

Influence of geochemical factors and speciation of radionuclides (Th and U) for their transport in natural waters

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Speciation of uranium and thorium in natural waters of the Semipalatinsk test site (Kazakhstan) has been studied. This territory has radioactive contamination, as well as uranium anomalies due to geological conditions. Technogenic lakes and waterstreams containing uranium and thorium in amounts reaching up to 800 µg/L and 3 µg/L, respectively, were studied.

The main source of natural radionuclides in waterstreams and small rivers is their leaching from water bearing rocks with intensive processes of sulfide minerals oxidation (due to the high $\text{SO}_4^{2-}/\text{Cl}$ ratio in water, from 10 to 60). But for lakes main source was leaching from soils underlying the bottom of the lake, as well as incoming terrigenous material.

It has been established that the dominant form of uranium and thorium is suspended matter (from 70 to 99% of the total). In the studied water bodies, Th/U was $1.1 \cdot 10^{-3}$ for tunnel waters and streams, for lakes - $2.8 \cdot 10^{-3}$ with more favorable conditions for the transition of thorium to the colloidal state. Using a nonparametric correlation, good consistency was found in Th-U(total) ($r=0.72$), Th(dissolved)-U(dissolved) ($r=0.76$), and Th(suspended)-U(suspended) ($r=0.73$) forms. According to modeling (Minteq3.1.), uranylcarbonate complexes (E.g. $\text{Ca}_2\text{UO}_2(\text{CO}_3)_3$) are the dominant species of uranium in a given system, but carbonate does not determine the intensity of its migration because its concentration is excessive.

According to the cluster analysis the accumulation of organic matter in tunnel waterstreams is associated with the enrichment of waters with iron and thorium. PCA shows that the Th and Th/U ratio determined by a single factor. Precipitation of thorium as a result of sorption processes, capture by colloidal particles restrict the migration of this element. In the U-Th pair, thorium properties determine the change in the ratio of these elements in water. Probably, the migration of the colloidal fraction of uranium and thorium is determined by one mechanism, but weakly displayed in the objects under study, against more strong factors.

The speciation profile of thorium display itself as indicators of colloidal transport for these waters.

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