Sulfate-reducing bacteria as major players in the formation of reef-microbialites during the last sea-level rise (Tahiti, IODP 310)

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During IODP Expedition 310, drowned Pleistocene to Holocene barrier reefs seaward of the modern fringing reefs of the volcanic island Tahiti have been drilled. The Tahitian deglacial (last sea-level rise ~15,000-9,000 yr) reef-succession is a coral framework encrusted by coralline algae and microbial carbonates, so-called microbialites. The laminated and partly dendritic reef-microbialites predominate the cores (up to 80 vol. %), which is very uncommon when compared with modern shallow-water coral reefs from Tahiti and other sites. The processes leading to that voluminous formation of microbialites in Tahitian coral reefs during the last sea-level rise are still under discussion.

Here we present lipid biomarkers, which were used for the first time to identify organisms, which were involved in the formation of these reef-microbialites. The most abundant compounds preserved in the microbialites are fatty acids. Among those, bacterially-derived terminally-branched fatty acids (*iso*- and *anteiso* $C_{15:0}$ and $C_{17:0}$) are unusually abundant with an average contribution of around 20% of all fatty acids. *Iso*- and *anteiso* $C_{15:0}$ and $C_{17:0}$ fatty acids are considered to be typical biomarkers of sulfate-reducing bacteria. Because enzymatic carbon isotope fractionation of heterotrophic sulfate reducers is insignificant, the minor shift between the average $\delta^{13}C$ values of the bulk organic matter (–20‰ to -19‰) and the average compound-specific $\delta^{13}C$ values of the *iso*- and *anteiso* $C_{15:0}$ and $C_{17:0}$ fatty acids (–19‰) agrees with sulfate reducers as source of the bacterial fatty acids. Sulfate-reducing bacteria are known to induce carbonate precipitation by increasing alkalinity. Biomarker evidence for the involvement of oxygenic phototrophs (e.g., cyanobacteria) in the microbialite formation was not found.

It is suggested, that strong weathering of Tahiti basalt elevated the deglacial nutrient levels. That promoted the growth of algal mats, which provided the organic matter for sulfate reduction. Our results imply that a rather specific community of bacteria, most likely dominated by sulfate-reducing bacteria, was responsible for microbialite formation in the coral reefs off Tahiti during the last sea-level rise.

Acidification-sensitivity of *M. edulis*

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Holistic Approach

Baltic *Mytilus edulis* were kept in a flow through system for 3 month at six different CO_2 concentrations ranging from 380 ppm to 4,000 ppm. During the experimental period calcification rates were determined using alkalinity anomaly (δTA) technique after Smith and Key 1975 [1] and shell growth was measured. Calcification rates showed that mussels start to dissolve at values higher than 2,400 ppm. This stands in contrast to Gazeau *et al*. 2007 [2] who found that mussels dissolved at values higher than ~1800ppm.

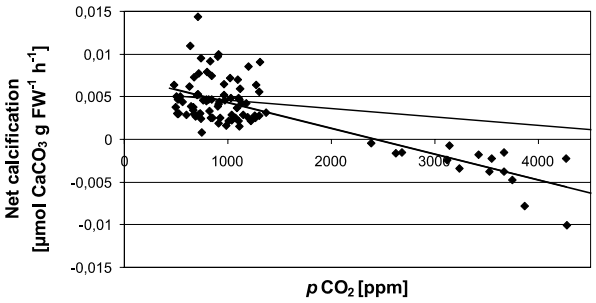

Figure 1: Net calcification rates vs. seawater pCO_2

At the end of the experiment hemolymph and extrapallial fluid were taken and pH, pCO_2 and elemental ratios were measured. Shell composition will be investigated via micro-probe and LA-ICP-MS. Further, the dry weight of tissue and lipofuscin accumulation will be determined as an indicator for stress. A second experiment was designed to investigate the combined effects of different CO_2 levels (380, 840 and 1,400 ppm) and temperatures (5, 10, 15, 20, 25°C).

[1] Smith and Key (1975) *Limnol. Oceanogr*. **20(3)** 493– 495. [2] Gazeau *et al.* (2007) *Geophysical Research Letters* **34**, L07603