With all Good Wishes for Christmas and the New Year!

NEWSLETTER
2014 | 04

Sonderforschungsbereich 754
Climate – Biogeochemistry Interactions in the Tropical Ocean

SFB 754

## 8th SFB 754 annual members assemblage

**GEOMAR, 11TH DEC 2014**

Currently the SFB 754 has 69 registered members of which 45 participated at this year's members assembly. Focus of this assembly was the preparation of the 3rd phase. Proposed subprojects of the 3rd phase are currently divided into four thematic blocks. Coordinators of the thematic blocks gave a presentation on results of the 2nd and outlook of the 3rd phase. Finally, Prof. Oschlies, speaker of the SFB 754, gave an update on the SFB 754 finances, outputs and activities for 2014 and presented an outlook and road map for 2015.

## Publications

**Achterberg, E. P. (2014) Grand challenges in marine biogeochemistry. Frontiers in Marine Science. 1 . p. 7. DOI 10.3389/fmars.2014.00007**

The ocean plays a central role in our earth's climate system and also provides a range of important ecosystem services, including food, energy, transport, and nutrient cycling. Marine biogeochemistry focuses on the study of complex biological, chemical, and physical processes involved in the cycling of key chemical elements within the ocean, and between the ocean and the seafloor, land and atmosphere. The ocean is increasingly perturbed by human induced alterations to our planet, including anthropogenic emissions of nitrogen, phosphorus, carbon and trace elements, and climate change. The establishment of a detailed understanding of biogeochemical processes, including their rates, is essential to the identification and assessment of climatic and chemical feedbacks associated with changes in the chemical and physical environment that are mediated through ocean biology, chemistry and physics. Important research areas in marine biogeochemistry involve the cycling of organic and inorganic forms of carbon, nitrogen and phosphorus, the cycling and biological roles of essential trace elements, and the fate and climatic impact of marine produced trace gases.

**Baars, O. and Croot, P. (2014) Dissolved cobalt speciation and reactivity in the eastern tropical North Atlantic. Marine Chemistry. DOI 10.1016/j.marchem.2014.10.006**

Recent studies highlight the role of cobalt (Co) as an important micro-nutrient with a complex scavenged type oceanic distribution. To better understand the biogeochemical cycle of Co we investigate the distribution, speciation and reactivity of dissolved Co in the eastern tropical North Atlantic in the upper 800 m of the water column. The study complements classical Co ligand titrations that require a thermodynamic equilibrium with evaluations of ligand-exchange kinetics and reducibility of potential Co(III) species. The experiments include additions of the artificial Co binding ligands dimethylglyoxime or Nioxime and detection by cathodic stripping voltammetry. Two pools of Co compounds are found: a labile fraction that exchanges Co within minutes and a strong/inert fraction that does not react within a 24-h period. The apparent Co(III) reducibility is highest at the chlorophyll-a maximum and decreases in deeper waters. Our results are in agreement with a possible release of Co(III) species, including vitamin B12, by phytoplankton and associated bacteria. The presented results have important implications for our understanding of the biological availability and the marine cycle of Co.

**Glock, N., Liebetrau, V. and Eisenhauer, A. (2014) I/Ca ratios in benthic foraminifera from the Peruvian oxygen minimum zone: Analytical methodology and evaluation as proxy for redox conditions. Biogeosciences Discuss., 11, 11635-11670, doi: 10.5194/bgd-11-11635-2014**

In this study the correlation of I/Ca ratios in three calcitic and one aragonitic foraminiferal species is explored. I/Ca ratios are evaluated as possible proxies for changes in ambient redox conditions across the Peruvian oxygen minimum zone to the ambient oxygen concentrations in the habitat of the foraminiferal species studied. Cleaning and measurement methods for the determination of I/Ca ratios are tested. All species show a positive trend in their I/Ca ratios as a function of higher oxygen concentrations. The most promising species appears to be *Uvigerina striata* which shows a highly statistically significant correlation between I/Ca ratios and bottom water (BW) oxygenation ($I/Ca = 0.032(\pm0.004) \times [O_2]_{BW} + 0.29(\pm0.03)$, $R^2 = 0.61$, $F = 75$, $P < 0.0001$). Only for the aragonitic species *Hoeglundina elegans* this relationship is not significant. The iodine volatility in acidic solutions, the species dependency of $I/Ca$-$[O_2]_{BW}$ correlations, and the individual variability of single tests need to be accounted for when applying the I/Ca ratio as a proxy for redox conditions.

**Duteil, O., Böning, C. W. and Oschlies, A. (2014) Variability in subtropical-tropical cells drives oxygen levels in the tropical Pacific Ocean. Geophys. Res. Let. DOI 10.1002/2014GL061774**

Previous studies found a negative trend in oxygen concentrations in tropical regions during the last decades. Employing a biogeochemical circulation model, the study highlights the importance of wind driven ocean transport associated with the Subtropical-Tropical Cells (STCs) in setting the oxygen levels in the tropical ocean. The observed and simulated slowdown of the STCs by 30 percent from the 1960s to the 1990s caused a decrease in oxygen transport to the tropics. Transport of phosphate was similarly reduced, decreasing export production and respiration. The effects of physical transport and biological consumption partly compensate, damping oxygen interannual and decadal variability. The results suggest that the observed residual oxygen trend in the tropical Pacific is mainly driven by changes in oxygen transport. Accordingly, the observed recent strengthening of the STCs leads to

the expectation of a pause in the oxygen decrease or even an increase of tropical Pacific oxygen values in the near future.

**Hummels, R., Dengler, M., Brandt, P. and Schlundt, M. (2014) Diapycnal heat flux and mixed layer heat budget within the Atlantic Cold Tongue. Climate Dynamics, 43 (11). pp. 3179-3199. DOI 10.1007/s00382-014-2339-6**

Sea surface temperatures (SSTs) in the eastern tropical Atlantic are crucial for climate variability within the tropical belt. Despite this importance, state-of-the-art climate models show a large SST warm bias in this region. Knowledge about the seasonal mixed layer (ML) heat budget is a prerequisite for understanding SST mean state and its variability. Within this study all contributions to the seasonal ML heat budget are estimated at four locations within the Atlantic cold tongue (ACT) that are representative for the western (0°N, 23°W), central (0°N, 10°W) and eastern (0°N, 0°E) equatorial as well as the southern (10°S, 10°W) ACT. The results for the equatorial ACT indicate that with the inclusion of the diapycnal heat flux the seasonal ML heat budget is balanced. Within the equatorial region, the diapycnal heat flux is essential for the development of the ACT. It dominates over all other cooling terms in the central and eastern equatorial ACT, while it is of similar size as the zonal advection in the western equatorial ACT. In contrast, the SST evolution in the southern ACT region can be explained entirely by air-sea heat fluxes.

**Young, J. W., Olson, R. J., Ménard, F., Kuhnert, P. M., Duffy, L. M., Allain, V., Logan, J. M., Lorrain, A., Somes, Christopher J., Graham, B., Goñi, N., Pethybridge, H., Simier, M., Potier, M., Romanov, E., Pagendam, D., Hannides, C. and Choy, C. A. (2014) Setting the stage for a global-scale trophic analysis of marine top predators: a multi-workshop review. Reviews in Fish Biology and Fisheries. DOI 10.1007/s11160-014-9368-4**

This study reviews the progress of an international collaboration that compiled regional diet datasets of multiple top predator fishes from the Indian, Pacific and Atlantic Oceans and developed new statistical methods that can be used to obtain a comprehensive ocean-scale understanding of food webs and climate impacts on marine top predators. Yellowfin tuna are used as an example in a "test" area in the Pacific Ocean. Stomach-contents data were analyzed using a modified (bagged) classification tree approach, which is being prepared as an R statistical software package. Bulk $\delta^{15}N$ values of yellowfin tuna muscle tissue were examined using a Generalized Additive Model, after adjusting for spatial differences in the $\delta^{15}N$ values of the baseline primary producers. Both techniques in tandem demonstrated the capacity of this approach to elucidate spatial patterns of variations in forage species and predator trophic positions and have the potential to predict responses to climate change. The results emphasize the necessity for quantitative investigations of global-scale datasets when evaluating changes to the food webs underpinning top ocean predators under long-term climatic variability.

**Scholz, F., Severmann, S., McManus, J., Noffke, A., Lomnitz, U. and Hensen, C. (2014) On the isotope composition of reactive iron in marine sediments: Redox shuttle versus early diagenesis. Chemical Geology, 389. pp. 48-59. DOI 10.1016/j.chemgeo.2014.09.009**

The isotope composition of reactive iron (Fe) in marine sediments and sedimentary rocks is a promising tool for identifying Fe sources and sinks across ocean basins. In addition to cross-basinal Fe redistribution, which can modify Fe isotope signatures, Fe minerals also undergo diagenetic redistribution during burial. The isotope fractionation associated with diagenetic processes does not affect the bulk isotope composition, but complicates the identification of mineral-specific isotope signatures. In this study new iron isotope data for Peru margin sediments and previously published data for sediments from the California margin are discussed to unravel the impact of early diagenesis and cross-basinal re-distribution on the isotope compositions of sedimentary reactive Fe pools.

**Osborne, A., Haley, B., Hathorne, E., Floegel, S. and Frank, M. (2014) Neodymium isotopes and concentrations in Caribbean seawater: Tracing water mass mixing and continental input in a semi-enclosed ocean basin. Earth and Planetary Science Letters, 406. pp. 174-186. DOI 10.1016/j.epsl.2014.09.011**

This study presents the first full water column Nd isotope (εNd) and concentration data for Caribbean seawater, stations close to the Orinoco River mouth and in the Florida Straits. The surface inflow into the southeastern Caribbean via the Guyana Current is characterized by an εNd signature of -10.9, a consequence of the mixing of εNdsignatures (-13.6) supplied by the Orinoco River with contributions from the Amazon River (~ -10). Sub-surface and intermediate waters within the Caribbean largely retain the εNd signatures of their source water masses from the Atlantic. The deep waters of the Caribbean show εNd signatures more radiogenic than the inflowing Upper North Atlantic Deep Water. This εNd shift can be explained by addition of radiogenic Nd to the deep Caribbean through weathering inputs from land. At the same time Nd must also be removed from seawater as evidenced by decreased Nd concentrations. It is suggested that the long residence time of deep waters in the Caribbean allows significant interaction of seawater with sinking particles and seafloor sediments resulting in more radiogenic values.

## Conferences

**1-DAY WORKSHOP "ENVIRONMENTAL CONTROLS ON MARINE NITROGEN FIXATION"**
22 February, Granada, Spain, Sophie Rabouille, Angela Landolfi, Andreas Oschlies

**ASLO AQUATIC SCIENCE MEETING,**
22 – 27 Feb., Granada,
Nitrogen cycle feedbacks: drivers of change?
Angela Landolfi, Wolfgang Koeve, Valeria Ibello

**EGU,** 12 – 17 April, Vienna
Ocean biogeochemical models: evaluation and intercomparison
Olaf Duteil, Wolfgang Koeve, Tatiana Ilyina, Fanny Monteiro

**GOLDSCHMIDT,** 16 – 21 August, Prague (CZ),
What are the Unifying Principles Common to all Three Oxygen Minimum Zones (OMZs)?
James Moffett, Aurélien Paulmier

## SFB 754 Intern

**17. DEC 2014**
TPs handing in first version pre-proposal

**16. & 17. FEB 2015**
Annual Retreat, Kieler Yacht Club

**20. FEB 2015**
final pre-proposal, budget, CVs of PIs & list of collaborators

**22. MAY 2015**
final version proposal

**3., 4. & 14. SEPT 2015**
Evaluation dry-run (Wissenschafts-Zentrum)

**16. & 17. SEPT 2015**
Evaluation (Wissenschafts-Zentrum, CAU, GEOMAR)

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