Natural heavy metal remediation by ferrihydrite

T. LINKE[1*], K. M. DIETMANN[2], K. DIDERIKSEN[3,4], V. RIVES[2], S. L. S. STIPP[3,5] AND S. R. GISLASON[1]

[1]Institute of Earth Sciences, University of Iceland, Sturlugata 7, 101 Reykjavik, Iceland (*correspondence: tol5@hi.is)
[2]GIR-QUESCAT, Dpto. Química Inorgánica, Universidad de Salamanca, 37008 Salamanca, Spain
[3]Nano-Science Center, University of Copenhagen, Universitetsparken 5, 2100 Copenhagen, Denmark
[4]Geological Survey of Denmark & Greenland (GEUS), Denmark pain
[5]Dept. of Physics, Technical University of Denmark, Fysikvej, Building 307, 2800 Kgs. Lyngby, Denmark

Ferrihydrite occurs in vast amounts in Icelandic soils and surface waters, especially in peat areas. Under reduced conditions in peat bogs, iron can be derived from rapid weathering of basaltic glass. Previous work shows that natural as well as synthetic ferrihydrite can adsorb large amounts of phosphate and heavy metals (e.g. Pb, As, and Cr) [1]. Due to its large specific surface area and high concentration of reactive sites, small quantities of ferrihydrite can significantly affect the properties of soils or the chemistry of associated soil solutions and surface waters [2]. For accurate model predictions of metal and phosphate adsorption a detailed characterisation of the ferrihydrite is necessary.

Ferrihydrite samples were collected along oxidation gradients in peat areas in S-Iceland. These areas receive high dust fluxes, primarily composed of basaltic glass. Using a range of techniques, the physical, chemical and mineralogical properties of the dried ferrihydrite samples were defined. The ferrihydrites high specific surface area (200 - 350 m^2/g) and the small particle size (0.5 - 50 μm) indicate a high reactivity. Small crystallite sizes of 0.5 to 1.5 nm lead to an absence of characteristic diffraction signals, which are only visible with high energetic Synchrotron X-ray radiation. Chemical and spectroscopic analysis show the association of amorphous silica (up to 8 %), manganese (<1 %) and some organic compounds with the ferrihydrites.

Geochemical models and laboratory experiments suggest that the reactive sites of the investigated ferrihydrites are not occupied by a significant amount of heavy metals or phosphates and have the potential to adsorb large amounts of contaminants for example from a close-by volcanic eruption.

[1] Linke & Gislason (2018), Energy Procedia 146, 30-37.
[2] Childs (1992), Journal of Plant Nutrition and Soil Science 155, 441-448