STUDY OF LANDSLIDE PROCESSES USING GRAVIMAGNETOMETRY METHODS IN THE RESIDENTIAL AREA OF MASAZIR

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Introduction

The damage caused by landslide processes in the world amounts to tens of millions of US dollars. Anti-landslide measures based on geological-hydrogeological and topographic-geodynamic studies are a rather laborious process both financially and methodologically. On the other hand, work on assessing the stability of operated engineering structures, areas of the earth's surface of mass habitation, etc. are extremely important.

The solution to the problem of assessing deformation processes on the surface of the earth's crust is possible not only by classical geological, hydrological and geodetic methods, but also by a complex of geophysical studies, in particular, gravimagnetometry methods. The methodology of these studies was developed at the Republican Seismic Survey Center of the Azerbaijan National Academy of Sciences and is widely used in landslide areas of civil and infrastructure construction.

This article discusses the probability of a landslide (deformation) process on the territory of the Masazir residential complex (Azerbaijan Republic). Methods of magnetometric and gravimetric monitoring were used.

The discussion of the results

Gravimagnetic studies on the area of the village of Masazir were held in two stages - in April and May 2015.

The purpose of the work is to study the geodynamic regime and assess the stress state of the geological environment in the area of the village of Masazir.

Magnetometric and gravimetric observations were carried out along 5 geophysical profiles with a step of 50-100 meters. In order to "normalize" the variations in the geomagnetic field strength, a stationary magnetic variation station of round-the-clock operation (MVS) was installed on the territory of study. Equipment proton magnetometer G-856 (USA) in the amount of 2 sets, gravimeter CG-5 (Canada) in the amount of 1 set.

The results of magnetic and gravity surveys were presented as maps of spatiotemporal increments of the geomagnetic field strength ΔT~f(t) and non-tidal gravity variations Δg~f(t) in 2D and 3D formats (Fig. 1, 2, 3, 4, 5, 6, 7, 8).

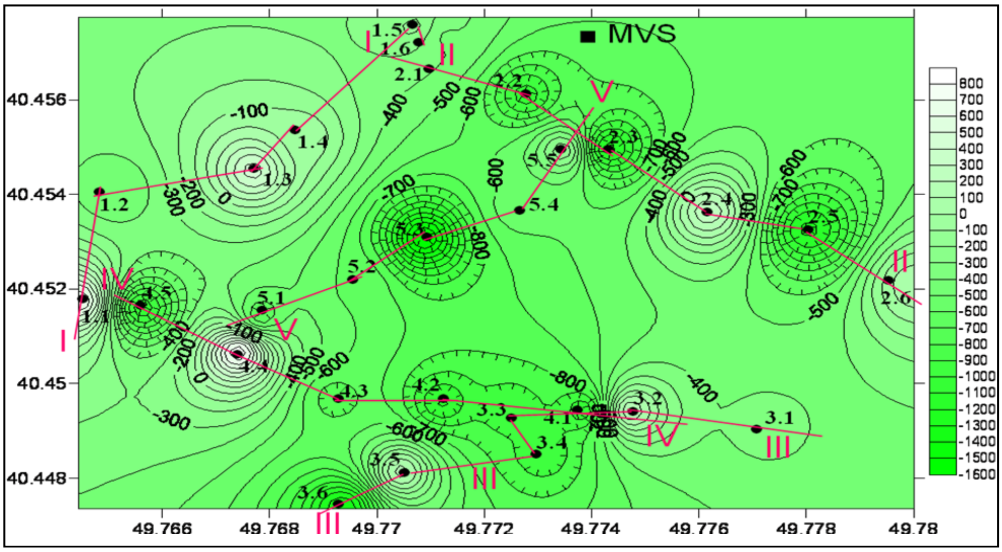

Figure 1. Stress-strain state of the geological environment in the Masazir area based on magnetometric data in 2D format (April, 2015).

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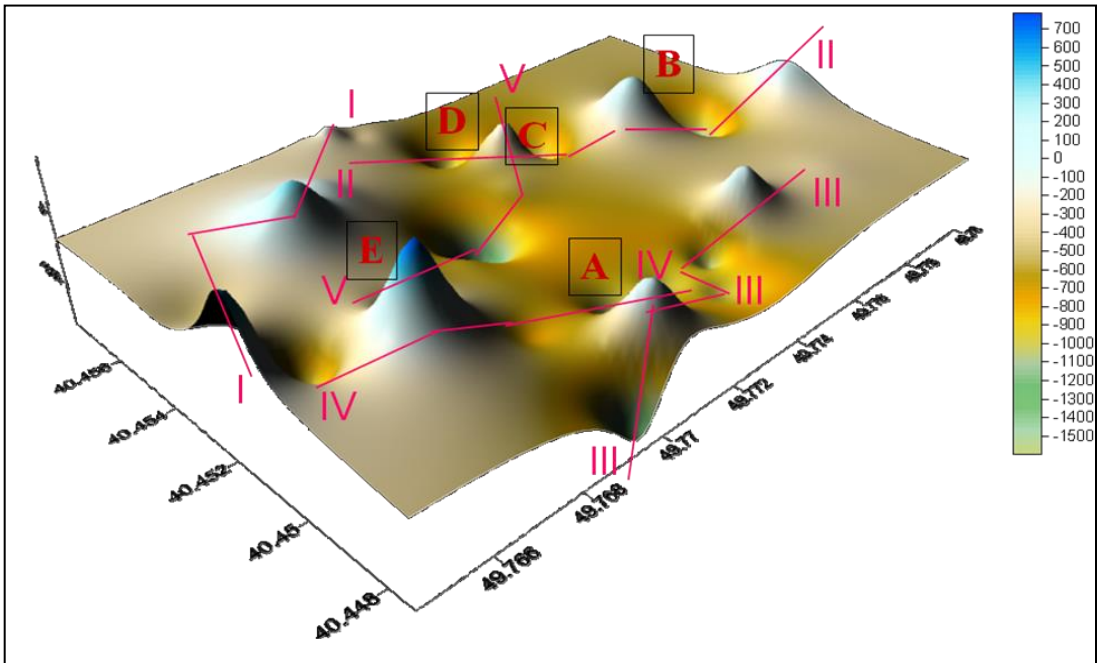

Figure 2. Stress-strain state of the geological environment in the Masazir area based on magnetometric data in 3D format (April, 2015).

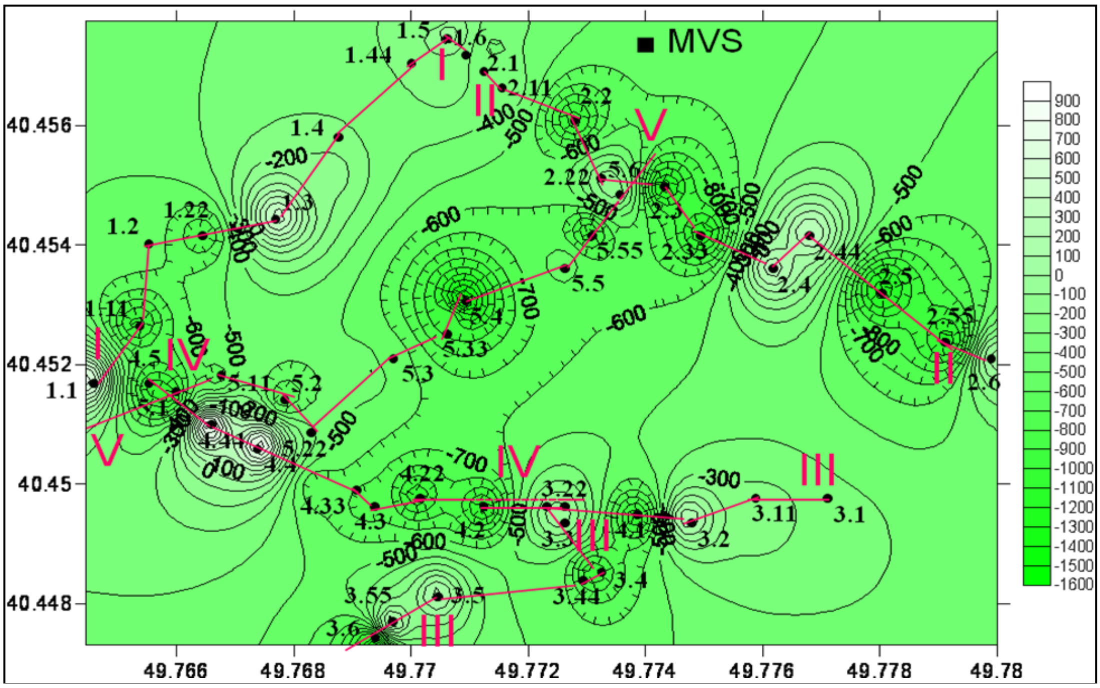

Figure 3. Stress-strain state of the geological environment in the Masazir area based on magnetometric data in 2D format (May, 2015).

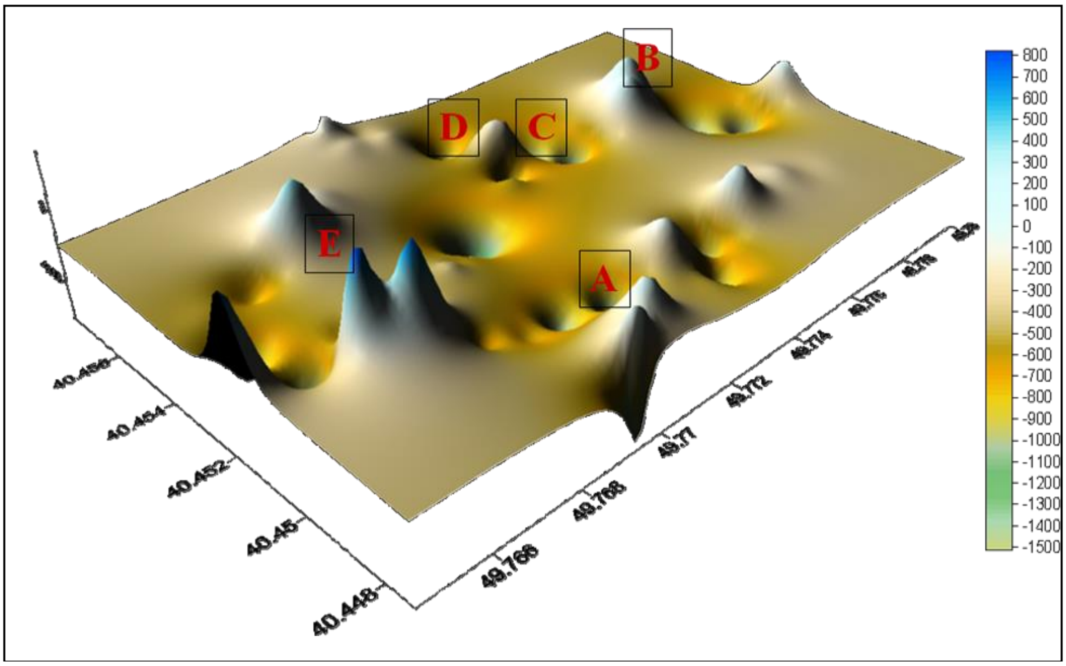

Figure 4. Stress-strain state of the geological environment in the Masazir area based on magnetometric data in 3D format (May, 2015).

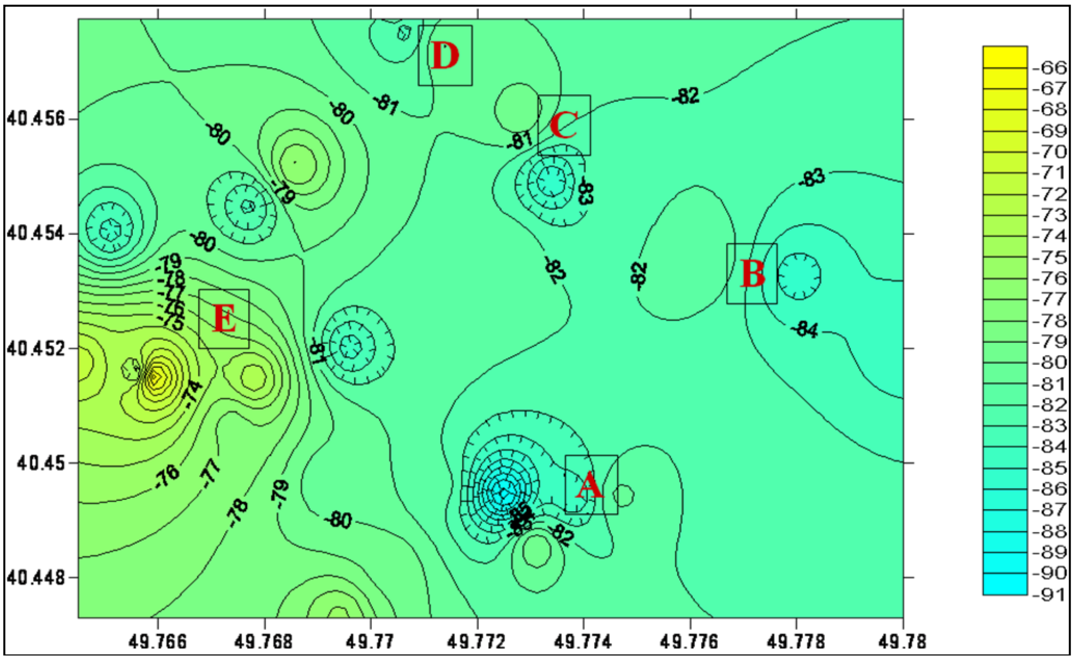

Figure 5. Stress-strain state of the geological environment in the Masazir area according to gravimetric data in 2D format (April, 2015).

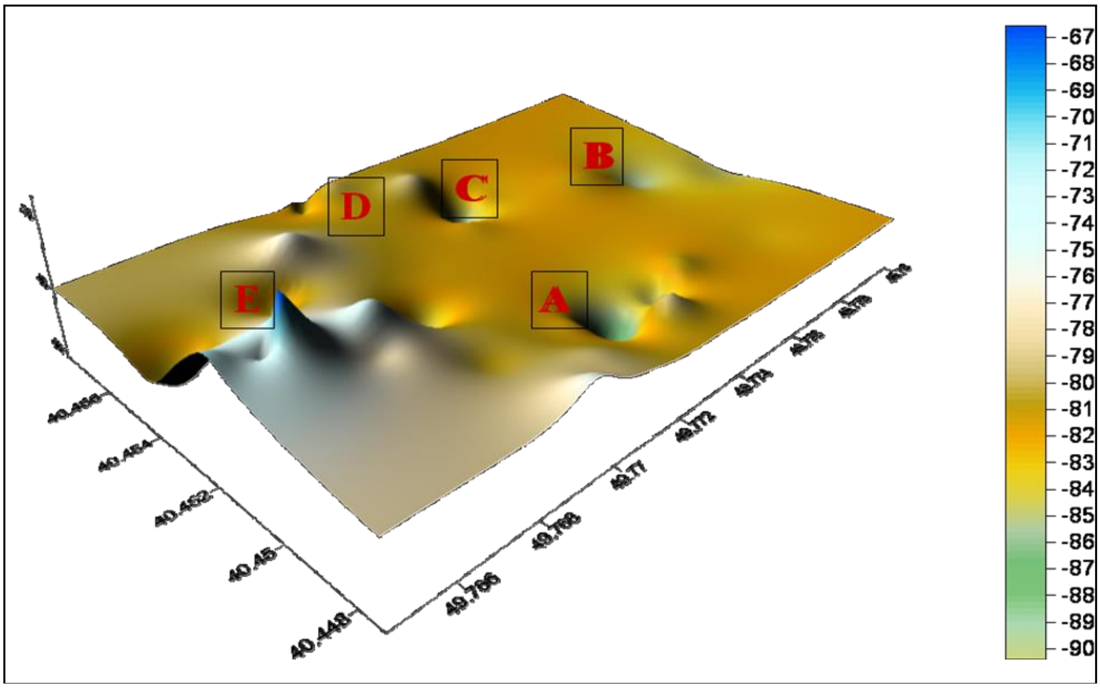

Figure 6. Stress-strain state of the geological environment in the Masazir area according to gravimetric data in 3D format (April, 2015).

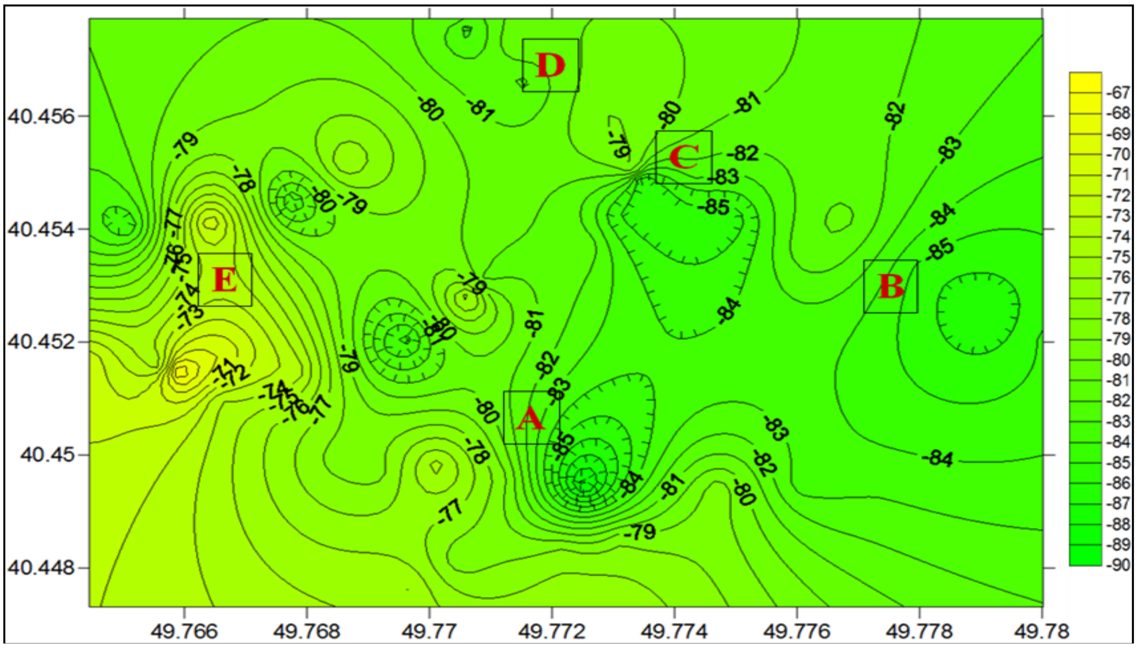

Figure 7. Stress-strain state of the geological environment in the Masazir area according to gravimetric data in 2D format (May, 2015).

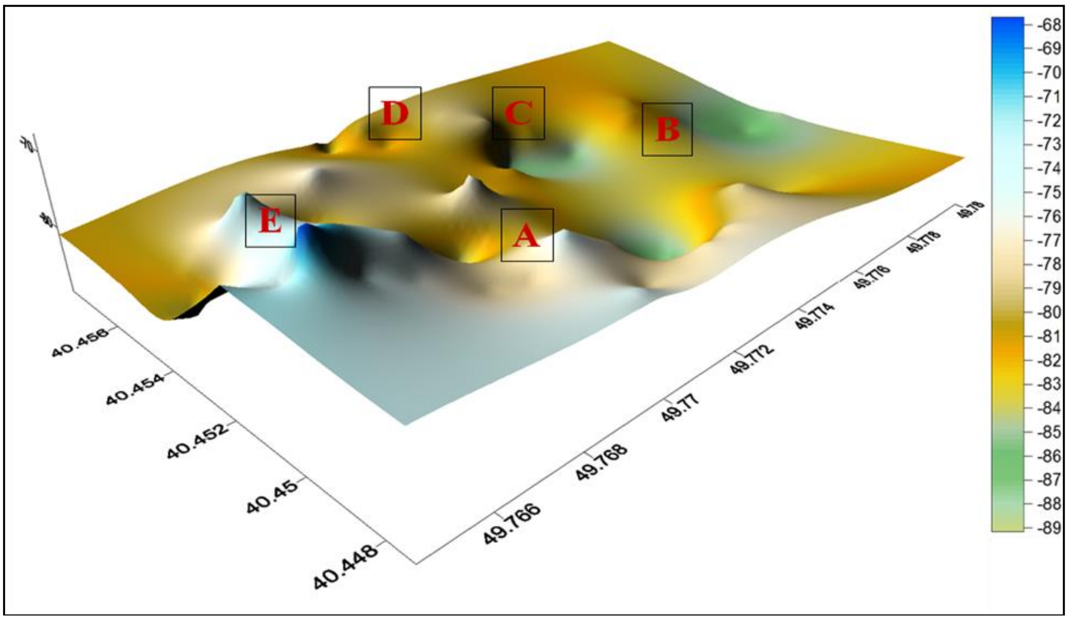

Figure 8. Stress-strain state of the geological environment in the Masazir area according to gravimetric data in 3D format (May, 2015).

Analysis of the results of gravimagnetic survey showed that the increments of the magnetic gradient ΔT~f(t) are in the range from -1606 nT to +788 nt, the gravitational field Δg~f(t) in Bouguer reduction is from -66.577 mg to - 90.404 mg. Residual fields are highly differentiated (non-uniform) in terms of increments ΔT and Δg. Sharply pronounced anomalies of the magnetic and gravitational fields are observed with both positive and negative increments of the field gradient. At the same time, magnetic and gravitational anomalies correlate with each other both in terms of the area of their manifestation and in terms of the sign of the field increment.

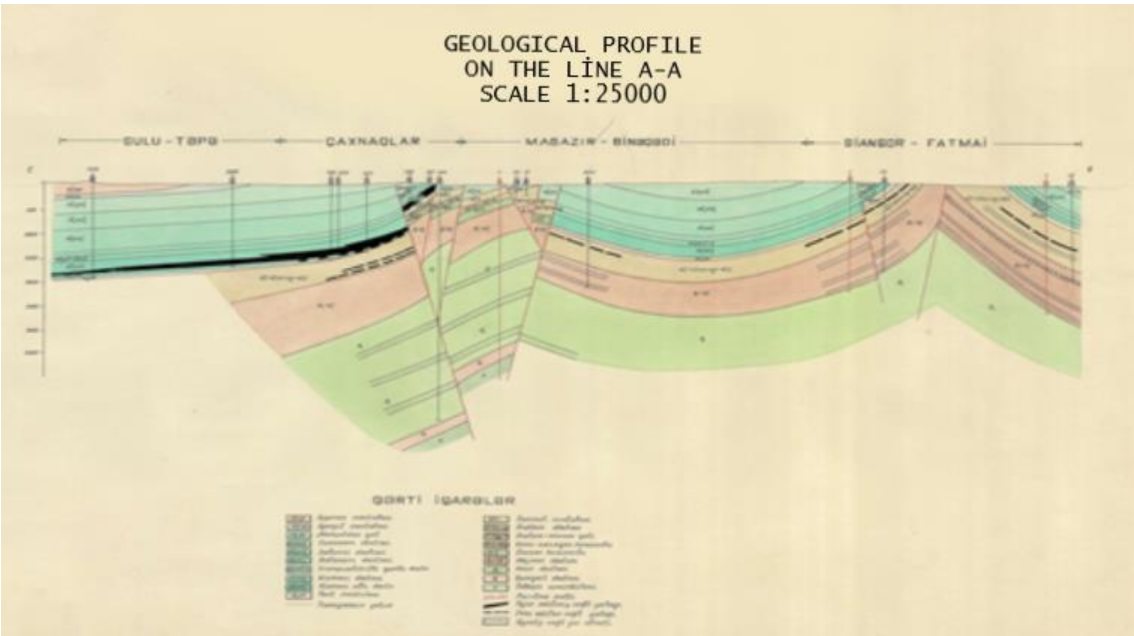

Figure 9. Geological section on the area of Masazir settlement.

It can be concluded that in the surface layers on the area of the village Masazir, there is a gravitational redistribution of perturbing masses of rocks under the action of compression (compaction) and tension (decompression) forces. The depth of penetration of disturbing masses is in the range of 70÷300 m, as indicated by the method of recalculating the gravitational field into the upper half-space.

This is a consequence of the accumulation of excess elastic energy under the action of geodynamic shifts, the direction of which, according to GPS observations, is north-northeast. It should be noted that the repeated gravimagnetic survey in May 2015 revealed the activation of the processes of decompression (stretching) of the environment in sector A, B, C, as well as the activation of compression processes in sector E, which is expressed in the formation of new (relative to the April survey) positive and negative anomalies geophysical fields (Fig. 5.7).

Remind that before the start of our research, an explosion of natural gas was noted in sector E in April 2015. At present, the tension of the environment is growing here. Compaction of rocks in sector E goes along profile I-I and is directed to the north-north-east (Fig. 7).

The results of gravimagnetic studies show that the high stress state of the geological environment in potentially dangerous sectors A, B, C, D and E can lead to a discontinuity of the environment and the release of gas and fluids to the surface. The radius of a single potentially dangerous gradient zone is about 80 m (about 0.02 km^2). It is here that there is a sharp change in areas of compression and tension, which is the reason for the high tension of the near-surface layers of the earth's crust.

The stress state of the geological environment in the area of the village Masazir can be explained by the modern activation of geodynamic processes along transverse rupture shear dislocations in the wedging zone of Maikop clays (Fig. 9).

Conclusions

1. The redistribution of rock masses in the surface layers of the earth's crust continues in the area of the village Masazir, as evidenced by the formation of local areas of tension in the environment under the action of geodynamic forces of compression and tension.
2. Stressed areas are zones A, B, C, D and E. The most dangerous area is zone E, where shear compression of the geological environment can be traced along profile I-I. The direction of the shift and the formation of the compression zone is north-northeast.

REFERENCES

1. Рзаев А.Г. и др., 2006 Связь аномальных изменений в напряженности геомагнитности геомагнитного поля с сейсмотектоническими процессами в литосфере Земли AMEA Xəbərlər Yer Elmləri.
2. Рзаев А.Г., Етирмишли Г.Д., Казымова С.Э. 2013. Отражение геодинамического режима в вариациях напряженности геомагнитного поля. Xəbərlər. Yer Elmləri, N4, s. 3-15.№3, с.58-63.