

Evaluation of metal contaminated sediments from Sør fjorden, Norway - whole-sediment toxicity and bioaccumulation of metals

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Introduction: The Sør fjord (Western Norway) has a long history of industry and pollution. The waterfalls from the mountain plateau Hardangervidda in combination with the deep and ice-free fjord gave good conditions for industry in Odda. In 1906 a power plant was built, and new industries were to follow, producing calcium carbide, calcium cyanamide, aluminium, zinc and titanium oxide. Environment concerns later became an issue and the Sør fjord was at one time considered as one of the most metal polluted fjords in the world [1]. Several remedial actions have been carried out in Sør fjorden, including disposal of metal containing sludge in mountain caverns and containment of contaminated sediment by the use of sheet pilings or capping.

Efforts to eliminate point sources have been made during the last two decades. Recent evaluations of the sediment, however, show high concentrations of contaminants in the surface sediments. Therefore, a remediation plan is under preparation.

Methods: Surface sediments from several sites in Sør fjorden were collected June 2007. Sediment samples from 3 and 2 selected stations were stored specifically for evaluation of bioavailability/bioaccumulation and whole-sediment toxicity, respectively, using benthic invertebrates (fig. 1).



Fig. 1: Bioaccumulation of metals from the sediments were evaluated by exposing the polychaet *Nereis diversicolor* (left) and the gastropod *Hinia reticulata* (right) to the sediments.

Bioaccumulation of metals from the sediment was tested using a mesocosm setup (28 d exposure), used earlier on several occasions [2] (fig. 1). Whole-sediment toxicity was evaluated exposing the polychaet *Arenicola marina* to the sediments

(including a clean reference sediment). Variables measured were survival, burrowing and casting-rate.

Results: The evaluated sediments were markedly to very strongly polluted with cadmium, mercury and lead. The metals accumulated mainly to higher concentrations in organisms exposed to the polluted sediments, compared to those exposed to the reference sediment (with some exceptions). However, the differences in tissue concentrations were not as high as the differences in sediment concentrations.

The testing of whole-sediment toxicity showed mortality in one of the sediments after 10 days (end of experiment). Furthermore, on both contaminated sediments more worms were observed on the sediment surface and the casting was less, indicating that the sediments were less attractive to the worms.

Discussion: The results indicate that it would be beneficial to improve the quality of the biologically active layer of the sediments.

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References: [1] Skei et al. (1972) *Water, Air & Soil Poll.*, **1**: 452-461; [2] Ruus et al. (2005) *Aquat. Toxicol.*, **72**: 273-292.