ANNUAL REPORT ON GEOTRACES ACTIVITIES IN FRANCE

May 1st, 2024 to April 30th, 2025

New GEOTRACES or GEOTRACES relevant scientific results

- **The silicon isotopes data from SWINGS cruise was used to quantify the specific dissolution flux from lithogenic silicon around volcanic subantarctic Heard and Mac Donald islands**. This specific flux is one of the highest measured so far and contributes to 10% of the dissolved silicon flux in the area. (Edwin Cotard, paper in revision for Limnol. Oceanogr.)

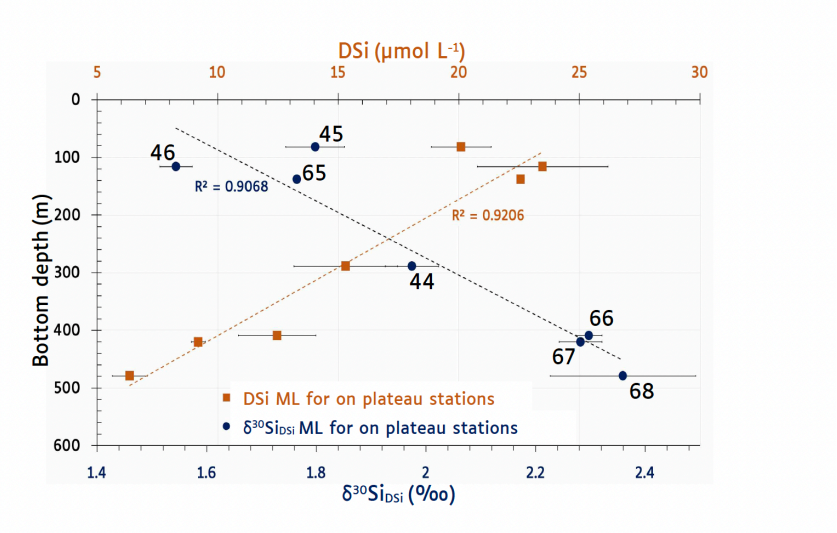

Figure 1: Mixed Layer DSi concentrations (µmol L^{-1}) (light blue triangles) and isotopic signatures δ^{30}SiDSi (‰) (dark blue squares) as a function of bottom depth (m), and associated regression line and coefficient of regression (R^2).

- **An inverse modelling approach to constrain ^{7}Be cycling in the subpolar North Atlantic (Lerner et al., Deep-Sea Research 2025)**

Beryllium-7 is a short-lived cosmogenic radionuclide that has been used as a tracer of atmospheric deposition at the sea surface and of physical processes in the upper ocean. These applications generally assume that (i) the fraction of marine ^{7}Be in particulate form is negligible, and/or (ii) the interactions between the particulate and dissolved forms of ^{7}Be in seawater can be neglected.

In this study, Lerner et al. (2025) tested different steady-state models of upper ocean ^{7}Be cycling from measurements of total ^{7}Be and particulate ^{7}Be activities collected at two stations of the GEOVIDE cruise in the subpolar North Atlantic (GA01 section; May–June 2014). The model of ^{7}Be cycling includes vertical advection, vertical diffusion, radioactive decay; it considers separately the ^{7}Be activities in the dissolved phase and in the particulate phase, and includes reversible exchange between these two phases.

Posterior estimates of ^{7}Be cycling rate parameters and deposition variables (eg. ^{7}Be adsorption and desorption rates; sinking speed of suspended particles; ^{7}Be budgets; atmospheric deposition) at GEOVIDE stations 51/60 and 69 in the subpolar North Atlantic are thus compared to estimates obtained from prior studies. Overall, the findings suggest that reversible exchange could significantly influence the oceanic cycling of ^{7}Be at some locations, and should not be systematically neglected when using $^{7}Be_d$ as an oceanic tracer.

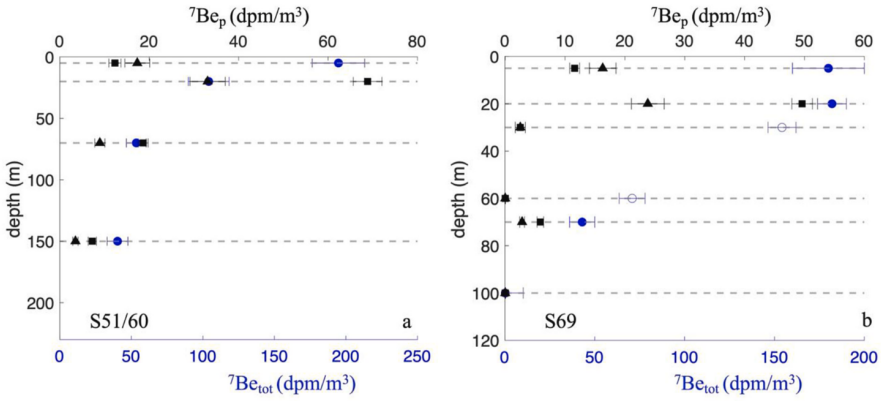

Fig. 2. Activities of total ^{7}Be (blue) and particulate ^{7}Be (black) at stations (a) 51/60 and (b) 69. Filled (open) markers show measured (interpolated) values, and triangles (squares) show corrected (uncorrected) ^7Be_p activities (see section 2.1). Error bars for uncorrected ^7Be_p activities represent ±1 standard deviation (counting statistics). Error bars for corrected ^7Be_p activities are calculated by propagating the errors in the uncorrected activities and the errors in the filter corrections. The horizontal dashed grey lines show the boundaries of the layers of the ^{7}Be cycling model. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

- **Aerosol dissolution and iron isotope fractionation during atmospheric transport (Camin et al., Atmospheric Chemistry and Physics 2025)**

Iron (Fe) limits approximately half of global oceanic primary production. This article presents the iron concentrations and isotopic compositions (δ56Fe) of aerosols over the equatorial and tropical Pacific, in previously undocumented areas. Particulate aerosols, > 1 µm, were sampled during the EUCFe (Equatorial Undercurrent Fe) campaign (RV Kilo Moana, PI: J. W. Murray, 2006). All but one aerosol samples were isotopically heavier than the crust, with a rather homogeneous signature of +0.31 ± 0.21 ‰ (2SD, n=9). **We suggest that these heavy δ56Fe signatures reflect isotopic fractionation of crustal aerosols caused by atmospheric processes**. Specifically, **the preferential dissolution of light Fe isotopes followed by the removal of the dissolved fraction** can explain the observed heavy Fe isotope signatures. The observed Fe isotopes signatures requires the dissolution and removal of 4 to 20 % – 13 % on average – of the initial aerosol Fe contents. Such fractionation has been observed previously in laboratory experiments, but never before in aerosols collected in situ. The removal of the dissolved fraction of the aerosols has not been previously documented either. This highlights the challenging use of iron isotopes to trace the origin of the aerosols and the unique and strong constrains brought by iron isotopes on atmospheric process studies.

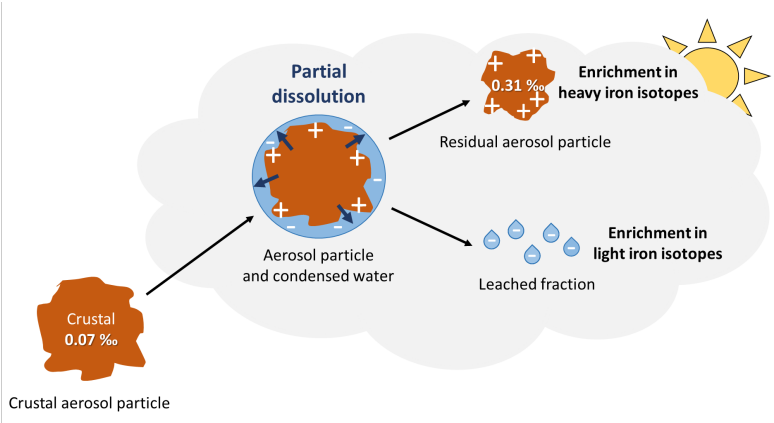

Figure 3 : Schematic of aerosol transformation during atmospheric transport. Partial dissolution and subsequent separation of the leached fraction leads to an enrichment in heavy iron isotopes in the particle and in light iron isotopes in leached fraction.

GEOTRACES or GEOTRACES relevant cruises

- **REFUGE-ARCTIC** expedition (PI: Mathieu Ardyna, IRL Takuvik; 4 weeks, August 2024), aboard the Canadian icebreaker NGCC *Amundsen*. Nares Strait – Canadian Arctic Archipelago. **GEOTRACES process study.**

New projects and/or funding

- PREVENT (Predicting the evolution and biological impact of the oceanic exposome during the environmental transition) funded by the French ANR. The aim of this project is to study the oceanic exposome and the combined effects of historical and emerging pollutants on marine organisms. The PREVENT project relies on a multidisciplinary consortium comprising experts in biogeochemistry, marine ecotoxicology, ecology, environmental economics and sociology. The experimental component of the PREVENT project will combine *in situ* measurements and mesocosm experiments, and will focus on trace elements (Fe, Mn, Cu, Zn, etc.), as well as historical (mercury) and emerging contaminants (lithium and microplastics).
- REFUGE-ARCTIC: The last Ice Area Refuge of the changing Arctic Ocean (PI: Mathieu Ardyna, CNRS-Takuvik). https://refuge-arctic.ulaval.ca/
- Horizon Europe Marie Skłodowska-Curie Actions 101152860 — SiCyMBSIA "Silicon Cycle in the Mediterranean and Black Seas: An Isotopic Approach (SiCyMBSIA)". Dr. Diksha Sharma (MSCA fellow) and Pr. Damien Cardinal (coordinator). March 2025 to Feb. 2027

GEOTRACES workshops and meetings organised

- SWINGS 3rd postcruise meeting organized in Flateurville, Auxerre, France, May 29th-May 31st. 28 participants.

Outreach activities conducted (please list any outreach/educational material available that could be shared through the GEOTRACES web site) *(We are particularly interested in recordings from webinars from GEOTRACES research)*

- **Thèse et vous podcast** presenting Capucine Camin's PhD work on iron isotopes in the equatorial Pacific (EUCFe) and North Atlantic (GEOVIDE).

Other GEOTRACES activities

- **Amundsen Science podcast** realized aboard Canada's research icebreaker, the CCGS *Amundsen*, during the REFUGE-ARCTIC cruise: « PASSAGES, épisode 5: les fjords du Détroit de Nares; épisode #7: les contaminants en Arctique ».
- Participation to the **"Jour de rêve" project** (Lycée Henri Matisse, Cugnaux, April 10, 2025), to present the job of marine geochemist.

New GEOTRACES or GEOTRACES-relevant publications (published or in press) *(If possible, please identify those publications acknowledging SCOR funding)*

- Baudet, C., Bucciarelli, E., Sarthou, G., Boulart, C., Pelleter, E., Goddard-Dwyer, M., Whitby, H., Zhang, R., Obernosterer, I., Gonzalez-Santana, D., Léon, M., van Beek, P., Sanial, V., Jeandel, C., Vivier, F., Vorrath, M. E., Liao, W. H., Germain, Y., Planquette, H. A hydrothermal

plume on the Southwest Indian Ridge revealed by a multi-proxy approach: Impact on iron and manganese distributions (GEOTRACES GS02). *Marine Chemistry,* https://doi.org/10.1016/j.marchem.2024.104401

- Camin C., Lacan F., Pradoux C., Labatut M., Johansen A., and Murray J. W.: Iron isotopes suggest significant aerosol dissolution over the Pacific Ocean, *Atmospheric Chemistry and Physics*, in press.
- Chifflet S., Zambardi T., van Beek P., Souhaut M., Vuong Bui V., Heimbürger-Boavida L.-E., Angeletti B., Ouillon S., Chu Van T., Mari X., 2025. Historical trends of metals and metalloids into lake and coastal sediments of Halong Bay (Vietnam), *Marine Pollution Bulletin* 211, 11490.
- Chowdhury, S., Berthelot, H., Baudet, C., González-Santana, D., Reeder, C. F., L'Helguen, S., Maguer, J.F., Löscher, C. R., Singh, A., Blain, S., 4, Cassar, N., Bonnet, S., Planquette, H., Benavides, M. Fronts divide diazotroph communities in the Southern Indian Ocean. *FEMS Microbiology Ecology*, 2024; fiae095, https://doi.org/10.1093/femsec/fiae095
- Cloete, R., Planquette, H., Drivers of Nickel distribution and seasonality in the Southern Ocean: New perspectives from the GEOTRACES GIpr07 transect *Journal of Geophysical Research: Oceans*
- *https://*doi.org/1*0.1029/2024JC021542*
- Conway, T., Fitzsimmons, J., Middag, R., Noble, T., & Planquette, H. (2024). Introduction to the special issue on twenty years of GEOTRACES: An international study of the marine biogeochemical cycles of trace elements and isotopes. *Oceanography*, 37(2), 6-7.
- 10.5670/oceanog.2024.415
- Deteix V., E. Cotard, S. Caquineau, W. M. Landing, F. Planchon, T. Ryan-Keogh, D. Cardinal (2024). Biogenic and lithogenic silicon along the GEOTRACES south West Indian Ocean section (SWINGS-GS02) and the islands mass effect on regional Si biogeochemical cycle. *Marine Chemistry*, 104412. https://doi.org/10.1016/j.marchem.2024.104412
- Ferreira E., Nmor S., Viollier E., Lansard B., Bombled B., Regnier E., Monvoisin G., Grenz C., van Beek P., and Rabouille C., 2024: Characterization of the benthic biogeochemical dynamics after flood events in the Rhône River prodelta: a data–model approach, *Biogeosciences* 21, 711–729, https://doi.org/10.5194/bg-21-711-2024.
- Lagarde M., Pham V., Lherminier P., Belhadj M., Jeandel C. (2024). Rare earth elements in the North Atlantic, part I: Non-conservative behavior reveals margin inputs and deep waters scavenging. *Chemical Geology*, 664, 10.1016/j.chemgeo.2024.122230, https://hal.archives-ouvertes.fr/hal-04690693
- Lagarde M., Pham V., Lemaitre N., Belhadj M., Jeandel C. (2024). Rare earth elements in the North Atlantic, part II: Partition coefficients. *Chemical Geology*, 664, 122298, 10.1016/j.chemgeo.2024.122298, https://hal.archives-ouvertes.fr/hal-04674291
- Lemaitre N, Lagarde, M and Vance D. Controls on Dissolved Cu Concentrations and Isotopes in the North Atlantic: The Importance of Continental Margins; Global Biogeochemical cycles, 39(5), e2024GB008453, https://doi.org/10.1029/2024GB008453
- Lerner P., Grenier M., Marchal O., van Beek P., 2025. An Inverse Modelling Approach to Constrain ^{7}Be Cycling in the Subpolar North Atlantic, *Deep-Sea Research I*, 220, 104465. https://doi.org/10.1016/j.dsr.2025.104465. *acknowledging SCOR funding*
- Ntangyong I.L., Chaigneau A., Morel Y., Assogba A., Okpeitcha V.O., Duhaut T., Marsaleix P., Stieglitz T., van Beek P., Baloitcha E., Sohou Z., Ouillon S., 2024. Seasonal and interannual variations of suspended particulate matter in a West-Africa, *Estuarine, Coastal and Shelf Science* 304, 108821, https://doi.org/10.1016/j.ecss.2024.108821
- Torres-Rodriguez, N., Yuan, J., Dufour, A., Živković, I., Point, D., Boulart, C., Knoery, J., Horvat, M., Amouroux, D., Bonnet, S., Guieu, C., Sun, R., Heimburger-Boavida, LE. (2025). Natural iron fertilization moderates hydrothermal mercury inputs from arc volcanoes. *Environmental Science and Technology*.

- Zhang, R. Blain, S. Baudet, C., Planquette, H., Vivier, F., Catala, P., Crispi, O., Gueneugues, A., Debeljak, P., Obernosterer I. Tagging of water masses with covariance of trace metals and prokaryotic taxa in the Southern Ocean. *Limnology and Oceanography Letters* https://doi.org/10.1002/lol2.10429

Please indicate if there is any forthcoming or planned GEOTRACES special issue publication

- SWINGS Special Issue in Progress in Oceanography (open for submission until February 2026). Submitted so far :

Completed GEOTRACES PhD or Master theses *(please include the URL link to the pdf file of the thesis, if available)*

- **Edwin Cotard PhD**. thesis defended on 11 April 2025 (Sorbonne Universite). Cycle biogéochimique du silicium de la zone subtropicale à la zone antarctique le long de la section GEOTRACES GS02 (Sud-Ouest de l'Océan Indien, SWINGS).
- **Torres-Rodriguez, N**. **PhD Thesis**. Dynamics and distribution of marine mercury species.. Aix Marseille University. Defended on October 17th 2024.
- **Alienor Hautcoeur M. Sc**. Thesis defended in June 2025 (Sorbonne Universite). Etude de la variabilité interannuelle des isotopes stables du silicium dans l'Océan Indien Sud

GEOTRACES presentations in international conferences

- D. Cardinal, M. Guyomard, E. Cotard, V. Deteix, S. Caquineau, I. Closset. How to measure Si isotopic signatures in specific phases of suspended particles? Keynote invited talk. Isotopes in Biogenic Silica (IBIS), Louvain-la-Neuve, May 2024
- E. Cotard, V. Deteix, A. Dapoigny, S. Caquineau, T. Ryan-Keogh and D. Cardinal. Silicon dynamic in the mixed layer during SWINGS transect. SILICAMICS conference, Brest, October 2024.
- Morgane Léon, Pieter van Beek, Virginie Sanial, Matthew A. Charette, Corentin Baudet, Stéphanie Jaquet, Bruno Lansard, Marc Souhaut, Paul Henderson, Audrey Guéneuguès, Stéphane Blain, Catherine Jeandel, Hélène Planquette. Radium isotopes in the Indian sector of the Southern Ocean during the SWINGS section (GEOTRACES GS02). 9th Ra-Rn workshop, Southampton (UK), June 2024
- Goldschmidt, Chicago (USA) – "What can we learn from the heavy iron isotope signatures of aerosols in the equatorial Pacific?". Oral presentation, 20 min, 2024. Capucine Camin, Catherine Pradoux, Marie Labatut, Anne M. Johansen, James W. Murray and François Lacan

Submitted by helene.planquette@univ-brest.fr (please include contact e-mail address)