. Six specimens of each treatment were selected according to the presence of non-fluorescent chambers past the Calcein mark. The CaCO_3 shells were analyzed using the LA-ICPMS. Water chemistry was analyzed using ICP-OES and ICP-MS. Experimental foraminifera added 90-160% of their original weight, based on alkalinity-depletion measurements during the experiment. The elemental ratios of Na, Mg and Li to Ca in *O. ammonoides* shells increased linearly with increasing seawater salinity. In contrast, $\text{Sr}/\text{Ca}_{\text{shell}}$ showed no resolvable change with salinity. Since $\text{Na}/\text{Ca}_{\text{shell}}$ does correlate with salinity, it appears that it could be used as a paleosalinity proxy. However, when variations of $\text{Na}/\text{Ca}_{\text{shell}}$ due to salinity are compared to variations due to Ca_{sw} , it is clear that salinity has a minor effect compared to the Ca concentrations. Thus, when reconstructing paleosalinity, $\text{Na}/\text{Ca}_{\text{shell}}$ will produce accurate results only for samples that are within the residence time of Ca_{sw} (~1My). Furthermore, regional and global changes in ocean salinity over geological time can only slightly affect the use of $\text{Na}/\text{Ca}_{\text{shell}}$ as a proxy for past changes in Ca_{sw} .

Hauzer, H., Evans, D., Müller, W., Rosenthal, Y., & Erez, J. (2018). Calibration of Na partitioning in the calcitic foraminifer *Operculina ammonoides* under variable Ca concentration: Toward reconstructing past seawater composition. *Earth and Planetary Science Letters*, 497, 80-91.