Hydrological and geochemical controls on Fe dynamics in a supratidal/intertidal zone

A. MORERA CHAVARRÍA[1], J. GRIFFIOEN[23], I. CHUECA GARCÍA[2], M. FANECA SÁNCHEZ[4] AND T. BEHRENDS[1]

[1]Department of Earth Sciences, Utrecht University, P.O. Box 80021, 3508 TA Utrecht, The Netherlands
[2]TNO Geological Survey of The Netherlands, P.O. Box 80015, 3508 TA Utrecht, The Netherlands
[3]Department of Innovation, Environmental and Energy Sciences, Utrecht University, P.O. Box 80115, 3508 TC Utrecht, The Netherlands
[4]Deltares, P.O. Box 85467, 3584 CB Utrecht, The Netherlands.

Pronounced and unexplained iron enrichments are frequently localized in Holocene, marine sediments of the coastal provinces of The Netherlands. A supratidal/intertidal zone in the province of Zeeland, The Netherlands is considered a current analogue for diagenetic processes of Holocene buried sediments. We hypothesize that the combination of dynamic redox gradients with oscillating hydrodynamics are triggering local enrichments of reactive Fe. Lateral and vertical variabilities in this zone are approached through sampling along several transects perpendicular to the gullies and following the intertidal to supratidal transition. The sediment samples were geochemically characterized and pore water was extracted and analysed. Groundwater dynamics in the area are simulated with a 3-D geohydrological model which is tuned with piezometer data. Reactive Fe ranges between 14-46% of the total Fe, and it shows a strong lateral and vertical variability along the supratidal/intertidal transects. The upper clay-rich unit is generally enriched in reactive iron. Pyrite is ubiquitous in the supratidal/intertidal area but also Fe oxides are considerably present. Fe oxides are the main Fe-bearing phase in the upper-distal part of the supratidal area, reaching up to 88% of the reactive Fe.. This is reflecting a varied redox zonation within the area of study. Pore water signatures indicate ongoing pyrite oxidation even in the saturated zone in the deeper sediments. Despite the dynamic Fe redox transformations, the predominant result of diagenetic processes seems to be changes in Fe speciation that do not lead directly to a spatial resistribution of solid Fe. Considerable spatial variability is thus observed in Fe contents but the formation of outliers with pronounced Fe enrichments remain enigmatic.