SYSTEMATIC STUDY OF STABLE ISOTOPE (Hg, C & N) IN BIVALVES ALONG THE FRENCH COASTLINE: Preliminary results from the Trococo project

Nicolas BRIANT[a], Christophe BRACH-PAPA[a], Jean François CHIFFOLEAU[a], Tiphaine CHOUVELON[a], Joël KNOERY[a], Nicolas SAVOYE[‡], Jeroen SONKE[§]

[a] Laboratoire de Biogéochimie des Contaminants Métalliques, *Ifremer, Centre Atlantique, F-44311, Nantes Cedex 3, France*

[‡] *Université Bordeaux, EPOC, UMR 5805, F-33400 Talence, France*

[§] *Observatoire Midi-Pyrénées, laboratoire Géosciences Environnement Toulouse, CNRS/IRD/université Paul-Sabatier, 14, avenue Edouard-Belin, F-31400 Toulouse, France*

nicolas.briant@ifremer.fr

Keywords: Mercury Isotopes; Bivalves; ROCCH, Trococo

Mercury (Hg) is a natural element with an only recently discovered biological role, and yet toxic to all living organisms. Its global biogeochemical cycle is dominated by its flux to the atmosphere, which human activities contribute to disrupt significantly (Amos et al., 2015). While some of the global Hg enters the coastal ocean through riverine discharge, most of the Hg enters the global ocean by atmospheric deposition. Marine organisms bioaccumulate and bioamplify this element throughout their food webs. Indeed, Hg is the only metal for which the bioaccumulation and biomagnification of its organic forms in particular (e.g., methyl mercury, MeHg) in food chains or food webs are well known (Fitzgerald et al., 2007). It is important because concentrations in some coastal species of high trophic level do approach sanitary thresholds. Understanding of the biogeochemical processes and mechanisms leading to observed Hg concentrations in coastal species is essential, as is the documentation of their geographical variability.

Since the 1970's, the ROCCH, a French Mussel Watch-like program, tracks contaminants on the metropolitan coastline using of bivalves as quantitative indicators of coastal chemical contamination. One of the purposes of this network is to track the sources of contamination. Advent of MC-ICP-MS analyses can provide access to information embedded at the isotopic level. The stable isotopic geochemistry of metal is indeed a very promising way to trace processes and transfers from one biogeochemical reservoir to another (Sonke and Blum, 2013). The seven stable isotopes of Hg undergo fractionation that can be dependent and independent of their mass (MDF and MIF, respectively), thereby potentially enabling to track biological processes (MDF) and transfer between geochemical reservoirs (MIF). By determining the isotopic composition in sets of dated samples, it also becomes possible to reconstruct the history of these processes. It was proposed by Day et al. (2014) to apply these methods to environmental samples to trace

the sources of contamination and refine the understanding of biogeochemical cycling of Hg. The coupling of these measurements with those of stable isotopes of carbon (C) and nitrogen (N) in biota, essential parameters for the study of the structure and functioning of trophic networks, will further clarify the contaminant bioaccumulation processes such as Hg (e.g., Cresson et al., 2014).

In this context and through the Trococo project (funding Ifremer, Région Pays de la Loire (Pollusols), and INSU/EC2CO), we wish to map for the first time on a national scale temporal and spatial isotopic variations of Hg, C and N on samples from a monitoring network. Our intention is to better discriminate the sources and trace the origin of Hg from bivalves (e.g., is Hg from the global ocean, associated with fluvial OM, or atmospheric local deposition…).

This study will present results from many tens of analyses of bivalves (mussels and oysters) from ~80 sampling stations along the French coast. To prevent bias brought by seasonal biological cycles affecting the bivalves, the selected samples have been collected within 3 weeks in early 2014 for the study of geographical variability. The seasonal variations will be studied by examining samples collected within 8 consecutive trimesters in two different sites. Finally, the decadal variations will be assessed using samples collected between 1987-2014 from 10 sites with ecosystemic, geographic, and taxonomic specificities. This investigation is the first world wide systematic study at a national scale of Hg, C and N isotopic composition in intertidal bivalves.

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Acknowledgments:

We gratefully acknowledge funding of this study obtained from Ifremer, Région Pays de la Loire (Pollusols), and EC2CO.