Deconvolving biogeochemical processes from the impact of ocean circulation: First insight on the Mediterranean dissolved barium dynamics

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Based on an unprecedented dissolved barium (D_Ba) data set collected in the Mediterranean Sea during a quasi zonal transect (M84/3 2011 cruise), we deconvolve the D_Ba distribution to isolate the contribution of biogeochemical processes from the impact of the oceanic circulation. We have built a simple parametric water mass analysis (Parametric Optimum Multi Parameter - POMP- analysis) to reconstruct the contribution of the different Mediterranean water masses to the thermohaline structure. These water mass fractions have then been used to successfully reconstruct the background vertical gradient of D_Ba reflecting the balance between the large-scale oceanic circulation and the biological activity over long time scales. Superimposed on the background field, several D_Ba anomalies have been identified. Positive anomalies are associated with topographic obstacles and may be explained by the dissolution of particulate Ba-rich material resuspended by the local currents. Negative anomalies are present in the mesopelagic region of the western and eastern basins as well as in the abyssal western basin. This represents the first quantification of the non-conservative component of the D Ba signal. These mesopelagic anomalies could reflect the subtraction of D_Ba during particulate biogenic Ba barite (P_Ba $BaSO_4$) formation occurring during organic carbon remineralisation. The deep anomalies may potentially reflect the transport of material towards the deep sea during winter deep convection and the subsequent remineralisation. D_Ba derived fluxes of P_Ba barite and organic carbon are in good agreement with other independent measurements suggesting that D_Ba can help constraining remineralisation horizon. This study highlights the importance of quantifying the impact of the large-scale oceanic circulation in order to better understand the biogeochemical cycling of elements and to build reliable geochemical proxies.