Morphological response of Foraminifera to environmental stress during the deposition of a Mediterranean sapropel

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Manuel Weinkauf[*,1]*, Tobias Moller*[*]*, Mirjam Koch*[*]*, and Michal Kučera*[*]

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[*]*Universität Tübingen, Fachbereich Geowissenschaften, Hölderlinstraße 12, 72074 Tübingen, Germany*
[1]*manuel.weinkauf@uni-tuebingen.de*

In this study we investigate the morphological reaction of Foraminifera on environmental stress associated with the onset of the deposition of Sapropel S5 in the Eastern Mediterranean Sea. At that time, the Eastern Mediterranean experienced pronounced environmental change, which led to local extinctions of several species of planktonic Foraminifera. This interval therefore offers an excellent opportunity to assess the evolutionary and ecological response to environmental stress preceding local extinction. Specimens of three different species of planktonic Foraminifera were analysed for changes in test morphology, as well as calcification rate, test size, and incidence of abnormal growth patterns. *Orbulina universa* shows one local extinction shortly after the onset of the sapropel and a second local extinction approximately 4000 years after sapropel onset. Throughout this interval a continuous decrease in calcification rate can be observed, interrupted by an abrupt further decrease in calcification rate and test roundness at the onset of the sapropel. Intervals shortly before both local extinctions show increases in test size and in the proportion of abnormal morphotypes. *Globorotalia scitula* displays stable abundances until shortly before the onset of the sapropel, followed by a rapid local extinction. Throughout this time the species shows a continuous decrease in calcification rate, but no distinct patterns in size, incidence of abnormal morphotypes, or general morphology. However, a significant increase in both growth rate and growth-rate variance in the last sample before extinction can be observed. Preliminary results for *Globorotalia inflata* imply that there is no effect of environmental stress on calcification rate in that species, but that the size is inversely correlated with relative abundance. These results show that environmental stress influences the morphology of foraminiferal tests on different time scales. On the time scale of centuries, test shape, size, and growth patterns seem to change independently of abundance, most likely reflecting evolutionary adaptation. On a shorter time scale, immediately preceding the extinctions, another type of morphological reaction can be observed—this seems to be associated with a relaxation of the geometrical growth pattern. We speculate that severe stress at those times either hinders internal control mechanisms that would normally ensure a more symmetrical growth pattern, or it induces the species to relax the morphogenetic constraints.