Model study of drill cutting deposition effects on sediment surface biogeochemistry and environmental state

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Produced water (PW) and drill cutting are the major sources of contaminants entering the sea from offshore oil and gas regular operation. Offshore drilling activities discharge large amounts of drill cuttings (a mixture of reservoir rocks, drilling mud and added chemicals), and cause increased sedimentation around oil and gas installations. These discharges may affect benthic fauna not only through sedimentation (burial), but also through changed grain size and particle shape, toxic effects and oxygen depletion. Previous studies have shown that water-based drill cuttings can significantly influence the oxygen penetration depth, fluxes of phosphorus, silicate, and therefore lead to reduction in number of taxa, abundance, biomass and diversity of macrofauna. Changes in the redox potential and hypoxia may release contaminants such as metals and lead to the formation of hydrogen sulfide and to the decrease in pH. This results in multistressors on the benthos (hypoxia, contaminants and acidification).

The goal of this study is to evaluate the effect of drill cutting deposition on the benthic layer biogeochemistry with focus on the chanding of redox conditions and transformation and transport of toxic metals (Hg and Ni species). In this study we use the 1-dimensional C-N-P-Si-O-S-Mn-Fe vertical bottom redox model (BROM) describing transport in the sediments, bottom boundary layers and the water column coupled with biogeochemical block simulating changeable redox conditions and the carbonate system processes block (Yakushev et al., 2017). Received scenarios are analyzed from point of view of satisfying to the Indicators for ecosystem assessments.

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