Geophysical Research Abstracts,
Vol. 11, EGU2009-1065, 2009
EGU General Assembly 2009

Simulation of the deep-sea biosphere by a continuous high-pressure bioreactor

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In ocean system Anaerobic Oxidation of Methane (AOM) followed by carbonate precipitation has a significant effect on the climate regulation, since this process avoids large methane emissions to the atmosphere and fixes carbon dioxide into carbonate structures. However the main difficulty to study AOM is that the consortia involved have extremely long doubling time (2-7 months) at ambient or low pressures. To simulate the in situ condition better and obtain a faster growth, we designed and constructed a unique continuous high-pressure bioreactor. The reactor can reach pressure up to 100 bars, representing a depth of 1000m below sea level; it can be operated in continuous or non-continuous style, simulating the different types of methane resource. By the help of this high pressure bioreactor system, we are also able to study the effect of environmental factors on AOM activity and on microbial community. Captain Arutyunov Mud Volcano (Gulf of Cadiz) sediment has been used as biomass resource and different molecular techniques (DGGE, cloning library, FISH) have been applied to examine the microbial community structure. By increasing methane partial pressure, an immediate increase of AOM activity has been observed before significant enrichment of biomass. A continuous methane flux is necessary to obtain optimal AOM activity. Bacterial community is more sensitive to the change of pressure compared with archaeal community.