Estuarine, Coastal and Shelf Science 303 (2024) 108783

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

Dynamics of molybdenum and barium in the Bay of Brest (France) explained by phytoplankton community structure and aggregation events

Valentin Siebert[a], Lukas Fröhlich[b], Julien Thébault[a,*], Bernd R. Schöne[b], Gaspard Delebecq[a], Marc Picheral[c], Matthieu Waeles[a], Brivaëla Moriceau[a]

[a] Univ Brest, CNRS, IRD, Ifremer, LEMAR, F29280, Plouzané, France
[b] Institute of Geosciences, University of Mainz, Johann-Joachim-Becher-Weg 21, 55128, Mainz, Germany
[c] Sorbonne Université, Centre National de la Recherche Scientifique, Laboratoire d'Océanographie de Villefranche (LOV), Villefranche-sur-Mer, France

ARTICLE INFO

Keywords:
Phytoplankton
Biogeochemistry
Aggregates
Molybdenum
Barium
Benthic-pelagic coupling

ABSTRACT

Primary producers are essential organisms for marine ecosystems because they form the basis of food webs, produce half of atmospheric oxygen and are involved in various biogeochemical cycles. At the end of a bloom event, phytoplankton cells are known to produce organic compounds that act as a 'cement', allowing the cells to stick together and form large sinking structures called aggregates. These aggregates are microenvironments with chemical properties that are very different from the surrounding water. The main objective of this study was to determine how the temporal variations in cell assemblages over time and the formation of aggregates following a bloom affect the concentrations of molybdenum (Mo) and barium (Ba) in the water column, which are elements typically measured within accretionary hard tissues (e.g., mollusc shells) to track phytoplankton dynamics in the environment. To do so, we performed an environmental monitoring from March to October 2021 at Lanvéoc in the Bay of Brest (France) during which several biological (e.g., variations in phytoplankton assemblages) and chemical (e.g., chemical properties of the water column) parameters were measured once to twice per week. Our results show that spring and summer blooms of *Gymnodinium*, known to be enriched in Mo, could be one of the reasons explaining the particulate Mo enrichments in the water column. In addition, large phytoplankton aggregates transported a significant amount of Mo to the seafloor and associated suspension feeders. In contrast, the temporal variations in dissolved and particulate Ba concentration were strongly influenced by the formation of diatom blooms. Interestingly, there was a significant shift in Ba from the dissolved to the particulate fraction during the largest diatom bloom in late spring, associated with a significant Ba transport to the seafloor, which may be explained by the adsorption of this element onto diatom frustules. This study therefore highlights the impacts of phytoplankton on the dynamics of these elements in coastal ecosystems.

1. Introduction

Marine phytoplankton are among the most important organisms of the biosphere. They are responsible for nearly half of the global primary production (Field et al., 1998). One fourth of this primary production occurs in coastal ecosystems (Boyce et al., 2010), although they represent only 2% of the earth surface (Charpy-Roubaud and Sournia, 1990). Moreover, microalgae are at the base of the trophic network and are involved in several biogeochemical cycles. In light of the events caused by their seasonal development (bloom, appearance of harmful algae, etc.), phytoplankton strongly modify the physical and chemical conditions of the water column on seasonal scales (Redfield, 1958) and these changes strongly affect organisms and ecosystems.

Naturally or under stressful conditions such as nutrient limitation due to a bloom event, high hydrodynamic energy or changes in temperature or light conditions, phytoplankton cells can excrete large amounts of extracellular polysaccharides (EPS) (Myklestad, 1995). In particular, one form of EPS has been studied and is now well-documented: transparent exopolymer particles (TEPs) (e.g., Alldredge et al., 1993; Passow and Alldredge, 1994; Passow, 2002). The

* Corresponding author.
E-mail addresses: valentin.siebert@univ-brest.fr (V. Siebert), lufroehl@uni-mainz.de (L. Fröhlich), julien.thebault@univ-brest.fr (J. Thébault), bernd.schoene@uni-mainz.de (B.R. Schöne), gaspard.delebecq@univ-brest.fr (G. Delebecq), marc.picheral@imev-mer.fr (M. Picheral), matthieu.waeles@univ-brest.fr (M. Waeles), brivaela.moriceau@univ-brest.fr (B. Moriceau).

https://doi.org/10.1016/j.ecss.2024.108783
Received 4 April 2023; Received in revised form 4 April 2024; Accepted 26 April 2024
Available online 30 April 2024
0272-7714/