

Proposition de stage de M2 - 2025

Titre

REFerence conditions based on historical FORaminiferal Monitoring: Case study of the Berre Lagoon (REFORM-Berre)

Sujet

Defining ecological quality status (EcoQS) of marine water bodies has become an important task for European States during the last decades due to the implementation of the Water and Marine Strategy Framework Directives (WFD and MSFD). This evaluation, based on biological and chemical quality elements, is performed by comparing the values of biotic indices or pollutant concentrations to reference conditions. The difficulty for the ecological evaluation is to find pristine reliable reference conditions since 1) the choice of reference station away from the pollution source might lead to environmental conditions (e.g. habitat, grain size...) that are not representative of the study area, and 2) nowadays pristine conditions barely exists. Regarding chemical evaluation, the measurements of contamination in the seawater requires to install passive captors or filtering organisms (e.g. mussels) for a given time period to concentrate the pollutant so that the analyses become possible for a correct price. The REFORM project (PHC Maimonide) aims to fill these gaps by coupling the reliability of benthic foraminifera as bioindicators in marine ecosystems and their ability to fossilize and thus give information on pre-impact conditions.

Benthic foraminifera (meiofauna) are used for environmental monitoring because they are distributed worldwide in usually high abundance in marine soft-sediments, have a short life cycle and they are sensitive to environmental changes (e.g. Mojtahid et al., 2008, 2006). Therefore, different biotic indices have been developed to define EcoQS of water bodies thanks to foraminiferal communities (Barras et al., 2014; Bouchet et al., 2012; Jorissen et al., 2018; O'Brien et al., 2021). Moreover, thanks to the fossilizing capacity of their shells (tests), the study of sedimentary archives supply an historical records of environmental changes and the assessment of the faunal assemblages prior to the anthropogenic impact (e.g. Dolven et al., 2013; Francescangeli et al., 2016). Finally yet importantly, foraminifera record the ambient seawater physico-chemical parameters in the geochemical composition of their carbonate test. Therefore they can be used as sentinels for changes in heavy metals (HMs) concentrations at the seabed environment (e.g. Hooper et al., 2022; Oron et al., 2021; Titelboim et al., 2018) or to track oxygen depletion by measuring redox sensitive elements in their shell such as manganese (e.g. Barras et al., 2018; Brinkmann et al., 2023).

For this internship, we want to combine these ecological and geochemical approaches on the study area of Berre Lagoon, located on the French Mediterranean coast, north-west of Marseille. This marine lagoon is under the influence of several anthropogenic activities (see GIPREB website etangdeberre.org). On the one hand, the EDF hydroelectric power plant, constructed in 1966, releases high volumes of fresh water enriched in suspended matters which have an impact on the stratification of the water column promoting low oxygenation of the deeper part of the basin. On the other hand, petrochemical industries released heavy metal contaminants in the lagoon for years before regulations became more strict and effective. The student will work on two stations: one in the central part of the lagoon, subject to hypoxic events, and one in the east part, mainly subject to chemical pollution. For each station, we will study the foraminiferal faunas of interface cores to analyse the living faunas and of a long sedimentary cores to record the historical evolution of the assemblages. The geochemical composition of the shell (e.g. Mn/Ca, Pb/Ca, Zn/Ca, Cu/Ca...) of selected species will be measured using a laser ablation ICP-MS located at Nantes University. Other parameters will be available for the sedimentary cores such as total organic carbon content, grain size, heavy metal in sediment and ²¹⁰Pb analyses for dating. The aim is to explore the potential of historical records based on benthic foraminifera as reference conditions to improve the accuracy of both ecological and chemical evaluation of the ecosystem quality.

Références :

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Compétence à acquérir ou à développer

Recherche bibliographique

Piquage et taxonomie de foraminifères benthiques (vivants et morts)

Analyse élémentaire par Ablation Laser ICP-MS sur les coquilles de foraminifères

Calcul de différents paramètres faunistiques (indices de diversité, densités, espèces indicatrices, indices biotiques...) et de ratios élémentaires (e.g. Mn/Ca, Zn/Ca, Cu/Ca, Mg/Ca, Sr/Ca)

Analyses statistiques de données

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Déplacements sur le site de Nantes pour les analyses LA-ICPMS

Durée du stage et gratification

Environ 590 €/mois

Durée de 5 mois de Janvier à Juin 2025. Les dates peuvent être modulées en fonction des dates de stage de l'étudiant.