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Biostimulation of uranium reducing bacteria in contaminated mine water for bioremediation purposes: multidisciplinary approach study.

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Uranium (U) and its mining have historically been strongly related to East Germany. From the second half of the 20th century onwards, the Federal States of Saxony and Thuringia have been the scene of intense mining activity. The cessation of mining activities in 1990, has led to the generation of U contaminated areas. Nowadays, conventional remediation methodologies are not able to remove soluble U entirely. Microorganisms offer an environmental friendly water remediation strategy for U through bioreduction or biomineralization. The present study describes a strategy for *in situ* bioremediation of U(VI) from a U mine water by biostimulation of the native U reducing microbial community.

The geochemical profile of the mine water was characterized by Inductively Coupled Plasma-Mass spectrometry (ICP-MS) and Ionic Chromatography (IC), showing a substantial concentration of U (1.01mg/L), SO_4^{2-} (335mg/L), Fe (0.99mg/L) and Mn (1.44mg/L). Cryo-Time-Resolved Laser Fluorescence spectroscopy (cryo-TRLFS) and Parallel Factor Analysis (PARAFAC) determined the aqueous species $Ca_2UO_2(CO_3)_3^{4-}$ as the main U species in mine water. In addition, 16S and ITS1 rRNA gene analyses were used to characterize the microbial community, indicating a relative abundance of natural microbial groups with U(VI)-reduction ability (e.g., *Desulfovibrio, Gallionella* and *Sideroxydans*). For the design of an *in situ* bioremediation technology for U contaminated waters, a set of anoxic microcosms supplemented with glycerol (10mM) as electron donor was previously designed. A thermodynamic Eh-pH dominance diagram calculated using Geochemist's Workbench predicted the reduction of U(VI) and the formation of the solid U-mineral (uraninite). After 3 months, ICP-MS and Ion-Chromatography analysis from the microcosms revealed a decrease of U (≈98%), SO_4^{2-} (≈88%) and Fe (≈91%). Furthermore, the black precipitate formed at the bottom of the microcosm was analyzed by UV-Vis spectroscopy, identifying mainly U(IV).

The results obtained revealed the enzymatic reduction of U(VI) to U(IV) by the addition of an electron donor in low concentrated U contaminated mine waters. Thus, this strategy might be an efficient bioremediation approach for U contaminated mine waters, by biostimulating their indigenous microbial community.