



Paired Mg/Ca $\delta^{44/40}\text{Ca}$ temperature estimates of *N. pachyderma* (sin.) in the Nordic Seas

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Reconstructing past SST of the Nordic Seas remains a challenging task due to several limitations and restrictions of proxies at the 'cold end'. Moreover, aberrant Mg/Ca ratios are reported from the polar to subpolar planktic foraminifer *Neogloboquadrina pachyderma* (sin.) from the western Nordic Seas, overestimating instrumental seawater temperature measurements. Here we reassess the limits of cold end calibrations using paired Mg/Ca to $\delta^{44/40}\text{Ca}$ temperature estimates on Holocene core tops of *N. pachyderma* (sin.).

We found that paired Mg/Ca to $\delta^{44/40}\text{Ca}$ signals of *N. pachyderma* (sin.) originating from the Norwegian Sea are positively correlated ($R^2 = 0.71$), indicating that both proxies are controlled by temperature. Absolute temperature estimates using a $\delta^{44/40}\text{Ca}$ temperature sensitivity of 0.17‰/°C and common Mg/Ca temperature equations (e.g. Elderfield and Ganssen 2000, Mashiotta et al., 1999) are in good agreement. In contrast, core top samples of *N. pachyderma* (sin.) from polar waters are characterized by a significantly different Mg/Ca and Ca isotope composition. In this 'polar group', Mg/Ca ratios are about twice as high as predicted by general *N. pachyderma* (sin.) Mg/Ca temperature calibrations, resulting in Mg/Ca temperature overestimations of up to 10°C. In this 'polar group', $\delta^{44/40}\text{Ca}$ ratios of *N. pachyderma* (sin.) appear fairly insensitive to temperature variations, reflecting the weak $\delta^{44/40}\text{Ca}$ temperature dependency of only $\sim 0.02\text{‰}/^\circ\text{C}$ also known from *O. universa* and inorganic precipitates. The geographical boundary between temperature-sensitive and insensitive specimens is clearly defined by the Arctic Domain in the central Nordic Seas and the Atlantic inflow in the Norwegian Sea. Therefore, we suggest that both, the incorporation of 'excess' Mg into the shell and the switch between the

two $\delta^{44/40}\text{Ca}$ temperature sensitivities, are linked by a common control mechanism of the foraminiferal metabolism, probably responding to a threshold in temperature and/or salinity of about 3°C and/or approx. 34.5 psu. This assumption is supported by SEM images showing differences in the layering of foraminiferal chamber walls between temperature-sensitive and insensitive specimens.