

## **ANNUAL REPORT ON GEOTRACES ACTIVITIES IN BELGIUM**

June 1st, 2015 to April 30th, 2016

### ***Meetings***

- Lemaitre N., H. Planquette, F. Dehairs, L. Monin, L. André, S. Jacquet, F. Planchon, 2015. Mesopelagic carbon remineralization from particulate excess Ba along the GEOVIDE transect in the North Atlantic. Goldschmidt, 2015, Prague.
- Lemaitre N., F. Planchon, H. Planquette, F. Dehairs, L. Monin, L. André, M. Leermakers, D. Fonseca Batista, A. Roukaerts, M. Castrillejo, Y. Yang, C. Jeandel, V. Sanial, R. Sauzède, L. Foliot and D. Fonseca Batista, 2016. Carbon export along the GEOVIDE transect in the North Atlantic (GEOTRACES GA01), Ocean Sciences 2016, New Orleans.
- Li X., D. Fonseca, H. Ingber, N. Roevros, F. Dehairs and L. Chou (2015) Iron biogeochemistry under a changing climate: impact on the phytoplankton growth and the diazotrophic nitrogen fixation. Goldschmidt 2015 conference, 16-21 August 2015, Prague, Czech Republic. Oral presentation.
- Li X., D. Fonseca-Batista, H. Ingber, N. Roevros, F. Dehairs and L. Chou (2015) The impact of iron biogeochemistry on the phytoplankton growth and the diazotrophic nitrogen fixation under a changing climate. SOLAS Open Science Conference 2015, 07-11 Septembre 2015, Kiel, Germany. Poster presentation.
- Li X., D. Fonseca-Batista, Julie Brouwers, Nathalie Roevros, F. Dehairs and L. Chou (2016) The marine diatom and diazotroph under future climates: Role of Iron. EGU 2016 General Assembly, 17-22 April 2016, Vienna, Austria. Poster presentation.
- Dehairs F., N. Lemaitre, H. Planquette, L. Monin, L. André, S. Jacquet and F. Planchon, 2016. Mesopelagic carbon remineralization along the GEOVIDE transect in the North Atlantic (GEOTRACES GA01), Ocean Sciences 2016, New Orleans.
- Fonseca Batista D., F. Fripiat, F. Deman and F. Dehairs, 2016. Nitrate isotopic composition across a North-South transect in the Eastern Atlantic Ocean: Significance of nitrogen input through N<sub>2</sub> fixation, Ocean Sciences 2016, New Orleans.

### ***Cruises***

- May 13-27, 2015: R/V Belgica 2015/14 cruise to the Bay of Biscaye and the Iberian Margin.
- August 3 -12, 2015: R/V Atlantic Explorer, Cruise AE1519: Test of underway measurement system for marine nitrogen fixation. Chief Scientist Nicolas Cassar (Duke University).
- October 27 – December 11, 2015: Antarctica, Davis station, Prydz Bay: Spring-summer temporal evolution of nutrient dynamics and primary production in fast ice ( O'Gorman Rocks and Anchorage Island). Chief scientists Delphine Lannuzel and Klaus Meiners (ACE-CRC and AAD).

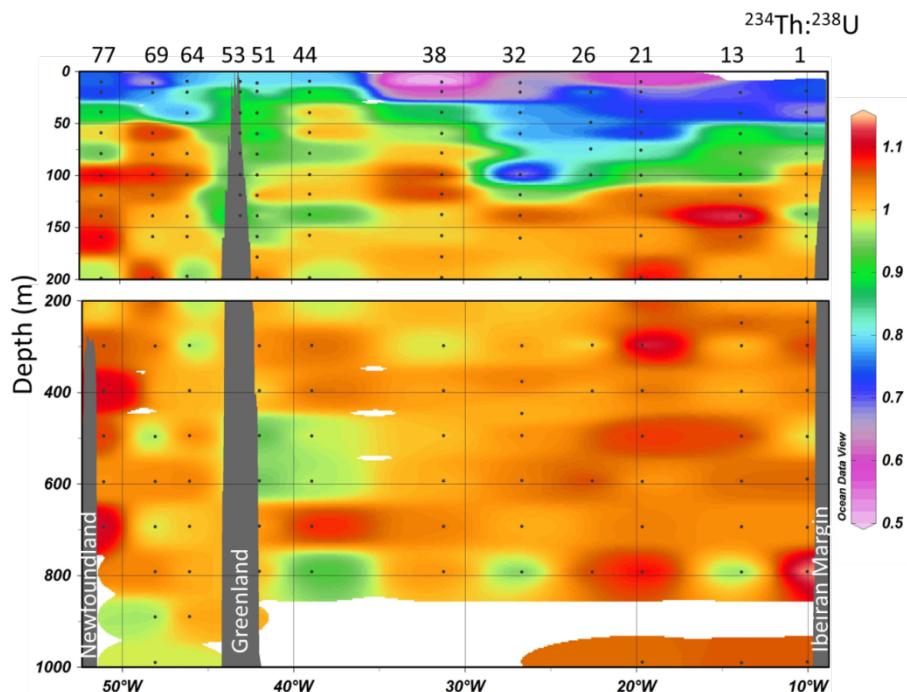
## New results

- Southern Ocean sea ice nutrient inventories:

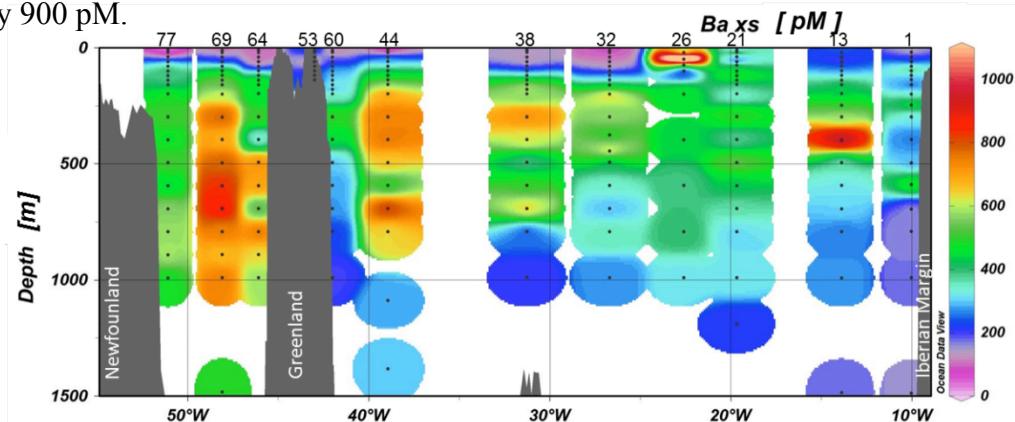
In the framework of SCOR working group “Biogeochemical exchange processes at the sea ice interface” we compiled Antarctic sea ice nutrient data. Some ~13500 published data (from 1980 to 2015, i.e., nitrate, nitrite, ammonium, phosphate, and silicic acid) were retrieved and these will shed light on the nutrient dynamics in this extensive overlooked ecosystem (up to 8% of the Earth Surface).

- POC export and remineralization in the North Atlantic Ocean (GEOVIDE cruise; June - July 2014):

Distribution of the  $^{234}\text{Th}/^{238}\text{U}$  activity ratio along the GEOVIDE section (Lemaitre et al., unpublished). Ratios range from 0.50 at station 38 in surface waters to 1.15 at station 1, 790 m. The  $^{234}\text{Th}$  activity deficit in surface waters reflects  $^{234}\text{Th}$  export flux, while excess  $^{234}\text{Th}$  at depth reflects remineralization of particles.



Distribution of particulate biogenic barium ( $\text{Ba}_{\text{xs}}$ ) along the GEOVIDE section (Lemaitre et al., unpublished). The distribution of  $\text{Ba}_{\text{xs}}$  is taken to reflect the intensity of remineralization of exported phytoplankton material. Generally, the maximum of  $\text{Ba}_{\text{xs}}$  content is located between 100 and 1000m in mesopelagic waters.  $\text{Ba}_{\text{xs}}$  concentrations are significantly larger to the west of station 44 and in particular in the Labrador Sea (stations 64, 69, 77), reaching nearly 900 pM.



- Nitrogen fixation activity in the North Atlantic

$\text{N}_2$  fixation rates obtained during field investigations in the eastern North Atlantic show higher photic zone integrated  $\text{N}_2$  fixation rates along the Iberian Margin compared to the Bay of Biscay. Although the initial dissolved Fe concentration were relatively high in the Iberian Margin (2.5-20 nM), Fe addition significantly enhanced the original  $\text{N}_2$  fixation rates.

We also observed very high  $\text{N}_2$  fixation rates (up to 1000  $\mu\text{mol/m}^2/\text{d}$ ; i.e. similar in magnitude to values observed at the Iberian Margin) in the vicinity of the North American margin and shelf (40°N). Margin systems thus appear to sustain significantly higher diazotroph activities, compared to open ocean systems.

### ***Relevant publications***

- Dehairs F., F. Fripiat, A.-J. Cavagna, T.W. Trull, C. Fernandez, D. Davies, A. Roukaerts, D. Fonseca Batista, F. Planchon and M. Elskens, 2015. Nitrogen cycling in the Southern Ocean Kerguelen Plateau area: Evidence for significant surface nitrification from nitrate isotopic compositions, *Biogeosciences*, 12, 1459-148.
- Fripiat F., M. Elskens, T. Trull, S. Blain, A.-J. Cavagna, C. Fernandez, D. Fonseca-Batista, F. Planchon, P. Raimbault, A. Roukaerts, and F. Dehairs, 2015. Significant mixed layer nitrification in a natural iron-fertilized bloom of the Southern Ocean, *Global Biogeochemical Cycles*, 29, 1929-1943.
- Fripiat, F., D.M. Sigman, G. Massé, and J.-L. Tison, 2015. High turnover rates indicated by changes in the fixed N forms and their stable isotopes in Antarctic landfast sea ice. *Journal of Geophysical Research: Oceans* 120, doi:10.1002/2014JC010583.
- Jacquet S. H. M., F. Dehairs, D. Lefèvre, A.-J. Cavagna, F. Planchon, U. Christaki, L. Monin, L. André, I. Closset, and D. Cardinal, 2015. Early season mesopelagic carbon remineralization and transfer efficiency in the naturally iron-fertilized Kerguelen area, *Biogeosciences*, 12, 1713-1731.
- Jeandel C., M. Rutgers van der Loeff, P.J. Lam, M. Roy-Barman, R. Sherrell, S. Kretschmer, C. German and F. Dehairs, 2015. What did we learn on the oceanic particle dynamics in the GEOSECS-JGOFS era? *Progress in Oceanography*, 133, 6-16.
- Mawji E., R. Schlitzer, E. Masferrer Dudas, et al., 2015. The GEOTRACES Group (150 authors), *The GEOTRACES Intermediate Data Product 2014*, *Marine Chemistry*, 177, 1-8.
- Miller, L.A., F. Fripiat, B.G.T. Else, J.S. Bowman, K.A. Brown, R.E. Collins, M. Ewert, A. Fransson, M. Gosselin, D. Lannuzel, K.M. Meiners, C. Michel, J. Nishioka, D. Nomura, S. Papadimitriou, L.M. Russel, L.L. Sorensen, D.N. Thomas, J.-L. Tison, M.A. van Leeuwe, M. Vancoppenolle, E.W. Wolff and J. Zhou, 2015. Methods for biogeochemical studies of sea ice: The state of the art, caveats, and recommendations. *Elementa: Science of the Anthropocene* 3:000038, doi:10.12952/journal.elementa.000038.
- Planchon F., D. Ballas, A.-J. Cavagna, A.R. Bowie, D. Davies, T.W. Trull, E. Laurenceau, P. van der Merwe, and F. Dehairs, 2015. Carbon export in the naturally iron-fertilized Kerguelen area of the Southern Ocean based on the  $^{234}\text{Th}$  approach, *Biogeosciences*, 12, 3831-3848.
- Roukaerts A., A.-J. Cavagna, F. Fripiat, D. Lannuzel, K. Meiners and F. Dehairs, 2016. Sea-ice algal primary production and nitrogen uptake rates off East Antarctica, *Deep-Sea Research II*, in press.

- Riou V., D. Fonseca Batista, A. Roukaerts, I.C. Biegala, S.R. Prakya, C. M. Loureiro, M. Santos, A.E.M. Muniz-Piniella, M. Schmiing, M. Elskens, N. Brion, M.A. Martins and F. Dehairs, 2016. Importance of N<sub>2</sub>-fixation on the productivity at the North-Western Azores Current/Front system, and the abundance of diazotrophic unicellular cyanobacteria, PloS-ONE, (DOI: <http://dx.doi.org/10.14284/40>).
- Trull T.W., D. Davies, F. Dehairs, F. D'Ovidio, E. Laurenceau, M. Lasbleiz, F. Planchon, B. Queguiner and S. Blain, 2015. Chemometric perspectives on plankton community responses to natural iron fertilisation over and downstream of the Kerguelen Plateau in the Southern Ocean, Biogeosciences, 12, 1029-1056, doi:10.5194/bg-12-1029-2015.
- van der Merwe P., A. Bowie, F. Quéróué, L. Armand, S. Blain, F. Chever, D. Davies, F. Dehairs, F. Planchon, G. Sarthou, A.T. Townsend, and T.W. Trull, 2015. Sourcing the iron in the naturally-fertilised bloom around the Kerguelen Plateau: particulate trace metal dynamics, Biogeosciences, 12, 739–755.

*Submitted/ in review*

- Charette M.A., P.J. Lam, M.C. Lohan, E.-Y. Kwon, V. Hatje, C. Jeandel, A.M. Shiller, G.A. Cutter, A. Thomas, P.W. Boyd, W.B. Homoky, A. Milne, H. Thomas, P.S. Andersson, D. Porcelli, T. Tanaka, W. Geibert, F. Dehairs, J. Garcia Orellana, Coastal ocean and shelf-sea biogeochemical cycling of trace elements and isotopes: lessons learned from GEOTRACES 2, submitted to Proceedings of the Royal Society of Sciences.
- Fonseca-Batista D., F. Dehairs, V. Riou, F. Fripiat, M. Elskens, F. Deman, N. Brion, M. Bode and H. Auel, Contribution of N<sub>2</sub> fixation to biological productivity along a meridional section in the Eastern Atlantic Ocean, in review for Progress in Oceanography (special issue on AMT).
- Lemaitre N., H. Planquette, F. Dehairs, P. Van der Merwe, A.R. Bowie, T.W Trull, E.C. Laurenceau-Cornec, D. Davies, C. Bollinger, M. Le Goff, E. Grossteffan, and F. Planchon. Impact of the natural Fe-fertilization on the magnitude, stoichiometry and efficiency of PN, BSi and PFe export fluxes, to be submitted to Deep-Sea Research I.
- Rembauville M., I. Salter, F. Dehairs, J.-C. Miquel and S. Blain, Particulate matter and diatoms export fluxes at KERFIX, a fixed station in the HNLC Southern Ocean, submitted to Marine Ecology Progress Series.

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