Benthic manganese cycle studied with 2D high spatial resolution methods at contrasted oxygen conditions in Gullmar Fjord

C. CHOQUEL[1]*, E. MEZTGER[1], E. GESLIN[1], T. JAUFFRAIS[2], A. THIBAULT DE CHANVALON[3], H.L. FILIPSSON[4], P. LAUNEAU[1], M. GIRAUD[1], L. JEAN-SORO[5], N. RISGAARD-PETERSEN[6], A. MOURET[1]

(*correspondence: constance.choquel@univ-angers.fr)
[1] UMR CNRS 6112 LPG, Angers University, Nantes University, France
[2] LEAD-NC, IFREMER, New Caledonia
[3] SUBATECH, Nantes, France
[4] Department of Geology, Lund University, Sweden
[5] IFSTTAR, GERS, EE, Nantes, France
[6] Department of Biosciences, Aarhus University, Denmark

In this project, we focused on the benthic Mn cycle using innovative methodologies, combining dissolved and solid phase analyses in 2D and at high spatial resolution. The deep basin of Gullmar Fjord (Sweden), is subject to autumn/winter stagnation of bottom waters leading to seasonal hypoxia. The sediments are Mn-rich and inhabited by macrofauna. This study highlights the contributions of bioirrigation and bioturbation to the Mn fluxes at the water-sediment interface and to the internal Mn recycled around burrows. Two stations were sampled during the hypoxic event: one in the deepest part of the fjord with hypoxic bottom waters and a shallowest one with oxic bottom waters. A 2D-DET gel combined with a colorimetric method was used to obtain the 2D distribution of dissolved Mn (Mn_d) in porewaters. The sediment slice facing the gel probe was embedded and analysed for : 1) sediment structures in 3D as macrofaunal burrows, 2) 2D Mn microdistribution by µXRF. In addition, ascorbate and HCl extractions were executed on dry sediment to quantify reactive Mn oxyhydroxides and carbonates.

At the hypoxic station, an enrichment of Mn was located in the superficial sediment and corresponded to a reactive Mn-oxyhydroxide phase, rapidly dissolved under hypoxic conditions as shown by Mn_d enrichment in the water column. Mn distribution in the embedded sediment of the oxic station was more scattered and there was almost no reactive Mn-oxyhydroxyde present, although µXRF measured counts were 30 times higher. [Mn_d] distribution was different and 10 times lower. For both stations, lateral distribution of Mn_d was altered by burrows (depletion of Mn). Based on 2D Mn_d distribution, a numerical approach will allow to evaluate Mn_d diffusive fluxes across the interface and bio-irrigation fluxes separately, estimating the internal Mn recycling.