Black Sea shelf microbial reefs

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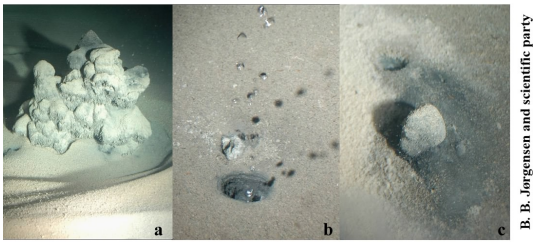
Introduction

Microbial reefs, fuelled by the anaerobic oxidation of methane, grow in anoxic waters at the Black Sea shelf (Figure a). The key methanotrophic microbes were identified, but little is known about the structures of reef-forming microbial communities.

In order to follow the reefs growth, we analysed sediment surrounding an active gas seepage (Figure b), a supposably initial reef stage (Figure c), as well as different parts of one reef (top, exterior and center) from the Danube Canyon by using molecular tools. Further reef samples from three different locations along the northwestern shelf (Metrol Cruise POS317/3: Danube Canyon, Northwestern Shelf and Paleo-Dnepr Area) were characterised to address the question whether the reefs are comparable structures.

Figure: Supposed stages of forming reefs



Discussion of results

A major fraction of the reef-forming communities consisted of anaerobic methane oxidising archaea (ANME) of which either ANME-1 or ANME-2 dominated certain reef parts. Key bacterial players were members of the sulphate-reducing *Desulfosarcina / Desulfococcus*, as well as *Planctomycetes* and *Verrucomicrobia*. The reef`s top was characterised by the abundance of huge, apparently active ANME-2 aggregates whereas the center comprised mostly single, probably inactive cells. Most ANME-1 were found in the center, however including numerous dead cells. The exterior of the reef was highly heterogeneous with respect to ANME distribution and bacterial diversity. The comparison of reefs showed a high variability between activity and abundance of different groups, but most key players appeared in all samples.

Conclusions

We hypothesize, that the most active microbial growth area of the reef is the top, whereas the center seems to be the oldest part. The reef`s exterior provides heterogeneous microniches and might grow more or less radially.

Reefs along the northwestern shelf differed remarkably. Certain groups seem to represent typical reef-forming microbes, but the variable community structures suggest various environmental conditions or reef ages.

Scientific drilling in the Barberton Greenstone Belt

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The Barberton Greenstone Belt in South Africa is a remarkable natural laboratory where conditions at the surface of the Archean Earth can be investigated. Shallow (100-1000m) diamond cores will be drilled in selected volcano-sedimentary successions in order to reconstruct the geodynamics of Archean sedimentation and volcanism, how these processes interacted at the interface between lithosphere-hydrosphere-atmosphere-biosphere, and the environments at the Earth's surface where life first emerged and subsequently evolved.

Despite generally good outcrop, nowhere in the Barberton belt are complete sections preserved, and crucial features such as the contacts of lava flows and critical sedimentary rock sequences are not exposed. Drilling is needed to obtain such sections and relatively unaltered samples. Two main targets have been identified. (1) Sedimentary sequences will provide information about erosion and sedimentation on the early Earth, the composition and temperature of Archean seawater, and one site where life may have emerged and evolved. Tidal sequences will inform us about the dynamics of the Earth-Moon system, and spherule layers and impact debris provide information about the nature and magnitude of meteorite impacts. (2) Successions of ultramafic to felsic volcanic rocks will provide new insights into volcanic processes, mantle dynamics, and interaction between oceanic volcanic crust and the hydrosphere and biosphere. The sources of hydrothermal fluids on the ocean floor, driven by circulation of seawater through the volcanic pile, constitute a second habitat of early life.

The project is supported by scientists from 13 countries in five continents and by the mineral exploration industry. Planning meetings have been held in Johannesburg (Oct 2006), San Francisco (Dec 2006) and Berlin (March 2007). Proposals for funding have or will be submitted to agencies in Europe, America and Asia and to the ICDP.