Modern stable isotope composition and apparent calcification depth of planktonic foraminifera in the Western Pacific Warm Pool

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Geochemical data from planktonic foraminifera collected with plankton tows can be used as a tool for characterizing the vertical structure of the upper ocean water masses and provide a tool for paleo-reconstructions. For realistic reconstructions the modern ecology of the different species should be known. However, the knowledge about the habitat and vital effects of these organisms from the central equatorial Pacific is limited. Here we present plankton tow data from the central equatorial Pacific (-3.051°S, -165.056°W).

Oxygen and carbon isotope measurements (δ18O and δ13C) on different test size classes of Globigerinoides ruber, Globigerinoides sacculifer, Neogloboquadrina dutertrei, Pulleniatina obliquiloculata, Globorotalia menardii, Globorotalia tumida and Globorotaloides hexagonus were used to assess their distribution and apparent calcification depth.

Our data indicate that the highest abundance of foraminifera >150µm occurs within the thermocline. The standing stock of living foraminifers (>150µm) decreases from 135/m³ in the surface layer to about 9/m³ in 500m water depth.

The isotope measurements on both foraminifers and water samples provide the opportunity to assess the apparent calcification depths for different foraminiferal species and compare those with their collection depths. The δ18O values increase with increasing calcification depth. Accordingly, the mixed-layer dwellers G. ruber and G. sacculifer show distinctly lower values than those from the deeper dwellers, e.g. G. hexagonus. The offset from the equilibrium calcite profile is most pronounced in the surface dwellers such as G. ruber and G. sacculifer with values of up to -0.8 ‰. We found no apparent size-controlled δ18O deviation from equilibrium calcite. In contrast, we observed a significant size-controlled δ13C deviation between the foraminiferal test and the δ13CDIC profile. The test δ13C values are marked by a trend towards heavier values with increasing test size.

To further constrain the calcification depths (habitat) of different foraminiferal species, we plan to measure foraminiferal Mg/Ca ratios to compare the Mg/Ca-derived water temperature with the in situ temperature profile. The assignment of modern habitat depths and identification of vital effects will be used for downcore reconstructions to analyse climate-driven changes in upper ocean stratification during the last 200,000 years.