VERTICAL MOVEMENTS OF THE EARTH' S SURFACE IN THE TERRITORY OF TASHKENT

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Abstract

Full Text

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To obtain quantitative characteristics of modern vertical movements of the earth' s surface, the method of repeated precision leveling is successfully used. In the territory of Tashkent a number of levelings were carried out: in 1896, 1930, 1939-1940, and 1962-1965. In 1966, already after the beginning of the earthquake, repeated levelings of some lines were also carried out.

Fig. 1. Map of relative velocities of vertical movements of leveling marks in Tashkent for the period 1939-1940 and 1962-1965 (in mm/year). *1* —wall marks, *2* —wall benchmarks, *3* —mark number

To study vertical movements of the earth' s surface in the territory of Tashkent, in particular for compiling maps of these movements before the beginning of the earthquake and during it, the levelings of 1939-1940, 1962-1965, and 1966 can be used. The levelings of 1896 and 1930 can practically not be used, since most of the benchmarks established in those years have not been preserved. It should be noted that many benchmarks from subsequent levelings, especially in the city center, also turned out to have been destroyed as a result of the earthquake.

On the basis of comparing the results of the above-mentioned levelings, two maps were compiled characterizing the relative vertical

Fig. 2. Map of relative vertical movements of the Earth' s surface in Tashkent for the period 1962-1965 and 1966. 1—leveling lines, 2—lines of relative vertical movements, 3—boundaries of the city of Tashkent, 4—fundamental benchmark, 5 —ground benchmark, 6—wall mark, 7—wall benchmark, 8—vertical movements of

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Figure 3. Graph of vertical movements of the Earth' s surface along the North-South line (No. 12-480—No. 12-289). 1—elevation marks, 2—relative vertical movements of the Earth' s surface for the period from 1962-1965 to May-June 1966, 3—relative vertical movements of the Earth' s surface for the period from 1962-1965 to July-August 1966.

Figure 3: Figure 3. Graph of vertical movements of the Earth' s surface along the North-South line (No. 12-480—No. 12-289). 1—elevation marks, 2—relative vertical movements of the Earth' s surface for the period from 1962-1965 to May-June 1966, 3—relative vertical movements of the Earth' s surface for the period from 1962-1965 to July-August 1966.

leveling marks in millimeters relative to ground benchmark No. 12-480. Seismic zones: 9—8 points, 10—7-8 points.

movements of the Earth's surface on the territory of Tashkent. Figure 1 presents a map of the rates of vertical movements for the period from 1939-1940 to 1962-1965. As the initial point, relative to which the displacements of the Earth' s surface were determined, the unnumbered mark in the building of the Tashkent railway station was adopted. To compile this map, the results of repeated leveling of 83 marks were used. Only two of them changed their position over 23 years by more than 25 mm. The elevations of the remaining marks changed over this period by less than 10-15 mm.

Thus, the average rate of vertical movements before the earthquake was 0.5 mm/year, and the direction of movement of different benchmarks varied.

Fig. 3. Graph of vertical movements of the Earth' s surface along the North-South line (No. 12-480—No. 12-289).
1—elevation marks, 2—relative vertical movements of the Earth' s surface for the period from 1962-1965 to May-June 1966, 3—relative vertical movements of the Earth' s surface for the period from 1962-1965 to July-August 1966.

A map of relative vertical displacements of points on the Earth' s surface for the

period 1962-1965—August 1966 is shown in Fig. 2. On this map, the vertical displacements are referred to a benchmark located near Keles station, i.e., at a distance of 12-15 km from the earthquake epicenter. The area of Keles station has small rates of vertical movements, on the order of $±$1-2 mm/year. The map also schematically shows the city boundaries, the epicentral zone of the earthquake, and lines of equal displacement of the Earth' s surface are drawn. The graph in Fig. 3 presents the vertical displacements of benchmarks along the benchmark line No. 12-480—benchmark No. 12-289 (north—south) for the periods 1962-1965—June 1966 and June—August 1966.

On the basis of the data presented, the following preliminary conclusions may be drawn:

1. During the period from 1939-1940 to 1962-1965 (Fig. 1), no significant vertical movements of the Earth' s surface were observed in the territory of Tashkent.
2. On the map of vertical displacements of the Earth' s surface (Fig. 2), after the earthquake it is clearly seen that an elongated zone of uplift of +40 ÷ +60 mm formed in the northeastern part of Tashkent. This zone has the same direction as the axis of the Karzhantau ridge. In the remaining part of the city, no significant vertical displacements are noted.
3. When considering the graph of vertical displacements along the line No. 12-480—No. 12-289, it is clear

it is evident that the ground surface between marker No. 14 and the unnumbered bench mark in the station building continued to rise even after the earthquake. Since June 1966 its uplift increased by 10-15 mm. The greatest uplift along this line in 1962-1965 reached 45 mm in the area of marker No. 1474.

4. Vertical movements of the ground surface in Tashkent are gradual and smooth in character; i.e., a slow tilting of individual sections of the ground surface is observed.

Repeated leveling work is continuing. It is to be hoped that it will make it possible to detect those vertical movements that are occurring at the present time as well, and also to delineate the uplift zone more reliably.

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