SECULAR CHANGES IN GRAVITY

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Abstract

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SECULAR CHANGES IN GRAVITY IN THE ARAL-CASPIAN REGION

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In work ([1]), for two extensive regions of the Russian Platform, it was shown that the observed changes over time in the values of gravity at reference points can be explained by secular changes in gravity (Δg_t), which is confirmed by the existence of a regular relationship between the distribution of the quantities Δg_t and the geological structure of the regions.

The present article considers analogous material from gravimetric observations carried out in the Aral-Caspian region in 1954–1966, with a mean square error of measurement of g of about ± 0.2 mGal. These works were conducted under the direction of E. A. Azarkina, Ya. B. Belen' kii, I. S. Nikitina, N. V. Epshtein, the author, and others.

Observations carried out at intervals of from 2 to 9 years were used. The observations of each year were tied to high-precision points determined under the direction of Yu. D. Bulanzhe by an expedition of the Institute of Physics of the Earth of the USSR Academy of Sciences. Analysis of the material made it possible, to a known extent, to reduce the influence of systematic errors caused by observational errors at the initial points, or by the use of different initial points, etc. Then the discrepancies between the primary and repeated observations were calculated. Comparison of the magnitude of these discrepancies with the magnitude of the measured gravity interval showed that the discrepancies obtained cannot be explained by errors in the scale value of the gravimeters used. Thus, the most probable assumption is that in the present case as well these discrepancies are explained by secular changes in gravity. To obtain homogeneous material, the changes in gravity per one year were calculated; these, similarly to what is accepted in magnetometry, we shall call the secular variation ([2]) and denote by $\Delta g'_t$.

On the map of secular variation (Fig. 1), regions of positive and negative values of $\Delta g'_t$ are distinguished. Most values of $\Delta g'_t$ do not exceed 0.2 mGal, although values exceeding 1 mGal are encountered. These values were usually calculated for a short interval of years, and thus they contain a large share of

Fig. 1. Scheme of the secular variation of gravity in the Aral-Caspian region.

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random error (or perhaps of an intensive high-frequency component Δg_t). Areas of anomalously large values of $\Delta g'_t$, in absolute magnitude, are conventionally shown by hatching. The values of $\Delta g'_t$ are plotted on a schematized copy from the tectonic map of Eurasia ([3]). A predominance is noted of northwestern trends of the isolines of $\Delta g'_t$, which correspond to the trend of the tectonic elements of the Tien Shan system. This accords with the idea of tectonic activation in the present epoch, in this part of Central Asia, of NW–SE trends, i.e., of the Tien Shan direction. The region of Tien Shan trends of $\Delta g'_t$ can be traced westward as far as the shore of the Caspian Sea, crossing the southern downwarp of the tectonic system of the Urals. In the Caspian depression the northwestern trends die out.

In the region where northwestern trends of $\Delta g'_t$ predominate, the existence of three extensive zones is noted. The southern negative zone corresponds to the South Mangyshlak trough. The middle positive zone of Δg_t corresponds to the North Ustyurt trough and, apparently, extends to the southern part of the Aral Sea. The Mangyshlak system

dislocations is located between the southern and middle zones, and, possibly, it corresponds to its own zone $\Delta g'_t$ (here, I repeat, there are few points). The northern negative zone is traced through the areas of the southern subsidence of the Urals (in the Chelkar area) into the region of the Syr-Darya uplift. A correspondence is emerging between the strikes of the isolines of $\Delta g'_t$ and the contour of the Syr-Darya uplift.

All that has been said makes it possible to think that in the Aral-Caspian region, too, repeated measurements at reference gravimetric points reveal

Fig. 1. Scheme of the secular variation of gravity in the Aral-Caspian region. **1** –values of the secular variation $\Delta g'_t$ (mGal/year), in parentheses – interval between repeated observations (years); **2** –isolines of the secular variation $\Delta g'_t$; **3** –areas of anomalous values of $\Delta g'_t$; **4** –axes and other elements of tectonic structures of linear type (**I** –zone of southern subsidence of the Urals, **II** –Mangyshlak system of dislocations); **5** –geological depressions (**A** –North-Ustyurt depression, –Chelkar trough, –Turgai syneclise, –Barsakelmes trough, –South-Mangyshlak trough, –Assake-Audan trough, –Khorezm-Kyzylkum trough, –Syr-Darya syneclise); **6** –geological uplifts (**a** –Syr-Darya uplift, –Tuarkyr system of dislocations, –Central Karakum arch); **7** –Caspian depression; **8** –southeastern boundary of the Caspian depression.

secular changes in gravity, despite the comparatively low accuracy of the measurements and the small time intervals between successive measurements. However, in order to establish this fact definitively, additional control measurements

are necessary.

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