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Reconstruct the past thermocline circulation in the Atlantic: calcification depths and Mg/Ca-temperature calibrations for 6 deep-dwelling planktonic foraminifera

C. Cleroux (1,2), P. deMenocal (1), J. Arbuszewski (1,3), and B. Linsley (1)

(1) Columbia University, LDEO, Palisades, United States (ccleroux@ldeo.columbia.edu), (2) Now at: Royal Netherlands Institute for Sea Research (NIOZ), The Netherlands (Caroline.Cleroux@nioz.nl), (3) Now at: Woods Hole Oceanographic Institution, United States (jarbuszewski@whoi.edu)

The subtropical cells are shallow meridional overturning circulations driven by the atmospheric circulation and the deep thermohaline circulation. They connect the mid-latitude and the tropic, release latten heat to the atmosphere and impact climate on decadal to longer time scale. The upper water column temperature and salinity structures of the ocean reflect this circulation. We present proxies to study these past structures.
We performed stable oxygen isotope (δ18O) and trace element ratio measurements on one surface-dwelling (G. ruber)1 and six deep-dwelling planktonic foraminifera species (N. dutertrei, G. inflata, G. tumida, G. truncatulinoides, G. hirsuta and G. crassaformis) on 66 coretops spanning from 35°N to 20°S along the Mid-Atlantic ridge. Comparison between measured δ18O and predicted δ18O (using water column temperature and seawater δ18O), shows that N. dutertrei, G. tumida, G. hirsuta and G. crassaformis keep the same apparent calcification depth along the transect (respectively: 125m, 150m, 700m and 800m). Calcification at two depth levels was also tested. For the six deep-dwelling species, we establish Mg/Ca-temperature calibrations with both atlas temperature at the calcification depth and isotopic temperature. We present Mg/Ca-temperature equations for species previously very poorly calibrated.
The δ18O and temperature (Mg/Ca derived) on the six planktonic foraminifera species faithfully reproduce the modern water column structure of the upper 800 m depth, establishing promising proxies for past subsurface reconstruction.

1 Arbuszewski, J. J., P. B. deMenocal, A. Kaplan, and C. E. Farmer (2010), On the fidelity of shell-derived δ18Oseawater estimates, Earth and Planetary Science Letters, 300(3-4), 185-196.