ASSESSMENT OF GEOLOGICAL RISKS IN THE TERRITORY OF ALIJANCHAY RESERVOIR

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INTRODUCTION

The research area is located in the Alijanchay river valley in the administrative territory of Oghuz region (Figure1).

The purpose of the work: Determination of geologically probable dangerous areas on the basis of complex geophysical studies in the territory of Alijanchay reservoir.

Alijanchay River takes its source from the mountainous part of Oghuz region and joins Kura River near Yevlakh city. The absolute height around the study area is 400 m (Figures 1, 2).

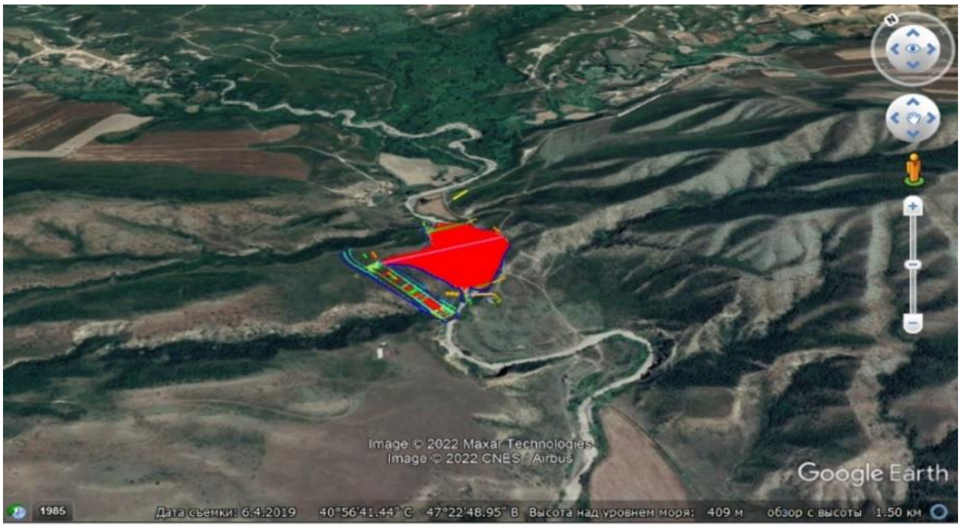

Figure 1. Area of the reservoir to be built on Alijanchay river, Oghuz region (marked red). On the right and left banks of the river slopes is 26-27^0 and 5-6^0, respectively.

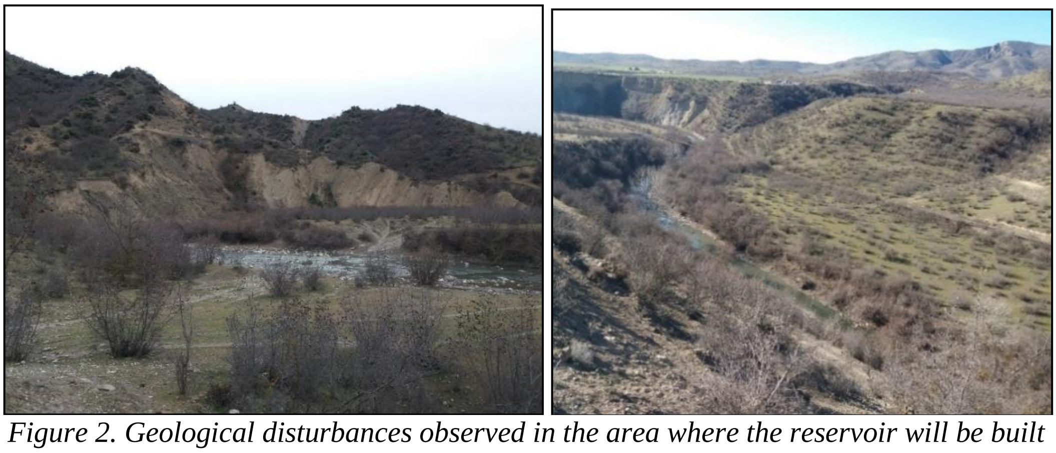

Figure 2. Geological disturbances observed in the area where the reservoir will be built

The area where the reservoir will be built is tectonically located on the southern slope of the Greater Caucasus, within the Alazan-Ayrichay synclinorium, which is characterized by a complex geological structure. The structure belongs to the northern tectonic element of the Kura megasynclinorium. The Alazan-Ayrichay synclinorium is filled with thick Quaternary alluvial-proluvial sediments. The northern boundaries of the synclinorium are composed of a mixture of Quaternary and Mesozoic deposits. Landslides, collapse, and collapse is not excluded in the area where the reservoir will be built (photo 3).

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The sedimentary complexes of the Lower Agjaghil, Agjaghil, Absheron, Upper Absheron and Baku-Caspian layers are included in the stratigraphic section of the research area. The total thickness of this layer reaches 1000 m.

Quaternary sediments are widespread in the foothills, they are continental facies, and lie everywhere transgressively over sediments of Absheron age.

The lithological composition of the sediments consists of sand, sandstone, gravel, clay and silt. Its total thickness is 200-300 m.

Figure 3. Local landslide and fall areas observed in the reservoir area.

Engineering-seismic exploration works

In order to study the inclination, direction and depth of probable landslide planes in the area, surface engineer seismic exploration works have been carried out. During the seismic exploration works of the surface engineering, the method of seismic exploration "Tested Microtremor" (Tested Microseisms) was used (Lowi, 2001).

This method is considered a time-efficient seismic method for constructing the share wave velocity profile in the study area. “The phase data of the recorded wave fields are used in the "Tested Microtremor" (Tested Microseisms) method.

The GEODE-24 engineer seismic station, 24 seismic receivers, a 115-meter-long seismic survey wire and an 11 kg impact hammer were used to study the tested microseisms.

Microvibrations created by the impact method are perceived as seismic waves.

The method of data acquisition and collection consists of obtaining 12 microvibration recordings in 30 seconds.

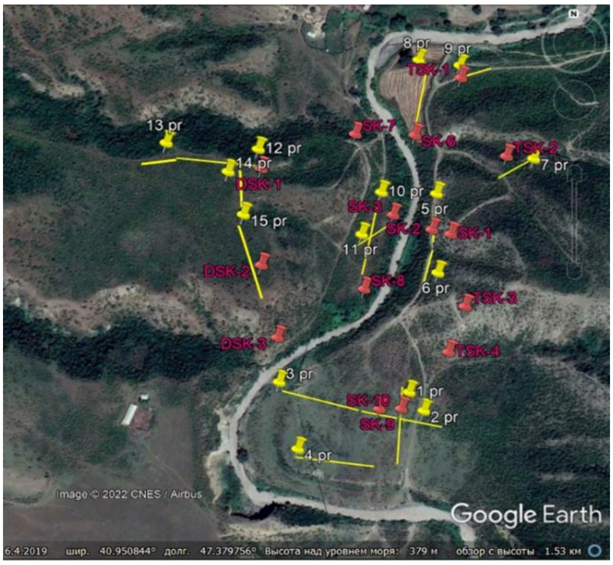


Figure 4. Location scheme of 15 seismic profiles in the research area.

Symbols:

SK, DSK, TSK – red signs - exploration holes, yellow signs - seismic profiles;

The results of the seismic profiles constructed in the research area (15 in number) were connected to geological exploration holes drilled in the area (two seismic sections are given as an example in the article, Fig. 5-6).

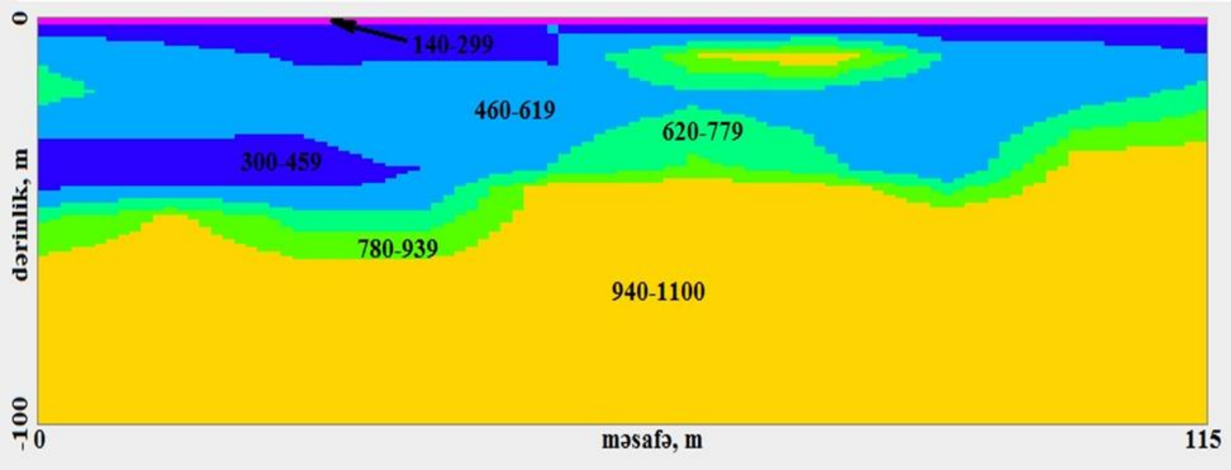


Figure 5. 2-Dimensional velocity cross section of transverse waves on seismic profile No. 1 (in m/s).

Seismic profile No. 1 was connected to hole SK-10 and the average transverse wave speed parameter was calculated in the field up to a depth of 30 m. The average transverse wave speed parameter is calculated by the following formula:

$$V_{s30} = \frac{30}{\sum_{i=1,N} \frac{h_i}{V_i}}$$

here h_i and V_i are layer thicknesses and transverse wave velocities down to a depth of -30 m. Based on the calculation, we get: Vs30= 440 m/s.

As can be seen from the profile, at a depth of 36-42 m, a weakly cemented clay-rich gravel bed is located. The transverse wave spread speed in this layer is 300-459 m/s.

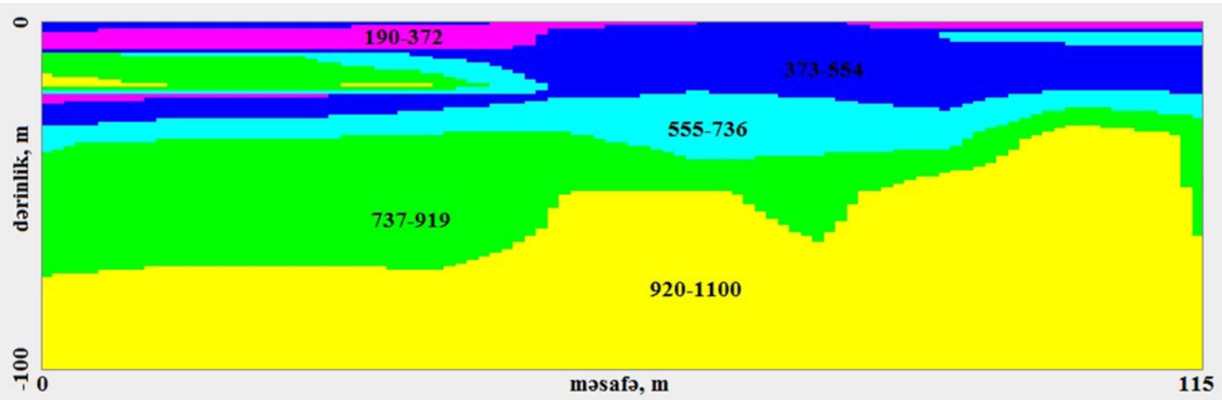


Figure 6. 2-dimensional velocity cross section of transverse waves on seismic profile No. 2 (in m/s).

Profile No. 2 was connected to the SK-10 hole and the average speed parameter of the transverse wave was calculated up to a depth of 30 m in the field. Vs30= 430 m/s

As can be seen from the profile, there is weakly moist, hard, semi-solid consistency with thin sand and sandy loams, sometimes with pebbles and gravel.

The transverse wave spread speed in this layer is 373-554 m/s. An additional lens-like layer with a speed of 310 m/s is observed inside the layer.

According to the normative document (Az DTN 3.2-1), soils on profiles are classified as class II due to their seismic properties.

On the basis of research conducted on 15 seismic profiles, 4 landslide prone and 2 collapse prone areas were identified in the region.

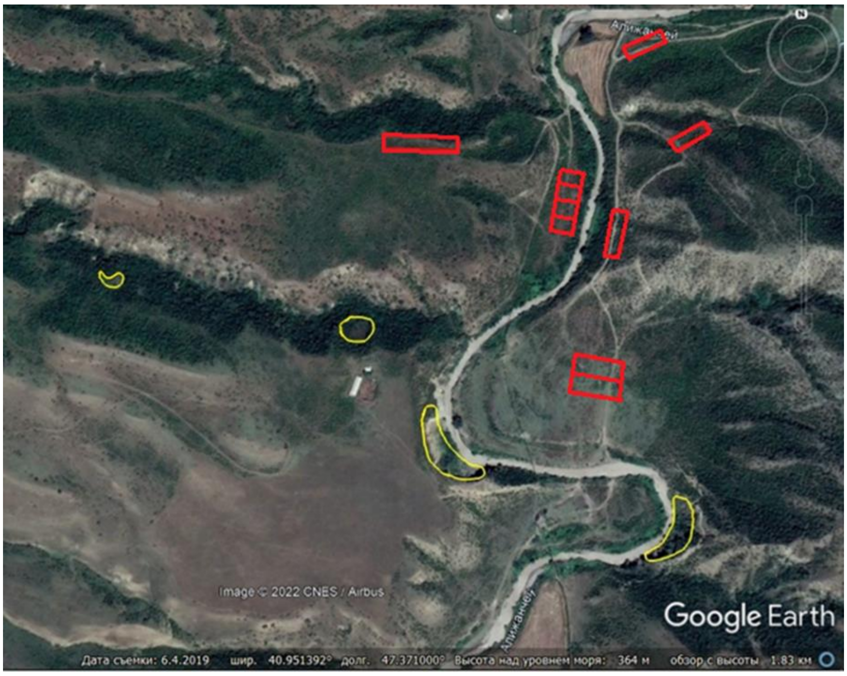
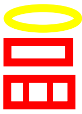


Figure 7. Probable landslide and collapse prone areas in the region

Method and results of gravimetric research studies

Symbols:



Observed collapse and landslide areas:

Lands prone to sliding

Areas prone to collapse

Gravimetric observations in the study area were performed by operators on foot with a high-precision CG-5 AutoGrav device made in Canada.

A local anomaly map and a 3D model were prepared in order to evaluate the distribution of gravity in the area and the depth dynamics by the gravimetric exploration method.

The obtained data allowed to monitor the geological-tectonic disturbances in different depth intervals in the area and to evaluate the geodynamic regime during the operation of the reservoir.

The research works were carried out by the method of repeated measurements at the observation and support points shown in the diagram (Figure 8).

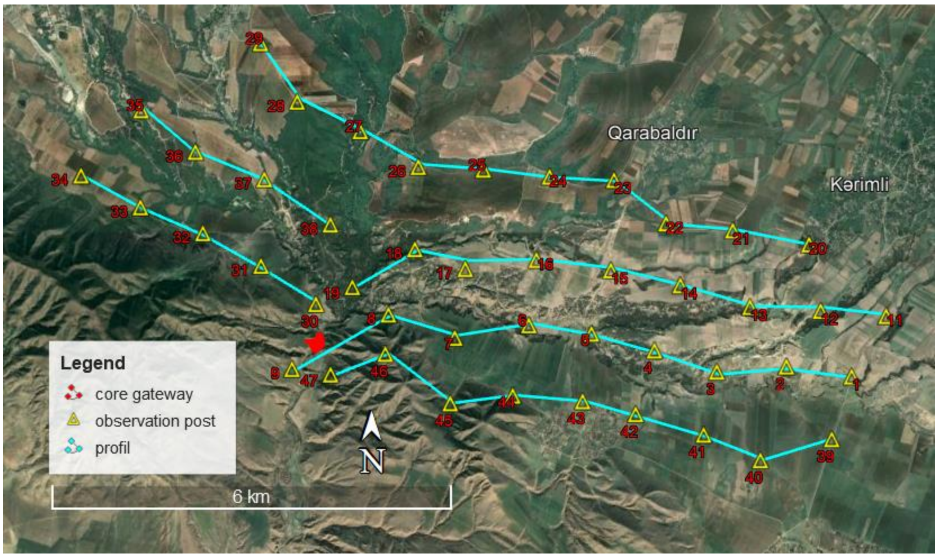


Figure 8. Location scheme of the gravimagnetometric observation points implemented in the research area.

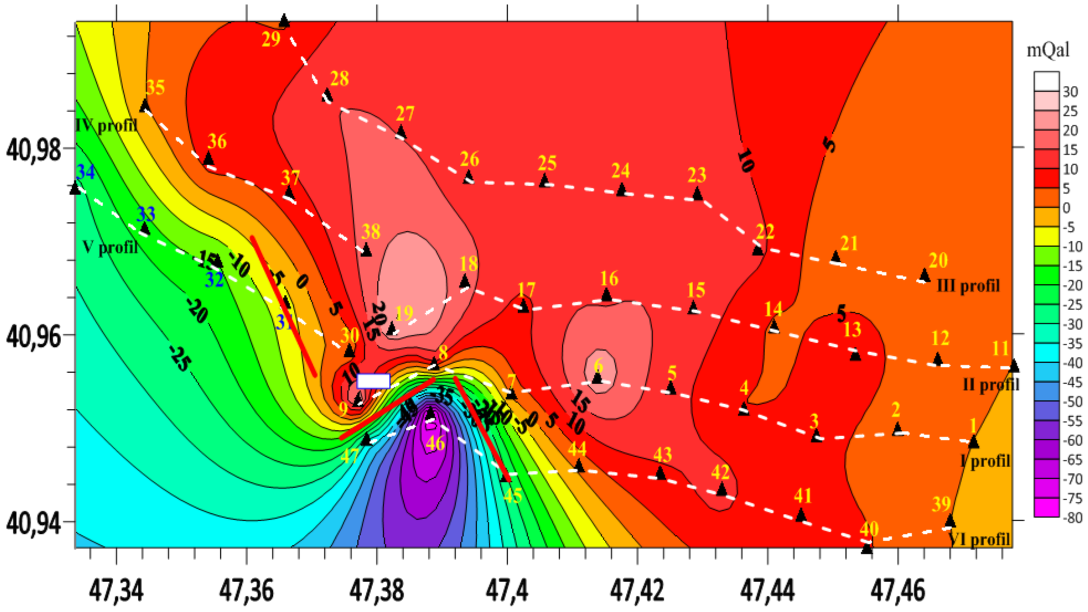


Figure 9. Gravity change map showing the stress-strain state of the study area.

Symbols: ▭ *reservoir dam.*
▲ *observation areas.* — — — *profiles.* ▬ *Fault zone*

As can be seen from the anomaly map reflecting the gravity field, there are anomalous zones marked by the variable value of the gravity force in the area. In the study area, gravity varies from 1.0 to 15 mGal with a monotonous increase from north to south. Another complex minimum-type anomaly in the gravity field is noted in the southwest wing of the map. In the anomaly, the voltage decreases from -5 mGal to -50 mGal.

The observation of minimum-type anomalies in the field suggests that there is a geological disturbance in a small area. A sharp change in the gradient around the mentioned minimum suggests that landslides, avalanches and subsidence will occur in these areas in the future.

Such a sharp opposite polarity of gravity anomalies in the area indicates the complex geological structure of the area. Based on the data of the gravity field, the results of the mentioned interpretation can be more accurately observed in the model built in 3D format, which reflects the stress-deformation state of the geological environment (Fig. 10).

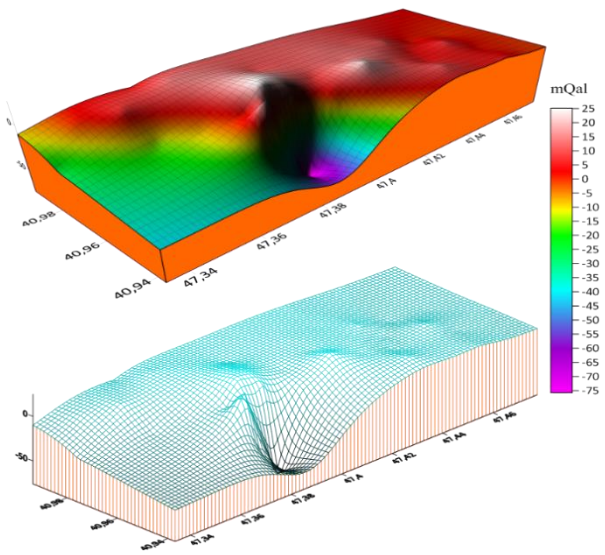


Figure 10. A 3D model representing the stress-strain state of the study area.

Method and results of magnetometric research studies

In order to assess the state of stress and deformation of the area where the reservoir will be built, magnetometric studies were carried out simultaneously with gravimetric studies.

In order to study the deep geological-tectonic structure of the area where the reservoir will be built, the magnetometric exploration method is of great importance in the complex conducted by engineering-seismic, geophysical and geodetic methods. With this method, maps reflecting the depth dynamics of the area and characterizing the change in geodynamic stress were drawn up.

The data obtained by the mentioned method allowed to monitor the tectonic disturbances (cracks) in different depth intervals in the area and to evaluate the geodynamic regime of the area.

Observations in the area were carried out by operators on foot, in 6 profiles with an American-made G-856 proton-type, high-precision, modern magnetometer.

Taking into account the topography of the area, a network of observation points was created and 2D map and 3D model reflecting the stress and deformation state of the magnetic field were constructed (Figures 11-12).

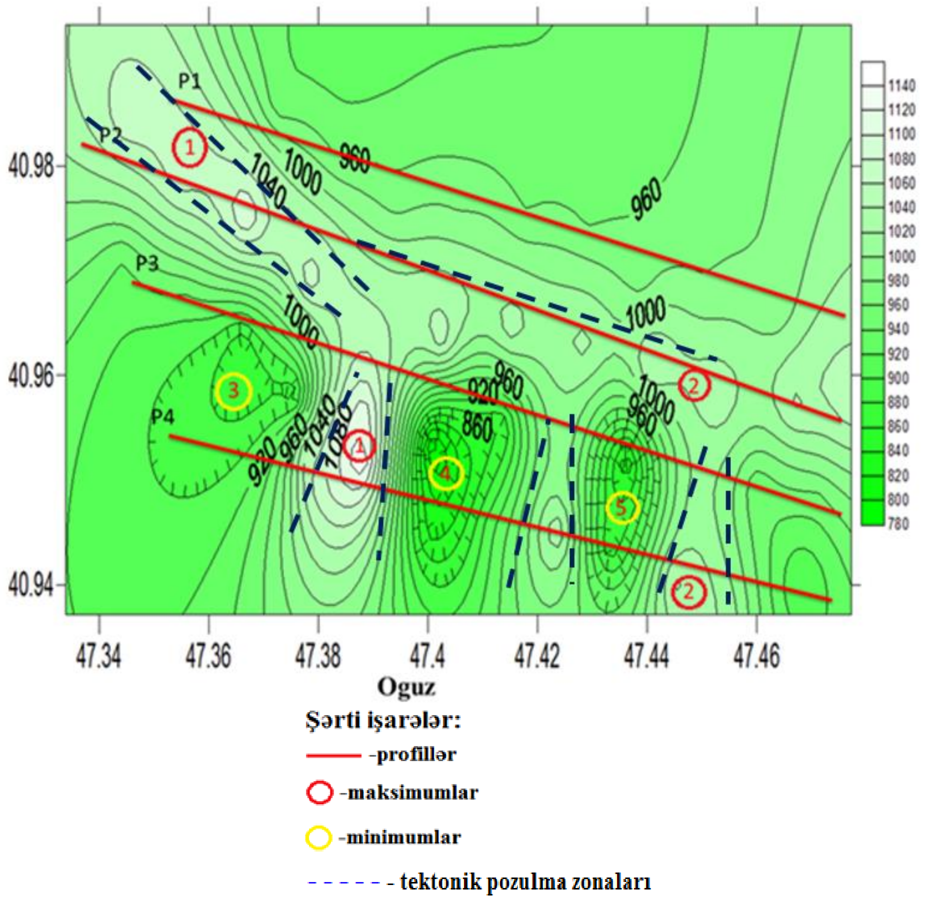


Figure 11. 2D Schematic map of the stress-strain state of the study area.

In the south of the map; Magnetic minima No. 3, 4 and 5 are observed. The minimums are arranged from the northwest to the southeast and are closed in a south-north direction. The intensity of these mentioned minimums continues with increases towards the edges, being 800 nT in the center.

In the center of maximum type geomagnetic anomaly No. 1, which is observed in the southwest of the map, the intensity is 1100 nT, and it is observed in a bent and stretched form up to the northwest wing of the research area.

While the northwestern part of this maximum is almost calm, it is observed in a complicated form in the south. It indicates complications in the geological structure of the southern wing of maximum No. 1 observed between two minimum anomalous areas in a small area. Such gradient changes in the magnetic field indicate that the geodynamic conditions of the area are complicated by tectonic disturbances.

The magnetic maximum No. 2 marked in the southeastern wing of the map has a differentiated form and is of a calm nature (Figure 11).

As can be seen from the 3D model, the tension of the geomagnetic field continued to decrease from the northwest to the southeast, and the maximum and minimum magnetic anomalies were sequentially arranged (Figure 12).

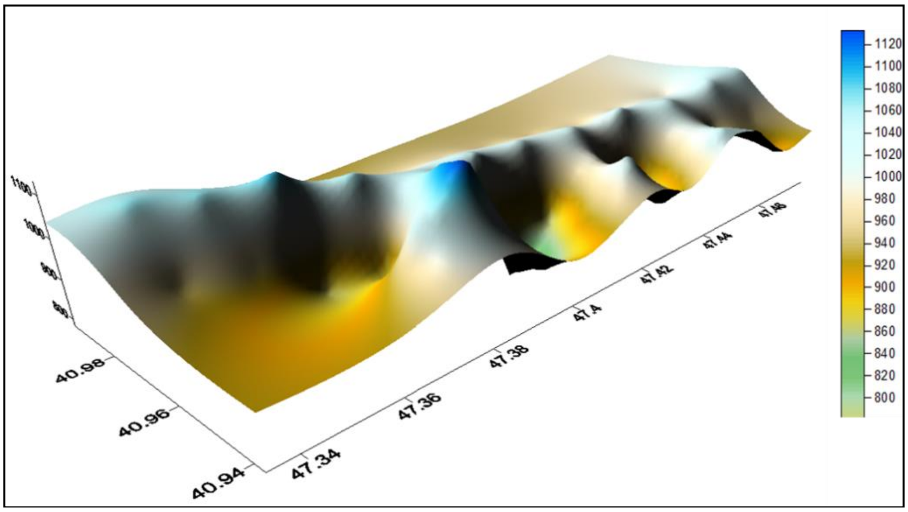


Figure 12. 3D model of the stress deformation state according to the magnetometric data taken in the area.

RESULTS

1. On the basis of the researches, 3 tectonic fault zones with probable risk are separated and the active dynamics of the mass characterizing the anomalous areas are indicated
2. 4 landslide-prone and 2 landslide-risk local areas have been identified in the area.

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