Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35445

Barium bioaccumulation in extracellular polymeric substances (EPS): Contrasting upwelling regions and oligotrophic settings

FRANCISCA MARTINEZ-RUIZ[1], MARTA ALVAREZ[1], STÉPHANIE JACQUET[2], LOREA TEIAETXE[1] AND ADINA PAYTAN[3]

[1]CSIC
[2]CNRS
[3]University of California, Santa Cruz

The precipitation of barium as barite ($BaSO_4$) in the ocean water column plays a central role in the marine barium cycle. This mineral has been widely used as a proxy for export production of organic carbon, although the mechanisms controlling its formation have remained poorly understood. There is increasing evidence supporting that extracellular polymeric substances (EPS), mainly produced by bacteria, provide microenvironments that facilitate barium nucleation, even when the ambient seawater is undersaturated with respect to barite. Barium nucleates in an initial transient phosphate phase which evolves to crystalline barite. We have investigated barite precipitation within EPS in a high-productivity upwelling region (north-east Atlantic upwelling region off the Galicia margin) and compared barite production and preservation in this region with that in low-productivity oligotrophic settings (western Mediterranean). In high-productivity systems, elevated primary production increases the abundance of organic matter and microbial remineralization, thereby promoting the localized supersaturation required for barium nucleation. Furthermore, organic matter aggregates play a significant role in protecting barite from dissolution. Consequently, higher productivity results in greater abundance of Ba-rich particles since barite is also protected during vertical export. By contrast, barite is scarce and poorly preserved in oligotrophic regions. Reduced EPS production and weaker remineralization restrict the formation of barium phases. Despite the Mediterranean is holding some of the most exceptional examples of barium records derived from enhanced productivity during sapropel deposition, at present it is generally oligotrophic. Here, low rates of EPS production and microbial remineralization limit barium nucleation. The restricted exchange with the Atlantic Ocean, as well as the higher salinity, temperature and alkalinity, further modulate barium nucleation and barite preservation. The abundance of barite is extremely low, with significant dissolution also observed in barite particles. Since barite is not effectively protected from dissolution, this is further contributing to low abundance in both the water column and underlying sediments. Overall, our findings support a mechanistic link between biological productivity, EPS dynamics and marine barite formation, and also emphasizes the significance of microbial-organic microenvironments in regulating barium cycling, helping to refine the interpretation of barite as a proxy for carbon export across different oceanographic regimes.