

# TRACE METAL MOBILITY IN A BLACK SHALE AREA IN CENTRAL SWEDEN

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## **Abstract**

Black shales of marine origin formed under anoxic conditions contain trace metals like Mo, U, Ni, Zn and As in elevated amounts. The mobility and availability of such metals have been assessed in a black shale area of Cambrian age in the southern Storsjön area in central Sweden. The assessment has concerned the levels of trace elements in soil, plants and water and its possible effect on animals and humans. Soils contain more or less the same amounts of trace metals as the black shale itself in the central parts of the studied area. Plants, and notable red clover have elevated amounts of Mo and the ratios of Cu/Mo are low with a risk for molybdenosis, secondary Cu-deficiency common in cattle. However the use of Cu-fortified concentrate used by the farmers seems to effectively counteract this effect. A metal hyperaccumulator, Alpine pennycress, is found in the area with 0.8 % of Zn in dry matter. U is elevated in water and groundwater but the presence of limestones in the area makes U less uptakeable by humans and this seems not to be a sizeable problem. Arsenic (As) is mobilized under reducing conditions in another Precambrian black shale area in northern Sweden. In this area there is a pronounced topography with no wetlands and below the permissible limit in water and groundwater. As is tied to ferric hydroxides on soils and it is neither taken up by plants nor leached away with water. On the whole there seems not to be any real problems with the trace metals in the area.

However, mining of the shale has been planned for the extraction of several of the metals. About 700 Mt of black shale is planned for mining over a 30-year period. Even then after extracting, there will be left 20-30 % of the metals in the waste material. This is probably a very serious long term threat. If the waste is placed in a wetland area there is immediate risk of mobilizing the arsenic into the water. If it is placed, as per another plan, in elevated parts of the terrain several of the other trace metals will be leached out over decades to come. In addition the risk of metal release there will be a massive destruction of an unusually beautiful landscape where people have made their living for more than thousand years.

## **Keywords**

Trace metals, Arsenic, Molybdenum, Wastewater, Groundwater, Black shale