Title

Investigating differences in nanoscale distribution of trace metals in biominerals

Authors

Giovanni De Giudicia\*, Carlo Meneghinib, Daniela Medasa, Carla Buosib, Ilaria carlomagnob, Alessandra Gianoncellic, Giovanni Birardac, Lisa Vaccaric, Antonietta Cherchia, Andrei Cristian Kuncserd

Affiliations

a Dipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Cagliari, Via Trentino 51, I-09127 Cagliari, Italy.

b Dipartimento di Scienze, Università di Roma Tre, 00146 Roma, Italy.

cElettra Sincrotrone Trieste (Italy)

 dNational Institute of Materials Physics, Laboratory of Atomic Structures and Defects in Advanced Materials, Atomistilor 105 bis , 077125 Magurele, Romania.

\*Corresponding author: gbgiudic@unica.it

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Abstract

Foraminifera are unicellular organisms widespread in marine ecosystems that, building Ca-carbonate shells, may incorporate trace metals present in the ocean waters because of natural or anthropogenic supply. The distribution and chemical speciation of these elements across the foraminifera shell is a research topic relevant for defining proxies in ocean and environmental sciences. Here we focus on Zn, being an abundant trace element in contaminated as well as clean waters. We reveal peculiar differences in Zn concentration and chemical speciation at the micro and nanometric scale with the formation of independent mineral phases, in particular hydrozincite and sphalerite. These differences appear to be related to the cellular mechanisms involved in the calcite shell biosynthesis: the Ca-carbonate synthesis in foraminifera can be either in extracellular or intracellular space, implying some diversity in physiology and cation transport process. Independent mineral phases of Zn dispersed in biogenic calcite material are likely due to an unravelled detoxification mechanism. Their formation is shown to be species dependent and is a tool for a deeper understanding of environmental processes, past ocean circulation and biogeochemical cycling.