Mobile fission and activation products in nuclear waste disposal

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When disposing nuclear waste in clay formations it is expected that the most radiotoxic elements like Pu, Np or Am do move only few centimetres to meters before they decay. Only a few radionuclides are able to reach biossphere and contribute to their long-term exposure risks, mainly ^{129}I, ^{36}Cl, ^{79}Se and in some cases ^{14}C and ^{99}Tc, whatever the scenario considered. The recent OECD/NEA cosponsored international MOFAP workshop focussed on transport and chemical behaviour of these less toxic radionuclides. New research themes have been addressed, such as how to translate molecular level information to large migration distances. Diffusion studies need to face mineralogical heterogeneities over tens to hundreds of meters. The large volume of traversed rock will provide so many retention sites that despite weak retention, even theses “mobile” nuclides may show significant retardation. The question however has been posed how to measure reliably very low retention parameters. Additionally, the radioactivity of some of the nuclides in the waste is so low that sophisticated techniques must be employed to measure them. An important issue is whether redox states or organic/inorganic speciation change from its initial state at the moment of release from the waste during long term contact with surfaces, hydrogen saturated environments etc.

Changes in soil reactive aluminium fractions following logging in podzols of British Columbia, Canada

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The potential for aluminium stress in ecosystems

Al is the 3rd most abundant crustal element, and in soluble forms is toxic to most organisms. The potential for acidic soils to be Al toxic is considerable. Ecosystems stressed by human interventions such as forest harvesting are particularly at risk.

This study investigates the effects of clear-cut logging on soil reactive Al fractions, including exchangeable Al (Al_{exch}), organically bound Al (Al_{org}), and Al associated with poorly crystalline minerals. The study soils are humo-ferric podzols located in the coastal mountains of southern British Columbia, Canada. These soils are strongly acidic and are at risk for Al stress. We collected soil samples from undisturbed plots (control), and compared them to samples from neighbouring plots that were clear-cut 1 to 15 years prior to sampling.

Results and discussion

Al_{exch} and Al_{org} are influenced similarly by logging. These Al pools are unaffected in plots logged 1 - 2 years ago, show an increase in plots logged 3 - 10 years ago, then decrease to control levels or below at 12 - 15 years after logging. This pattern matches closely the observed variation in the organic matter content. Organic matter provides exchange sites as well as sites for specific Al adsorption.

The increase in Al_{exch} is mitigated by a concomitant increase in exchangeable calcium. The Ca/Al ratio, a valuable ecological indicator used for the identification of the risk of adverse effects due to Al stress, was remarkably constant in control and logged plots.

Poorly crystalline mineral fractions consist mainly in imogolite-type material (ITM). Control soils average 23g/kg ITM in the B and C horizons. Logged soils exhibit highly variable ITM content, indicating a possible disruption of the podzolization process. With an Al/Si ratio around 2, ITM stores a significant fraction of the reactive Al in these soils.

Conclusion

All reactive Al pools in these soils are affected by logging. The impacts of these changes on the ecosystem are under investigation.

Selected Reference

Cronan, C.S., & Grigal, D.F. (1995). Use of Ca/Al ratios as indicators of stress in forest ecosystems. *J Environ Qual* **24**: 209-226.