Stability of heavy metals in submarine mine tailings

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The present focus on deep-sea mining and the consequent production of waste material has led to an increased interest in sub-marine tailings and their possible environmental impacts. During the last centuries tailings from several mines in Norway were deposited in fjords. However, little is known about the stability of toxic elements in these tailing and the environmental impact they may have.

This study aims to document whether different tailing compositions affect the submarine biogeochemical processes and the mobility of heavy metals in the deposits. Two different submarine tailings and one background site in Ballangsfjorden (Mid-Norway) were sampled by piston coring. One deposit (Fornesodden) consist of olivine rich material from the Bruvann nickel mine (1989 – 2002) and the other deposit (Ballangsleira) of sulphide and quartz- rich material from the older Bjørkåsen mine (1909 – 1964).

The results revealed that the tailings at Fornesodden are rich in Ni and Cr, while the tailings at Ballangsleira are high in Zn and Cu compared to the background sediment. However, the top layer of the background sediment is highly enriched in Zn, Cu and Fe, indicating migration of mine tailings. Extracted pore-water was enriched in Fe and Mn for both tailings, and the pH was lower (Ballangsleira) and higher (Fornesodden) than in the background sediment and surface seawater. At Ballangsleira the pore-water was enriched in Zn, Ni, and to some degree also in Co, Cu, Cd and Pb, particularly in the upper 30 cm of the core. At Fornesodden the pore-water had elevated concentrations of Ni and to some degree in Co in the upper part of the core, but also contained some Ni and Co in deeper parts. The background sediment also showed enrichment of Fe and to a lesser degree also of Zn in pore-water from the upper 25 cm, corresponding to the high metal concentration of the solid sediment. The results clearly demonstrate that the pore-water is affected by the tailing composition, and that heavy metals are locally mobilized.