The impact of dredging on the geochemical cycling in coastal ecosystems

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The intensity of anthropogenic activity in the coastal ocean is rapidly increasing, and this puts more and more pressure on local marine ecosystems (Halpern et al., 2008). Industrial activities, such as bottom trawling and dredging, have a profound impact on the seafloor via the relocation and homogenization of the surface layer sediment (IADC/CEDA, 1997). Dredging is connected to the maintenance of man-made waterways and access channels to harbours, the construction of wind farms and coastal defence, as well as land reclamation. In the European Union alone, dredging results in the excavation of 200-250 million tons of sediment per year, of which ~80 % is redeposited in marine environment (EuDA annual report 2005), thus illustrating the large scale on which this operates in coastal waters.

The coastal seafloor receives high amounts of organic carbon, which limits the oxygen penetration depth, and allows for the preservation and burial of organic carbon. This makes these sediments an essential carbon sink that couples the long- and short-term carbon cycle (Middelburg and Meysman, 2007). Frequent dredging in coastal waters directly disturbs this carbon sink and thus could leave an anthropogenic fingerprint on the global carbon cycle. To date, the magnitude of this impact has however not been quantified.

We investigated the sediment biogeochemistry at a field site in the shallow Southern North Sea, ~5 km offshore the Belgian coast (BCZ130, N 51°16.3', E 2°54.3') during 12 consecutive monthly campaigns over 2014. Unexpectedly, a major disturbance event took place between the May and June 2014 sampling campaigns, which affected the upper ~15 cm of the sediment and had a major impact on the geochemical cycling. Evidence from both *in situ* data and model simulations suggest that this disturbance was caused by the deposition of a 15 cm thick layer of dredged harbour sediment. Our results show that this deposition event induced a reset of the geochemical cycling within the upper seafloor, which leads to an alternating sequence of electron acceptors, following the thermodynamic energy gain. It takes > 1 year for the mineralisation rates to return to the steady state. This result implies that 1 - 2 depositions per year keeps the seafloor in a permanent transient state. The anthropogenic influence on the biogeochemistry of these coastal systems is likely larger than previously acknowledged.

Keywords: dredging; carbon cycle; mineralisation; transient diagenesis

References

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