



Uranium Migration in Sandstone-Type Uranium Deposit by Acid In-Situ Leaching - an example from the Kujeertai

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The factors influencing uranium migration in water-rock systems during acid in-situ leaching (ISL) were studied at the Kujeertai uranium deposit in Xinjiang. Using an ISL unit, we tested the sequential effects of a leaching solution without oxidant (H₂SO₄ solution 4–8 g/L) and a leaching solution with oxidant (H₂SO₄ 3–7 g/L, and Fe (III) 2–6 g/L). The observation of the leaching process revealed clearly defined stages of uranium migration from the solid mineral to solution. At the beginning of the acid ISL process, the oxidant was not added to the leaching solution and the dissolution of hexavalent uranium at the mineral surface led to a rapid increase in uranium concentration followed by a decrease in uranium concentration in the solution. This change occurred when the pH value was less than 4.5 and there was sufficient SO₄²⁻ ligand. Following the decrease in hexavalent uranium at the ore surface and a decline in uranium migration intensity, the addition of Fe(III) oxidant facilitated the oxidation of tetravalent uranium, which enabled strong uranium migration again. In this process, the dissolution of uranium had a strong positive correlation with the reduction of Fe(III), and the ratio of the uranium dissolution to the Fe(III) reduction ranged between 0.041 and 0.091. Furthermore, the deportment of uranium was another important factor affecting uranium migration. Uranium located on the mineral surface can be completely exposed to the solution and the dissolution and migration intensity was significantly affected by hydrogeochemical conditions. The uranium present in microfissures and in the ore matrix could not be fully exposed to the solution, and the intensity of uranium migration in the microfissure was primarily controlled by corrosion and permeability of the ore. Therefore, the hydrogeochemical conditions and the deportment of uranium were the external and internal factors that significantly affected the dissolution and migration of uranium in the early and middle stages of the experiment. However, in later stages, as the concentration of uranium in the ore decreased, increases in the chemical potential of the solution, specifically acidity and the amount of oxidant, had a limited or insignificant impact on the dissolution of uranium.