

Role of bacteria on uranium migration in a calcareous peatland

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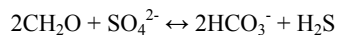
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The assessment of a polluted site is usually undertaken through its hydrogeochemical characterization and the impact of the implied conditions on pollution migration. However, in specific natural environments, such as peatlands, microbial activity can also affect, directly or indirectly, this migration.

A calcareous peatland polluted with uranium particles (about 3.5 ppb) contained high concentrations of total dissolved uranium from the surface to 0.8 m deep (up to 7.10^{-6} mol.L⁻¹). This can be explained by the formation of the major complex Ca₂UO₂(CO₃)₃. Even though uranium particles have also been found between 0.8 and 2 m, total dissolved uranium concentrations are very low (1.10^{-10} mol.L⁻¹). At these latter depths, where the peat remains humid (water – table from 0.25 to 0.8 m), uranium solubility can decrease due to reducing conditions. The increasing occurrences of framboidal pyrite particles at depths lower than 0.8 m suggest reducing conditions related to sulfate – reducing bacteria.

In order to study the impact of these bacteria on the physico – chemical conditions of the peat soil, batch experiments were performed. Using various types of carbon sources (ethanol, oxalate) and doping with sulfate, trimethylphosphate and uranium, at 25 °C and 5 °C, the total dissolved uranium content was followed throughout the incubation. The ethanol – doped batch incubated at 25 °C shows a significant decrease of uranium from $1.95.10^{-5}$ to $3.93.10^{-8}$ mol.L⁻¹ in 200 hours. Other parameters (pH, Eh, dissolved oxygen, [SO₄²⁻], [HS⁻], etc.) are also followed and compared to the equation of microbially – mediated sulfate reduction:



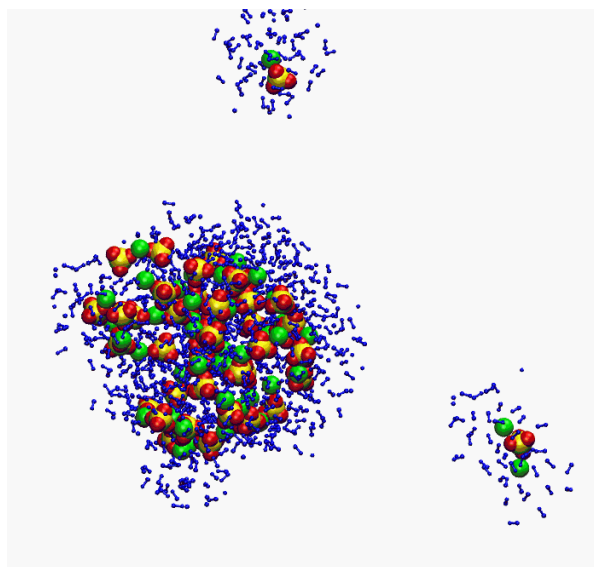
These batch experiments and the identification of the bacterial populations (via 16S rDNA sequence) show that sulfate – reducers in peatlands produce reducing conditions that can immobilize uranium and possibly other trace metals.

The role of solvent in the kinetics of barite nucleation

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Crystallization from a supersaturated solution is one of the fundamental geochemical processes. Although several very successful models that provide a qualitative understanding of the crystal growth process exist, in most cases the atomistic detail of crystal growth is not fully understood. Here it is shown how the combined use of computer simulations and experiments can help in understanding the kinetics of nucleation and crystal growth of barite. It is found that the solvent plays a prominent role in determining the rates of both two and three-dimensional nucleation in solution. The results of this study are expected to be valid also for other divalent ion salts, as their crystallization kinetics are often remarkably similar.



References

- [1] S. Piana, F. Jones and J. D. Gale (2006) *J. Am. Chem. Soc.* **128** 13568-13574
- [2] S. Piana, F. Jones and J.D. Gale *Int. J. Cryst. Growth.* Manuscript submitted.