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Abstract**Full Text**

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GEOPHYSICS

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ON TEMPORAL VARIATIONS OF THE SECOND DERIVATIVES OF THE POTENTIAL OF THE FORCE OF GRAVITY*(Presented by Academician M. A. Sadovsky, 18 VII 1969)*

The study of temporal variations of the second derivatives of the potential of the force of gravity was begun in 1967. For three months of that year, round-the-clock investigations were carried out in a mine of the Central Geophysical Observatory of the Institute of Physics of the Earth, Academy of Sciences of the USSR (Fig. 1, *I*). In 1968 similar investigations were continued in a seismoactive region of Central Asia (Fig. 1, *II*), where the technical possibility of measuring variations in curvature differences and gravity gradients was tested. In both cases the values of the variations of the second derivatives proved sufficient for them to be measured by gravitational variometers. The variation in curvature differences reached an especially large magnitude; it exceeded by several times the error of the averaged measurement results obtained according to a special program in rooms with a constant temperature regime and processed according to a special scheme. The mean daily variations of the gravity gradients were also recorded with sufficient confidence, although, as was to be expected, their magnitude was several times smaller than the variation in curvature differences (Fig. 1).

Proceeding from a number of considerations, we came to the conclusion that the period of several days would be the most suitable for characterizing the tectonic state of the Earth's interior. It was assumed that variations with a multiday period would make it possible to judge better the place and time of impending tectonic phenomena. The exclusion from the results obtained of small variations that are of little interest in solving the problem could be achieved only with the aid of continuous variometric measurements in time and by calculating mean daily values, in which the effects of measurement errors and small variations would be weakened.

The results of the processing of such measurements are shown in Fig. 1. On them are plotted curves characterizing the course of changes in the mean daily variations of the second derivatives, calculated from 4 series of 4 cyclic measurements carried out during each day according to the "5 azimuths" program.

Fig. 1

Figure 1: Fig. 1

With the aid of such curves, very weak variations of the gravity gradients, with an amplitude of 1-2 E and a period from 21 to 27 days, were distinguished.

More intense variations are observed in the curvature differences, whose amplitudes reach 10 E . However, in these variations one can observe only sharply expressed changes in amplitudes, and no regularity in time can be discerned in them. It may be asserted that the variations in curvature differences have a stochastic character, since they lack the repeatability characteristic of the curves of the gravity gradients.

Considering the action of tectonic processes to be the main source of variation in curvature differences and gravity gradients, we left open the question of the influence of the magnetic field on the readings of the variometers. This question should be considered from the standpoint of clarifying the influence of instrumental errors, which we did not manage to carry out. In any case, these investigations cannot alter the conclusion concerning the tectonic character of the observed variations. There are also no grounds to fear systematic influences

baric field on the readings of the variometers. This can be verified by comparing the curves of the gravity gradients and the differences of curvatures with the curves characterizing the course of changes in air pressure (Fig. 1B). At the same time it was important to determine the nature of the influence of disturbance of leveling and of the initial direction of the variometers. To determine the magnitude

Fig. 1. Plots of the mean daily values of the gravity gradients and of the differences of curvatures, recorded according to a program of 4-cycle variometric measurements in the building of the Obninsk Observatory in 1967 (**I**) and in the gallery of the Talgar gorge in 1968 (**II**)

of the influence of the first factor, special investigations were carried out, on the basis of which the conclusion was drawn that small disturbances of leveling cannot substantially affect the readings of the variometers and, consequently, cannot change the conclusions about the nature of the origin of the variations of the second derivatives. To exclude the influence of disturbance of the initial directions of the variometers, it was sufficient to confine oneself to theoretical calculations and, in accordance with them, systematically to monitor the established marks so that the disturbances of the directions did not exceed a certain value.

Thus, having assessed the influence of extraneous disturbances, especially those having a systematic character, we substantially strengthened the conclusion that the observed variations in the differences of curvatures and in the gravity gradients arise from the influence of tectonic processes, the nature of which can

be judged from the averaged curves presented in Fig. 1.

The vertical line Z in Fig. 1, **II** indicates the beginning of the Iranian earthquake and of a series of strong earthquakes that followed it on the territory of the Armenian SSR. A characteristic feature observed within the time interval to which the beginning of the Iranian earthquake belongs is the fork-like branching of two curves: W_{Δ} and $2W_{xy}$. We explain this clearly expressed geometrical feature by a source closely connected with the group of the earthquakes mentioned and with a change in the shape of the level—

surface of the gravitational potential. A number of other characteristic features observed on the same graphs are shorter-lived and less intense, and their sources, possibly, “dissipate” in the Earth’s interior in a calm manner, causing very weak earthquakes or microseisms.

It should also be noted that there is a general character to the change in the gravity gradients, which is manifested both in their periods and in their amplitudes. The periods of the gravity gradients are indicated in the figures by vertical strokes, from which their duration can be determined. It is also of interest to note the general change in W_{Δ} on the smoothed wave curve (the dashed line in Fig. 1, *II*), on which a noticeable amplitude and a large period are clearly traced and easily determined.

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

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