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Characterization of Geochemical Barriers in a former Uranium Mining District

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Geochemical barriers are epigenetic zones in which selected elements are retained and their further transport is prevented. Microorganisms can enhance metal retention by direct reduction of metals or radionuclides or by formation of reducing agents like Fe(II) or sulphide. The aim of this study was to investigate if microbial activities contribute to heavy metal and radionuclide retention in a heavy metal contaminated soil. The study site was located in the former uranium mining district Ronneburg (Thuringia, Germany). In a soil profile two distinct geochemical barriers for heavy metals and uranium were identified. One manganese-rich barrier showed accumulation of Cu, Ni, Cd, Co, Zn and La and an iron-rich barrier showed accumulation of Cr and U. Throughout the soil profile total cell numbers counted after staining with DAPI approximated 10^6 cells/ g soil (ww). Aerobic CO_2-formation rates were low with about 2 nmol g soil $(ww)^{-1}$ h^{-1}. No anaerobic microbial activities were observed in anoxic soil microcosms. After addition of 0,1 % yeast extract, nitrate- and iron-reduction were initiated. Microorganisms were probably limited by carbon availability due to the low organic carbon content of the soil. Numbers of culturable cells detected in oxic pH 5 groundwater media approximated 10^5 cells/ g soil (ww). Higher numbers of cells were detected in media enriched with Ni than with Cu. DGGE was used to detect differences in microbial populations between the soil horizons. The low cell abundances and microbial activities indicated that the accumulation of heavy metals and radionuclides in both geochemical barriers was not caused or significantly enhanced by microbial activities.