

STUDY OF SEISMIC ACTIVE EARTH FRACTURES OF TAVOKSOY AREA USING GPS AND GEOPHYSICAL (MAGNETOMETRIC, GRAVIMETRIC, RADIOMETRIC) METHODS

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ABSTRACT

In the article, Tavoksoy geodetic micropolygon was studied by geophysical works and GNSS method, horizontal and vertical movements of active earth faults were determined by interpreting the data obtained from them. Geophysical (magnetic exploration, gravity exploration, radiometry) methods provide information on changes in anomalies in active earth faults.

Keywords: *GNSS, Geophysics, Magnetic Survey, Gravity Survey, Radiometry, Chart, Anomaly*

INTRODUCTION

The territory of Tashkent and its surrounding areas is one of the most densely populated regions of our republic in terms of demographics, and in addition, taking into account the location of many production facilities of industrial importance for the development of the economy in these regions, it is important to carry out geological and geophysical studies in order to assess the seismic condition of the region.

The Tavoksoy earthquake ($M=5.2$) occurred on December 6, 1977 near the village of Tavoksoy. The epicenter of the earthquake is located at a depth of 15 km in the Piskom Tashkent seismogenic zone, with a strength of 7 points and a magnitude of 5.1. Seismic waves reached 7 points in Chirchik, Ghazalkent, 5 in Chorvok, 6 in Tashkent, 4 in Yangiyul, and 3-4 in Okhangaron. Several buildings were damaged in Tavoksoy, Azodbosh, Iskandar and other places.

The direction of the epicentral zone spread over the earth stretches from the north-east to the south-west along the Karjantau Tashkent fault. The area of the 3-point earthquake was 65,700 km² [Shukurov *et al.*, 2017).

MATERIALS AND METHODS

In addition, in order to determine the modern movements of the earth's crust, at the beginning of 2016, complex geological-geophysical research was conducted at the Tashkent geodynamic range, and the results of the research can be considered as the first steps in the quantitative assessment of the deformation of the earth's crust [Shukurov *et al.*, 2017).

As part of the scientific-research works to assess the seismic activity of the Karjantau deep fault on the basis of a set of geological-geophysical methods, field observation works were carried out with a tachymeter device in Tavoksoy geodynamic range every quarter, that is, on 06.05.2016, 11.07.2016 and 14.12.2016. Figure 1 below shows the plan view of the points where geodetic measurements were carried out in the Tavoksoy geodynamic range [Shukurov *et al.*, 2017).

As a result of the conducted research, the results of the tacheometric measurement work carried out in 2016 at the Tavoksoy geodynamic landfill were processed and analyzed in the same system as the results of the

leveling work carried out in 1979. As a result, 36-year vertical movement amounts of points were determined (Fig. 2) (Shukurov, 2013; Shukurov et al., 2017).

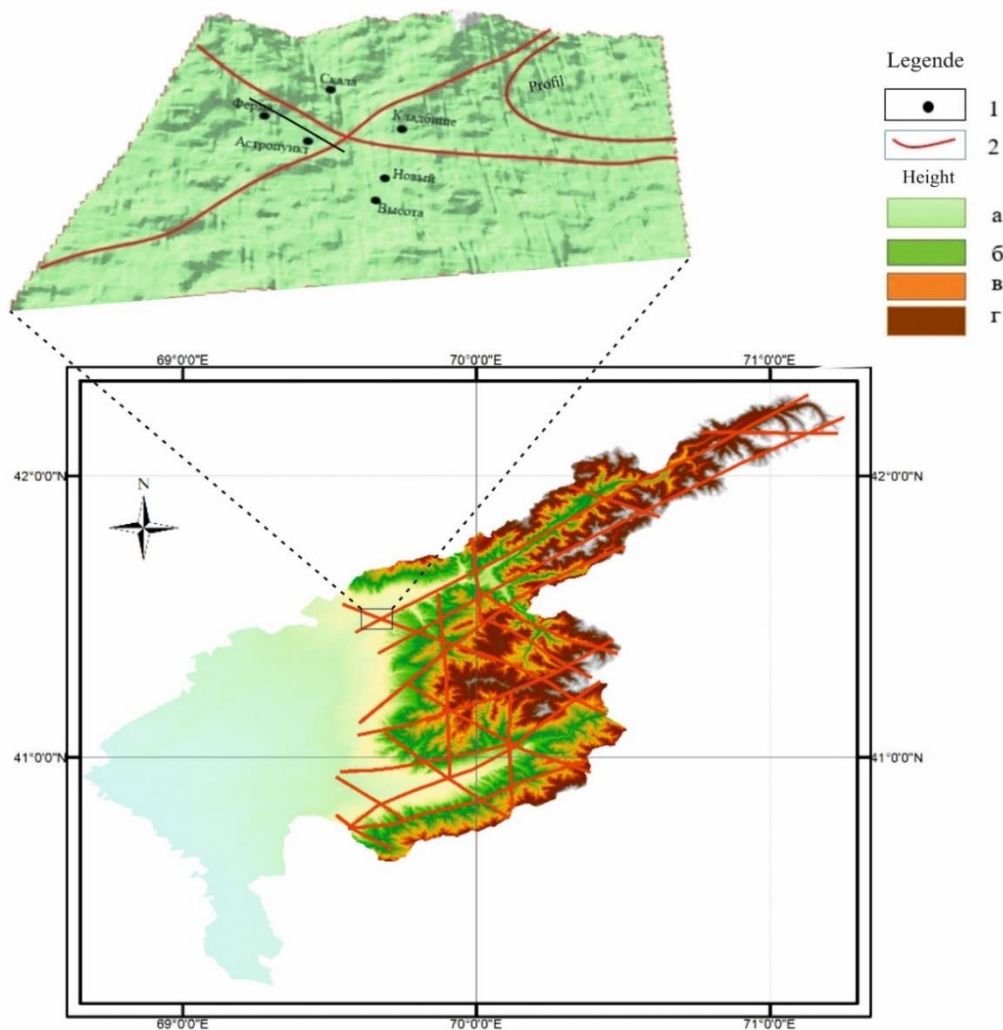


Figure 1. Tavoksoy geodynamic range, a view of the intersection of Karjantau and Tavoksoy active earth faults in a space image.

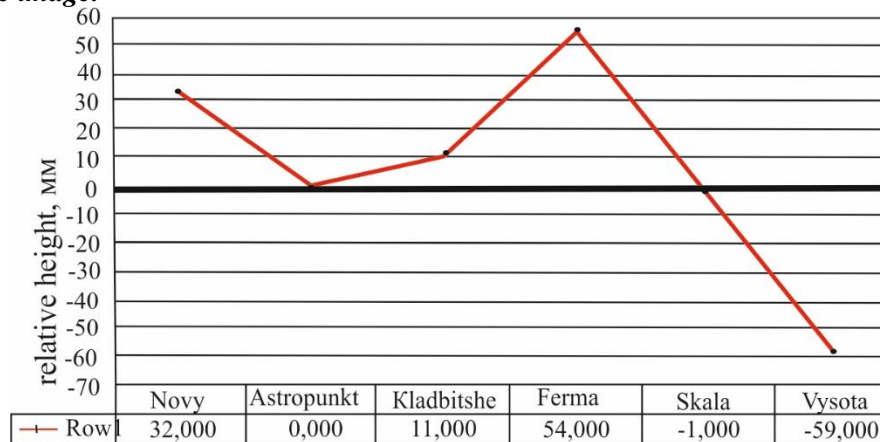


Figure 2. Graph of 36-year vertical movement quantities of points in the Tavoksoy geodynamic range.

RESULTS AND DISCUSSION

Figure 3 shows the relative height values in mm. At points "Scale" and "Vysota" located in the north of the Karjantau fault, subsidence of -1 mm and -59 mm was observed. At the geodetic monitoring points "Novyy", "Klaadbitshe" and "Ferma" located in the southern part, it was observed that the rise was 32 mm, 11 mm, 54 mm. It was found that the amount of vertical movement in the vicinity of "Ferma" and "Vysota" points has changed more than the other points. The reason for this is that the points mentioned above are located in areas close to the deep Karjantau fault [Shukurov *et al.*, 2017].

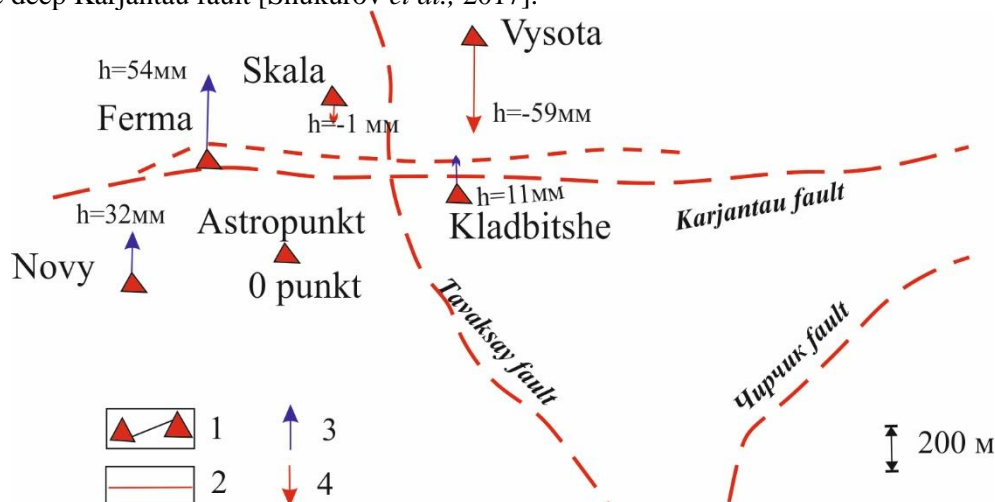


Figure 3. The Karjantau deep fault and the Tavoksoy fault intersected schematic map of the area. Conditional signs. 1-triangulation points, 2-earth fault, 3-vertical movement (+), 4-vertical movement (-)

According to the information given above, it follows that it is extremely important to continue complex monitoring works in Tavoksoy micropolygon. Based on this, in 2022, 2 times (on 10.04.2022 and 21.08.2022) observation works were carried out using modern geodetic devices. It used GNSS devices manufactured by the Chinese company South.

In the area of the Karjantau fault zone of the Tashkent geodynamic range, measurements were carried out by magnetometric, radiometric (SRP-88) and gravimetric (GNU-KS) methods, and information on the determination of the geodynamic activity of the active fault zone was presented.

Geophysical (gravimeter, radiometer) measurement methods were also carried out at the Tavoksoy geodynamic point together with the geodetic survey, in which the value of the earth's gravity (mGal) was measured for each point using the GNU-KS gravimeter and the values (mGal) were obtained.

Measurements were carried out at geodynamic points in order to study the natural radioactivity of rocks and to determine the increase in radioactivity in active earth cracks using radiometry method SRP-88 radiometer in the studied area.

In practice, there are classifications that differ in the duration of the absence of information, which can be determined depending on the approach of the researchers, the sensitivity of the studied parameters, and other characteristics.

Core research. The analysis of the conducted research shows that long-term leaders do not appear in all fields. In most cases, they are invisible in geodetic, seismostatistical, and in some cases geomagnetic forecasting methods. For example, G. Benof [1960], analyzing the series of disappearances of earthquakes per unit of time, determined that there is periodicity in seismic activity on the scale of the Earth. This period varies from 10 to 18 years. For K.Mogi Alpine seismic belt, this periodicity was found to be equal to 35-40 years [Golovkov *et al.* 1990]. R. N. Ibragimov according to the results of Abdullabekov [1974], the activity of strong earthquakes in seismically active regions of Uzbekistan is repeated every 40 ± 5 years. For different parts of the world, the spectrum of such repetitions is even wider, depending on the geological-tectonic and

geodynamic conditions of each region, and the duration may last from several years to 800-1000 years [Golovkov and Dr., 1990]. It should be noted that the time of seismic activity in all points is much shorter than the time of seismic silence, equal to 1/3 on average. Long-term harbingers of earthquakes are evident in some geophysical field variations. Such fields include the earth's magnetic field. These field variations are long-, medium- and short-term changes related to the preparation and occurrence of an earthquake in the earth's crust and have been recorded before many earthquakes. For example, in Fig. 5, as an example, samples of long-term and medium-term indicators of the geomagnetic field recorded in the geodynamic polygons of Uzbekistan are presented. As can be seen from the given graph, the earthquake associated with the Tovoqsoy earthquake, which occurred on December 6, 1977 with a magnitude of $M=5.2$, began in 1975 and lasted for about three years [5]. The 1988 Darautkurgan earthquake with a magnitude of $M=5.1$ lasted for about 4 months. It is worth noting that despite the almost equal strength of both earthquakes, their indicators are fundamentally different from each other. This situation indicates that the problem of earthquake prediction is extremely complex.

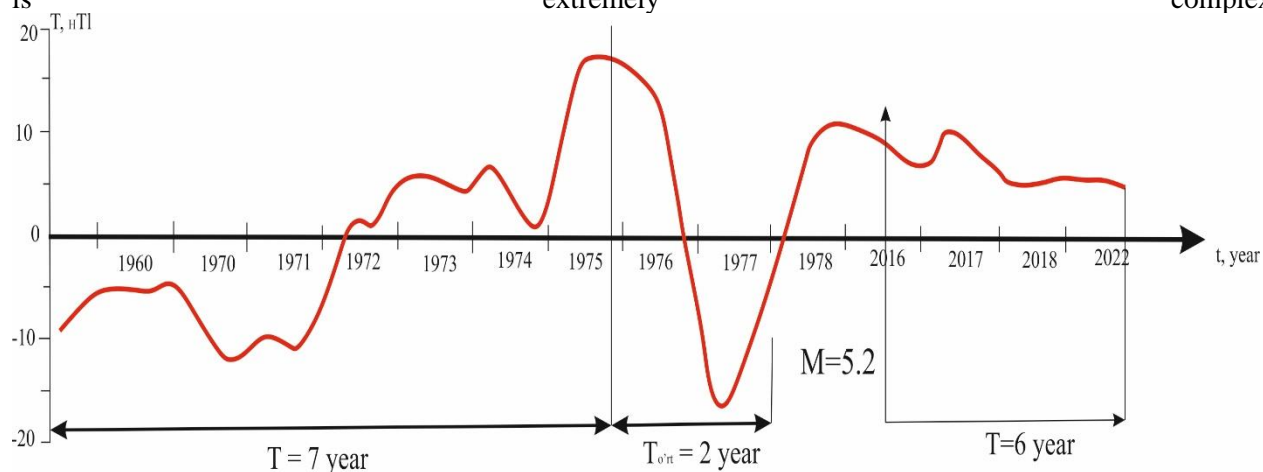


Figure 5. Long-term anomalous change of the geomagnetic field associated with the Tavoksoy earthquake.

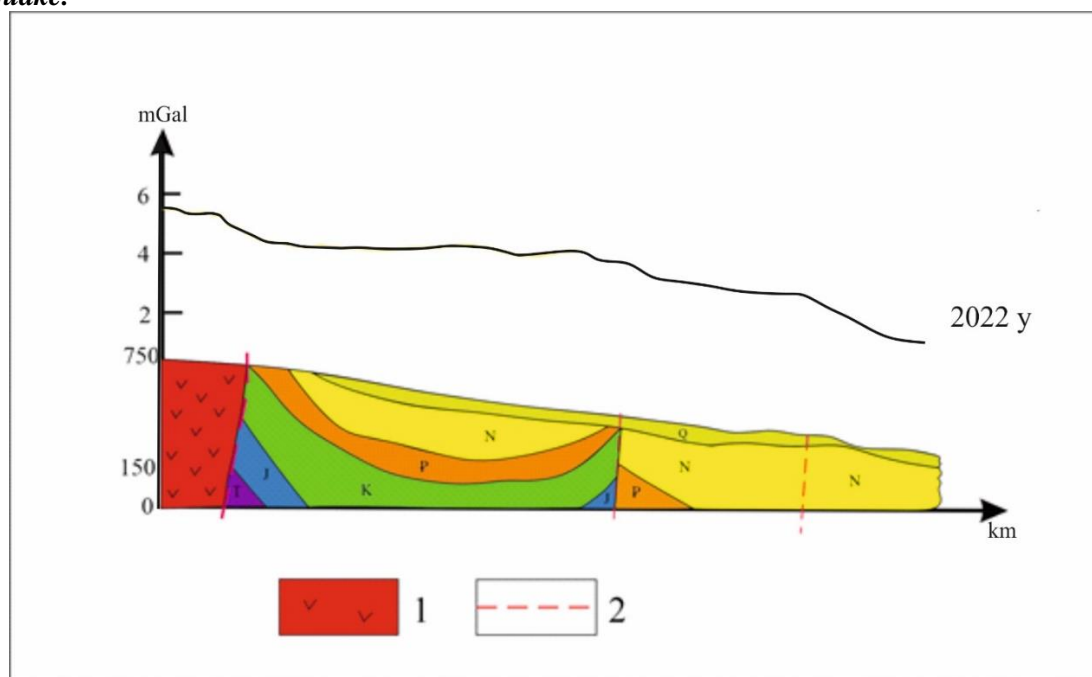


Figure 4. The graph of the change of gravity.

The method of gravity prospecting is based on the study of the distribution of the gravity field on the earth's surface, and it is a very effective method for determining the geological structure of the earth's crust. The gravitational field is related to the density difference of rocks inside the earth. In the area where the measurements were taken, mainly igneous rocks are widespread, the density of granites is 2.6 g/cm³, the density of granodiorites is 2.8 g/cm³, and the density of gabbro is 2.9 g/cm³. The distribution of gravity value Δg (mGal) of measured values obtained by gravimeter GNU-KS is presented in Fig. 4.

The purpose of carrying out high-precision gravimetric measurements in our scientific research is to determine changes in the distribution of gravity along active earth faults.

The variation of gravity over the terrain has a maximum value of 5.616 mGal at Vysota point and a minimum value of 4.617 mGal at scale point.

In 1975, the first gamma-mapping works were carried out in the Tavoksoy area. The gamma activity of the igneous rocks scattered in the Tavoksoy area varies in the range of 15-50 μR /hour. According to the results of gamma mapping, radioactivity in the Karjantau fault zone was 20 mkr/hour. The difference in the results of measurements in the area from 1975 to 1978 is 4 mkr/h, the main reason for the increase in intensity in gamma mapping for 3 years is the Tavoksoy earthquake that occurred in 1977 (Yarmukhamedov, 1988). As shown in Figure 5, gamma mapping was carried out 4 times with different years. In the graph, it is observed that the intensity of the values of the radioactive field decreases. We performed gamma mapping with the SRP-88 radiometer in 2022 and obtained the graph shown in Figure 5. It was observed in the graph that our measurements are lower than the values measured in 1979, the reason for which is conditioned by the change in the level of activity of the Karjantau, Tavoksoy earth faults.

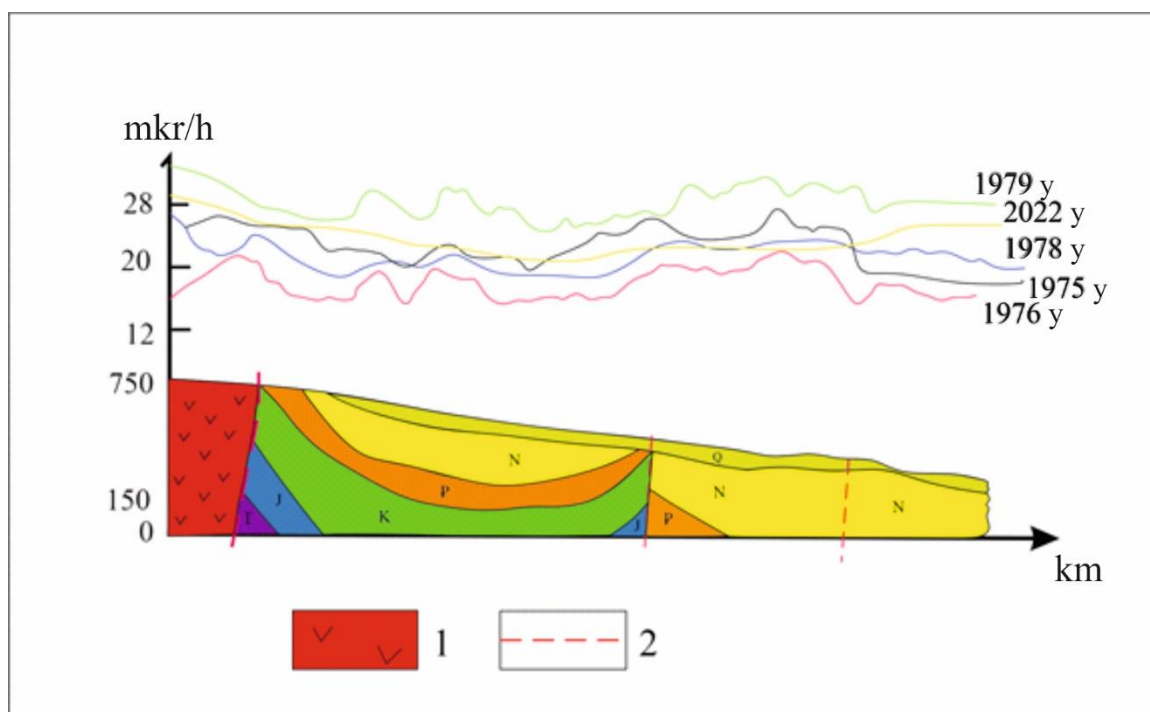


Figure 5. Graph of natural radioactivity values of rocks. 1- Paleozoic (Intrusive) rocks 2- active earth faults.

Radioactivity levels on Earth can vary depending on their sources and environmental conditions. For example, in places where the amount of radioactivity is high in granite rock, the level of radioactivity may be high. The level of radioactivity also depends on the composition of the earth's cracks, if the composition of the earth's cracks contains a radioactive element, it gives an anomalous change in gamma mapping.

Anomalous changes in the intensity of earth cracks through gamma mapping work, that is, anomaly changes indicate the activity of earth cracks, one of the main reasons for the occurrence of earthquakes is the physico-

chemical process in the interior of the earth, that is, as a result of radioactive elements, a mountain occurs through the transition of rock to another rock.

CONCLUSION

As a result of conducting practical work with the geophysical and GNSS method at the Tavoksoy geodetic range, the activity of earth faults was determined. The obtained data were interpreted in programs. In the analysis, the results of the 1st measurement were subtracted from the results of the 2nd measurement, and the vertical and horizontal movements of the points were determined. The most changes were observed in "Ferma" 2566, "Klaadbitshe" 4391, "Vysota" 4132 points. It is clear from this that in the results of the previous 36-year level geodetic observation works, it can be seen that the change was mainly observed at the points "Ferma" 2566, "Klaadbitshe" 4391, "Vysota" 4132. It has been established that there is a periodicity in the occurrence of earthquakes in seisoactive zones and within the globe.

Earthquakes were mainly interpreted as magnetic field anomalies of active earth faults, gravity anomalies of gravure exploration methods, gamma mapping results, and an increase in anomalies was observed where there are earth faults.

The horizontal and vertical movement of the Karjantau fault was determined by the GNSS method, and the movement and activity of this fault can be connected with the Talas-Fergana deep fault, the reason for which is the igneous rocks in the earth as a result of the active fault movement.

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