European Mineralogical Conference
Vol. 1, EMC2012-271, 2012
European Mineralogical Conference 2012


# Environment derived signals recorded by patterns of biological mineralization: Mytilidae shell ultrastructure from low pH field and culturing experiments

S. Hahn (1), R. Rodolfo-Metalpa (2), E. Griesshaber (3), W. W. Schmahl (3), D. Buhl (1), J. M. Hall-Spencer (2), C. Baggini (2), K. T. Fehr (3), F. Melzner (4), and A. Immenhauser (1)

(1) Institute of Geology, Mineralogy and Geophysics, Ruhr-University Bochum, Bochum, Germany (sabine.hahn@rub.de), (2) Marine Institute, Marine Biology and Ecology Research Centre, University of Plymouth, Plymouth, United Kingdom, (3) Department of Earth and Environmental Science, Ludwig Maximilian University, Munich, Germany, (4) Department of Biological Oceanography Research Division 2: Marine Biogeochemistry, Leibniz-Institute of Marine Science (IFM-GEOMAR), Kiel, Germany

Bivalve shells represent excellent archives and offer unique opportunities for reconstructing environments of formation. However, their value as archives of ocean acidification events is underexplored. In our approach combining microstructure imaging, crystallographic texture analysis and trace element geochemistry we investigated the ultrastructural and geochemical responses of Mytilidae shells to acidified seawater. Specimen of Mytilus galloprovincialis from the harbour of Ischia were transplanted to naturally acidified environment near $CO_2$ vents with mean pHT 7.3 and to a control setting with mean pHT 8.1 on the east coast of the island of Ischia. Most prominently, the shells recorded the shock of transplantation, both in their shell ultrastructure and textural record as well as in their geochemical record. Shell calcite, precipitated under acidified seawater responded to the pH gradient by an in part disturbed ultrastructure. These data suggest that care is needed when interpreting potential acidification signals from short-term field experiments. This is because numerous parameters (metabolic processes, seawater pH, factors such as salinity, water temperature, food availability and population density) affect shell chemistry and ultrastructure and an experimental bias cannot be excluded. In order to circumvent these problems, we investigated cultured bivalves from aquaria experiments. Juvenile specimen of Mytilus edulis (Kieler Fjorde) were transplanted into aquaria representing different pH levels (pH 8.0 (385$\mu$atm), pH 7.7 (1200$\mu$atm), pH 7.5 (2400$\mu$atm) and pH 7.2 (4000$\mu$atm)). First results show that calcite precipitated from the most acidified seawater (pH 7.2) responded by an in part disturbed ultrastructure as found in the case of the field experiments. This is considered of significance a transplantation shock can be excluded and features observed represent genuine effects of low pH environments. Furthermore, a disturbed shell ultrastructure is a feature that has a reasonable fossilization potential. Conversely, culturing experiments represent analogues of limited value for real-world environmental settings as the focus is commonly on one factor (here pH) only. We propose that the combination of field and culturing data, as shown here, is perhaps the most promising approach.