4.66.14

Remediation of As and Cu contaminated site in SW England – initial investigations

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Leaching of As from soils creates a great potential hazard for groundwater contamination. Treatment of As rich soils, particularly when As is accompanied by other potentially toxic metals, such as Cu, presents a particular challenge due to contrasting bahaviour of the two elements.

An As and Cu contaminated old mining site in SW England is being studied. The aim of the project is to investigate possible remediation options for a bare mine tip.

Firstly, the distribution and speciation patterns for both contaminants: As and Cu were studied. Sequential extractions, ED SEM and XRD analyses were employed. Initial leaching experiments on the waste material were also conducted. The amount of As released was measured by GFAAS while Cu and other elements were measured by ICP-AES.

The mean As content in waste material is 17000mg/kg, while Cu-1750mg/kg. The soil is very acidic (pH<4) and low in OM content (3%). Natural immobilization of As appears at some parts at the site, where As is found fixed in a form of iron arsenates and iron-lead arsenates. Primary As and Cu minerals - arsenopyrite and chalcopyrite were found in samples from the waste tip.

Preliminary results from the leaching experiments show that Cu is much more mobile than As in the waste material. Only 0.002% of total As was leached out by 0.01M $CaCl_2$ as compared to 3.25% of total Cu being solubilised in the same conditions. Maximum As concentration in the soil leachate was found to be only 46.5 ppb, while Cu concentration reached maximum of 5.6mg/l. Low pH and relatively high levels of easily available Cu prevent development of vegetation on the waste tip.

However, as revelaed by another batch experiment, the fate of both As and Cu can be influenced significantly by adding organic matter and phosphorus. The concentrations of Cu in leachate decreased to < 0.1mg/l while As levels increased up to 400 ppb.

Due to low pH and low OM content treatments such as liming and OM addition (e.g. compost) often considered as beneficial, may potentially increase As mobility. This and other treatments aiming for Cu stabilization will be now further tested in leaching columns. Further leaching tests will be conducted to investigate how mobilizable As will be under differing environmental conditions simulated by various leaching media.

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Analytical and toxicological methods for identification of unresolved complex mixtures ('humps') of hydrocarbons in the environment

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Many hydrocarbons in the environment originate from anthropogenic sources such as petroleum residues. When examined by gas chromatography (GC) these mixtures are often unresolved and appear as 'humps' or unresolved complex mixtures (UCMs) of hundreds of thousands of chemicals. We have shown that a UCM isolated from a crude oil is toxic to the blue mussel *Mytilus edulis* and that UCMs isolated from polluted mussels collected in the environment are also toxic to clean mussels. It is now important that the components of the UCMs are identified.

Recently we have used GC x GC-time of flight –mass spectrometry to resolve and identify some of the toxic UCM compounds. Amongst the toxic components are branched alkyl benzenes and alkyl tetralins. We present the data for a number of toxic UCM fractions.

We have also used a variety of ecotoxicological biomarker assays to monitor the toxicity of further UCMs, including neutral red retention and micronucleus formation in addition to mussel feeding rates.

The results indicate that UCMs are an overlooked environmental burden.