

Naturally Occurring Uranium in Groundwater of the North Western Sahara Aquifer System (Northern Africa) (pp. 1-47) $100.00

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Abstract:

Uranium concentrations in water are controlled by a number of factors, among the most important being pH, Eh and concentrations of coexisting dissolved ions. Uranium as a redox-sensitive heavy metal occurs in water principally under oxic conditions in its hexavalent (U(VI)) form. It is usually complexed in solution, especially with carbonate ligands, but also less significantly with phosphate, fluoride or sulphate depending on their respective dissolved concentrations and ambient pH. Under anoxic conditions, U is reduced to tetravalent U(IV) state and its concentration in water is usually low due to the insolubility of this form. On the other hand, despite their long radioactive half-lives that should induce a secular equilibrium between 238U and 234U isotopes, large range of natural variation of 234U/238U ratios have been found in water (0.5-40). The mechanism of such fractionation is preferential leaching of 234U compared with 238U from solid phase, caused by radiation damage of crystal lattice upon alpha decay of 238U, oxidation of insoluble tetravalent 234U to soluble hexavalent 234U during decay, and alpha recoil of 234Th (and its daughter234U) into solution phase. In the last few decades, the behaviour of uranium isotopes in groundwater has contributed to an understanding of the mechanisms of geochemical reactions and transport processes in rock water systems. Uranium concentrations and isotopic fractionation in groundwater has been related to lithology, geomorphology, hydrochemistry and geological conditions of the aquifer. This chapter describes the concentrations and distributions of uranium isotopes (234U and 238U) in groundwater from the North-Western Sahara Aquifer System (NWSAS) of Northern Africa and discusses the most likely sources and controls on U mobility. The ranges of uranium are compared to concentrations observed in groundwater worldwide in order be placed within a wider context. The NWSAS, one of the greatest system in the world, covers an area of over 1 million Km2 shared by Algeria, Libya and Tunisia and lodges huge water reserves which are, however, mostly non-renewable and not fully exploitable. The system is mainly constituted by two deep aquifers: the Continental Intercalaire and the Complexe Terminal, to which is connected a third less important one in term of reserves and extension, the Djeffara basin. Due to increasing exploitation, the resource is currently confronting many risks such as water salinity, declining artesianism, natural discharge depletion or piezometric level drawdown. The objective is to investigate uranium distribution as a natural radioactive element and natural variation of uranium isotopic activity ratio in such a context of a large water-rock system with low to no-renewable groundwater.