Sonderforschungsbereich 754
Climate-Biogeochemistry Interactions in the Tropical Ocean

SFB 754 colloquium: **Monday, 14. April 2014, 13.15h**
Hörsaal, GEOMAR, west shore

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Title:
Is there significant turnover of H2 in the Ocean

Abstract:
Atmospheric hydrogen concentrations result from a number of counteracting processes. H_2 is mainly produced due to photooxidation of methane and other hydrocarbons in the upper atmosphere and due to fossil fuel and biomass burning. By far the largest proportion of hydrogen (80-90%) is estimated to be consumed by microorganisms in the soil whereas the remaining part reacts with OH radicals. Since OH radicals are important for the degradation of methane, hydrogen levels indirectly control the amount of this green house gas. Currently, the atmospheric concentration of H_2 is about 0.5 ppm. The processes governing hydrogen concentrations and exchange in marine and freshwater environments are poorly understood. In general it seems that tropical surface waters act as hydrogen sources contributing about 6 % to global hydrogen production. Contrary to this temperate surface waters act as hydrogen sinks. We analyzed the occurrence of different hydrogenase genes, the enzymes involved in H_2 turnover, in marine as well as freshwater environments [1,2]. It turned out that hydrogenase genes are surprisingly widespread in surface waters with a clear bias to coastal regions. H_2 consuming hydrogenases could be found almost everywhere indicating that hydrogen could serve as additional energy supply in the marine realm. The tools for detecting hydrogenase genes have been limited until now but we were able to invent a universal marker for the detection of NiFe-hydrogenase genes [2]. Some hydrogenases can cope with atmospheric oxygen levels whereas most hydrogenases are inhibited by O_2 [4,5] and are important in microaerobic or anaerobic environments. Therefore, OMZs are predestined for a high abundance of these genes/enzymes but remain untapped in this respect. This talk will focus on recent new insights into the distribution of hydrogenases in the water column and OMZs and discuss the potential impact of hydrogen turnover on the marine carbon cycle.

References:

[1] Barz et al. (2010) Distribution analysis of hydrogenases in surface waters of marine and freshwater environments. PLoS One 5, e13846.

[2] Gutekunst et al. (2014) The bidirectional NiFe-hydrogenase in *Synechocystis* sp. PCC 6803 is reduced by flavodoxin and ferredoxin and is essential under mixotrophic, nitrate-limiting conditions. J Biol Chem 289, 1930-1937. doi: 10.1074/jbc.M113.526376.

[3] Beimgraben et al. (accepted) *hypD* as a marker for NiFe-hydrogenases in microbial communities of surface waters, Appl Environ Microbiol

[4] Germer et al. (2009) Overexpression, isolation, and spectroscopic characterization of the bidirectional [NiFe] hydrogenase from *Synechocystis* sp. PCC 6803. J Biol Chem 284, 36462-36472.

[5] McIntosh et al. (2011) The NiFe-hydrogenase of the cyanobacterium Synechocystis sp. PCC 6803 is working bidirectional with a bias to H_2 production. J Am Chem Soc 133, 11308-11319.