Geophysical Research Abstracts, Vol. 8, 04900, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04900

Trace element content of foraminifera tests: potentialities and limits to record changes in past seawater composition

D. Stüben (1), M. Meudt (1), Z. Berner (1), U. Kramar (1), G. Keller (2)

(1) Institut für Mineralogie und Geochemie, Karlsruhe University, Germany, (2) Department of Geosciences, Princeton University, USA (doris.stueben@img.uni-karlsruhe.de)

Epifaunal foraminifera largely build up their tests in isotopic and chemical equilibrium with ambient seawater. As a consequence, the isotope composition of the carbonate test became a highly valued tool in paleoclimatic and paleoenvironmental reconstructions. In contrast, relatively little attention was paid to its trace element composition, though the Ca-carbonate test represents a relatively simple and stable chemical system in which trace elements are incorporated depending on their concentration in the water the foraminifera are living in. A larger circulation and acceptance of the approach as a tool in paleoceanographic reconstruction is hampered not only by difficulties in getting rid of different impurities which adhere on, or are enclosed in the miniscule tests, but also from possible post-depositional, diagenetic changes in their pristine composition. In this study we explore the potential of the trace element composition of foraminiferal tests as a tool for reconstructing the impact of hydrothermal activity on past seawater composition. The afore mentioned problems may be overcome by adopting an appropriate cleaning procedure and by using multivariate statistical methods (cluster- and factor analysis), which allows to discern different influencing factors (including diagenesis, if present) based on characteristic element associations. The approach was successfully tested on an Upper Maastrichtian sedimentary section from the Ninetyeast Ridge (DSDP Site 216, north-eastern Indian Ocean). To permit an independent validation of the results, element contents in the thoroughly cleaned foraminiferal tests were complemented and compared with geochemical data on bulk rock samples (element concentrations, Pb isotope data), and on the carbonate fraction of the sediment (C- and O- isotope data) as well as with already published litho- and biostratigraphic data (Keller, 2003; 2005). The approach proved to be an efficient way

to decipher the meaning of the trace element composition of foraminiferal tests and to detect changes in seawater composition due to hydrothermal activity.

The covariance, i.e. the association of the elements Co, Cu, Zn, and Pb in benthic foraminiferal tests represents a typical hydrothermal element group and reflects the intensive volcanic activity in the Ninetyeast Ridge area during the deposition of the upper part of the foraminiferal biozone CF3 of the Upper Maastrichtian. This interpretation correlates well with conclusions from independent indicators, like Pb isotope ratios ($^{207}Pb/^{206}Pb$, $^{208}Pb/^{206}Pb$) and element contents in bulk rock. Thus, the occurrence of the above element association in foraminifera tests constitutes a well-supported paleo-indicator for the identification of hydrothermal influence on the element composition of seawater. Further identified element associations reflect changes in micronutrients (Ni, Cd), in oxygenation condition of the bottom water (Mn) and in evolution of the global sea level (Sr). Nevertheless, the element associations, as in the present study, are supposed to differ from case to case in function of the concrete geochemical/ geodynamic situation and therefore should be tested and adjusted accordingly for any given section when using a similar methodical approach.

Keller, G. (2003): Biotic effects of impacts and volcanism. Earth and Planetary Science Letters 215: 249-264.

Keller, G. (2005): Biotic effects of late Maastrichtian mantle plume volcanism: implications for impacts and mass extinctions. Lithos 79: 317-341.