

Proposition de Sujet de thèse 2017

Nom du laboratoire (et n° de l'unité) dans lequel se déroulera la thèse :
LEGOS, UMR5566

Titre du sujet proposé :

Terres Rares et composition isotopique du Nd : deux traceurs essentiels en Atlantique Nord (campagne GEOVIDE, programme GEOTRACES)

Rare Earth elements and Nd isotopic composition: two major oceanic tracers in the North Atlantic Ocean (GEOVIDE cruise, GEOTRACES project)

Financement :

acquis (*préciser nom de l'organisme*) x mis au concours (contrat doctoral ministériel)
candidature auprès d'un organisme (*préciser nom de l'organisme*)

Spécialités de l'école doctorale : (*cocher **une seule** spécialité sans la modifier*)

- Astrophysique, Sciences de l'Espace, Planétologie
- Climat, Océan, Atmosphère, Surfaces Continentales
- Ecologie Fonctionnelle
- Hydrologie, Hydrochimie, Sol, Environnement
- Sciences de la Terre et des Planètes solides

Nom et statut (PR, DR, MCf, CR, ...) du (des) responsable(s) de thèse (**préciser si HDR**) :
Catherine Jeandel, Docteur d'Etat, DRCE CNRS

Coordonnées (téléphone et e-mail) du (des) responsable(s) de thèse :
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Résumé du sujet de la thèse (*le descriptif ne doit pas dépasser une page recto/verso*)

Contexte scientifique général, Compétences souhaitables,...

The ocean plays a key role in regulating Earth's climate by storing and transporting heat and carbon around the planet. The role of its circulation in initiating and/or responding to global climate change is though poorly constrained. The neodymium isotopic composition (ϵNd) of seawater has been recognized as a powerful tracer of ocean circulation and water masses in the past and present ocean. In addition, Nd belongs to the family of the Rare Earth Elements (REE), the oceanic distribution of which informs us on processes like particle/dissolved exchanges. Understanding these mechanisms is particularly important since they yield the imprint of the modern tracers in the sediments, which are then analyzed for paleoceanographic issues.

Indeed, paleoceanographic studies are significantly dependent on the "messages" information brought by trace elements and their isotopes and, therefore, the understanding of their cycles in the modern ocean brings in a greater ability to understand the past and present oceanic system. The present project will enable a better constraint of the Nd cycle in the ocean. Besides that, given the importance of particulate sources for the oceans, and the absence of such data in the Subpolar North Atlantic, analysis of REE concentrations and Nd IC in particles will allow a greater comprehension of the mechanisms involved in the "Boundary Exchange", a process that represents a larger source of elements for the water column than the dissolved river and dust inputs.

The ϵNd and Rare Earth Elements will be measured in samples collected through an interdisciplinary oceanographic transect in the North Atlantic (GEOVIDE cruise, on board R/V Pourquoi Pas? 15/05 - 30/06/2014) in the framework of the GEOVIDE Project (Figures 1 and 2). This area is crucial for the Earth climate as it represents a major overturning of the so called Meridional Overturning Circulation (MOC), which plays a key role in the absorption of anthropic carbon (C_{ant}).

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The objectives of this project are: 1) to better establish how the water masses of the northern part of the Atlantic Ocean and Labrador Sea are acquiring their isotopic composition 2) to better constrain the land-ocean processes and transfer. To this extent, the following measurements will be made.

- Analyze the isotopic composition of Nd and REE in samples collected during the cruise GEOVIDE in their dissolved and particulate phases.
- Characterize the sources and sinks of Nd and REE and to quantify the fluxes at the ocean boundaries.
- Map their distributions and their physical and chemical speciation along the transect.
- Investigate the link between REE and the production, export and remineralization of particulate organic matter.
- Analyze dissolved/particle exchanges (jointly carried out with other tracer analysis (as Fe and its isotopes) that are being conducted within the GEOVIDE and help in the understanding of physical and chemical processes driving these exchanges).

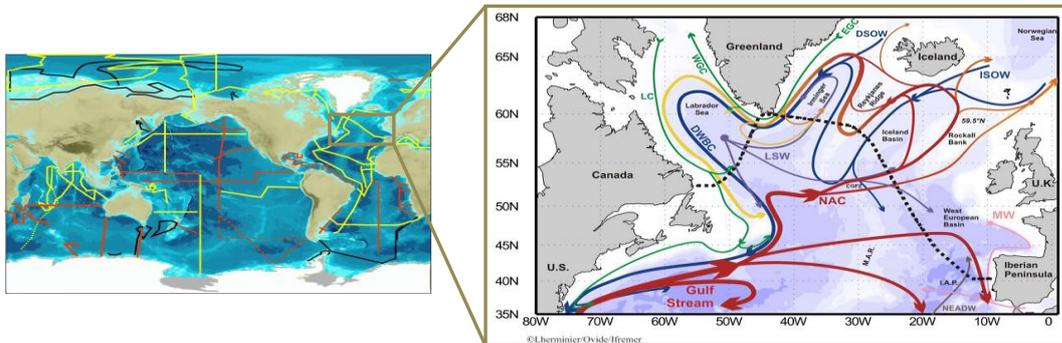


Figure 1: (a) Map of the completed (yellow or black for the International Polar year) or proposed (red) GEOTRACES cruises in the global ocean. (b) Main circulation patterns of the North Atlantic. From surface to bottom: NAC: North Atlantic Current; EGC: East Greenland Current; WGC: West Greenland Current; LC: Labrador Current; MW: Mediterranean Water; LSW: Labrador Sea Water; ISOW: Iceland-Scotland Overflow Water; DSOW: Denmark Strait Overflow Water; NEADW: North-East Atlantic Deep Water; DWBC: Deep Western Boundary Current. Topographic features: Mid-Atlantic Ridge (MAR), Charlie-Gibbs Fracture Zone (CGFZ), Iberian Abyssal Plain (IAP).

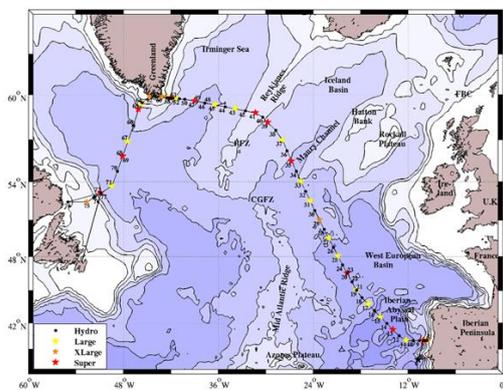


Figure 2: Detailed GEOVIDE section. Black points: Hydrographic stations (CTD/Niskin cast), Yellow stars: Large stations (CTD/Niskin and Clean-rosette casts), Orange stars: XLarge stations and Red stars: Super stations (CTD/Niskin, Clean-rosette and in-situ pump casts).

The data set will represent more than 200 analyses of REE concentrations and Nd isotopic compositions (IC), which will considerably improve our knowledge of this key area of the world oceans. At least 3 articles in peer reviewed journal will be produced from this work.

The laboratory work will be conducted at LEGOS, at Observatoire Midi-Pyrénées (OMP), Toulouse. Thanks to the OMP facilities, the student will benefit of a clean laboratory for sample processing and mass spectrometers for concentration and IC analyses.

Catherine Jeandel (PhD, senior research scientist at the highest level at CNRS) will supervise the thesis work and Dr Pascale Lherminier (IFREMER, physical oceanographer specialist of the MOC, LOPS, Brest) will co-supervise. The student will be integrated in the "Toulouse Isotopie Team" (TIM).

Taste for thorough analytical work (in clean laboratory) and good knowledge of english are required.