Interactions between biological and physical effects modify local biogeochemical cycling processes in offshore wind farms

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In order to meet the increasing demand for renewable energy production, many European countries have installed offshore wind farms (OWFs), thereby introducing large surfaces of artificial hard substrates in marine areas often exclusively consisting of sandy sediments. Near the sea surface, these artificial communities are dominated by the blue mussel (*Mytilus edulis* : 18-38 kg m^{-2}). Below this mussel belt, the amphipod *Jassa herdmanni* is the dominant organism (minimum 10 000 ind. m^{-2}). In order to investigate the functional importance of these new communities, we performed clearance rates experiments and found that both *M. edulis* (0.27 l $gDWT^{-1}$ h^{-1}) and female *J. herdmanni* (0.12 l $gDWT^{-1}$ h^{-1}) act as important filter feeders. Given their high densities on the turbines, this result in the filtering of more than 500 000 l of seawater by the OWF fouling fauna of 1 gravity-based foundation each day. The subsequent production of detritus and (pseudo)faeces by the fouling fauna creates a continuous additional source of organic matter to the often permeable sediments. Our detailed study in the vicinity of a wind turbine in the North Sea revealed an increase in organic matter, a fining of the sediments and a change from a species-poor to a species-rich benthic community dominated by the ecosystem engineer *Lanice conchilega*. Our experiments on the effects of the physical fining of the sediments revealed a decreased penetration depth of advective water currents, a reduced trapping of diatoms and a decreased mineralization efficiency. Large densities of *L. conchilega* further result in an increased trapping of fines, accelerating the physical changes in the sediment matrix caused by increased deposition rates. As such, benthic degradation of organic matter will then no longer be governed by physical processes, but mediated by biological processes (bioturbation, bio-irrigation). As a consequence, the introduction of fouling communities on artificial hard substrates in the water column will be reflected in the sea-floor functioning through a shift from permeable sediments with very efficient mineralization processes towards sediments where organic matter can be accumulated for longer periods.

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