Summary

While there is a growing knowledge of diazotrophic diversity in the oceanic water column (e.g. Farnelid et al., 2011, Fernandez et al., 2011, Löscher et al., 2013), information on diazotrophs and N_2-fixation in marine sediments is relatively sparse and can be considered as one major gap in knowledge on the marine nitrogen cycle. One recent study (Bertics et al. 2013) showed an unexpected diversity of diazotrophs in sediments of the Baltic Sea, as well as active N_2-fixation. This finding challenged the classical view of N_2-fixation being most active in nutrient-depleted waters like subtropical gyres and being absent in nutrient rich sediments. Existing data of the benthic diazotrophic diversity are, however, restricted geographically and by limited sequencing depths of classical Sanger sequencing. Thus, we propose an in-depth Illumina sequencing analysis of samples collected at several marine locations world-wide, which would provide the first survey of the *nifH* gene pool in marine sediments and yield insights into the composition and diversity of benthic diazotrophs. Results of this study are of importance for understanding the marine nitrogen budget which is still missing a term on the N input side. This might be at least partially explained by unexpected N_2-fixation sources such as benthic N_2-fixation.

State of the art

Preliminary studies on benthic diazotrophic diversity (Gier, Löscher, unpublished) revealed the prevalence of the functional gene for N_2-fixation (*nifH*) in sediments off Peru, which belonged to new clusters of diazotrophs. Bertics et al. (2013) presented already a small snapshot on the *nifH* diversity; however, the sequence dataset is rather small. N_2-fixation activity in the sediment off Peru was detected and quantified; integrated rates (0 – 20 cm sediment depth) were as high as 0.229 ± 0.010 mmol N m^{-2} d^{-1} at the 244 m station in the oxygen minimum zone off Peru. These rates are in the same range as rates measured at Boknis Eck in the Baltic Sea (0.22 ± 0.005 mmol N m^{-2} d^{-1}, Bertics et al. 2013). These results indicate that N_2-fixation by benthic microorganisms is an important process, introducing new bioavailable N to marine sediments and might impact globally on oceanic nutrient budgets.

Contribution of the project to the SFB goals

The current study is a collaboration between subprojects B4 and B6. The original goal of subproject B6 and B4 was the identification of N_2-fixing bacteria in oxygen minimum zones. The current study extends the original idea by adding the diversity aspect of benthic diazotrophs in the world oceans to the project, instead of just proofing their presence and activity in sediments. Information on the diazotrophic diversity is of particular importance, as they are essential to interpret potential reactions on future environmental changes and links to other biogeochemical cycles. The results will thus contribute to a better understanding of N cycling in OMZ sediments, improve our knowledge on sources of fixed N and could be applied to other regions worldwide

Importance of the SFB for the project

To realize our goal to characterize the diversity of benthic diazotrophs of various ocean regions, the knowledge of biogeochemistry and microbiology is required. In order to extrapolate on a broader perspective, it is necessary to combine and coordinate within the framework of the SFB. Only a large scale project such as the SFB offers the possibility to get a broad variety of samples and sample locations and to put together scientific methods and results from different subprojects.