Geochemical and biological controls on the product of microbial U(VI) reduction

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Bioremediation of the uranium-contaminated subsurface involves the reductive transformation of soluble U(VI) species to less mobile U(IV) species by the *in situ* stimulation of indigenous microorganisms. The U(IV) mineral uraninite, $UO_{2(s)}$, is considered the most desirable product of bioreduction due to its low solubility and high stability under reducing conditions. However, the formation of uraninite may be inhibited under certain geochemical conditions, leading to the formation of biomass-associated U(IV) complexes, referrred to as monomeric U(IV).

In this study we examine the role of medium composition and extracellular polymeric substances (EPS) as inhibitors or promoters of uraninite precipitation. Uranium L_{III} edge X-ray absorption spectroscopy and a wet chemical extraction technique are used to differentiate between U(IV) species. It was previously reported that under controlled conditions in a simple medium containing bicarbonate and PIPES buffer at pH 6.8 (BP), the reduction of U(VI) by *Shewanella oneidensis* led to the formation of uraninite. In contrast, in a more complex Widdel Low Phosphate (WLP) medium, contaning numerous salts, the reduction by the same bacterium led to the formation of monomeric U(IV).

The results show that varying concentrations of NaCl (i. e, ionic strength alone) cannot acount for the molecular U(IV) production observed in WLP medium. The presence of phosphate or calcium ions in the medium has a larger influence on the U(VI) bioreduction product, leading to an increase in monomeric U(IV) formation. Moreover, bacterial EPS production indirectly affects U(IV) speciation. The product of U(VI) reduction in BP medium by a mutant of *Shewanella oneidensis* deficient in EPS production was richer in monomeric U(IV) than that of the wild-type under the same conditioon.

This work begins to explore the complexity of the factors influencing the product of U(VI) reduction. More in-depth investigation of the biological and geochemical factors influencing uranium bioreduction is warranted.

Analysis on environmental and economic sustainable development

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Eco-environment is the basis for social and economic development, and the two have the unity of opposites. Depletion of natural resources for eco-development will inevitably affect the environment. Today, the deteriorating eco-environment makes human beings aware that the past social economic development was at the expense of the eco-environment. Human beings must seek coordinated development of soc-economy and the eco-environment.

Now take Chengdu city as an example, we have researched the region's vertical coordination of ecological environment and social economic development from 2001 to 2010. This research employed the method of Principal Component Analysis (PCA) to determine the ecological environment and socio-economic index weight. Based on the index weight, we set up the established evaluation model for sustainable development. And we found the regional ecological environment and socio-economic interaction law. From 2001 to 2010, social and economic development level of Chengdu were steadily rising, and the ecological environment of the ten years were basically flat, no improving. During the ten years, the construction of the ecological environment was far behind the social and economic development.

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