Selected quotations on the mobility of uranium in groundwater.

Park, Charles F. Jr. and MacDiarmid, Roy A., 1970, Ore Deposits, Second Edition, W. H. Freeman, San Francisco, 522 p.

> "Uranium and vanadium are relatively soluble in the oxidized forms, as hexavalent uranyl dicarbonate and tricarbonate complexes and as tetravalent vanadium complexes. Geochemical studies indicate that the metals would be most stable in solution within a mildly reducing, neutral to alkaline environment that contains abundant CO_2 (Hostetler and Garrels, 1962). Precipitation takes place under more strongly reducing conditions such as those produced by the action of carbonaceous material or H_2S." (Chapter 15: Telethermal Deposits – Colorado Plateau Uranium-Vanadium Deposits, p. 367)

Levinson, A. A. (1974) Introduction to Exploration Geochemistry, Applied Publishing Ltd, Maywood, Illinois, 614 p.

> "Uranium forms complexes with carbonate and sulphate ions, and the resulting complex is soluble under the alkaline pH conditions characteristic of many surface waters." (Chapter 11, Exploration in Canada, p. 430)

> "Andrews and Wood (1972) explained that the release of Rn is dependent on the extent to which rocks are fractured and on the ability of groundwater to circulate through such rocks." (p. 431)

> "The radon content in groundwater and stream water is determined by the physical nature of the rock and aquifer to a much greater extent than by the uranium content of the formation." [referring to Andrews, J.F. and Woods, D.F. (1972) Mechanism of radon release in rock matrices and entry into groundwaters, Transactions of the Institution of Mining and Metallurgy, v. 81 Section B, p. B198-B209]

Dyck, W. , (1979), Application of hydrogeochemistry in the search for uranium; in : Geophysics and Geochemistry in the Search for Metallic Ores; Peter J. Hold, editor; Geological Survey of Canada, Economic Geology Report 31, p. 489-510.

"L'uranium s'oxyde facilement à l'état hexavalent en présence d'oxygène dans les eaux naturelles. Sa mobilité dans les eaux de surface et peu profondes est nettement renforcée par la faculté des carbonates et humates à former des complexes avec l'uranium dans les eaux neutres et basiques ou des sulfates dans les eaux acides, et la faculté des phosphates et silicates à former des complexes dans les eaux neutres. La matière organique absorbe fortement l'uranium, et réduit la migration de l'ion uranyle dans les eaux de surface. La grande abondance des bicarbonates dans les eaux souterraines qui traversent les roches sédimentaires favorise une dispersion et un lessivage importants et étendus de l'uranium dans le sol dans la zone d'oxydation." (Résumé, p. 490)

"Under reducing conditions, U is not mobile. In fact, it precipitates from solution... Conversely, under reducing conditions, the soils and rocks retain U and become depleted in Fe and Mn and certain decay products of U, particularly Ra." (p. 491)

"Very turbulent streams and lakes will contain less radon than quiet ones. Samples more than 5 to 10 metres from the bottom of a lake or stream will seldom contain measurable concentrations of Rn." (p. 494)

"As surface water becomes groundwater, it picks up CO_2 from decaying matter and carbonates and becomes a more effective leaching agent." (p. 495)

"Korner and Rose (1977) found that Rn in groundwaters was anomalous near U mineralization but U not. However, the rate of water turnover is not the only factor, the porosity of the ground and the type of sediments also influence Rn and Ra release into the waters." (p. 500)

" Conclusions: ... Uranium is easily oxidized to the hexavalent state. Its mobility in surface and near surface waters is enhanced by the complexing action of carbonates in neutral and basic waters, of sulphates and fluorides in acid waters, and of silicates in neutral waters. Solid organic matter adsorbs uranium strongly and is responsible for limiting migration of the uranyl ion in surface waters. However, dissolved organic matter is also an important complexing agent of uranium and can enhance its dispersion under appropriate conditions. The greater abundance of bicarbonates in groundwaters within certain sedimentary rocks results in intensive leaching and wide dispersion of uranium in the zone of oxidation." (p. 505)