

Anthropogenic impact on mudflats, lagoons and mangroves

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Les environnements côtiers subissent une pression anthropique grandissante. Les vasières, lagunes et mangroves sont des sites d'accumulation de sédiment où les contaminants peuvent être stockés de manière temporaire et définitive. Le temps de résidence de ces contaminants va dépendre des processus physiques, chimiques et biologiques qui dans ces environnements sont très variables au cours du temps et dans l'espace (du μm au km). Les zones d'accumulation de sédiment constituent aussi des écosystèmes clés où beaucoup d'organismes trouvent refuge. La compréhension du fonctionnement de ces environnements et l'impact de la pression anthropique requièrent des approches méthodologiques très diverses et parfois très innovantes. Le développement de techniques de mesure à haute résolution spatiale et temporelle est donc un pré-requis que nous nous efforçons de dépasser. Cette thématique est en développement au laboratoire mais un certain nombre de projets est en cours ou en cours d'évaluation.

1. High spatial and temporal resolution techniques to chemicals across the water-sediment interface

Gel techniques allow water sampling across the sediment water interface at high spatial resolution to analyze very small volumes to reach a millimeter spatial resolution. We developed a technique for alkalinity determination from gel samples [1] and more recently by the coupling of gel techniques, colorimetry with hyper-spectral imaging, the simultaneous analysis of free sulphides, dissolved iron and phosphorus in two dimensions and at 100 μm resolution [2] (Fig. 1).

2. Early diagenesis and bioturbation

2D imaging highlights the role of the macrofauna and eelgrass ryzomes in the oxygenation of anoxic sediments and thus the inhibition of the production

and the diffusion of dissolved reduced iron. Thanks to these techniques, we were able to highlight the complexity of the sources of phosphorus in the interstitial waters in tidal mudflats of the Bay of Arcachon (ANR IZOFLUX) and the Loire estuary (Regional project RS2E).

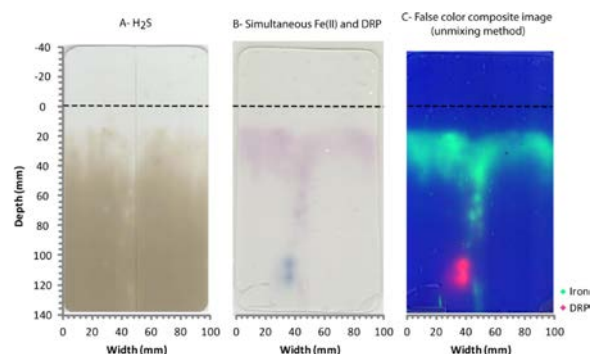


Fig. 1 : Example of sulfide, iron, and phosphorus distribution in porewater from the sediment of a *Z. noltei* seagrass meadow from the Arcachon lagoon [2]

3. Control of physical parameters on diagenetic processes

Seasonality is a main forcing parameter of diagenetic processes. Temperature exerts direct control on benthic organism metabolism and indirectly and, more surprisingly, on the solubility of calcareous tests of shallow infaunal foraminifera.

In the Loire estuary, hydrology governs sedimentation rates and salinity in mudflats. These parameters in turn influence meiofaunal ecology and dynamics. Such dynamics is not often studied despite its importance for proxy and/or bioindication development.



Fig. 2 : Gel probes deployment in the *Brillantes* mudflat of the Loire estuary

In the Bay of Bourgneuf, primary production seems to be driven by the dispersion of nutrients from oyster colonies fixed onto rocky outcrops and/or from subterranean continental effluxes. In order to understand nutrient sources and their impact on benthic ecology a regional project (COSELMAR) started in 2013. Sediment chemistry and foraminiferal assemblages are investigated simultaneously.

4. Impacted mangroves

Two proposals were recently submitted to the ANR program. The first aims to study the biodegradability of persistent pesticides in mangrove sediments off Fort de France. Our research will focus on the role of bioturbation. The second project aims to study the societal and environmental impact of uses of mangrove of Guinea and Madagascar.

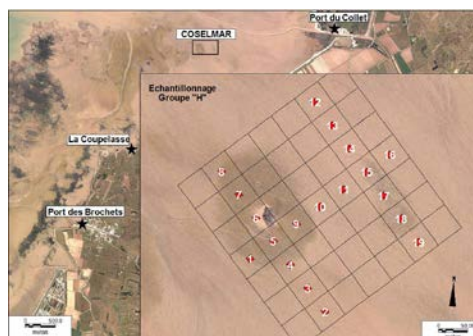


Fig. 3 : Sampling grid around a natural oyster colony in the Bourgneuf mudflat

Collaborations

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Publications

1 - **Metzger, É.**, Viollier, E., Simonucci, C., Prévot, F., **Langlet, D.**, Jézéquel, D. (2013). Millimeter-scale alkalinity measurement in marine sediment using DET probes and colorimetric determination. *Water research*, 47(15), 5575-5583.

2 - **Cesbron, F.**, **Metzger, E.**, **Launeau, P.**, Deflandre, B., Delgard, M.L., **Thibault de Chanvalon, A.**, Geslin, E., Anschutz, P., Jézéquel, D. (2014) Simultaneous 2D imaging of dissolved iron and reactive phosphorus in sediment pore-waters by thin-film and hyperspectral methods. *Environmental Science & Technology*. In press.

3 - Delgard, M. L., Deflandre, B., **Metzger, É.**, Nuzzio, D., Capo, S., **Mouret, A.**, P. Anschutz. (2012). In situ study of short-term variations of redox species chemistry in intertidal permeable sediments of the Arcachon lagoon. *Hydrobiologia*, 699, 69-84.