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Radium Isotopes in the Groundwater Analysis and its Application Study

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ABSTRACT

The transport of radionuclides in groundwater has attracted the attention of nuclear geochemists and hydrogeologists in recent year because of the possibility of release of nuclear waste products into aquifers. Many of the radionuclides of interest sorb on surfaces in the aquifer. This sorption retards the transport of the radionuclides through the aquifer. Detailed information on the sorption process in the aquifer, as well as on the flow characteristics of the groundwater, is necessary for the construction of an adequate model of solute transport in an aquifer.

In this work, we describe a procedure for making in situ measurements of the sorption characteristics of an aquifer using the radioactive daughters of naturally occurring ^{238}U and ^{232}Th. Because of their widely different geochemical properties, their behaviors may serve as indicators of the in situ chemical behavior of other nuclides injected into system. So, measurements of the distribution of these natural decay series nuclides yield site specific empirical data on the in situ sorption processes. Parameters such as distribution coefficients or retardation factors derived from these measurements may be used in models of transport of both radioactive and stable nuclides that show analogous chemical behaviors.

For the analysis of radium isotopes in groundwater, radium was absorbed by flowing water sample into MnO_2 coated acrylic fiber column. After then, each radium isotopes were determined by gamma-ray and alpha spectrometry.

Key words: radium isotope analysis, MnO_2 coated acrylic fiber, groundwater

Table 1. Gamma ray energies of each radium isotopes

Radionuclide	γ -energy(keV)
^{224}Ra	238.6 (^{212}Pb)
^{226}Ra	186
	295.2, 351.9(^{214}Pb)
^{228}Ra	911.1 (^{228}Ac)

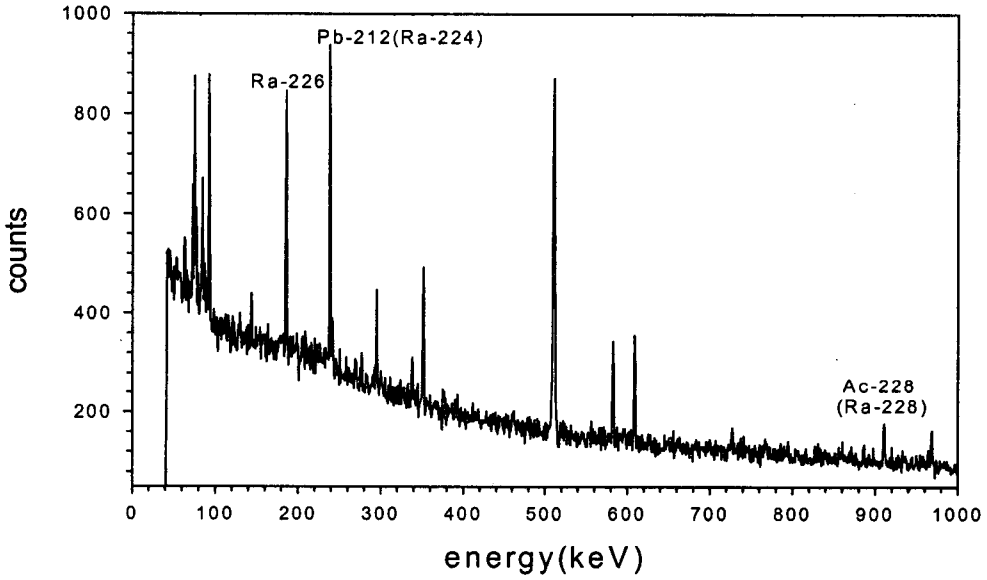

Fig. 1 Gamm-ray spectrum of radium isotopes after secular equilibrium.

Table 2. Analytical results and the detection limit of each radium nuclides.

Isotope	α -spectrometry(Bq/L)	γ -spectrometry(Bq/L)	L_D(Bq/L)
^{223}Ra	2.0×10^{-5}	-	1.1 x 10-5
^{224}Ra	1.7×10^{-3}	1.3×10^{-3}	1.4×10^{-5}
^{226}Ra	3.1×10^{-4}	3.7×10^{-4}	1.1×10^{-5}
^{228}Ra	-	3.2×10^{-3}	6.1×10^{-5}