Insights in the methanogenic degradation of BTEX and PAH in different geological systems

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Biodegraded oil is found in many reservoirs worldwide. The more complex hydrocarbons belonging to the PAH and BTEX groups are harder to degrade by prokaryotes than e.g. alkanes. To understand the degradation processes of these hydrocarbons into simpler components, it is very important to get insight in the microbial communities and metabolic processes involved.

The lack of alternative electron acceptors in many habitats limits the possible anaerobic degradation pathways to methanogenesis, which has been shown to be the most important process in different hydrocarbon reservoirs. The composition of the microbial communities in enrichments from habitats with differing geochemical settings, e.g. shallow and deep subsurface terrestrial and marine systems showed a relatively similar composition, independent of the sampling site. Especially methanogenic Archaea, members of the *Syntrophaceae* and sulfate-reducing Prokaryotes contributed to the community in most enrichments. Moreover, in samples from a Chinese oilfield, the crucial process, the conversion of alcanoic, aromatic and polyarmoatic hydrocarbons to methane, was proven in incubations via 13C-labeling [1]. The further molecular biological analysis of this habitat confirmed the presence of methanogenic Archaea as well as of different Bacteria capable of hydrocarbon degradation. In the ongoing work 13C-labeled substrates combined with SIP of proteins and DNA is used to identify the actively involved microorganisms. Preliminary analyses revealed labeled proteins belonging to methanogens, SRB and *Syntrophus* species thus confirming the 16S results. In addition the results from these enrichments are compared with data from environmental samples of gas, shale and oil reservoirs, to determine the *in situ* importance of the enriched hydrocarbon degraders.

[1] Jiménez, Morris, Cai, Gründger, Yao, Richnow, Krüger (2012) *Organic Geochemistry* 52, 44-54.

Observed large- and meso-scale oxygen changes in the ocean

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Model results predict a decline in ocean oxygen and observations confirmed declines at different locations [1]. Within the research initiative 'Climate – Biogeochemistry Interactions in the tropical Ocean' the temporal-spatial scales of oxygen changes were investigated. Large scale oxygen changes for the world ocean were derived at 300 dbar for the last 50 years and in the South Atlantic Ocean even for a 70 year period [2]. Declining upper-ocean oxygen levels in many regions, especially in the tropical oceans, are dominant, whereas areas with increasing trends are found in subtropical and in a few polar regions. A comparison to a numerical biogeochemical Earth system model reveals that the magnitude of the observed change is consistent with CO_2-induced climate change, however there is a large mismatch between observed and modeled oxygen trends.

In the equatorial Pacific the zonal current bands are important in resupplying oxygen to the oxygen minimum zone in the eastern Pacific. In the Pacific strong oxygen changes are related to the Pacific Decadal Oscillation while oscillations on shorter time scales like an El Nino signal in the upper 350 m are superimposed upon this signal [3].

Meso-scale related oxygen changes are expected to be important on the poleward side of the tropical oxygen minimum zones. Recent measurements of the oxygen distribution of eddies near the Peruvian shelf as well as mooring observations at the Stratus mooring at ~20°S, 85°W show a large expanded low oxygen layer in anticyclonic eddies while in cyclonic eddies the low oxygen layer decreased.

The derived results indicate the importance of a large range of temporal-spatial scales which needs to be investigated further.

[1] Keeling *et al.*. (2010) *Annu. Rev. Mar. Sci.*, **2**, 199-229. [2] Stramma *et al.* (2012) *Biogeosciences,* **9**, doi:10.5194/bg-9-1-2012. [3] Czeschel *et al.* (2012) *J. Geophys. Res.*, **117,** doi:10.1029/2012JC008043.

10.1180/minmag.2013.077.5.19