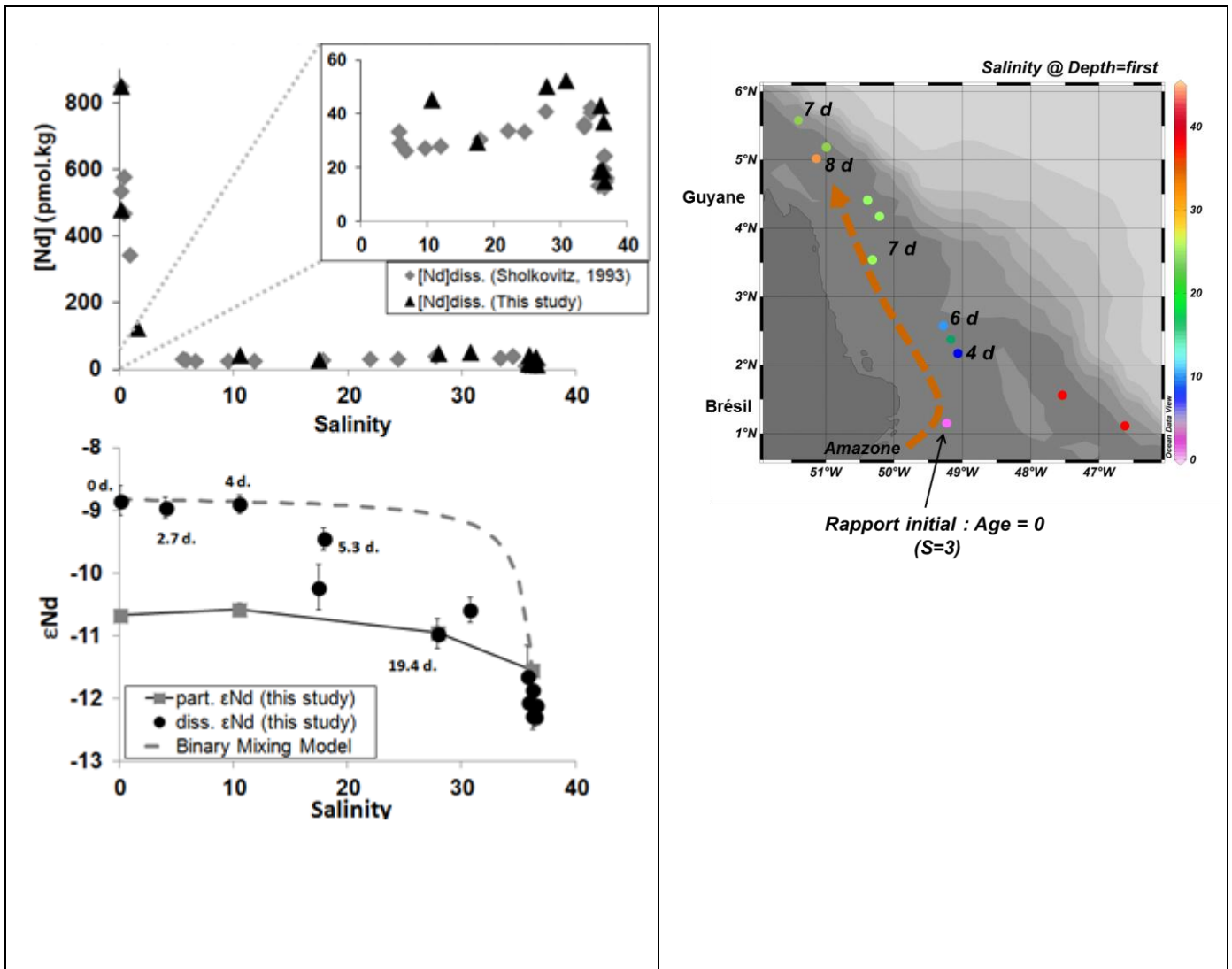


## FINAL REPORT PROGRAM LEFE

Program LEFE/ AMANDES	Project Title	Years 2010-2011
PI Catherine Jeandel, LEGOS, 33561332933 Participating Laboratories :LEGOS, GET, CEREGE, IFREMER-Nantes	Contribution to <i>GEOTRACES (Process Study)</i>  Other funding sources : ANR-BLANC 2006-2010	
<p><b>Objectives</b> (2-3 lignes) :</p> <p>The main objective of the AMANDES project was to better understand the physical and chemical fluxes, including geochemical tracers, from continents to the oceans. AMANDES focuses in particular on the physicochemical exchange along the Amazon River estuary, and its impact on Atlantic ocean water masses</p> <p><b>main results</b> (y compris les relevés de conclusions des réunions de coordination si c'est l'objet du financement LEFE)</p> <p>Three approaches were followed to achieve the main objective: 1) Method development (ex. characterizing the Amazon River suspended matter composition for river discharge evaluation, and trace element and isotope analysis as tracers for solid-solute exchange (REE, Nd, Ra, Pb, Be, Hg) 2) 4 Oceanographic expeditions (15 days each) on the Amazon shelf to deploy buoys for current measurements, and water column sampling during different seasons (ANTEA,/IRD, Nov. 2007, jan ., Apr and July 2008) 3) Development of a hydrodynamical model of the tidal dominated Amazon estuary, consistent with local forcing (river influx, Eastern currents) and validated by in situ field (tides, currents) and remote sensing observations.</p> <p>New developments on chemical and isotopic analysis of collected water samples were successful for Hg as well as for Rare Earth Element (REE) concentrations. More specifically, Rousseau et al (2013) developed a very powerful and precise method for the REE analysis, using 10 spikes. He successfully applied this method in the salinity gradient and along the Brazilian margin (T. Rousseau thesis defended in 2013, CNPq/CNRS; 2 other papers submitted). In addition, Ra isotope results (van Beek et al, in prep.) allow estimation of the « age of water » following the river exit and/or its last contact with margin sediments: such information coupled to the concomitant Nd parameter evolution allows –for the first time- establishing kinetics of dissolved/particle exchange within the estuary. Results are consistent with in vitro batch experiments under controlled conditions (Jones et al, 2012; Oelkers et al, 2012).</p> <p>Important progress was made on the ocean circulation model for the Amazon plateau by the PhD work of Y. Le Bars (financed by ANR). Model-observation correlation standard deviation for the M2 wavelength was improved by a factor 2 (le Bars et al, 2009) and a tidal atlas is currently under construction. The final phase of this work will include an improved simulation of wave impact on sediment resuspension in order to properly account for sediment transport.</p> <p>The AMANDES project has brought together numerous researchers at LEGOS-GET-CEREGE and helped shape the “Coastal Oceanography Pole” at OMP, which before only consisted of coastal dynamics research: because of AMANDES, this pole now includes a geochemistry theme (tracers and particle transport). 26 publications in peer-reviewed journal have been published based on Amandes so far. Finally, numerous international collaborations have started with Brazil (Brasilia, Recife, Rio) and the UK (Univ. Bristol, Derek Vance, U isotopes). Expedition reports, hydrological, bathymetry and current data as well as meta-data can be found at SISMER, <a href="http://www.obs-vlfr.fr/cyber/amandes/">www.obs-vlfr.fr/cyber/amandes/</a> and wre currently sent to the Geotraces data Center.</p>		



(Left) During the cruise Amandes 3, the concentration and the isotopic composition of Nd were determined in the dissolved (lozenges in the upper panel, dots below) and suspended matter (grey squares lower panel) along the salinity gradient. The sharp drop of dissolved Nd reflects the precipitation of colloids when the ionic strength increases. The slow concentration increase that follows ( $S > 3$ ) can only be explained by the contribution of Nd released by the lithogenic material. This process is suspected to play a significant role in the oceanic Nd balance and is consistent with the results obtained under controlled conditions in the laboratory (Pearce et al, 2013). (Right) « Radium ages » of the waters in the Amazon Plume. These ages are very helpful to constrain model dynamic. They also provide temporal milestones allowing kinetic calculation for the processes observed along the gradient (numbers reported in the lower panel of the figure left)

**Future of the project :**

Our final ambition is to couple the particle transport and the dissolved/particle chemistry to the dynamical model. This is the research project of Anouk de Brauwere and she is currently preparing a Marie-Curie fellowship on this topic, at the interface between the ECOLA and GEOMAR teams of LEGOS.

**Nombre de publications, de communications et de thèses**

(citer au maximum 5 publications en lien direct avec le projet)

26 publications, 29 communications dont 4 nationales, 4 rapports techniques, 3 masters, 4 doctorats se sont basés sur des données AMANDES a ce jour

Le Bars Y., Lyard F., **Jeandel C** and Dardengo L. The AMANDES tidal model for the Amazon estuary and shelf /*Ocean Modelling*, 31, pages 132 - 149, 2010. doi:10.1016/j.ocemod.2009.11.001 *Amandes*

Martinez J.M., Guyot J.L., Filizola N., Sondag F. Seyler P. Increase in suspended sediment yield of the Amazon River assessed by monitoring network and satellite data. DOI : 10.1016/j.catena.2009.05.011. *Amandes*

van Beek P., Souhaut M., Reyss J-L., 2010. Measuring the radium quartet ( $^{226}\text{Ra}$ ,  $^{228}\text{Ra}$ ,  $^{224}\text{Ra}$ ,  $^{223}\text{Ra}$ ) in water samples using gamma spectrometry, *Journal of Environmental Radioactivity*, 101, 521–529

Jones M.T., Pearce C .R., Oelkers E.H., **Jeandel C.**, Eiriksdottir E. and Gislason S.R. Suspended river material as key parameter in the global strontium cycle *Earth and Planet. Sci Letter*, (2012), pp. 51-59 DOI information: 10.1016/j.epsl.2012.08.04

Tristan C. C. Rousseau, Jeroen E. Sonke, Jerome Chmeleff, Frederic Candaudap, François Lacan, Geraldo Boaventura, Patrick Seyler and Catherine Jeandel Rare earth element analysis in natural waters by multiple isotope dilution – sector field ICP-MS *J. Anal. At. Spectrom.*, 2013,28, 573-584