Barium cycling in the ocean: the role of bacteria in marine barite precipitaion

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Temporal and spatial variations in ocean primary productivity are crucial to the understanding of the global carbon cycle. Estimates of past primary production have been mostly based on paleoproductivity proxies, among which barite and excess Ba are important proxies. The use of these proxies is bases on the correlation of particulate marine barite and organic carbon fluxes in the ocean water column and core top sediments. However, the ocean is undersaturated with respect to barite and neither precipitation mechanisms in seawater nor processes leading to saturation conditions are well established. The role of bacteria has been suggested in this regard since the capability of certain marine bacteria to promote barite precipitation under experimental conditions has been demonstrated [1]. This is also supported by the close relationship between bacterial production and particulate Ba in the ocean water column [2, 3, 4]. In our previous experiments bacteria played a role by providing the necessary S for barite precipitation, which is not needed in seawater where sulphate is available. We have further investigated Ba precipitation under experimental conditions and particulate Ba from natural settings in order to provide new insights into barite formation. We demonstrate how bacterial biofilms, particularly extracellular polymeric substances (EPS) can contribute to bioaccumulation of Ba and to barite precipitation. We argue that in high productivity regions increasing organic matter degradation would involve higher bacterial activity, producing EPS and promoting barite precipitation. This finding is also in line with the suggestion of sinking organic aggregates providing appropriate microenvironments for barite saturation in the ocean water column.

[1] Gonzalez-Muñoz et al. (2012) Geology 40, 675-678. [2] Dehairs et al. (2008) Deep Sea Res. II 55, 1673-1683. [3] Jacquet et al. (2011) Deep Sea Res. II 58, 2222-2234. [4] Planchon et al. (2013) Biogeosciences 10, 803-820.