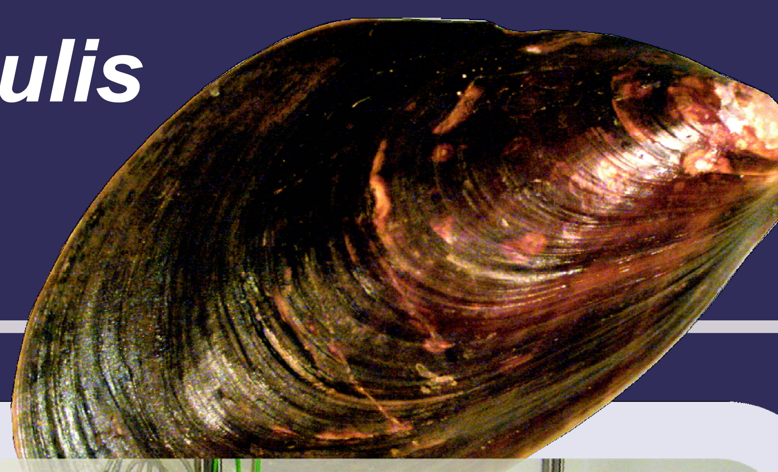
The influence of increased pCO_2 on the calcification of *Mytilus edulis*

Agnes Heinemann[1], Jan Fietzke[1], Jörn Thomsen[1], Anton Eisenhauer[1] and Frank Melzner[1]
[1]Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany



Background and aim of the study

One of the most important and abundant calcifying organisms in several marine ecosystems is the blue mussel, *Mytilus edulis*. Blue mussel beds are also common features in the Kiel Fjord (Baltic Sea), a habitat dominated by low salinity (10-20), low alkalinity (1900-2150 µmol kg^{-1}), highly variable pH (~7.3 to 8.3) and high pCO_2 (max. value of 2340 µatm). The resulting calcium carbonate saturation state (min. values: Ω_{arag} = 0.34 and Ω_{calc} = 0.58) is significantly lower than in the open ocean.[1] Carbonate saturation during summer in Kiel Fjord is already significantly lower than the IPCC prediction for the future global ocean.[2]

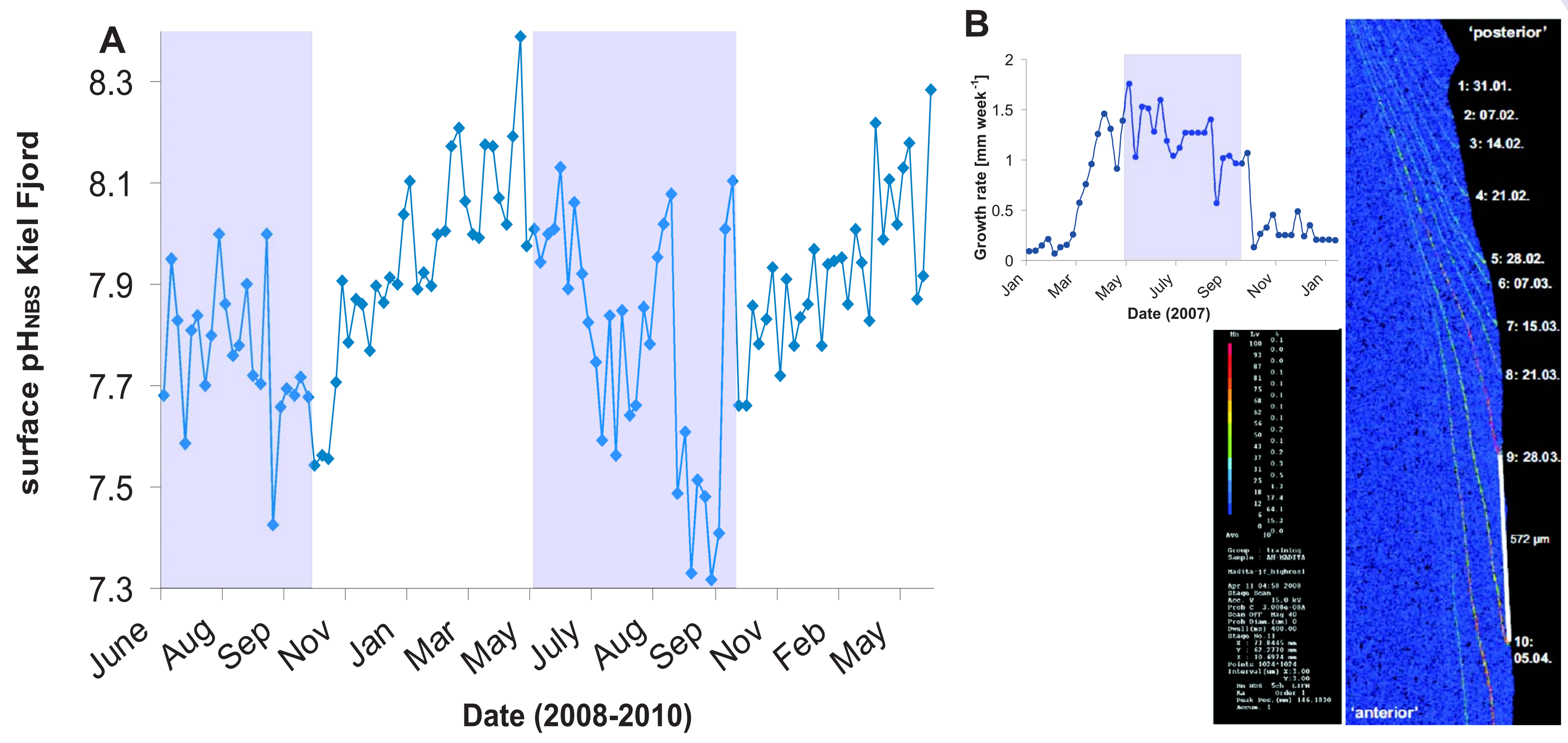
To contribute to the understanding of calcifying organisms' ability to live under ocean acidification conditions and of biomineralisation mechanisms, *M. edulis* from this habitat were cultured under different CO_2 conditions.

Experimental Setup

Mussels from Kiel Fjord were kept in a flow through system for 3 months. Experimental setup comprised using CO_2 concentrations between 387 µatm and 4,000 µatm.

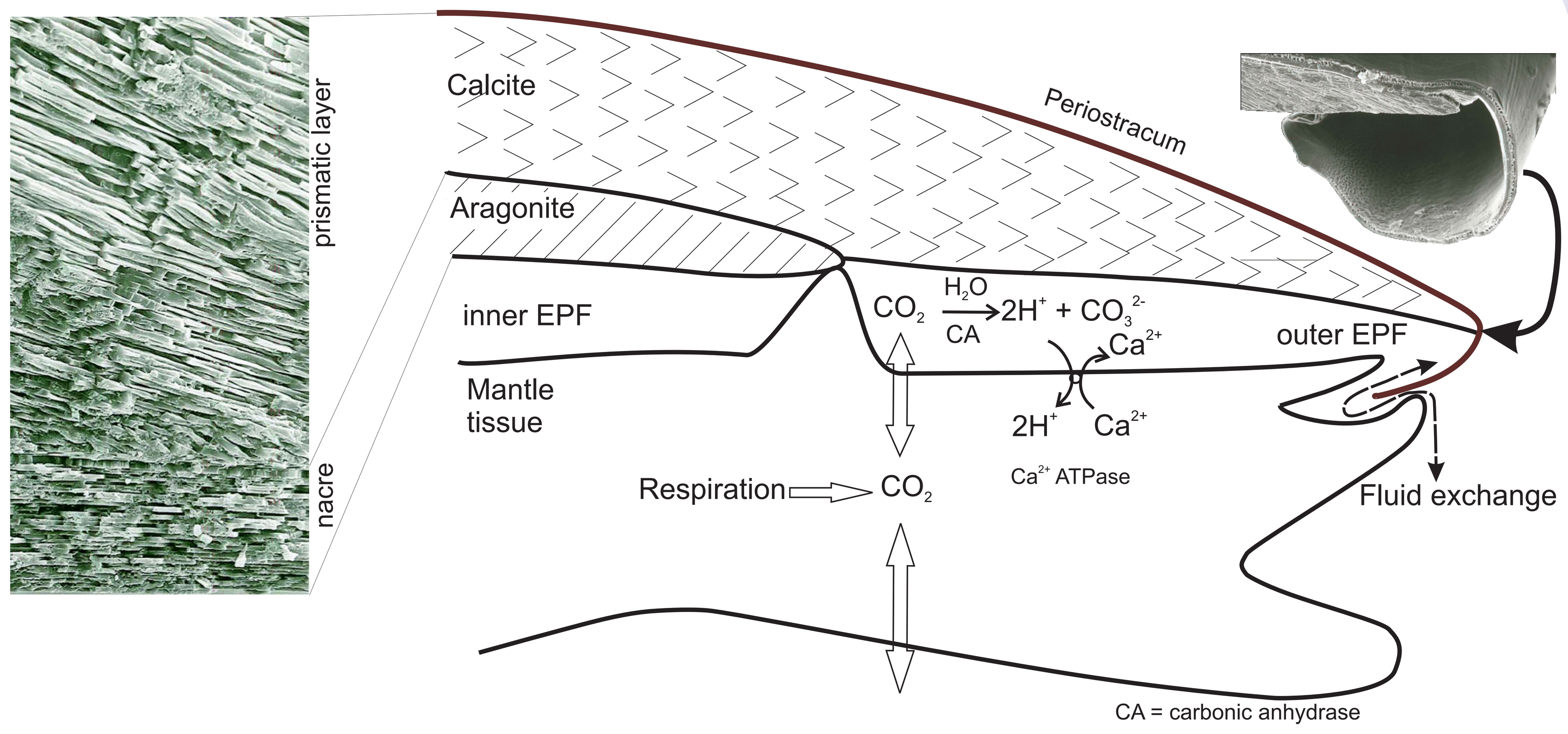
At the end of the experiments hemolymph and extrapallial fluid (EPF) were taken and analysed for pH, pCO_2, bicarbonate and elemental ratios (Mg/Ca and Sr/Ca).

Boron isotopes ($\delta^{11}B$), used in isotope geochemistry as a pH proxy, were investigated by LA-MC-ICP-MS[5] in shell portions (calcite) precipitated during experimental treatment.

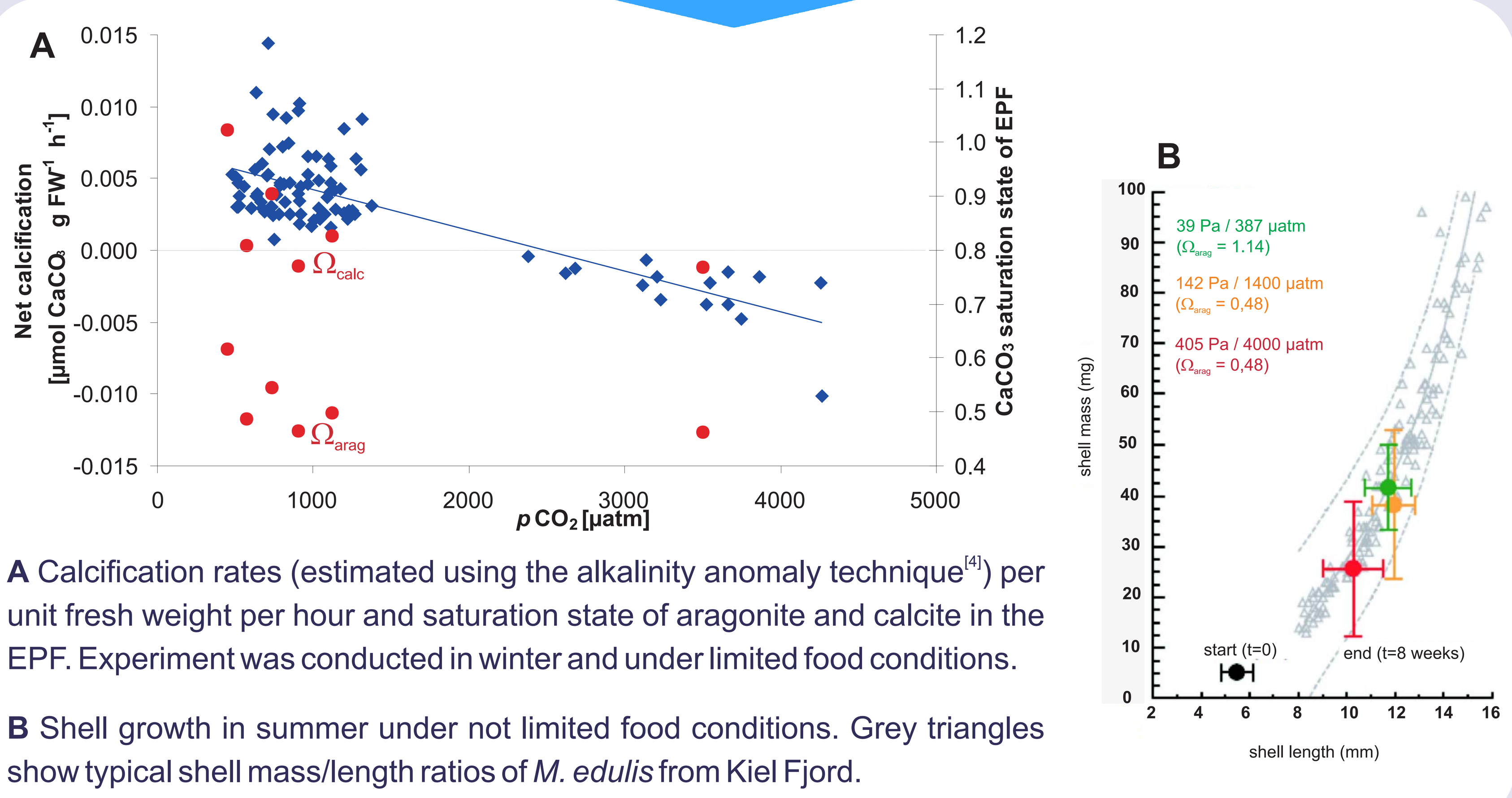


A Time series of Kiel Fjord surface pH and **B** Mn-marked calcite of *M. edulis* grown in Kiel Fjord.[1]

***M. edulis* in Kiel Fjord reaches maximum growth while water pH decreases to 7.3.**



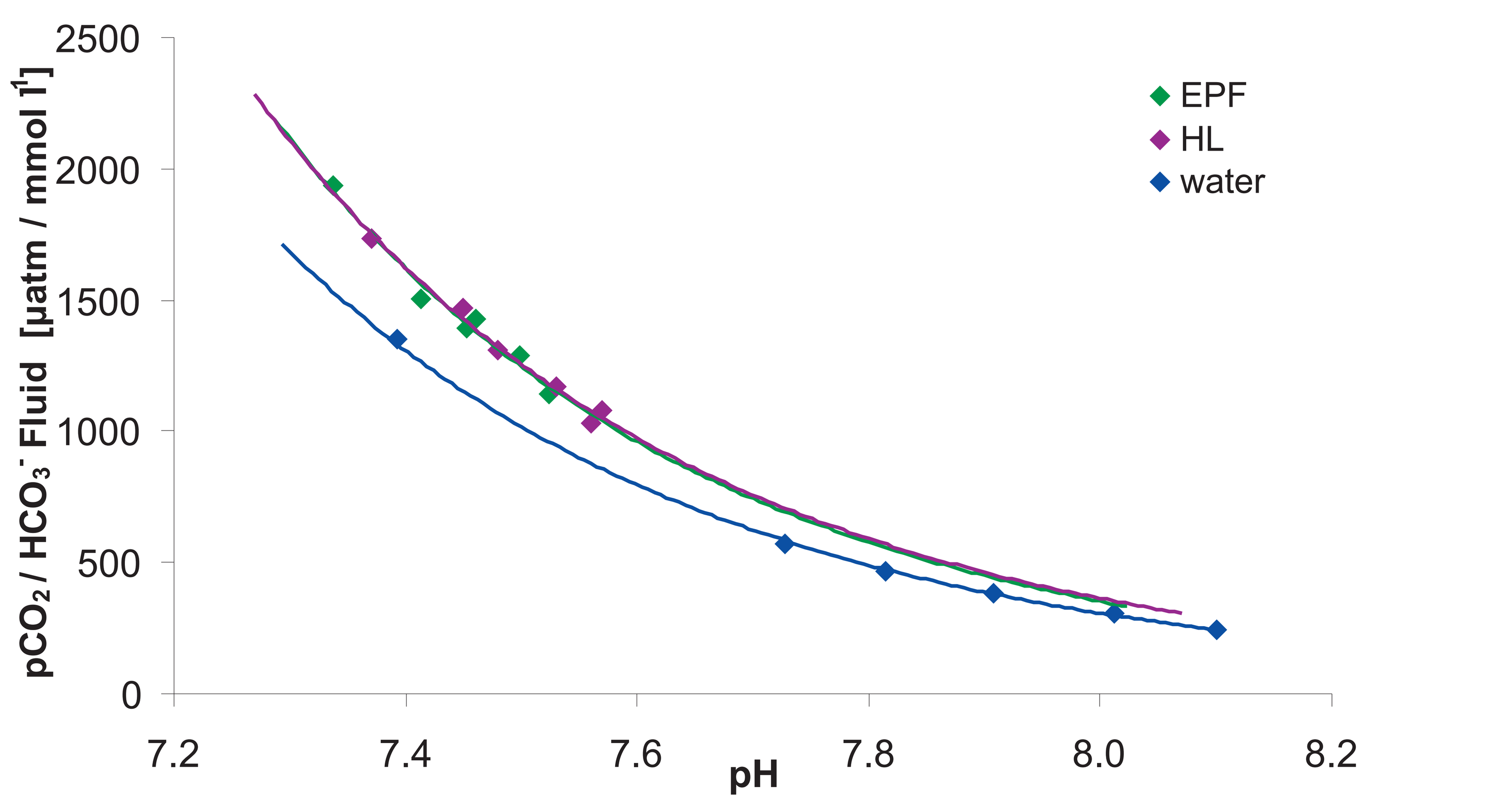
Modified schematic anatomy of a bivalve and SEM pictures of *M. edulis* showing the shell layers and the edge.[3]



A Calcification rates (estimated using the alkalinity anomaly technique[4]) per unit fresh weight per hour and saturation state of aragonite and calcite in the EPF. Experiment was conducted in winter and under limited food conditions.

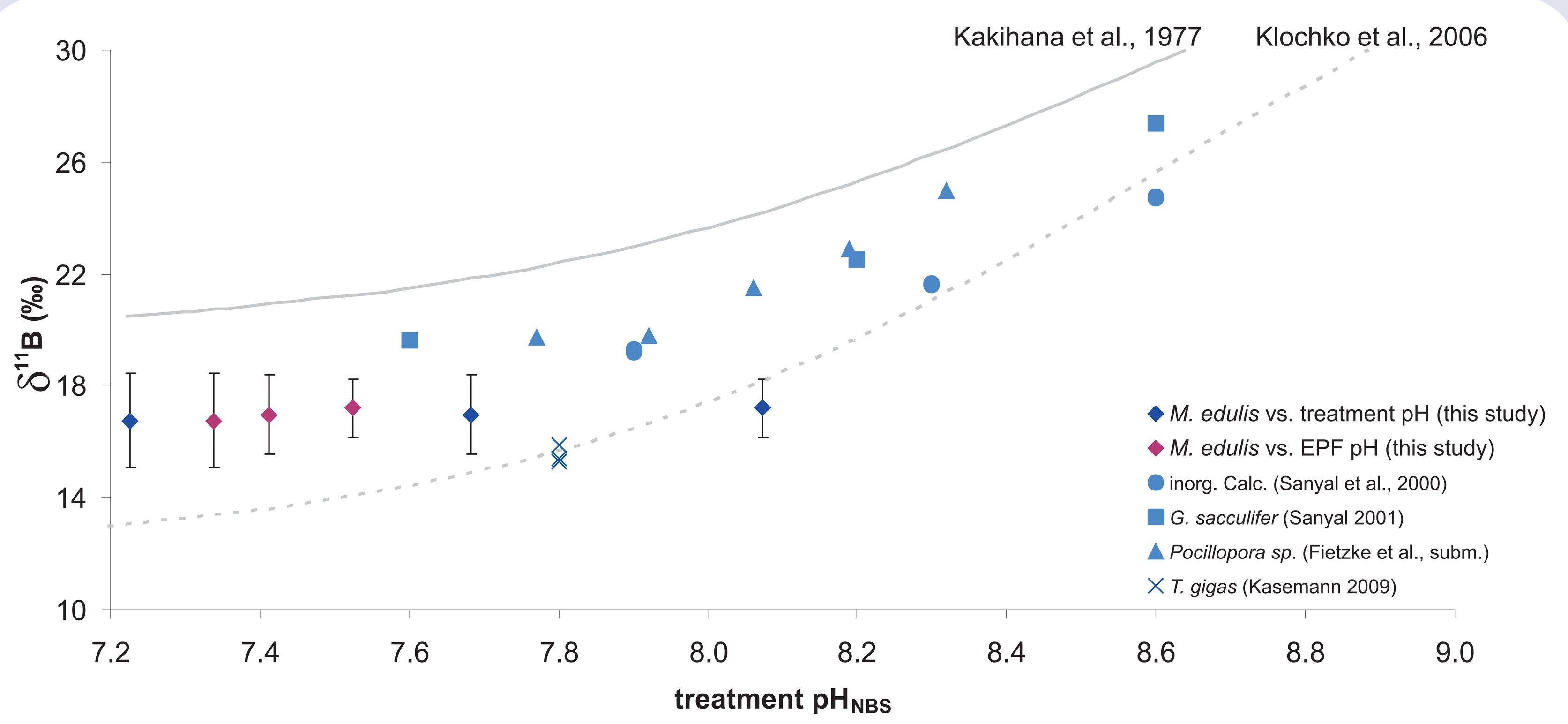
B Shell growth in summer under not limited food conditions. Grey triangles show typical shell mass/length ratios of *M. edulis* from Kiel Fjord.

Proper food conditions may drastically improve the tolerance of *M. edulis* with respect to ocean acidification.



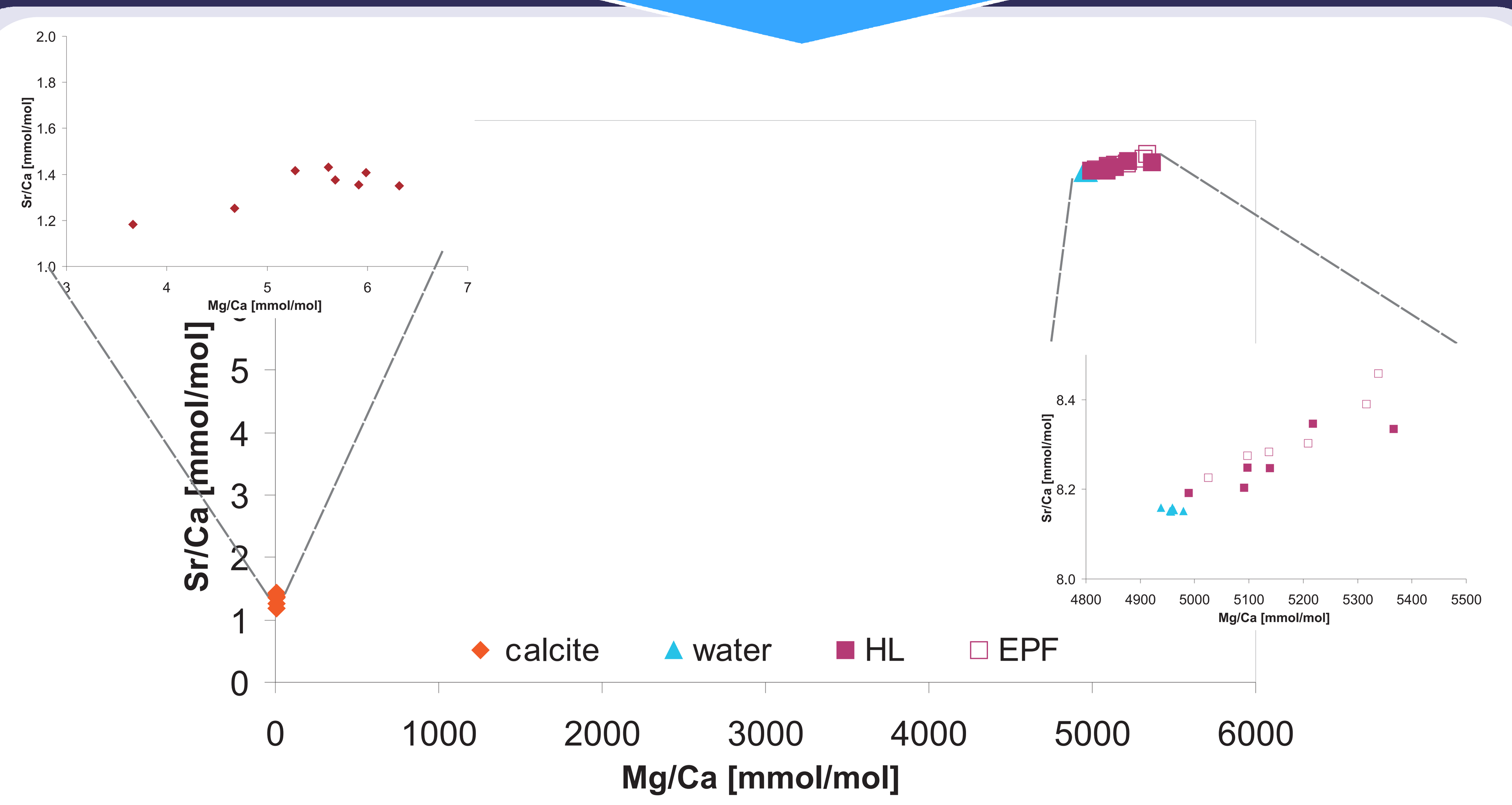
Acid-base parameters of hemolymph and extrapallial fluid compared to ambient treatment water.

***M. edulis* is able to calcify under low pH and high pCO_2 conditions in its fluids and doesn't accumulate HCO_3^-.**



Boron isotopes measured by LA-MC-ICP-MS[5] in *M. edulis* shell calcite (5 individuals per treatment) grown under different CO_2 conditions. Blue diamonds are plotted against treatment (water) pH, pink diamonds against internal (EPF) pH. Values of *T. gigas* plotted against internal pH.[6]

$\delta^{11}B$ in *M. edulis* is extremly variable within and between individual shells. $\delta^{11}B$ seems to reflect the internal pH (7.3-7.5).



Elemental ratios in calcite shell layer, EPF and HL of *M. edulis* and ambient water.

Shell formation induces trace metal offsets between *M. edulis* body fluids and ambient water.

Literature

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Contact Agnes Heinemann
Marine Biogeochemistry
aheinemann@ifm-geomar.de
www.ifm-geomar.de/~aheinemann

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