

Radionuclides in the Archaean Rocks adjacent to the Nizhnekansky Rock Massif (Siberian Craton)

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Natural radionuclides have been investigated along with geological exploration of the rock massif for underground isolation of radioactive wastes. Perspective site of rock massif is mainly formed by archaean paragneisses with dykes of gabbros or dolerites that experienced granulite-facies metamorphism at the Palaeoproterozoic time. This time is considered to be connected with intrusion of the Nizhnekansky granite massif caused by accretion of archaean Angaro-Kansky microcontinent to the Siberian Craton. The massif of igneous rocks is situated in 5 km eastwards from the searched site.

Exploration methods included well boring up to 700 m depth with radiometric logging and bedrocks sampling. All 101 samples were tested by gamma ray spectrometry, atomic absorption spectroscopy, ICP MS, and partially were analyzed by chemical methods.

Studies in archaean rocks have shown that they are characterized by low level radioactivity that is not hazardous for personnel, population, and nature. The mean activity of ^{232}Th , ^{238}U and ^{40}K in gneisses is $82\pm 26 \text{ Bq}\cdot\text{kg}^{-1}$, $32\pm 18 \text{ Bq}\cdot\text{kg}^{-1}$ and $673\pm 253 \text{ Bq}\cdot\text{kg}^{-1}$, but in dyke rocks activity is essentially lower $32\pm 19 \text{ Bq}\cdot\text{kg}^{-1}$, $33\pm 30 \text{ Bq}\cdot\text{kg}^{-1}$ and $3786\pm 184 \text{ Bq}\cdot\text{kg}^{-1}$ respectively. These results contradict the notion that granulite-facies rocks are usually depleted in U and Th. Thorium average content in gneisses (20 ppm) exceeds its average value in the earth's crust (13 ppm), while U and ^{40}K average contents (2.6 ppm and 2.7 ppm) are close to their values in crust. Gneisses also have higher Th/U ratio (table).

Ratios	Archaean Crust	Gneiss	Dykes	Granit
Th/U	4.2	7.7	3.0	7.3
Th/Sc	<0.6...0.7	1.91	0.61	1.84
Ce/Cr	< 0.6	0.6	0	2.8
Cr/Th	> 25	4.4	10.5	2.4

Characteristic ratios show that gneisses are more similar to granite than to typical archaean crust (table). We consider that a probable source of gneisses enrichment in thorium is the granite intrusion of Nizhnekansky massif that caused migmatization and metasomatism in adjacent rocks and their enrichment in some elements originated from granite magma.