Mobility and bioavailability of metals in a Cambrian black shale area in central Sweden

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Cambrian black shales are found in southern Sweden and in the Caledonian moutains in Norway and Sweden. This site is situated in the Storsjön area in C Sweden and is an anticlinal hill on both sides overlain by carbonates. The shale is enriched in Mo, Ni, U and V. The study concerns the mobility and bioavailability of these metals both in the aquatic and terrestrial spheres. Main conerns has been the ttansfer of Mo into plants and the possible effects on cattle and the consumption of groundwater by the local population.

Mo occurs in soils up to over 50 ppm and in plants in similar amounts in dry matter. This could imply a risk of molybdenosis as excess molybdenum could cause secondary Cu deficiency, especially if the Cu/Mo ratio is low approaching ~ 2. The diagnosis of molybdenosis is difficult while diffuse symptomes are seen. Possibly sulphides and the sulphate derived from sulphide oxidation might counteract excess uptake of Mo in fodder plants. In S. Sweden with similar figures in fodder molybdenosis has been observed in cattle och possibly also in moose. *Trifolium pratence* and notably *T. hybridum* are enriched in Mo. High contents of Cd and Zn are found in some *Salix spp*. *Thlaspi caerulescens*, a well known metal accumulator is found in the area with high metal contents.

Another concern is the groundwater concentrations of U often exceeding the preliminary limit of 35 µg/l. By physical speciation through filtering and dialysis it is found that the U as well as Mo is present as dissolved or as small complexes, less than 1 kD. Themodynamic calculations with Visual MINTEQ shows that U is largely present as uncharged Ca-U-complexes which is a problem for its removal but renders it less uptakeable by humans and less kidney toxic (Prat et al. 2009).

The elevated level of Mo and U does not seem to be an emvironmental threat. However plans to utilize the shale for microbial extraction of the metals could be highly dangerous. Experience from a former uranium mine in S. Sweden shows that the U left in waste rock will be fast mobilized [1].

[1]Kalinowski et al. (2004) *Geoderma* **122**: 177-194.
Prat el al. (2009) *Environ. Sci Technol*. **43**: 3941-3946.