

Burial, dilution and bioaccumulation: modeling the fate of mercury species entering the seawater with drilling waste

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Drilling activity results in appearance of produced water (PW) and drill cutting that are the major sources of contaminants entering the sea from offshore oil and gas regular operation. Metals in PW discharges are significantly above coastal water background level (Ba, Fe, and Hg – a factor > 1000). Ba and Fe are redox sensitive and may precipitate upon discharge that also influence the behavior of other metals (by coprecipitation). Some species of Hg are bioavailable and toxic. The goal of this study is to evaluate the effect of PW on oxygen depletion, nutrient regime and transport and transformation of metals in the benthic layer.

We use a biogeochemical model BROM (Bottom RedOx Model [1]) that considers transport of matter in the water column, the Bottom Boundary Layer, and in the upper sediment together. This model includes descriptions of organic matter formation, decay, and reduction, oxidation and transformation of N, C, S, Mn, Fe and P and Si species. In this study, we plan to parameterize transformation of the chemical elements injected with PW to the seawater in highest concentrations, i.e. Ba, Fe, Mn, and Hg.

Observation results showed no Hg accumulation in the upper sediment around drilling wells. Sedimentation of drill cutting causes oxygen depletion in the upper sediment layer that can result in Hg species transformation to toxic methylmercury followed by its release to the bottom water. We will numerically assess the intensity of these biogeochemical transformation of Hg species and estimate its environmental impact.

[1] Yakushev, E. V., Protsenko, E. A., Bruggeman, J. et al. (2016). Bottom RedOx Model (BROM, v.1.0): a coupled benthic-pelagic model for simulation of seasonal anoxia and its impact, *Geosci. Model Dev. Discuss.*, doi:10.5194/gmd-2015-239, in review. This research is funded by VISTA – a basic research program and collaborative partnership between the Norwegian Academy of Science and Letters and Statoil.