How is benthic biogeochemical cycling affected by sediment fining arising from human activities?

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Several human activities, for instance the installation of offshore windfarms (OWFs) or sand extraction, are disturbing coastal areas in the Belgian Part of the North Sea (BPNS) causing pressures such as the fining and the hardening of the sediment. Those pressures might have an impact on benthic ecosystem functioning and thus on the services they provide (e.g. carbon storage, nutrients availability).

This study investigates the impact of those pressures on the benthic biogeochemical cycling. Using stirring chambers, we ran closed-core sediment incubations with samples collected in August 2016 at different stations along a gradient of sediment permeability (cohesive and permeable sediments). We calculated fluxes of oxygen, dissolved inorganic carbon (DIC) and nutrients across the sediment water interface and linked it to the macrofaunal activities (bioturbation, bio-irrigation). Our results show that cohesive sediments have higher oxygen consumption, and DIC and ammonia (NHx) effluxes compared to permeable sediments. Lower oxygen consumption, DIC and NHx effluxes where observed when permeable sediments were subjected to anthropogenic fining as a consequence of sand extraction compared to undisturbed permeable sediments. This result is also associated with a lower bioturbation.

Mass budget modeling will allow for quantification of the mineralization and coupled nitrification/denitrification processes at each station. By doing so, the effect of anthropogenic activities and associated pressures on benthic ecosystem will be assessed.

Keywords: ecosystem functioning; nutrients fluxes; bio-irrigation; bioturbation; oxygen consumption; mineralization; nitrification; denitrification