The shelf-to-basin iron shuttle in the Black Sea revisited

WYTZE. K. LENSTRA[1*], MARIE J.M. SEGURET[1], MARTIJN HERMANS[1], ROB WITBAARD[2], PETER KRAAL[1], AMY KUZMINOV[3], SILKE SEVERMANN[3], ADRIAN TEACA[4], THILO BEHRENDS[1], NIKKI DIJKSTRA[1], CAROLINE P. SLOMP[1]

[1]Department of Earth Sciences – Geochemistry, Utrecht University, the Netherlands (*correspondence: w.k.lenstra@uu.nl)
[2]Royal Netherlands Institute for Sea Research (NIOZ) and Utrecht University, the Netherlands
[3]Department of Marine and Coastal Sciences, Rutgers, The State University of New Jersey, USA
[4]National Institute of Marine Geology and GeoEcology, GeoEcoMar, Romania

Continental shelves act as an important source of the essential nutrient iron (Fe) to marine waters. The mechanisms and rates of release of Fe from shelf sediments and its lateral transport on continental shelves ("shuttling") are still incompletely understood, however.

Here, we present geochemical data on Fe dynamics in the water column and sediment at 7 stations along a shelf-to-basin transect in the north-western Black Sea. Using a combination of X-ray spectroscopy and sequential extractions, we show that Fe is present in the form of poorly crystalline Fe-oxides in surface sediments at all sites on the oxic shelf and at the hypoxic shelf break. High concentrations of porewater Fe near the sediment-water interface were only observed at sites near the coast. In-situ benthic flux measurements with landers reveal that major release of dissolved Fe to the water column only occurred at these same sites. Here, bottom waters were oxygenated and we suggest that bioirrigation by polychaetes and bivalves contributed substantially to the observed release of dissolved Fe to the overlying water. The coastal release of Fe gave rise to an offshore plume of dissolved Fe on the shelf. This plume did not extend to the shelf break, however, and our watercolumn data suggest that most transport of Fe to the deep basin takes place in the form of poorly crystalline iron oxides that are transported laterally near the seafloor. Our results highlight the key role of bioirrigated coastal sediments in supplying Fe to the shelf-to-basin Fe-shuttle in the Black Sea.