Geochemical and microbiological controls on the corrosion and transport of depleted uranium in soil

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Assessment of the environmental impact of depleted uranium (DU) from munitions in oxic soil is hampered by limitations on information regarding uranium mobilisation and transport. Soil geochemistry, mineralogy and microbiology have been shown to have a significant effect on the behaviour of uranium within many natural environments.

The aim of this study is to determine the relative influence of geochemical and microbiological factors within the context of the overall biogeochemical processes, including the speciation and mineralogy of the uranium present during the DU metal breakdown.

In this study 2 soil columns were collected from field sites (Kirkcudbright and Eskmeals) in the UK where DU metal samples had been buried for ≈8 years. The Kirkcudbright soil is organic and clay rich, whereas the Eskmeals soils is a quartz-rich dune sand. Samples of soil up to 50cm from the DU metal were analysed by Sequential Extractions (SE), Scanning Electron Microscopy (SEM), mini-focus X-ray Adsorption Spectroscopy/ X-ray Fluorescence (XAS/XRF), X-ray Diffraction and pore water analysis (ICP-MS). The microbial population in the soil was also characterised using culturing and Biolog techniques.

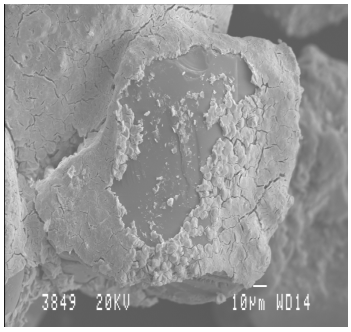

Figure1. Schoepite coating on soil particle.

The SE and XAS data indicate that wihtin the soils the uranium is only present as U(VI). In the Eskmeals site the contaminated soil is dominated by schoepite ($(UO_2)_4O(OH)_6.6H_2O$) coating the quartz grains (fig. 1). In the Kirkcudbright soils mini-focus XAS and XRF analysis indicate the U is more dispersed and associated with ferric oxyhydroxide minerals. The contaminated zone around the corroding metal is relatively small in the Eskemeals soil, with total [U] <10ppm within 10cm of the DU metal. The bacterial community counts from the soil are not affected by the U concentration, but there is a significant decrease in the metabolic diversity within the contaminated zone. The pore water in the contaminated zone also contains high concentrations of oxalic acid indicating a significant biological response.

The distribution pattern study of rare earth elements in Choghart iron ore mine, Bafq area, Iran

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From the metallogenic points of view, Iran is divide into several provinces and belts out of which, metallogenic province of Saghand-Golpayegan-Bafq has a special importance. The presence of rare earth elements along with the elements such as Fe, P, U and Ti is known only in this province. Metallogenic province of Saghand-Golpayegan-Bafq is made of the different mines, out of which, the Choghart iron ore mine is one of them. This mine is one of the most important iron ore mines of Iran which could be important due to presence of the REE. The Choghart iron ore mine is situated in central Iran plateou and its geographical coordinate is as: 55º28′02″ longitude and 31º42′00″ latitude. In order to study the behaviour of REE in Choghart mine, samples from magnetite and apatite have been analysed by NAA. Aquired results show that, as a whole, magnetites from this mine are not much enriched from the REE. All magnetites show less LREE enrichment and only the aquired sample from the borehole with degree of high purity of iron shows more enrichment in LREE. $(La/Lu)_{cn}$ ratio shows that the fractionation between LREE and HREE occur nearly in all magnetites but magnetite with degree of high purity of iron shows more extent of fractionation between LREE and HREE in Choghart mine. Also these conclusions show that Choghart mine apatites are enriched from REE in such away that the percent of REE in these apatites is about 1.54%. The great slope of spidergrams and amount of $(La/Lu)_{cn}$ ratio show intense fractionation between LREE and HREE, depletion of HREE and enrichment of LREE in these apatites. Therefore apatites from this mine have very high values in order to obtain LREE or Ce group. We come to know that in mineral processing stage of iron ore of Choghart mine, if the apatite concentration with degree of high purity produces, then the extraction of these elements will be considerable.

Keywords: Rare earth elements, magnetite, apatite, Choghart mine, metallogenic province.

References

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