GEOPHYSICS

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Figure 1

Figure 1: Figure 1

Abstract

Full Text

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SOME DATA ON THE STUDY OF SOIL AND PLANT SAMPLES IN THE REGION OF THE TUNGUSKA CATASTROPHE OF 1908

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In order to clarify the possible connection between the radioactivity of Tunguska soil and plant samples and the explosion of the Tunguska cosmic body in 1908, we carried out studies of radioactivity and measurements of tree growth in the catastrophe region.

Figure 1 presents the results of field radiometric investigations with an RP-1 radiometer in the region of the Tunguska catastrophe and the results of laboratory studies of soil and plant samples from this region.

The data of Fig. 1 show that the radioactivity of tree ash in the region of the explosion epicenter has an elevated value in comparison with samples taken on the periphery; moreover, the maximum radioactivity of tree ash coincides with the explosion epicenter (the dead-forest zone, about 10 km in diameter). At the same time, the radioactivity of the surface layer of soil is practically independent of distance from the epicenter.

Fig. 1. Distribution of the radioactivity of soil and plants in the region of the Tunguska catastrophe of 1908.
1 $-\gamma$-activity of the surface layer of soil (RP-1), 2 $-\beta$-activity of the surface layer of soil (RP-1, STS-6), 3 $-\beta$-activity of the ash of brushwood (RP-1, STS-6), 4 $-\beta$-activity of the ash of trees (counter MST-17)

To resolve the question of the nature of the Tunguska radioactive anomaly, a set of comparative laboratory studies was carried out on tree samples from the region of the Tunguska catastrophe and from various regions of the Urals and Siberia. Spectral analysis showed that the β-radiation of Tunguska wood samples differs substantially from the radiation of natural radioactive elements. The principal components of the β-radiation of the wood ash of the Tunguska samples proved to be: β-radiation of K^{40} ($E_\beta = 1.35$ MeV), β-radiation of the radioactive chain $Sr^{90} \rightarrow Y^{90}$ ($E_\beta = 0.535,\ 2.18$ MeV; $T = 28$ yr), and β-radiation of the decay chain $Ce^{144} \rightarrow Pr^{144}$ ($E_\beta = 0.309,\ 2.97$ MeV; $T = 282$ days) (1). Moreover, the main share of the radiation of the Tunguska samples is made up of radiation from short-lived isotopes with a half-life of about one year (in 5 months the activity of the control samples decreased by 30%). From this it may be concluded that the Tunguska radioactive anomaly formed mainly in recent years.

To determine the cause of the formation of the anomaly precisely at the epicenter of the explosion, studies were carried out on the conditions of deposition of radioactive fallout on trees; these showed that the activity of the dead forest considerably exceeds the activity of the trunks of standing and fallen trees.

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This is explained by the external contamination of the tree by radioactive fallout and by the shielding of the trunk of the growing tree by its crown (the needles or leaves of the trees take up the main share of the fallout). These features of tree contamination are common to all the regions studied. It should also be noted here that all trees in the indicated regions are contaminated to one degree or another by radioactive fallout—the products of nuclear explosions of recent years. For comparison, we were unable to find a clean, uncontaminated tree.

On the basis of the investigation of all the factual material, the formation of the Tunguska radioactive anomaly may be explained as follows: 1) in the region of the Tunguska catastrophe, as in other remote regions of the globe, radioactive fallout fell uniformly over the entire region; 2) despite the uniformity of the fallout, on different objects the deposits were distributed unevenly: more on dead standing trees, less on fallen trees and on the trunks of growing trees; 3) since measurements of the radioactivity of tree ash under field conditions were made on the ash of campfires (Figs. 1, 3), then, insofar as in the epicenter mainly dead standing trees were burned in the campfires, elevated radioactivity readings were obtained here. At the same time, at distances of more than 5 km from the epicenter, in the area of the forest fall, mainly fallen trees were burned in the campfires, which give a reduced value of radioactivity. And finally, beyond the zone of forest fall, arbitrary trees were burned in the campfires, most often felled growing trees that had dried after felling. The ash of such campfires also gives radioactivity values that are reduced relative to the epicenter. The same applies to the collection of samples, from the results of the study of which, under laboratory conditions, the curve of the dependence of the radioactivity of tree ash on distance to the epicenter was constructed (Figs. 1, 4). These ideas are confirmed by additional studies, which showed that the radioactivity of samples taken under identical conditions is not connected with the position of the tree relative to the epicenter.

Fig. 2. Change in radioactivity across a tree section. 1 —pine from the Urals, 60 years old; 2 —pine from Vanavara, 250 years old.

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Figure 2: Fig. 2. Change in radioactivity across a tree section. 1 –pine from the Urals, 60 years old; 2 –pine from Vanavara, 250 years old.

Fig. 3. Cross-section of a 227-year-old larch from a grove at a distance of 5 km from the epicenter

Figure 3: Fig. 3. Cross-section of a 227-year-old larch from a grove at a distance of 5 km from the epicenter

Thus, the difference in the conditions of deposition of radioactive fallout (dead standing tree, growing and fallen tree, bogs, glades in the forest, crevices in stones, etc.) fully explains the change in the total specific radioactivity of the Tunguska tree samples and of the surface layer of the soil.

From all that has been said it follows that, because of the strong contamination from nuclear tests, the investigation of the integral specific radioactivity of Tunguska samples does not answer the question of the connection of their radioactivity with the Tunguska catastrophe of 1908. To answer this question it is necessary to conduct special differentiated studies of the radioactivity of Tunguska samples in order to determine the place and time of radioactive contamination of the locality.

In studying the radioactivity of growing trees from various regions of the Urals and Siberia, an interesting feature was revealed: the specific radioactivity of the wood changes across the section of the tree; the activity of the outer layers of a growing tree (the last 12–15 annual rings) exceeds several times the activity of the inner layers (the heartwood of the tree). Spectral analysis of the β-radiation of tree ash showed that 1) the radioactivity of the inner layers of trees is due mainly to the content of potassium salts (not considered here–

...derive trees growing on natural radioactive anomalies); 2) the increased activity of the outer layers of the trees is due to the content in the wood of artificial radioactive isotopes–products of nuclear explosions. Apparently, this phenomenon can be explained by the property of trees to accumulate, in the course of growth, certain elements, including radioactive ones. The concentration of radioactive elements in plants, compared with their concentration in the soil, may increase by several tens of times ([2], [3]).

Fig. 3. Cross-section of a 227-year-old larch from a grove at a distance of 5 km from the epicenter

As an example, Fig. 2 presents the curve of the distribution of radioactivity across the cross-section of a tree for regions of the Urals. The graph (Fig. 2, 1) shows that the radioactivity of the wood rises sharply from the time of contamination of the soil by radioactive fallout from nuclear tests.

Fig. 4. Influence of the Tunguska explosion of 1908 on tree growth

Figure 4: Fig. 4. Influence of the Tunguska explosion of 1908 on tree growth

Thus, some growing trees (with distinct annual rings of wood growth) are a sensitive indicator of an increase in radioactivity and of the time of contamination of an area by radioactive fallout—products of a nuclear explosion.

The method of studying the radioactivity of wood by individual annual growth rings can be applied to elucidate a possible connection between the radioactivity of Tunguska trees and the Tunguska explosion of 1908. From this point of view, curve 2 in Fig. 2, obtained for trees from the region of the Tunguska catastrophe, is noteworthy: in contrast to trees from other regions, these trees show a sharp increase in radioactivity after 1908.

Fig. 4. Influence of the Tunguska explosion of 1908 on tree growth. 1 —larch from the epicentral region, 227 years old; 2 —larch from Vanavara (65 km from the epicenter), 266 years old

3. The meteorite expedition of 1958, under the direction of K. P. Florensky, discovered anomalously rapid tree growth in the region of the Tunguska catastrophe. Florensky explains this phenomenon by an increase in fertilizer after the fire and by increased illumination within the forest thinned by the windfall ([4]). Of course, an increase in light and fertilizers improves the conditions for tree growth, but these causes do not explain the manyfold increase in wood growth observed in the region of the Tunguska catastrophe. According to our data, tree growth at the epicenter of the explosion increased in some places by more than 7–10 times in comparison with normal tree growth under taiga conditions. Apparently, such vigorous growth cannot be explained by any of the usual taiga causes of increased tree growth.

As an example, Fig. 3 presents a cross-section of a 227-year-old larch that survived the catastrophe of 1908 and continued to grow until 1960.

This larch was cut down in a grove at a distance of about 5 km from the epicenter, where there had been no fire or forest fall and, consequently, the usual conditions for tree growth (light, fertilizers, water regime, etc.) had practically not changed. However, the growth of trees in this grove after 1908 increased fivefold in comparison with the preceding years (Fig. 4). From this it may be concluded that the vigorous growth of trees after 1908 in the region of the Tunguska catastrophe is unusual for taiga conditions and is a direct consequence of the Tunguska explosion.

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Note: Figure translations are in progress. See original paper for figures.