Radium in plants as prospecting feature of uranium ores

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The method of radium biogeochemical prospecting of uranium ores is based on favourable regularities of radium accumulation by plants and on unfavourable regularities – uranium, and also on development highlyproductive radiometric method of radium determination due to alpha-activity of ash – mineral concentrate of plants, which does not require expensive chemical preparation of samples for the radiochemical analyses.

From available publications abroad and close soviet works of 1950-s it was known that uranium has a very low intensity of absorption by plants, which is different from many chemical elements. Its plant-soil coefficient (PSC) equal to ratio of contents in plants ash and in soil changed from 0,000n to 1,0. Low contents of uranium in plants over its ore bodies demanded highlysensitive and expensive methods of its determination with the chemical preparation of samples and perl-luminescence end. This expensive method with lazer use is applied to determine the low contents of uranium nowadays.

Conjugated determinations of uranium in soils and plants showed that in majority of plants growing over uranium ore bodies, there were no statistically reliable anomalies of uranium even at presence of highly-contrast anomalies in soils. The reliability of revealing of uranium ore bodies due to little contrast biogeochemical anomalies of uranium in leaves and branches of trees and bushes and in overground parts of grasses was approximately equal to 20%. Use of alpha-analysis of plants ashes without any chemical preparation gave quite different results. Background of alpha-activity of ash and rather contrast local alpha-anomalies in it exceeding the local background in tens and hundreds times were determined by 5-10 minutes measurements. These anomalies wide to 10-20 m at the step of sampling 10 m were situated over vein ore bodies and could be interpreted quantitatively. Radiochemical analysis of alpha-anomaly samples showed that practically the whole their alpha-activity was stipulated by radium, and the direct proportionality was established between them. So, there was a possibility to standard alpha-activity of plants ash due to radium.

All "unexpected" primary results were explained during the last decade. At present it is explained by presence of the system of nonbarrier-barrier accumulation of chemical elements in plants. Radium turned out to be nonbarrier chemical element, which is accumulated in all 139 studied bioobjects of plants, direct proportionally to its concentrations on the nutrition horizons of studied plants. Uranium in overwhelming majority studied bioobjects of plants is accumulated according to background barrier, non-informative type.

Recommended method of uranium ores prospecting according to radium in plants takes account of all regularities of its accumulation by plants.

Scheelite in plants

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Scheelite was detected on tungsten deposit Bom-Gorkhon in Zabaikalye in ash of outer layers of pine and larch trunks bark (*Pinus sp*. L.) and (*Larix sp*. Mill). These and some other biological objects accumulate tungsten linear proportionally to their concentration on nutrient horizons of the appropriate plants species according to the nonbarrier type up to rather high concentrations exceeding the local background in hundreds and thousands times. In particular, on Bom-Gorkhon deposit the tungsten concentrations in pine, larch, cedar and birch bark reached 0,1–0,6% in ash at the background contents $1\text{-}3\cdot10^{-4}$ %.

The presence of tungsten mineral form in ash was established first with scintillation emission spectral analysis (SESA) by S.I. Prokopchuk in the Vinogradov Institute of Geochemistry of SB of AS SSSR. Like the studied before gold particles we called them tungsten particles. SESA allows to reveal availability mineral forms of the studied elements (Au, Ag, W, Nb, Ta, Ti, Pb and others) and with the help of amplitude analyzator AI-256 to determine an approximate spectrum of the sizes of their own minerals and a spectrum of sizes of minerals containing the significant quantities of the studied chemical element. It is important that SESA allows to reveal submicroscope removals of elements mineral forms (with the size <0,1 mkm for gold; the minimal size of tungsten particles, which can be determined by SESA, has not been established yet), is rather highly-productive (one analyst can do 100-200 SESA during a shift) and allows to study the spectrum of sizes of their own minerals from <0,1 mkm up to >10 mkm. According to the results of the SESA the plants ash samples with the greatest quality of large tungsten particles, the sizes of which reached 10-20 mkm according to the data of SESA, were selected. Some united samples with large tungsten particles with the weight 10 g were subjected to a special research to availability for tungsten minerals. In heavy nonmagnetic fraction of some samples of pine and larch trunks barks outer layers ash two or three grains with the size 3-10 mkm with blue luminescence under the ultraviolet-irradiation were detected. These tungsten particles were identified as scheelite according to the optical properties and positive microchemical reaction to tungsten. This scheelite is certain to have a biogenic origin, as in the ores of Bom-Gorkhon deposit tungsten is represented by hubnerite and in the zone of oxidation – by tungstite. There is no scheelite in these tungsten ores, in the zones of its oxidation and in soils.

It is possible that besides scheelite, other biogenic minerals – tungsten bioliths are formed in plants. Tungsten phosphate is mostly probable among them, as plants contain the significant quantity of phosphorus (the order 1-10% P_2O_5 in ash).