Geophysical Research Abstracts
Vol. 16, EGU2014-128-1, 2014
EGU General Assembly 2014

Experimental evidence of biomineralisation for three benthic foraminiferal species under different redox conditions: implications for paleo-redox proxies interpretation

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Foraminifera are among the most used group of organisms for paleoceanographic and paleoenvironmental reconstructions thanks to their ability to fossilize and the preservation potential in marine sediments. Calibrations of foraminiferal-based proxies are therefore of crucial importance for precise reconstructions together with uncertainty estimates of paleoenvironments; experimental approaches are increasingly used to deepen the understanding of biological and ecological aspects of biomineralization that can influence shell geochemistry.
Some of the most important and still unanswered questions are: under which circumstances can foraminiferal biomineralization take place? Can their shells record different oxygenation levels and redox fronts migrations at the sediment-water interface?
The hypothesis of their ability to biomineralise even in absence of oxygen was investigated in an experimental study.
Calcein-labeled specimens of three benthic foraminiferal species, Ammonia tepida, Bulimina marginata and Cassidulina laevigata were introduced in different sediment layers of reconstituted cores (up to 10 cm depth). The sediment layers were separated by 100 μm mesh-size nets preventing specimen migrations. We could therefore evaluate the ability of the species to calcify at different redox fronts in the sediment. The results show that all species were able to calcify within 2 months in hypoxic. Two of them (Ammonia tepida and Bulimina marginata) are also able to calcify in completely anoxic conditions. The result suggests that foraminifera could register in their calcareous shells the migration of redox fronts associated to bottom-water oxygen depletions and anoxic events. With the help of microanalytical tools it will potentially be possible to reconstruct past oxygen levels with much higher accuracy and precision and to obtain proxies of completely anoxic conditions.