Long-term fate and transport of fission products and actinides in geosphere

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Global natural distribution pattern of radionuclides and homologues elements between fluids and rock formations allow a certain classification of mobility with respect to charge/valence when considering the fate of radionuclides in geological formations.

Ion exchange and surface complexation allow prediction of mobility influencing environmental parameters for Se, Cs and I. Diffusion rates in compact clay are very low since the clay rock pores are so small that electrostatic repulsion limits the available space for anion diffusion and even certain of these “mobile” nuclides may show significant retardation. However, in much less compact systems like aquifers, fixation of sparingly soluble radionuclides on mobile clay particles provides additional transport vectors. In a shallow waste disposal site a complex relationships between the clay /radionuclide/solution system, influence of transportable organic matter, the colloid loads, size distribution and the hydrodynamics of the aquifer was observed.

An important issue is whether redox states or organic/inorganic speciation change along transport path.. In deep geologic conditions like those foreseen for high level nuclear waste disposal, very anoxic to reducing conditions are often attaint assuring very slow migration rates of actinides, Tc(IV), Se(0) etc. but even in soils, in close vicinity to the atmosphere, microbial activity may lead to fixation of low redox states of elements like Tc.

The complex interplay between radionuclide mobility influencing factors has recently been studied for Selenium in soil type environments: competition and synergies between reactivity of different mineral surfaces (clay, quartz, calcite iron hydroxide) solution composition, microbes and their influence on bioavailability.

A factor often overlooked in assessing long term radionuclide mobility is the potential irreversible entrapment of radionuclides by slow mineral/water reactions. At solid/solution equilibrium the dynamics of dissolution and precipitation is still ongoing, allowing not only adsorption on stable surfaces but as well incorporation in the sub-surface of the mineral, protecting it from release by sorption/desorption equilibrium.

Definition of a clean energy system for decontamination of acid mine waters and recovering their metal load

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Acid mine drainage (AMD) is one of the largest hydrochemical problem resulting from anthropic activity, with consequences worldwide. For this reason is understandable the importance of innovative measures for recovering rivers affected AMD. Taken in account the substantial changes in terms of European legislation on water quality, under the framework of Directive 2000/60/EC (Water Framework Directive, WFD), the proposal of remediation measures for streams affected by AMD in the period marked by the standard has become even more relevant.

The most common techniques, applying corrective measures to mitigate the process, have high costs of installation and maintenance, or poor performance. On the other hand, the cheaper approaches often cause undesirable discharges of pollutants.

The aim of the system presented in this study is to neutralise acid mine waters and recover their metal load, using energy obtained from renewable sources. With this approach, the treated water is produced without releasing emissions into the atmosphere, without using fossil fuels and at an acceptable cost. At the same time, it allows the Cu dissolved in the waters to be separated from the rest of the metal load and sulphates. Therefore, it makes possible the metal´s recovery, transforming an environmental passive into an industrial income, in an economic context in which the price of Cu reaches around 7300 US$/ton.

www.minersoc.org
DOI:10.1180/minmag.2013.077.5.7