Advances in understanding the mobilization of trace metals and dissolved sulfide in Belgian coastal and Gotland basin sediments

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The difference in redox conditions of the bottom waters in the Belgian coastal zone (BCZ) and the Gotland basin (GB) has a strong influence on the mobilization of metals and dissolved sulfide in the sediments of those two marine systems. One dimensional (1D) profiles; and two dimensional (2D) high resolution (HR) images; show the demarcation of mobilization zones. High levels of dissolved sulfide (up to 100 µM) were found in GB sediments; with distinct hot spots located at the sediment water interface (SWI) and at deeper depths. The mobilization of Fe is highly influenced by the dissolved sulfide levels and high sulfide concentration results in low Fe levels (less than 1 µM). This is also the case for other trace metals like Co; Ni; Cu and Zn; but not for Mn which increases with depth in the sediment. The dissolution of Manganese-Carbonate-phosphate solid phase is responsible for this phenomenon. In BCZ sediments; a different metal mobilization scenario is observed. Less dissolved sulfide (maximum 12 µM) is present in BCZ sediments; with a hot spot region discovered below the SWI and shaped as outspread petals. The 1D distributions of Fe; Mn and Co in BCZ sediment are closely related but opposite to those of Cd; Pb; Ni; Cu and Zn. Interestingly; 2D-HR images reveal information that is hidden in this 1D profile: for example; Co is co-mobilized with Mn and not with Fe below the SWI. In both sediments several microniches were discovered at the SWI and in deeper sediments using 2D-HR images. Inside microniches metal sulfide precipitation/mobilization was investigated by the calculation of Saturation Indexes (SI) confirming the observed field results.

Keywords: Trace metal mobilization; High resolution and two-dimension imaging; Microniches in sediment; Sediment water interface; Diffusive Gradients in Thin-films