The propagule method as a tool to study assemblage dynamics in benthic foraminifera: An example with pH variations

Anna E. Weinmann¹, Susan T. Goldstein², Maria V. Triantaphyllou³, and Martin R. Langer⁴

¹Geology-Paleontology Department, Natural History Museum Vienna, Vienna, Austria (anna.weinmann@nhm-wien.ac.at)
²Department of Geology, University of Georgia, Athens, Georgia, United States of America
³Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens, Athens, Greece
⁴Institute for Geosciences, Section Paleontology, Rheinische Friedrich-Wilhelms-Universität Bonn, Bonn, Germany

Benthic foraminifera are important indicators for ecological studies. The assemblage composition of local communities can be used to analyze influences of environmental variables such as temperature, salinity, pH, and others. In recent years, the experimental propagule method has emerged as an effective tool to evaluate the influence of these variables on assemblage dynamics of benthic foraminifera. Propagules (tiny juveniles) of benthic foraminifera are widespread and can survive outside of a species’ natural distribution range. Their ability to become dormant and be re-activated once local conditions become suitable, is an important driver behind the capacity of foraminiferal assemblages to react quickly to environmental changes. In the laboratory, the propagules are first separated from the coarser fractions by sieving and then cultured under different conditions.

In the present study, we analyzed the effect of ocean pH on the composition of shallow-water assemblages from Corfu Island (Greece). Like other calcifying organisms, assemblages of foraminifera are susceptible to pH variations and have revealed compositional shifts along natural or experimental pH gradients. Our experimental set-up included four pH treatments between 6.5 and 8.5 at constant temperature and salinity (22°C and 38 ppt) for 5 weeks.

At the conclusion of the cultivation experiment, we found high numbers of grown specimens (825–1564 per replicate) and a high survivability rate throughout all treatments (78–87%). Higher pH (7.8 and 8.5) resulted in assemblages that were dominated by monothalamous and porcelaneous species, whereas lower pH (6.5 and 7.2) lead to a reduction in porcelaneous and an increase in agglutinated species. Several taxa showed significant positive or negative correlations with decreasing pH values.

Our results are congruent with previous findings that reported compositional shifts from calcareous to agglutinated taxa with decreasing pH (both from culture and field observations). Our study also indicates that the activation of propagules is an important mechanism behind assemblage dynamics in shallow-water foraminifera. As such, it offers an improved insight into potential resilience and recovery mechanisms of foraminiferal assemblages with regard to local or seasonal pH variations as well as ongoing ocean acidification.