Chemical and bacteria leaching of a low-grade and high-fluorine uranium ore in column reactors

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The purpose of the Study and Mineralogy

The purpose of the study is to investigate the technical feasibility of using bioleaching on a low-grade and high-fluorine uranium ore from China, which is not economically exploitable with conventional technologies. The ore contains 0.19% uranium and 1.0% fluorine. Uranium is present primarily as pitchblende and secondarily as coffinite and infrequently as brannerite and uranothorite.

Column Bioleaching Experiments

52-day column bioleaching experiment was conducted with finely ground ore (−0.8 mm) at ambient temperature to study the effect of bacteria on uranium extraction. For the sake of contrast, column chemical leaching experiment was also conducted at same time. The chemical leaching experiment used only sulfuric acid, but the bacteria leaching experiment used sulfuric acid and A. ferrooxidans as well.

Results

The leaching rate of U is 91.8% for the bacteria leaching experiment and is only 78.5% for the chemical leaching experiment. The sulfuric acid consumption is 4.73% and 4.97% for bacteria leaching and for chemical leaching respectively. The microorganism used in the bioleaching test resisted high concentration of total fluorine ranging from 1.8g/L to 2.0g/L in the leachate. The experiments suggested the feasibility of bioleaching for extraction uranium from this kind of uranium ore.

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Flow dynamics and $^{3}H/^{3}He$ ages of deep groundwater at Gardermoen (Oslo Airport, Norway)

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Sandy, quaternary, deposits at Gardermoen constitue the central part of Norway's largest unconfined aquifer. The steady influx of temperate, nutrient rich groundwater is essential for ecology and geomorphology of local conservation areas. The establishment of Oslo Airport (OSL) at Gardermoen in 1998 was therefore approved by the authorities on the condition that the groundwater quality would not be deteriorated. Extensive, continuous monitoring of groundwater quality and fluxes is performed at OSL and numerous research projects have been carried out. Knowledge about the deeper parts of the aquifer, however, is limited.

The total water balance in the study area is well constrained. The sandy deposits form a ridge, with relatively permeable sediments in the North-East and decreasing permeability towards the South-West. The aquifer is solely precipitation fed (40 cm/a net recharge). The groundwater flow is directed towards the North-East (80% of flux) and South-West (20% of flux), away from a crescent shaped groundwater divide and into the effluent rivers Risa and Sogna.

In this study water samples from 20 wells (1.5 – 30m below phreatic groundwater table) have been analyzed for major ions, ^{3}H and noble gases (He, Ne, Ar, Kr, Xe). The tritium concentrations range from 8–52 TU and the $^{3}H/^{3}He$ water ages from 1.5–53 years. The water ages generally increase with depth and distance from the groundwater divide. The hydraulic head in some wells deviates from hydrostatic conditions due to underpressure in lower (semi-) confined units. Using water ages in multi-level wells for calibration of flow models (2D grid sections), we investigate different scenarios with respect to flow separation and vertical flow components due to geological heterogeneities. Using ionic content and water ages as tracers is complicated by indication of mixing with fossil seawater (9.5 ka BP) from basal silt deposits.

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