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Elemental compartmentalization changes of marine diatoms as a reporter of biogeochemical cycles

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Studies of phytoplankton elemental composition constitutes a direct measurement of environmental changes, allowing anticipating consequences of anthropogenic alterations to organisms, ecosystems and global marine geochemical cycles. Traditional bulk size-fractionation techniques used to measure phytoplankton elemental composition may present ambiguous results due to considerable detrital matter occurrence. Alternatively, nuclear microprobe techniques are a powerful tool, allowing qualitative imaging of distribution, and quantitative determination of intracellular concentrations.

Coscinodiscus eccentricus are pollution tolerant diatoms that often dominate the phytoplankton community in coastal zones. They are efficient scavengers of trace elements being used as biomonitors of metal pollution. The present study aimed at evaluating metal content and compartmentalization changes in whole cells of Coscinodiscus eccentricus exposed to different metal loads in vitro. Control and metal exposed diatom cells were analysed with particle induced X-ray emission (PIXE), Rutherford backscattering spectrometry (RBS), and scanning transmission ion microscopy (STIM). The STIM image information about density variations of the sample together with the mapping of the major elements, such as C and Si using RBS, and minor elements, such as S and K using PIXE, enabled to identify intracellular compartments. Metal exposure caused drastic alterations in cell morphology. Quantitative elemental transepts across cells also enabled us to identify changes in metal compartmentalization after exposure.

Results on metal mapping of diatoms gave clues about transport, toxicity, and fate of metal in the ecosystem. These aspects highlight the value of diatoms as biomonitors of environmental quality and allowed estimating consequences of metal pollution in marine biogeochemical cycles.

Primary author: GODINHO, Rita M (Instituto Português do Mar e da Atmosfera, Lisboa, Portugal)

Co-authors: ALVES, Luis C (C2TN, Instituto Superior Técnico, Universidade de Lisboa, Sacavém, Portugal); CABRITA, M.T. (Instituto Português do Mar e da Atmosfera, Lisboa, Portugal); PINHEIRO, Teresa (IBB, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal)

Presenter: PINHEIRO, Teresa (IBB, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal)

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