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Biogeochemical impact on Uranium migration in aquifers near to sludge depository

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The work presents data on the aerobic and anaerobic microbiological processes impact on Uranium migration in upper aquifers polluted with sulfate and nitrate ions near to sludge depository of Novosibirsk chemical concentrate plant. Sludge depository was built in 1960s and still works. Uranium concentration in subsurface water reaches in several zones 1-2 mg/L and its migration depends on some geochemical aspects of water horizon: mineral sorption capacity, TOC, Eh, oxidizers concentration (O₂, NO₃, Fe⁺³, etc.) and biogeochemical processes.

We have studied chemical and microbiological characteristic of water samples of contaminated and uncontaminated areas and have obtained main data for biogeochemical modelling of Uranium migration capacity. It was indentified, that different microbial communities consist of aerobic organotrophic, denitrifying, sulphatereducing and fe-reducing bacteria, and there where strains capable of forming biofilms on sandy minerals in aquifer.

Biogeochemical modelling in PHREEQC software shows, that Uranium immobilization is possible in local areas with high content of organic substances, and the most important microbiological process is the redox potential reduction due to aerobic respiration. After that in anaerobic conditions redox-dependent Uranium reduction can be expected. Moreover, in the presence of sulfate ions, further anaerobic processes of microbial sulfate reduction and iron reduction lead to the formation of iron sulphide, which plays the significant role as an antioxidant buffer in the case of oxygen migration.

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