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Fig. 1

Figure 1: Fig. 1

Abstract

Full Text

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GRAVITATIONAL ANOMALIES AND THE THICKNESS OF THE EARTH' S CRUST IN CONTINENTAL REGIONS

(Presented by Academician D. V. Nalivkin on 26 III 1957)

At the present time, thanks to the availability in a number of regions of sufficiently reliable data from gravimetric and seismological investigations, it is possible to pose and partially resolve the following question: does the character of regional gravitational anomalies agree with the character of the deep structure of the Earth' s crust as established by seismology? It may be assumed that for continental regions there should be an approximate proportionality between the intensity of regional gravitational anomalies and the thickness of the Earth' s crust. This proportionality should not hold for coastal regions and oceans, since within the latter not only the thickness but also the composition of the Earth' s crust changes, and instead of the Bouguer anomalies close to zero or negative that are characteristic of continents, regional positive anomalies appear. The possibility of an approximately linear relation between the thickness of the continental crust and the intensity of gravitational anomalies follows from the presumed rather considerable difference in the mean density of the material of the crust and of the subcrustal layer (up to 0.4 g/cm^3). At the same time, however, this linear dependence must be complicated and disturbed by the influence on the gravitational field of density heterogeneity in the sialic shell, caused by its internal structure, and also, to some extent, possibly by heterogeneity in the composition and structure of deeper layers. It may also be affected by the incomplete correspondence between the position of the Mohorovičić boundary and the boundary between the sialic and simatic shells of the crust.

Fig. 1

All this is well confirmed by the factual data, on the basis of which a diagram has been compiled (see figure) of the dependence of the intensity of Bouguer

anomalies Δg on the thickness of the Earth's crust as determined seismologically.

More reliable data are shown by circles, less reliable data by crosses. The numbers in the diagram refer to different regions, which are indicated below.

1, 2. Two seismo-gravimetric profiles between Lake Balkhash and the Tien Shan, compiled from the data of the works of G. A. Gamburtsev et al. (1). The values of Δg and the depths to the Mohorovičić surface, determined by the DSS method, are compared at the ends and at the middle points of both profiles.

3. The Korkino region (Western Siberia). Data from seismological studies during the large explosion of 1936 (2) were used in their latest interpretation, given by E. F. Savarenskii (4). The mean value of Δg for the seismic profile is indicated.

4. The region of Heligoland and Western Germany. Various variants are indicated for the interpretation of seismic data obtained during the explosion on Heligoland Island in 1947 (3, 8). The mean value of Δg was determined from the gravity map of Western Europe (5).

5. Seismo-gravimetric profile from the Schwarzwald to the Alps (10).

6. Alps. Two variants of the seismic section of the Earth' s crust (7, 11). The anomaly Δg was determined from the gravity map of Western Europe (5).

7. Canada (13).

8. Sierra Nevada. Crustal thickness according to Gutenberg (6), anomaly Δg according to Woollard (11).

9. Central Appalachian region. Crustal thickness according to Gutenberg (8), anomaly Δg determined from the gravity map of the USA (9).

10. USA: the states of New York, Pennsylvania, Tennessee, Maryland, Minnesota (13).

From the data presented it is evident that zero values of the anomaly Δg correspond to a crustal thickness of about 30 km. For regions with greater crustal thickness, negative anomalies Δg are noted everywhere. The large "scatter" of the values of Δg at constant or nearly equal values of crustal thickness, and the insufficient quantity of data, do not permit a confident judgment as to the nature of the relation between crustal thickness and the intensity of the anomalies. It may, however, be considered that, to a first approximation, this relation is linear in character, with a change in crustal thickness of 10 km corresponding on average to a change in the magnitude of the anomaly Δg of approximately 100 mgal.

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