In situ sediment investigation in a lake influenced by mining activity

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The investigation of the sediments in the lake Hörntrasket was part of the project aimed to find the reason for the reduction of the lake fauna. Earlier investigations have showed elevated concentrations of some of the metals in the lake water.

One of the goals of our part of the project was to explain reasons for high metal content in the lake water. We had three hyphotesis: pollution from the mining industry, release from natural sources such as bedrocks and release from the lake sediments. The profile of bioavailable concentrations of the 12 heavy metals in the sediment pore water were determined using in situ sediment probe deployed in the spring season in the four sites in lake. The bioavailable metal pollution in lake sediment, situated in mining area, was relatively low.

METHOD

Lake Hörnträsket situated 2 km from the town Kristenberg and next to four mining sites.

Rocks in the lake basin area contain heavy metals sulfidminerals such as FeS_2, $CuFeS_2$, FeAsS, PbS, ZnCdS and etc.

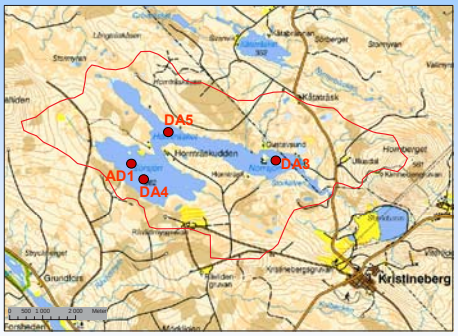


Fig 1. Lake Hörnträsket area

In the map (Fig 1) mining sites are marked by yellow and sediment sampling sites in the Hörnträsket lake (area 6.55 km^2) by red.

DGT (Diffusive Gradients in Thin film) sediment probe (Fig 2) was deployed for 36 hours in the sediment column taken from four deep (9-16 m) areas in the lake. After sectioning the mass of metal on the resin layer was measured by ICP-MS.

Fig 2. DGT sediment probe

Chemical-physical properties of the water column was measured by Multi-Sensor Modul MSM 9 probe.

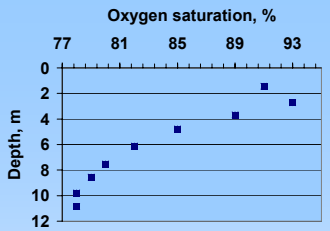
Fig 3. Multisensor Modul MSM 9

Sediment samples for analysis were taken at the same sampling occasion using kajakprovtagare?. High water content (92%) made impossible sediment core sectioning and cosequently the analysis.

CONCLUSIONS

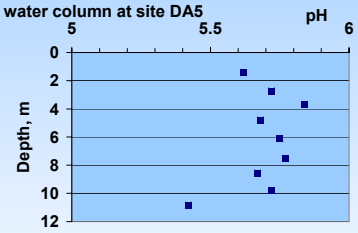
- Results of the metal concentrations in the sediment pore water and high oxygen content near the sediment surface have opposed our hypothesis that sediments might be the source of the heavy metal pollution in the lake.

RESULTS

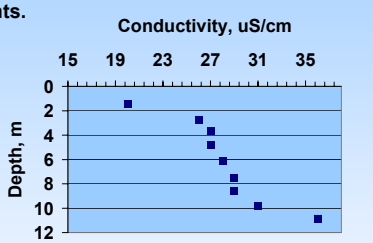


Graph 1. Oxygen saturation profile in the water column at site DA5

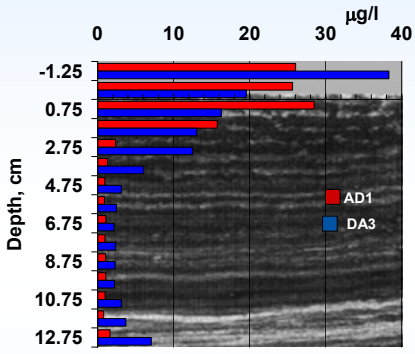
Lake water column is saturated by the oxygen (Graph 1) even late in spring when usually other lakes have decresed oxygen content especially in the bottom. Therefore redox potential has high positive value along all water column. Conductivity is increasing with the deepness in the water column which might be explain by the hight amount of ions in the streams entering lake or by diffusion of anions from the sediments.



Graph 2. pH profile in the water column at site DA5



Graph 3. Conductivity profile in the water column at site DA5



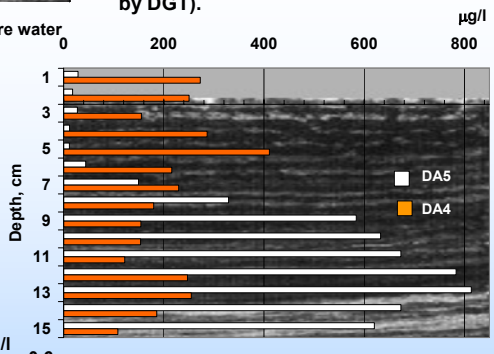
Graph 4. Cu profile in the sediment pore water

The depth profiles of Cu, Cd and Zn were similar with the highest pore-water concentrations at the sediment-water interface and decreasing concentrations with depth.

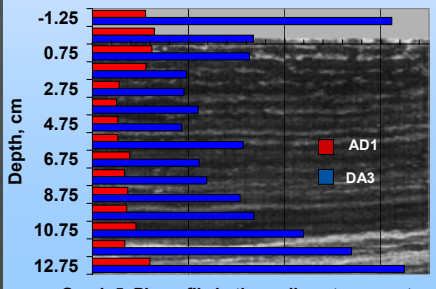
The concentration of Cu in the sediment pore-water was significantly lower than the concentration in the lake water column (at site DA3 - 607µg/l at the 1.5 m deep from bottom measured by DGT).

The top sediments were oxidized at all sites as indicated by low pore-water concentrations of Fe, typically in the range 20-30 µg/l.

At two of the sites the Fe concentration was increasing with depth, indicating reducing conditions.



Graph 6. Fe profile in the sediment pore water



Graph 5. Pb profile in the sediment pore water

The pore-water concentration of Pb was rather law and constant with depth. In the top sediments the Pb concentrations were in the range 0.04 – 0.3 µg/l.