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Barite Precipitation on Suspended Organic Matter in the Ocean Water Column

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Despite decades of research, barite formation in the ocean water column has been widely discussed since most of the world´s ocean mesopelagic zone, in which barite forms, is generally undersaturated with respect to this mineral. Recent evidence from experimental work and also from observations in microenvironments of intense organic matter mineralization in the ocean support that barite forms via transient amorphous precursor phases that evolve to barite crystals. This crystallization pathway is further supported by the close association of barite particles with extracellular polymeric substances (EPS) at depths of higher bacterial production. Barite particles association with exopolymers demonstrates that microbial processes and exopolymer production play a major role in promoting locally high concentrations of Ba and barite precipitation. Scanning and high-resolution transmission electron microscopy analyses from particulate samples collected using multiple-unit large volume in-situ filtration systems have shown how these amorphous precursor phase nucleate, demonstrating that phosphate groups in EPS and bacterial cells are the sites for binding Ba. EDX maps have shown the nature of these P-rich nanometer-sized amorphous particles that evolve to poorly crystallized barite and to micrometer-sized barite crystals. The strong link between organo-mineralization and microbial processes further supports the role that such processes play in biomineralization in the ocean. The distribution of particulate Ba and Ba isotopes in the water column is also consistent with such precipitation mechanisms. Hence, processes involved in barite precipitation including primary production, export production, organic matter degradation, bacterial respiration, EPS formation, aggregation, and sinking, need to be taken into account when interpreting temporal and spatial variability in the Ba:Corg ratios and barite accumulation in marine sediments.