

The speciation of Au, Ag, Hg, Th and U in peat polluted by acid mine drainage

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The peat substance is one of the more popular natural sorbents that is used to recovery of elements from aqueous solutions including other similar materials. Ursk's sulfide-bearing waste piles (Ursk, Kemerovo region, Russia) have been formed more 50 years ago. The wastes of the cyaniding primary Cu-Zn-polymetallic ores and these of the oxidation zone have been dumped as a two piles. The natural stream draining the waste piles has been transformed in acid mine drainage (AMD). The wastes have not been fixed and hence ravine's swampy territory below the tailings piles have been covered with the derived waste matter. The interactions between the bog peat substances, AMD and wastes pore solutions have occurred for 50 years. It have been established the elements precipitation and concentration on peat substance. The Zn, Cu, Pb, Zn concentrations in peat samples are comparable to these in the wastes. The ore contained 4 ppm of Au. The contains of Au in waste covering the peat substance range from 0.2 to 1.7 ppm. It have been obtained that the concentrations of Au in the peat that is contacting with sulfide-bearing waste are 0.3-14.3 ppm. The Fe hydroxides, sulfides, jarosite, gypsum are established there.

The speciation of Au, Ag, Hg, Th and U in peat material has been determined using the selective extraction technique. It have been identified the following elements forms in peat substances: the water-soluble forms, these associated with organics/sulfides and with the Fe(III) hydroxides/oxides and residue. The part of all being studied elements is partially attributed to the water-soluble compounds (0.1 Au, 0.6 Hg, 0.08 Th, 0.5 U ppm). Gold is partly presented as organ-complexes ore sulfides (up to 1.4 ppm). In places where the gold concentration is in reaches 10 ppm, it appears mostly in the native form. The submicrometer gold Cu-bearing grains are observed among secondary minerals of Fe and are formed on the detrital material. Silver may enters as isomorphic admixture in the jarosite and mainly presets in contaminated peat as Fe(III) hydroxides/oxides fraction. Mercury as organ-complexes and/or as the secondary sulfide of Hg has been registered in peat samples. The major unit of U is associated with organic material and Th is with residual fraction.

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Organic and inorganic scCO₂-rock interactions – Results from laboratory experiments

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Mineralogical changes in the reservoir in the cause of CO₂ injection and its propagation may provide information on e.g. CO₂-induced geochemical interactions and are of great importance for the estimation of potential risks of geological CO₂ storage. To overcome the gap of direct observations, experimental studies at simulated reservoir conditions are an important tool to study all types of potential CO₂-fluid-rock interactions *ex situ* on mineral phases or real reservoir samples.

In this broad experimental study, our aim was to examine the role of supercritical CO₂ (scCO₂) on the mobilization of organic compounds from mineral phases as well as the changes in elemental and mineralogical composition of reservoir and cap rock samples due to the defined temporal exposure to scCO₂ under varying p-T-conditions. For this purpose several flow-through experiments using scCO₂ have been performed [1] on real rock samples of different lithologies from an real CO₂ storage site: the Ketzin site in Germany.

ScCO₂-extracts as well as untreated and scCO₂-treated rock samples were analysed using a variety of organic and inorganic geochemical, mineralogical and microscopic techniques to detect changes compared to untreated twin samples.

Generally, organic matter mobilization – mainly the low molecular weight organic acids formate and acetate - occurred linearly within the first 8 hours, then continued with decreasing extraction yields. XRD and XRF analyses revealed no quantitatively distinguishable changes in elemental and mineralogical composition between scCO₂-treated and untreated twin samples. However, SEM images indicated blastesis and corrosion effects on mineral surfaces as well as a partly loss / destruction of primary cements due to the exposure to scCO₂.

[1] Scherf *et al.* (2011) *Energy Procedia* **4**, 4524–4531.