N_2-fixation footprint on nitrate isotopic composition in temperate Northeast Atlantic Ocean

FLORIAN DEMAN*[1], DEBANY FONSECA-BATISTA[1], FRANÇOIS FRIPIAT[1-2], EMILIE LE ROY[1-3], DARSHANA NUWAM THILAKARATHNE[1], NOLWENN LEMAITRE[1-4-5], ARNOUT ROUKAERTS[1] AND FRANK DEHAIRS[1]

[1]Analytical, Environmental, and Geochemistry, Earth Sciences Research Group, Vrije Universiteit Brussel, Brussels, Belgium. [*florian.deman@vub.be]

[2]Climate Geochemistry, Max Planck Institute for Chemistry, Mainz, Germany.

[3]LEGOS, Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (CNRS/CNES/IRD/UPS), Observatoire Midi Pyrénées, Toulouse, France.

[4]Institute of Geochemistry and Petrology, ETH Zurich, Zurich, Switzerland.

[5]Laboratoire des Sciences de l'Environnement Marin (LEMAR), UBO/CNRS/IRD/IFREMER, UMR 6539, IUEM, Plouzané, France.

The dual nitrogen (N) and oxygen (O) isotopic composition of nitrate is a powerful tool to study the oceanic N biogeochemical cycle. Internal cycling (e.g. nitrate assimilation and nitrification) as well as sources (N_2-fixation) and sinks (denitrification) can be identified. We report N and O isotopic compositions of nitrate in the water column along the GEOTRACES GA01 section (GEOVIDE; May-June 2014) in North Atlantic (from Iberian margin to Greenland) and Labrador Sea (from Greenland to Newfoundland). All stations exhibit an increase of both $\delta^{15}N$ and $\delta^{18}O$ signals in surface waters. This indicates a partial nitrate assimilation by phytoplankton during the growing season. Signals decrease with depth reaching the mean Atlantic Ocean deep values ($\delta^{15}N$ = 4.8 ‰; $\delta^{18}O$ = 1.8 ‰). However, in the Western European basin (between 20°W and 10°W), a significant $\delta^{15}N\text{-}NO_3^-$ minimum is observed in subsurface waters (150 – 600 m). This imprint of low $\delta^{15}N$ nitrogen input to the nitrate pool can be attributed to remineralisation of nitrogen coming from N_2-fixation. When plotting $\delta^{18}O$ versus $\delta^{15}N$, we observe a clear offset from the 1:1 slope anchored on the mean Atlantic Ocean deep values, suggesting that part of nitrate used in surface waters by phytoplankton is coming from remineralisation of nitrogen initially brought into the oceanic pool through N_2-fixation. While significant diazotroph activity is indeed observed in West European basin (see abstract of Fonseca-Batista et al.), it is also likely that the N_2-fixation imprint is advected with water mass circulation.