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Size-dependent seasonality of fluxes, stable isotopes and trace element composition of the planktonic foraminifera Neogloboquadrina pachyderma s. and Globigerina bulloides in the Irminger Sea

L. Jonkers (1), P. Jimenez-Amat (1), and G.-J. A. Brummer (2)

(1) Universitat Autònoma de Barcelona, Institut de Ciència i Tecnologia Ambientals, Spain (lukas.jonkers@uab.cat), (2) Royal NIOZ, Dept. Marine Geology, Den Burg, the Netherlands

Foraminiferal interspecies stable isotope and/or trace element contrast is commonly used to infer past water column stratification. This approach relies on differences in the depth or seasonal habitat of the species involved. However, from sediment samples it is impossible to disentangle the separate effects of depth and seasonality. In situ observations of the settling flux, on the other hand, can provide such information. Here we present a 2.5-year time-series of shell flux and composition from moored sediment traps in the Irminger Sea, north-western North Atlantic. The annual temperature in the Irminger Sea varies between 5 and 10° C, our data thus provides crucial information on the use of foraminiferal proxies at low temperatures. In order to assess the influence of test size on the shell chemistry, we have examined the stable isotope and trace element composition of N. pachyderma s. and G. bulloides in two narrow size fractions: 150-250 and 250-315 μm.

Small N. pachyderma s. show a bimodal flux pattern, with a first pulse in early spring before the onset of upper water column stratification. The second pulse arrives in mid summer, around the sea surface temperature maximum. Large tests on the other hand, arrive in a single pulse in early spring. All G. bulloides tests settle in a single pulse, large ones in late spring and the smaller tests during mid to late summer.

Stable oxygen isotopes for the larger tests are consistently more positive for both species. The annual patterns follow the seasonal stratification cycle and the larger annual amplitude of G. bulloides is in agreement with a slightly shallower habitat than N. pachyderma s. Carbon isotope values show considerable intra-annual variability in both species, but the patterns differ in timing and magnitude, indicating different biological controls on its incorporation into the tests. Importantly, δ13C values vary independently from stratification/ventilation of the upper water column.

Trace element (Mg, Mn, Sr) to Ca ratios in both species show a clear seasonal pattern following the temperature and stratification cycle. The amplitude of the changes in N. pachyderma s. is however much smaller. The difference in the seasonal amplitude in the trace elements between N. pachyderma s. and G. bulloides is larger than in the oxygen isotopes, indicating that not the depth habitat of N. pachyderma s., but biological factors affect its trace element composition. Nevertheless, these new data complement to the low end of the existing Mg/Ca-temperature calibrations.

Both the oxygen isotopes and the trace element/Ca reflect the seasonal temperature cycle, N. pachyderma s. slightly deeper in the water column at $\sim$ 50 m. However, it is the difference in the flux patterns that predominantly sets the sedimentary signal. The interspecies contrast thus dominantly reflects seasonal, rather then depth habitat differences.