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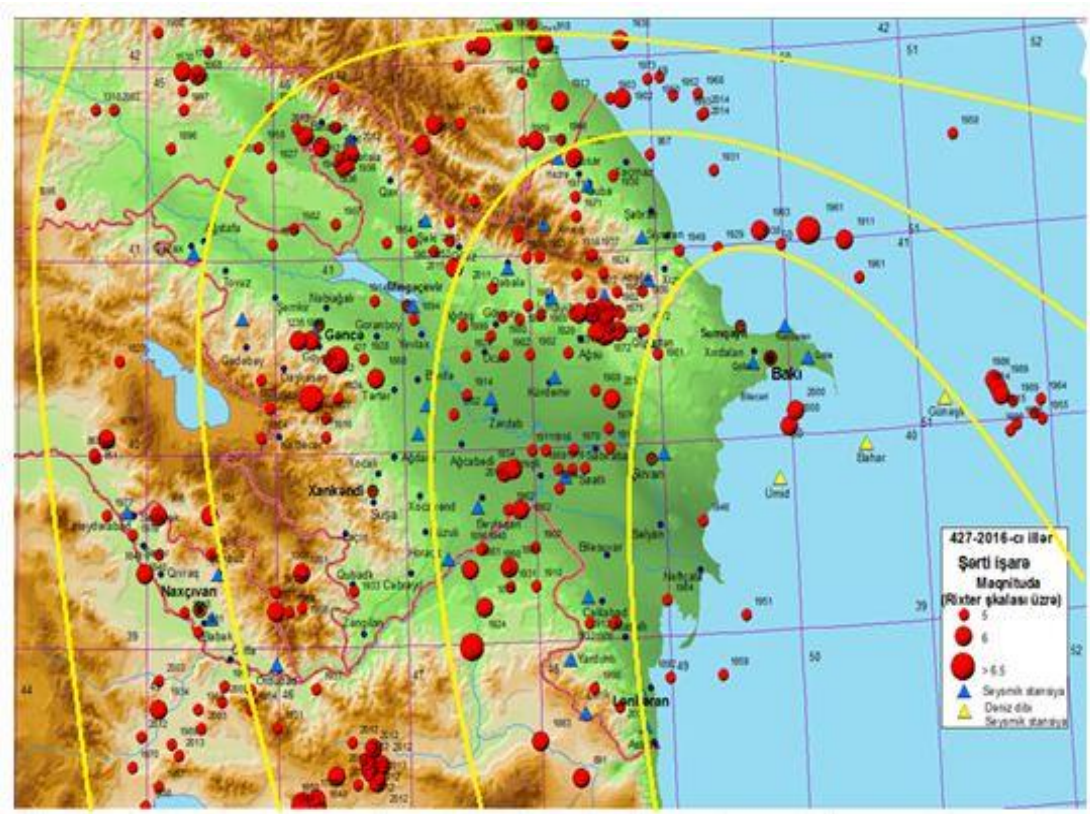
SEISMOPROGNOSIS OBSERVATIONS IN THE TERRITORY OF AZERBAIJAN



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Republican Seismic Survey Center of
Azerbaijan National Academy of Sciences

SEISMOPROGNOSIS OBSERVATIONS IN THE TERRITORY OF AZERBAIJAN

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.3-13

MANIFESTATION FEATURES OF LANDSLIDE PROCESS AROUND THE MINGACHEVIR RESERVOIR (2014)

G.J. Yetirmishli[1] , T.Y. Mammadli[1], A.G. Rzayev[1], R.B. Muradov[1], S.E. Kazimova[1], E.S. Garaveliyev[1], S.S. Ismayilova[1], I.E. Kazimov[1], Baghirov E.M[1]

ABSTRACT. The landslide incident was recorded around the Mingachevir water basin on August 27, 2014. The landslide process occurred in the Boz mountain range mainly on its north-east slopes. The boundary of the slip plane and the active area directed South West - North East of Boz mountain slopes exposed to landslide were determined in this zone. Studies have shown that the depth of the slip plane is different in the separate fields of this area and it changes between 6 to 88 meters.

Introduction

Widespread of the mobility (movement) of soil masses on the sides of the Mingachevir reservoir is related to the loss of equilibrium as a result of variability of the physical and mechanical features of rocks and abrasive activities of reservoir waters. The land mass is divided into three groups when considering the causes of the stability disturbance of them: external influences increased of the loading activities and the decrease of the resistance forces of land against displacement. The external impact that causes the occurrence of landslide around Mingachevir reservoir is the abrasive activity that destroys the natural support of the soil masses located in the slopes of the reservoir water. Talking about the increased performance of the loading, it should be noted that, the reason of possible displacements may also be the increase of soil mass as a result of the absorption of atmospheric water. Resistance to displacement and reduction of pulling forces are conditioned by changes of resistance forces and attachment to friction. The intensive process of rocks erosion (the collapse of rocks by wind) of Mingachevir reservoir slopes sharply reduced the volume of displacement characteristics and it creates favorable conditions for occurrence of landslide. The reasons listed above that creation of soil masses displacement from the slopes of the reservoir and the complex of physical-mechanical features of different genetic type allow to study the condition of transition to unstable situation of soil masses rocks that formation of reservoir sides and occurrence the landslides.

The landslide incident was recorded around the Mingachevir reservoir on August 27, 2014. The seismological, engineer-seismology, gravimetric, magnetometric, geodynamic studies were conducted with the aim of detailed research of sliding processes.

Mingachevir reservoir and adjacent areas like other regions of Azerbaijan are characterized by seismic activity. Even though the strong earthquakes were recorded a little far from the water basin but directly medium strong seismic shocks had occurred in the area of reservoir [New Catalog 1977; Catalog 1980-2014]. (Fig.1).

Seismic activity in this area is related to tectonic faults formatting the tectonics of the areas.

The Mingachevir reservoir is located on the western edge of the Middle Kura Depression. From the north, this zone is separated by the Ajichay-Alat depth fault from the Vandam anticlinorium that is the south structure of Greater Caucasus. From the southern part, the zone is surrounded by the Kura depth fault (Fig. 2).

From the east and west sides, the zone is surrounded to anticaucasus direction by Sharur-Zaqatala and Arpa-Samur depth faults and Ganjachay transverse fault breaking off the basin and then going through it (Shikhalibeyli, 1996).

[1] *Republican Seismic Survey Center of Azerbaijan National Academy of Sciences*

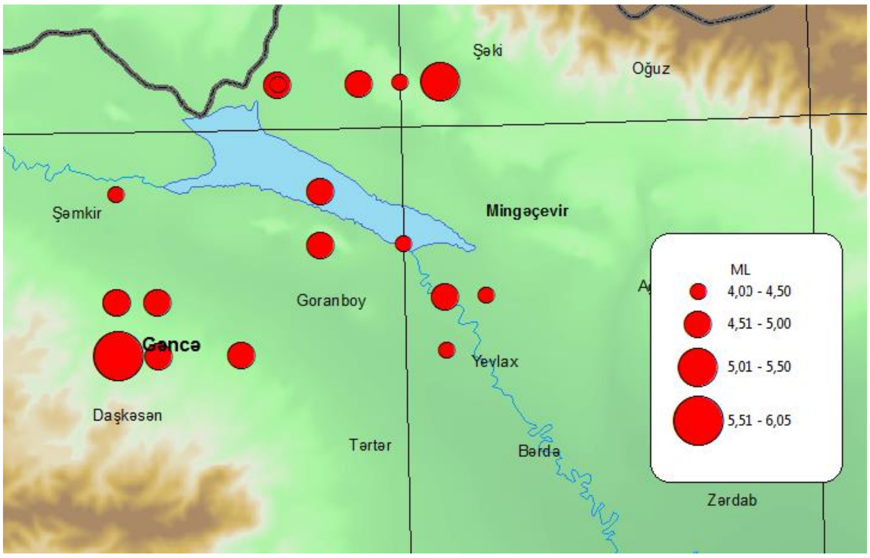

Figure 1. The maps of earthquakes epicenters with a magnitude of ≥ 4.0 tha occurred near the Mingachevir reservoir over the 1900-2018 years

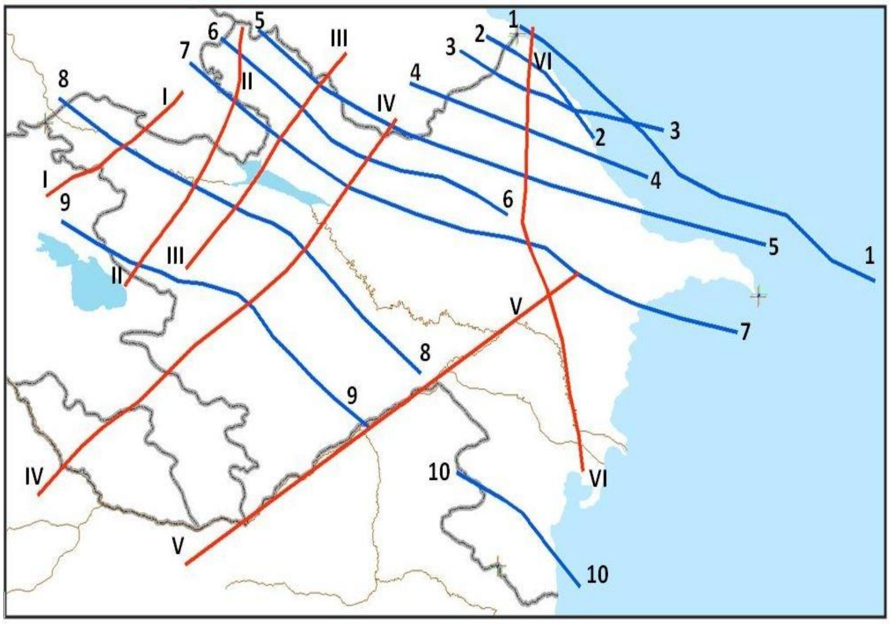

Figure 2. The map of tectonic faults of Azerbaijan area

1-1 Makhachkala – Turkmenbashi
2-2 Khudat – Gilazi
3-3 Akhtı-Nugadi-Gilazi
4-4 Siyezen
5-5 Qaynar-Zengi
6-6 Vandam
7-7 Ajıchay-Alat
8-8 Kura
9-9 Lesser Caucasus
10-10 Talish

I-I Gazakh-Siqnakh
II-II Sharur-Zagatala
III-III Ganjachay
IV-IV Arpa-Samur
V-V Palmir-Absheron
VI-VI West-Caspian

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.3-13

Seismological researches have been carried out in the sliding area due to extensive research of the sliding incident. Seismic observation data of seismic stations operating in the territory of the Azerbaijan Republic shows that 19 weak earthquakes (ml-06-2.5) around Mingachevir reservoir were recorded during the period of 03.07-10.12.2014 years (Fig.3).

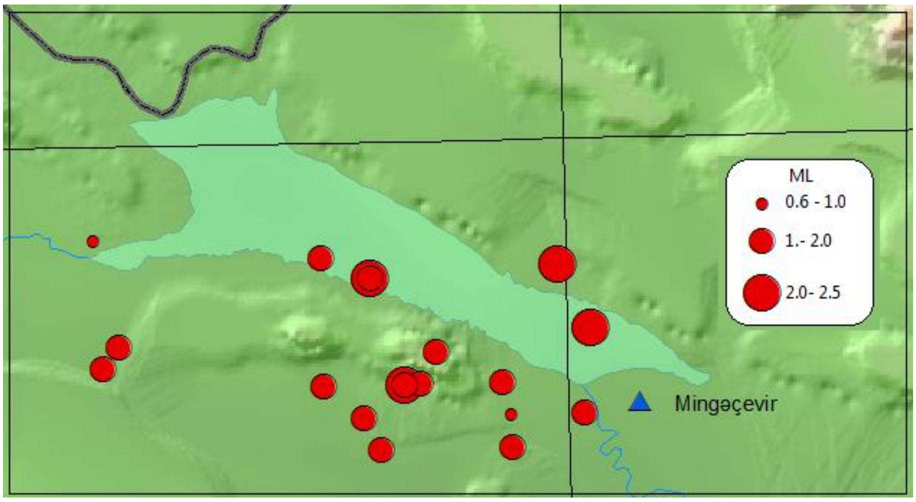

Figure 3. The epicenters of earthquakes that have been occurred around Mingachevir reservoir during the period 03.07-10.12.2014 years.

Analysis of earthquake records at Mingachevir seismic stations shows that the sliding process was started in early July. Thus, the records of landslides vibrations differ from earthquakes that had been recorded on the stations.

Additionally, 3 mobile seismic stations were installed around the area covered by the sliding process in order to follow the process more closely on August 29 (Fig.4) and the registration of numerous sliding processes that occurred in this area had been continued.

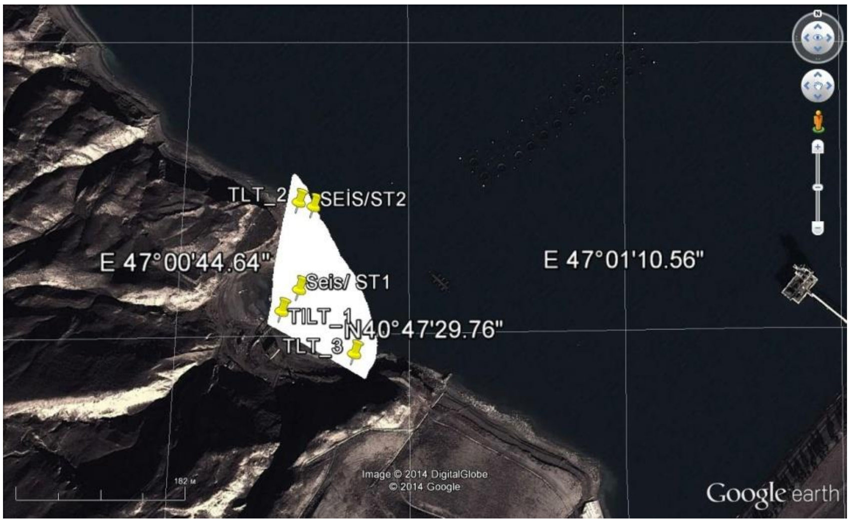

Figure 4. The location scheme of mobile seismic stations (GURALP) around the Mingachevir reservoir

Totally 80 landslides have been recorded in this area. The durability of sliding processes (vibrations) lasted 7-12 seconds. Carrying out construction works, traffic flows and etc. near the landslide area can create resonance effects here. In this regard, the analyses of the amplitude-frequency parameters of the vibration in the sliding zone (A,f) had been carried out. The registration of vibrations was recorded in different weather conditions, during the production of equipment and transportation. The analysis of vibration records shows that rocks vibrations created by natural and artificial sources (transportation, construction and etc.) in the sliding area are separated from each other by frequency spectrum (Fig.5,6)

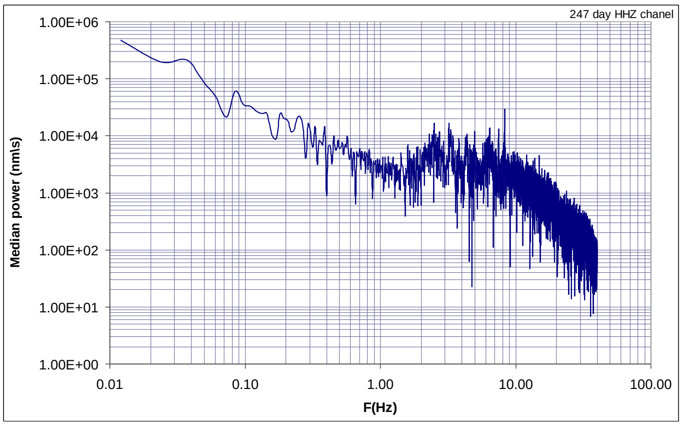

Figure 5. Vibration spectrum received on HH channel at ST1 mobile station on September 4.

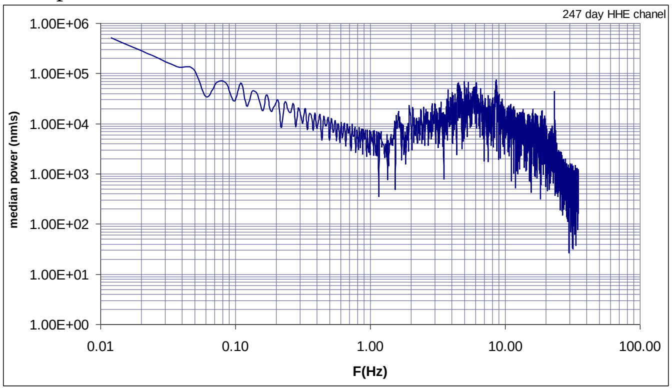

Figure 6. Vibration spectrum received on HHE channel at ST1 mobile station on September 4.

Distribution of transverse v_s waves on depth along the seismic profile 1,2,2a,3 and 4 (Fig.7) had been studied in the area. Seismic records had been collected from motorboats that going on the river, vehicles moving through nearby areas and other impacts according to each profile. Profiles are associated with a geological exploration well BN0.1-1 drilled at depth of 100 m. in the area.

The profile numbered 1 extends to north-south in the field of research (Fig.8). In this profile, there were mainly 3 wave reflective layers on depth. The first layer consists of fine-grained sand, dusty sand ground and the second layer consists of moist clay and fine-grained sand ground and the third consists of clay ground.

The profile numbered 2 extends to the north-west – south-east in the research area, mainly 3 seismic wave reflective layers were recorded by depth. The first layer consists of fine-grained sand, dusty sand ground and the second layer consists of moist clay and fine-grained sand ground and the third consists of clay ground.

Seismic section installed on other profiles that mentioned above and correlation of well data allows us to say that moist clay ground and friction plane are located at the depths of 6 to 88 meters in separate parts of research areas.

High precision gravimetric researches were conducted by three profiles with gravity force measurement method in the region where the sliding process was being in the slope of Mingachevir Boz mountain.

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.3-13

Two of the gravimetric profiles cut tectonic faults off but the third one was set parallel to them.

Variations of gravity force change from 0.81 to 7.228 mGal in the I profile and from 0.076 to 5.326 mGal in the II profile. Intensive changes are observed that in the gravity force measurements at the 2 and 3 stations I profile and 6 and 7 stations in II profiles and this reflects in itself the incompatibility of the gravity force valuation in the measurements (Fig.10)

Figure 7. The location scheme of the seismic profiles in the area

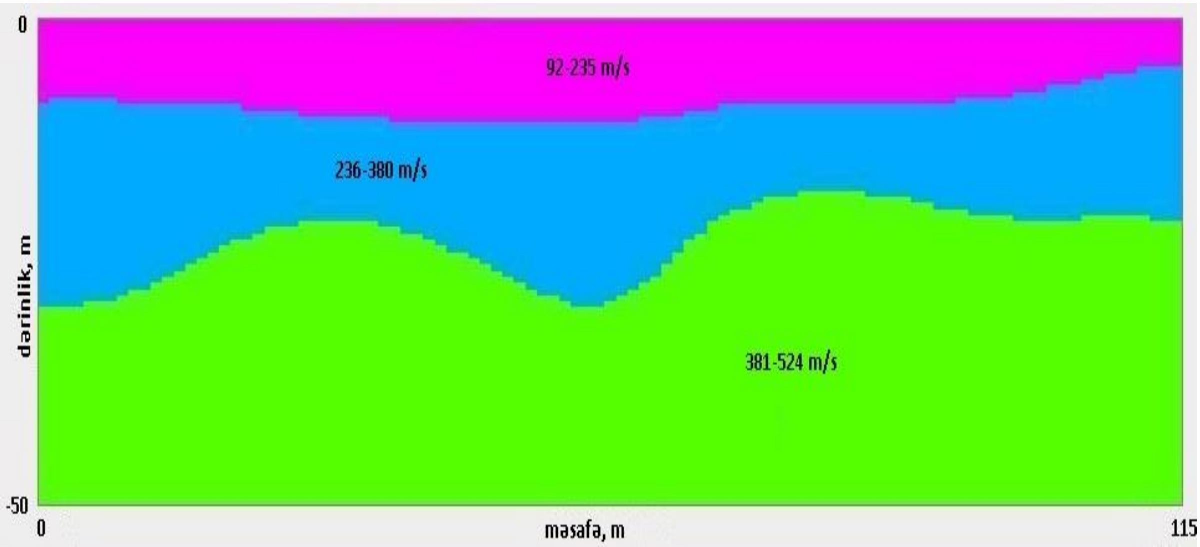

Figure 8. 2-dimensional speed model of Vs transverse wave for the seismic profile numbered 1

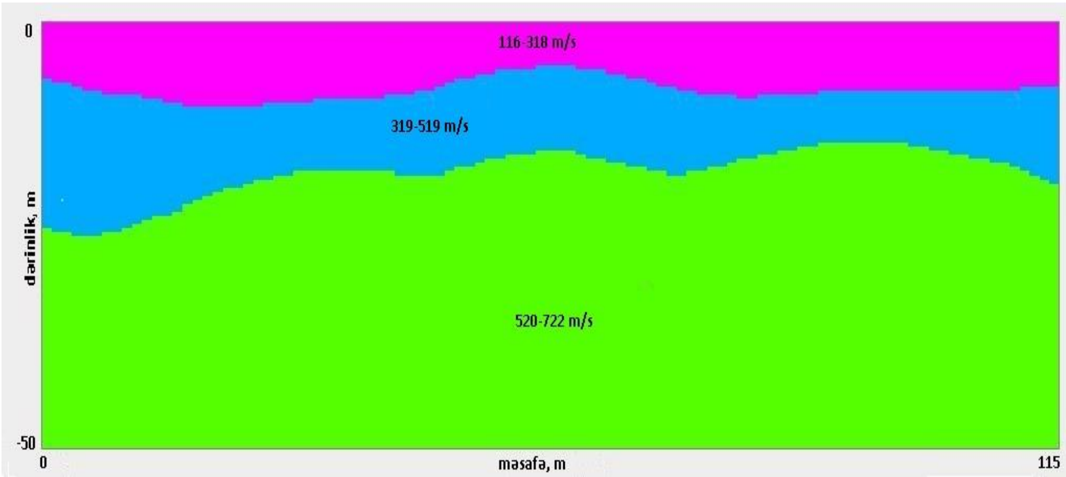

Figure 9. 2-dimensional speed model of Vs transverse wave by the seismic profile numbered 2

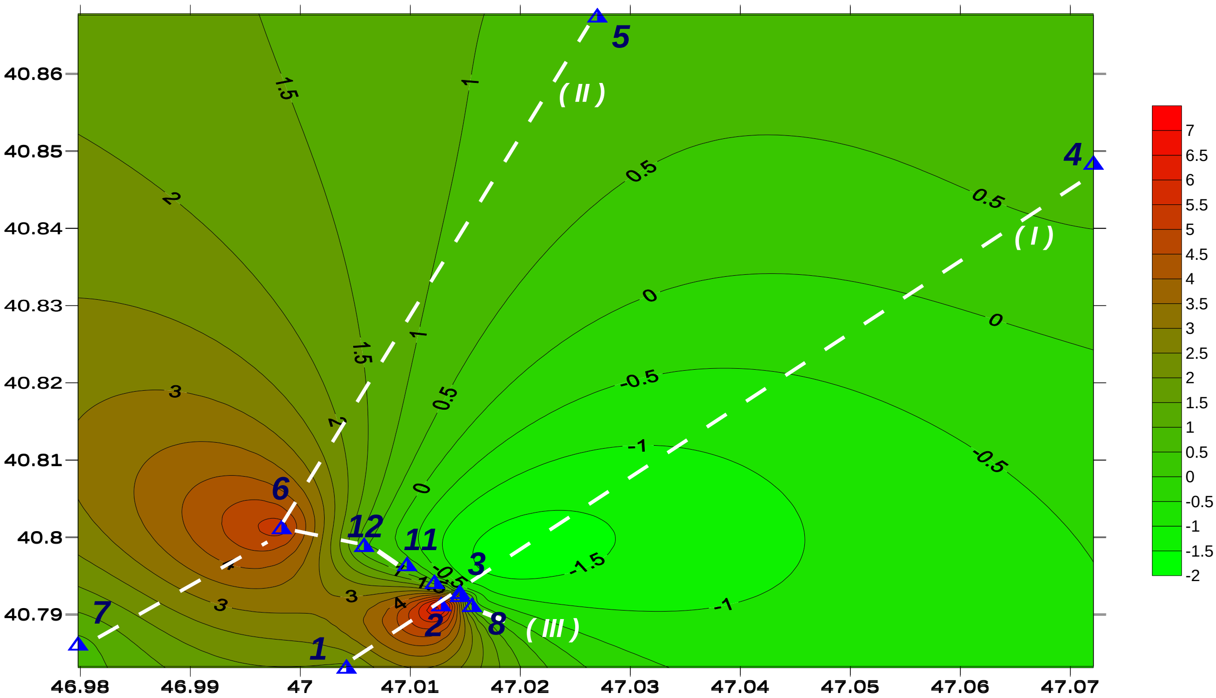

Figure10. The isoanomas map of gravity forces in 2D format

There is a sharp decline in gravity force during crossing time from 2 numbered station to 3 numbered station in I profile and this decline shows that, there is a slip plane in this area (Fig.10, 11).

The analogical situation is observed in the II profile during the crossing time from 6 numbered station to 5 numbered stations. Here, there is a sharp incompatibility of the gravity force value.

Thus, it can be assumed that the boundary of the slip plane extends from 2 numbered stations in the I profile to the 6 numbered stations II profile.

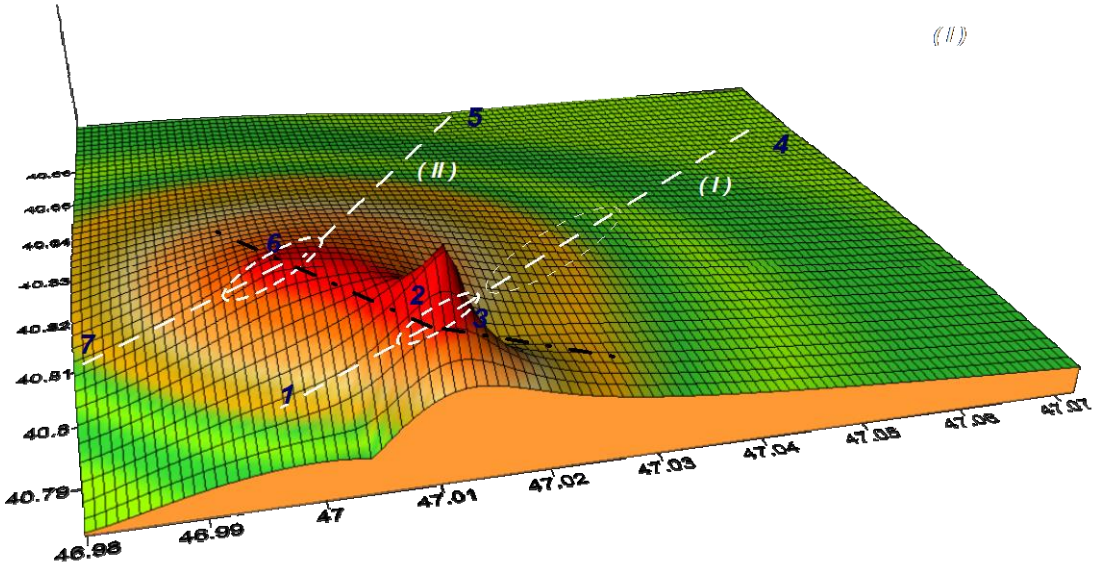

Figure11. The map of isoanomas in gravity force in 3D format

It should be noted that, gravimetric researches along I and II profiles indicate that the geodynamic movements are pointing to the occurrence of sliding process at a depth of 52 meters.

Magneto metric studies had been conducted on five profiles (P1-P1, P2-P2, P3-P3, P4-P4, P5-P5) (Fig.12) in the south – south-eastern part of Mingachevir reservoir. The initial analyses of the increase of geomagnetic tension gradient on these profiles allow allocating a zone that is in the tension-deformation situation in the south of the water basin, geological environment north of Mingachevir. This tension-deformation situation come into sight in the high rise in gradient of geomagnetic tension area complicated by the sharp decrease (minimally) of the gradient increase.

A-A line separating the opposite directions of the ΔT gradient shows that, the fracture zone where the sliding process occurs by impact the gravitational forces of the masses is formed. The geological environment along the P4-P4 and P5-P5 is very calm and here no anomalous geological-tectonic movements are observed (Fig.13,14).

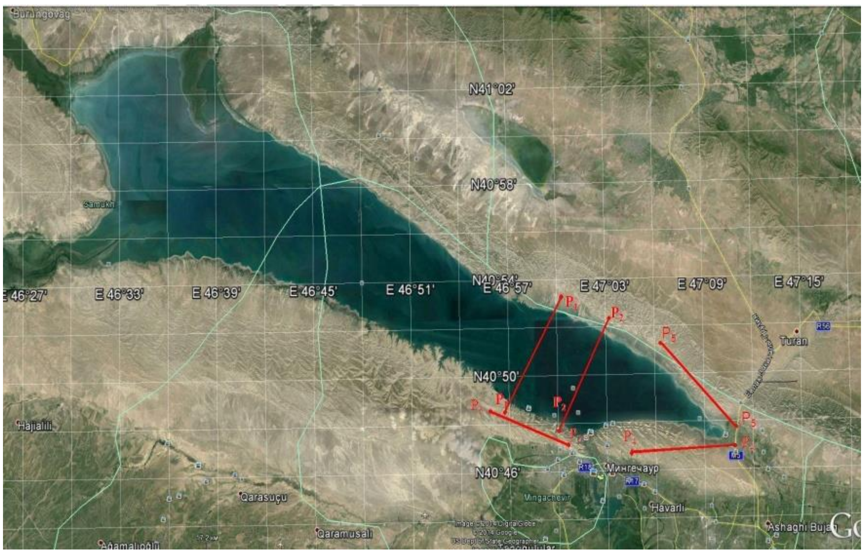

Figure 12. Magnetometric profiles in Mingachevir reservoir.

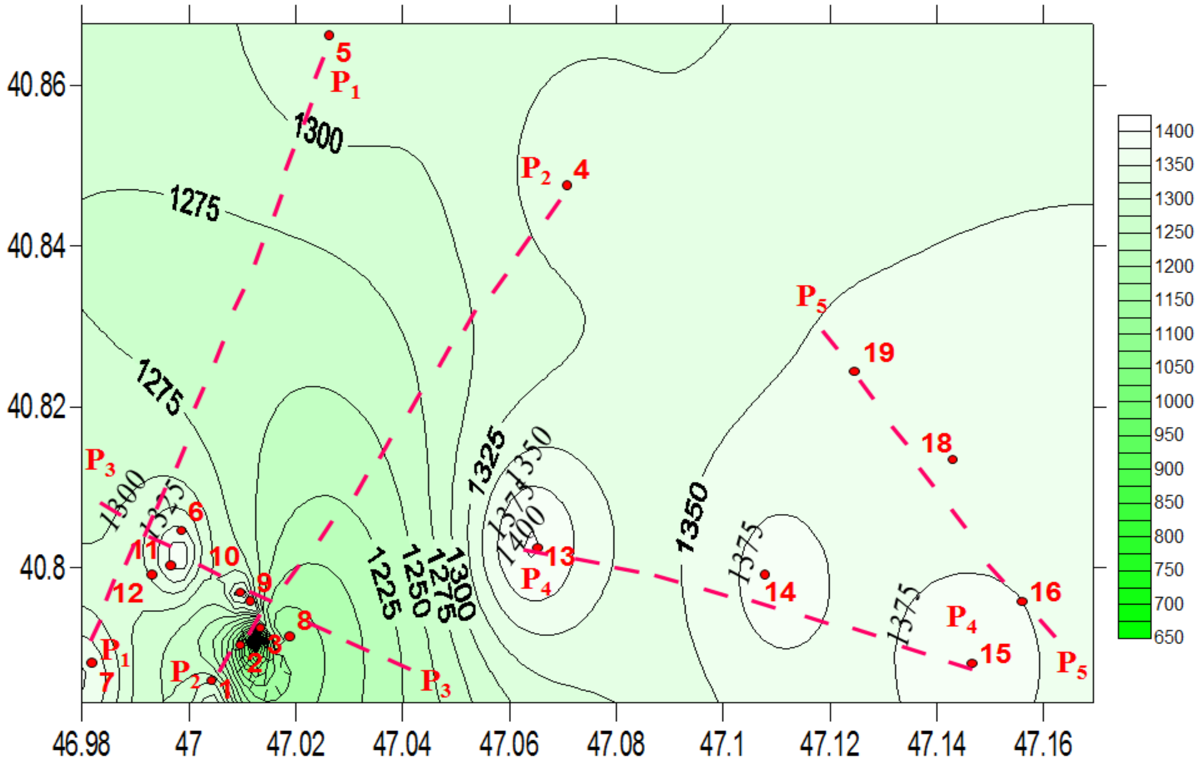

Figure 13. Map of distribution of ΔT gradient tension of geodynamic field in the 2D format in the Mingachevir reservoir.

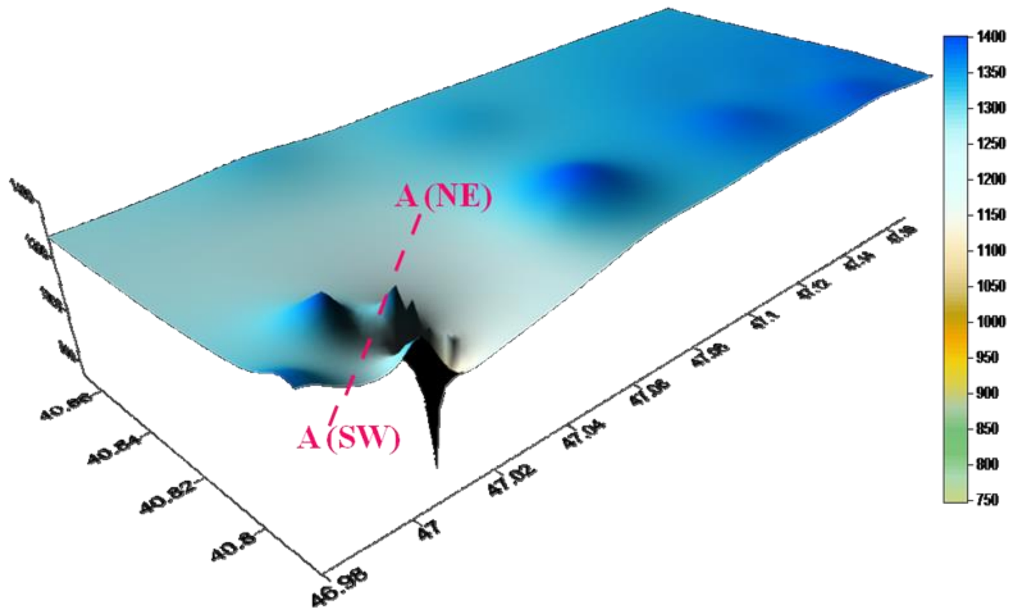

Figure 14. Map of distribution of ΔT gradient tension of geodynamic field in the 3D format in the Mingachevir reservoir (29.08.2014).

Repeating magneto metric measurements have shown that, there is a tension in the geological environment on the profile P3-P3. A-A line directed North East- South West is a zone in the environment where gravity sliding processes are likely to occur.

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.3-13

Two temporary GPS (Trimble NetR9 branded) stations had been installed in the research zone to monitor the dynamics of horizontal movements in the area (Fig.15).

Figure15. The location scheme of GPS stations

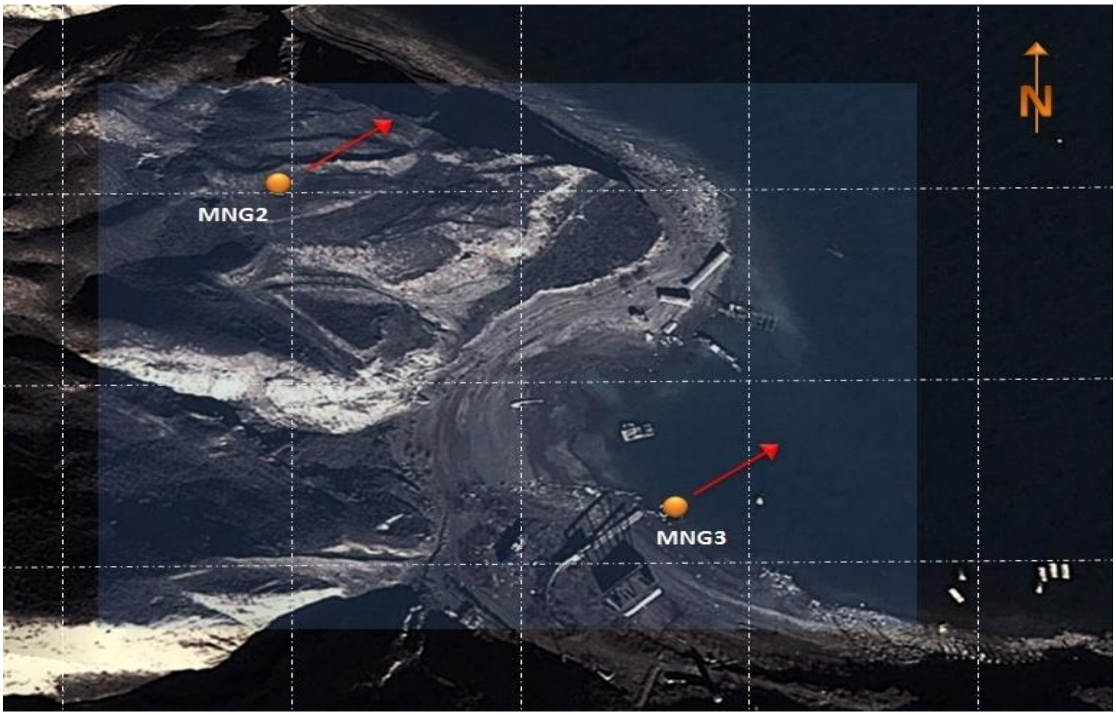

Figure16. The map of directions of horizontal displacements at GPS stations.

Analysis of initial data shows that the horizontal movements generally inclined to North East direction (Fig.16). However, in the early days, movement was recorded in the 1 mm S-SW direction but later, it was observed that the movement was gradually moving towards the North-North East direction. Throughout the recent movements, the maximum value of horizontal displacement was 3 mm.

During the next 12 days, the general tendency of sliding movement was in the direction of North-North East. The landslide in size 3-7 mm had been recorded in the South-South Western direction during the first days of the observation and then up to 5 mm in the direction of North-North East.

The data analysis obtained during research period at another station indicated that the sliding movements directed to the North-North East direction. In early days, even if the sliding that directed South-South West in size 1,0-1,5 mm had been observed, later movements directed to North-North East in size 2 mm had been recorded.

Analysis of data received from stations over the next 3 months showed that there were intermittent displacements in the direction of North East- South West (Fig.17). Up until the end of the observation, the movements directed South East were dominated. During the observations in October horizontal displacement was recorded in size 1,0-1,5 mm directed to North East- South West. In subsequent days, the values of horizontal displacement gradually decreased to 0.9-1.2 mm and the direction inclined to North-North-East direction. In December, the displacement dimensions were in size 0.5 mm.

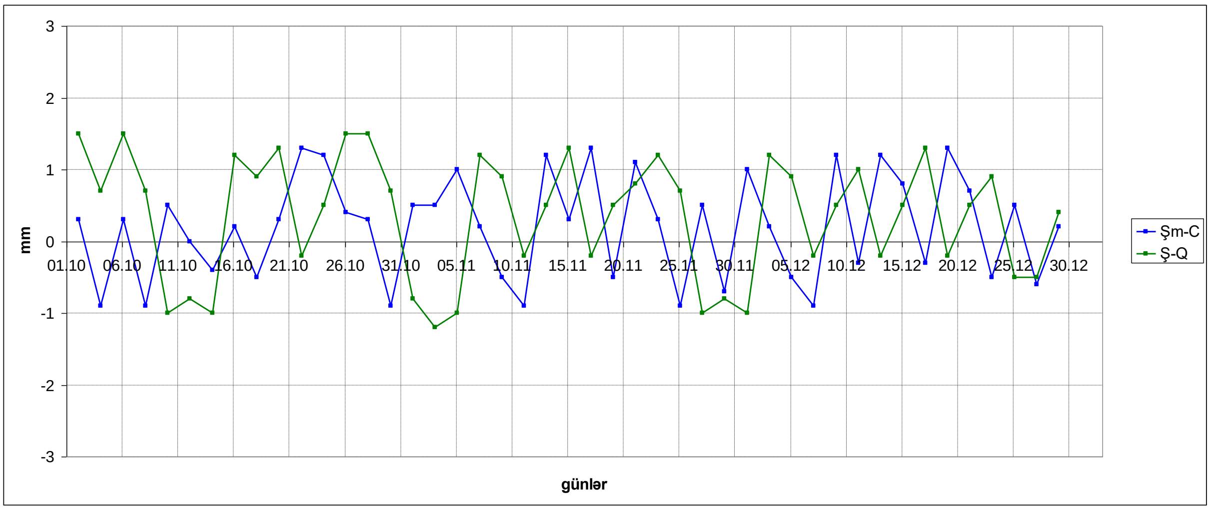

Figure17. The values of horizontal displacements directed to North South and East West received on 01.10-26.12.2014 at GPS station.

In order to investigate the deformation processes in the research area '701D' branded slope-measuring devices (tilt meters) were placed in three areas. These tilt meters were installed in triangular form to avoid the occurrence of random deformation cases. Two of them were installed in the sliding zone and the third one (POINT) was installed out of the zone.

The received initial data indicates that the vertical movements of amplitude in size 1-2 mm were in this area.

Conclusion

The following results have been obtained on the basis of seismological, engineer-seismological, and geophysical (gravimetric, magnetometric) and geodynamic (GPS and Tilt meter) researches:

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.3-13

- The analysis of the vibration records at Mingachevir seismic stations (frequency spectrum) caused by sliding processes shows that the sliding process has begun in early July.
- The studies show that the depth of landslide flatness was different in separate areas of research field and it ranged between 6 to 88 meters.
- Horizontal movements in the sloping zone during the first days were directed to the North East but gradually moved to the North –North East direction then the general tendency of sliding movements has changed in the direction of North-North East. In the area, intermittent displacements have been recorded in the direction of North East- South West.
- Vertical movements in size of 1-2 mm amplitude were observed in the sliding area. The southern side at the foot of the hill has been exposed to collapse. As a result of vertical movements, in the area, the surface bending had occurred.

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Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.14-18

KINEMATIC PARAMETERS ACCORDING TO PALEOMAGNETIC DATA OF BLOCKS MOTION IN NAKHCHIVAN AUTONOMOUS REPUBLIC

A.A.Bagirova[1], A.G.Rzayev[2]

ABSTRACT. The article presents the results of studies of the Jurassic and Cretaceous sediments of sections of the Nakhchivan Autonomous Republic, the aim of solving the problem of horizontal movements of the Earth's crust. The paleomagnetic studies were carried out in four sections. Jurassic and Cretaceous sediments have been studied in the sections of Negram, Chalkhan Gala, Jagrichay and Paiz. In the early years, based on paleomagnetic data, kinematic parameters of the movement of blocks and horizontal movements of the north are determined.
Keywords: *magnetization, susceptibility, horizontal displacement, kinematic parameter, tectonics, gorst rise, stratigraphy, lithology*

Introduction

The territory of Azerbaijan Republic covers the eastern part of the Caucasian segment of the Mediterranean Belt, a characteristic feature of the Earth's crust structure, which, like the Caucasus as a whole, is its tectonic heterogeneity, expressed in a complex ratio of structural and formation units constituting it with a different lithologic-stratigraphic section, the character of deformation and history of geological development.

The current state of research in the field of paleomagnetism of the Meso-Cenozoic rocks of the Lesser Caucasus allows us to consider in more detail the problem of horizontal movements of the Earth's crust.

The role of paleomagnetic data for solving a number of issues related to the restoration of the relative position of tectonic units, their paleogeographic position, kinematics, and drift is difficult to overestimate. The whole diversity of paleotectonic reconstruction schemes, both regional and global, is unthinkable without a paleomagnetic structure that provides the basis for models of the geological development of the region.

Paleomagnetic studies on the territory of the Nakhchivan Autonomous Republic were carried out on the Jurassic and Cretaceous sections.

Magneto-mineralogical studies were carried out according to the generally accepted technique in rock magnetism and paleomagnetism.

When studying the magnetic properties and diagnostics of ferromagnetic minerals, we were guided by the works of T.Nagaty, D.M.Pecherskiy, S.Y.Brodskaya, V.E.Pavlova and others. (1)

For confident paleomagnetic constructions, first of all it is necessary to establish the nature of the natural residual magnetization Jn^0 and determine the ferromagnetic minerals responsible for Jn.

Non-heating methods of magnetic mineralogy were used, including demagnetization of natural residual magnetization in alternating magnetic fields, methods of magnetic cleansing and methods of sedimentation of sedimentary rocks.

Thermo magnetic studies were carried out, including removal of the temperature demagnetization curves of the residual saturation magnetization, determination of the Curie points and the results of thermal heating.

Measurements of the magnitude and direction of the natural residual magnetization were carried out on a two-speed spin-magnetometer JR-6.

The magnitude of the magnetic susceptibility was measured by the Czech device KT-5 (1,2,3).

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The discussion of the results

Paleomagnetic studies on the territory of the Nakhchivan Autonomous Republic were carried out on the Jurassic and Cretaceous sections. For paleomagnetic studies, 110 oriented pieces were selected from which 330 cubes were cut out. (5)

We studied two sections of the Jurassic sediments: the Negram and Chalkhan Gala sections. In these sections, Callovian, Aalen, Bayos and Bat Jura were investigated. From the Negram section, 30 samples were selected, of which 80 cubes of Jurassic sediments were cut out. All samples of the above collections have been temporarily cleaned. The total thickness of the studied section is 295 m. The entire collection is processed in the paleomagnetic laboratory by the standard method.

Stereograms were constructed for the rocks of the Cretaceous and Jurassic deposits of the Nakhchivan Autonomous Republic, which gave positive results.

Figures 1 and 2 show stereograms of the In distribution before and after temporary cleansing in the presence of the Earth’s magnetic field.

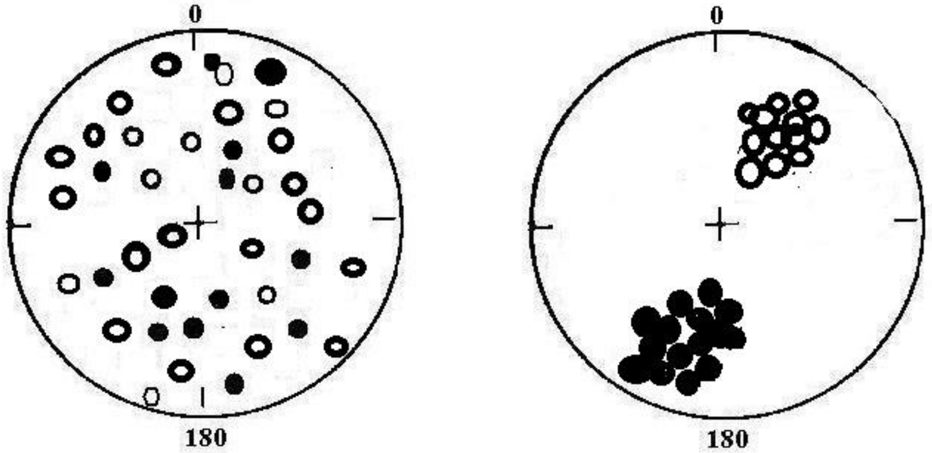

Figure 1. In distribution of Jurassic rocks of the Nakhchivan AR (a- before magnetic cleaning; b- after magnetic cleaning)

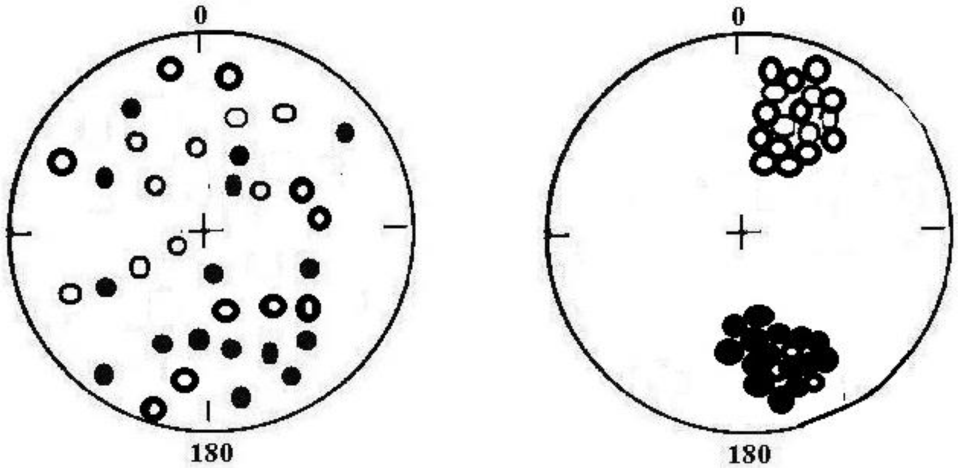

Figure 2. In distribution of Cretaceous rocks of the Nakhchivan AR (a- before magnetic cleaning; b- after magnetic cleaning)

According to paleomagnetic data, it was found that in the Jurassic time, the Negram section was located at a paleolatitude of 24^0 and moved to the north by 1,400 ± 300 km, the translational speed was 2.1–2.2 cm/year. The Negram block turned accordingly clockwise by 21^0, and the Chalkhan Gala section, being at a paleo-latitude of 25^0, moved to the north by 1,300 ± 300 km with a translational speed of 2.0–2.1 cm/year. Block Chalkhan Gala turned, respectively, clockwise at 32^0.

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.14-18

As a result of studies conducted in the Negram section, 3 zones of direct polarity and one of reverse polarity were established. In the section of the Chalkhan Gala in the Aalen and Callovian sediments there is only one zone of direct polarity. There are two zones of direct polarity and one zone of reverse polarity in Bayos and Bat levels. The Aalen deposits studied in both sections Negram and Chalkhan Gala have a direct polarity.

As a result of the conducted studies, 7 zones - 4 of direct polarity and 3 zones of reverse polarity - were established in the Negram section, and only one zone of direct polarity in the Chalkhan Gala section in the Aalen and Callovian deposits. In bayos and in bat, one zone of direct polarity and one zone of reverse polarity were revealed (Fig.3).

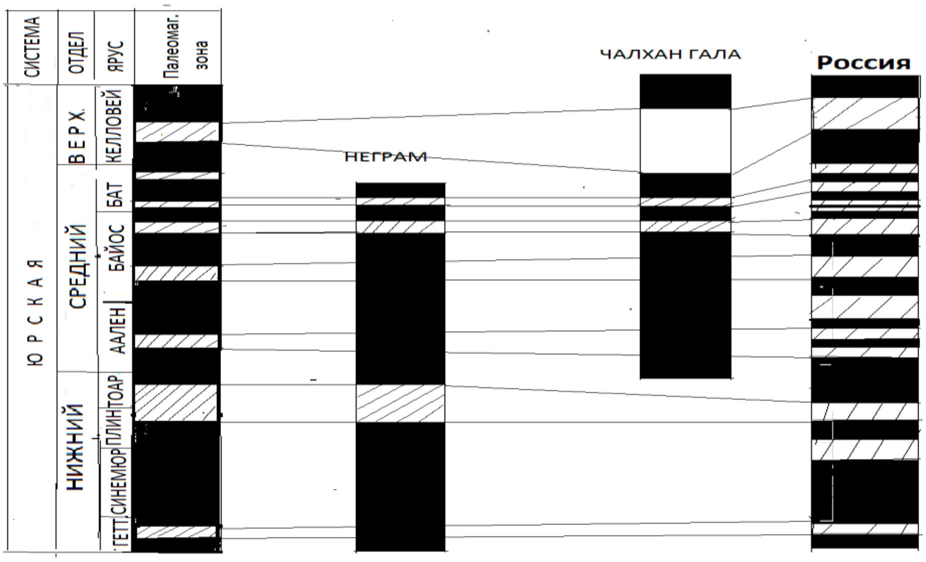

Figure 3. Regional diagram of magnetostratigraphic sections of the Nakhchivan Autonomous Republic: 1-zone of reverse magnetization; 2-zone of direct magnetization; 3- unexplored parts of the crust; 4-lines of correlation

Cretaceous sediments in the territory of the Nakhchivan Autonomous Republic are represented by lower and upper sections. Of the Lower Cretaceous sediments, only Albian formations were found.

Upper Cretaceous sediments in the basin of the Arpachay River are developed by separate small islands, in the basin of the Jagrichay River they are widespread, stretching along the strip between the settlements of Aznabyurt and Paiz. Alba deposits in this band are fixed in small areas in syncline troughs in the area of Aznabyurt and Gulistan. Deposits of Cenomanian and Turonian are exposed in the western and southern parts along the bed of the Jagrichay River. Cognac santona and kampana deposits occur in the central and eastern parts of this band, while younger deposits — Maastricht, Danish stage and Paleocene — are recorded only in the southern and eastern parts of this band (4.6).

We studied 2 sections of Cretaceous sediments - Paiz and Jagrichay. In these sections, rocks of the Upper Cretaceous sediments (cognac-santon, Maastrich) were investigated.

From the Paiz section, 35 rocks of Cretaceous sediments were selected. From each ore, 4 cubes with a 24 mm rib (105 cubes in total) were subsequently cut out. All samples of the above listed collections have been temporarily cleaned. The total thickness of the studied part of the section is 685 m., the length of the section is about 1,200 m. The values of the natural residual magnetization Jn of the selected samples vary within narrow limits from $2 \cdot 10^{-6}$ to $26 \cdot 10^{-6}$ SGS ($2 \cdot 10^{-6}$ to $26 \cdot 10^{-6}$A/M). As a result of laboratory studies, we concluded that the magnetization of the studied rocks is primary and corresponds to the direction of the geomagnetic field of the formation time of the studied rocks (Fig.4).

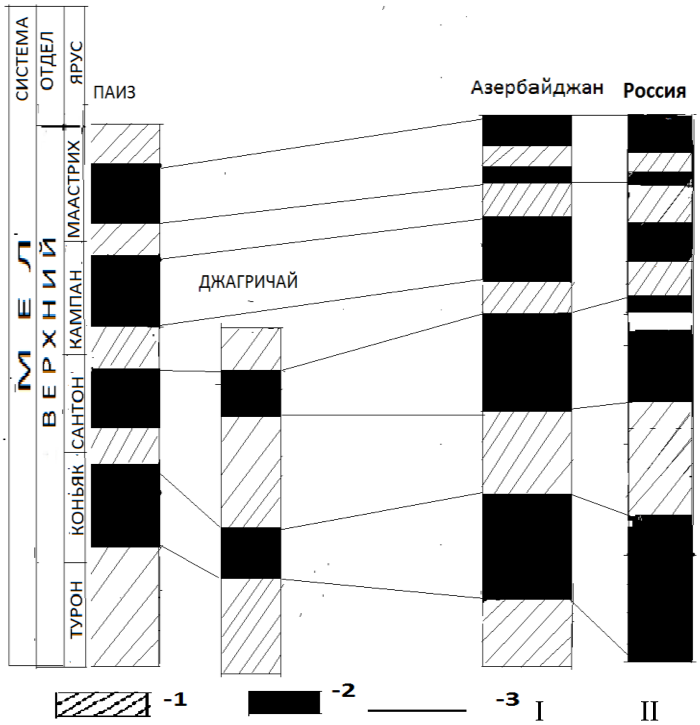

Figure 4. Regional scheme of magnetostratigraphic sections of the Upper Cretaceous of the Nakhchivan AR. 1- reverse magnetization zone; 2 - direct magnetization zone; 3- correlation lines; I - summary scale of the Mesozoic of Azerbaijan; II - the general scale of Russia

The average directions of magnetization and the coordinates of the paleomagnetic pole of the studied region were also determined: D = 44.3^0, J = 66.3^0. K = 9, α_{95} = 13, F = 53, λ = 88. The calculated paleomagnetic pole differs from the Middle Paleopole of the Lesser Caucasus. According to paleomagnetic studies, it was found that in the Cretaceous time, the Paiz section, being at a paleo-latitude of 29^0, moved to the north by 1,250 ± 250 km with a speed of 2.0-2.1 cm/year. The Paiz block turned clockwise by 36^0 (Table 1).

Table 1
Paleomagnetic directions and paleomagnetic poles of the studied sections of the Nakhchivan Autonomous Republic

Section name	Age	Coordinates of the research		Direction NRM		K	A_{95}	Polarity	Paleomagnetic poles		Θ	Θ	φ_m
		φ	λ	D	J				φ	Λ			
Chalkhan Gala	Middle Jura	39.3	45	32	48	14	6	N	6	64	8	6	29
Negram	Middle Jura	39.5	45	34	45.9	11	8	R	8	67	9	5	24
Paiz	Upper Cretaceous	39.1	45	44.3	66.3	9	13	N	53	88	16	10	30
Jagrichay	Upper Jura	39	45	36	70	11.4	15	R	61	91	11	9	28

The Jagrichay section cut 1.2 km south-west of the river Jagrichay. Here there is an anticlinal fold along the river ravine. From the Jagrichay section, 18 oriented pieces were selected (of which 2-4 samples of the cube were cut out with a 24 mm rib, a total of 72 samples). The total thickness of the

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.14-18

studied part of the section is 186 m; the length of the section is about 500 m. The values of the natural residual magnetization Jn of the selected samples vary in a narrow range from 7 • 10^{-6} to 86 • 10^{-6} SGS (7 • 10^{-6} to 86 • 10^{-6}A/M). Magnetic susceptibility ranges from (17÷196) SI units. In most cases, the viscous magnetization did not exceed 40% Jn.

All samples were subjected to stepwise cleaning with an alternating magnetic field of up to 4 • 10^{4} ^{6}A/M in increments of up to 2 • 10^{2}A/M.

The results of laboratory studies indicate the primacy of the nature of the natural residual magnetization and the compliance of its direction with the paleo-time of formation of the studied rocks.

The average directions of magnetization and the coordinates of the paleomagnetic pole of the studied region were also determined: D = 36^{0}, J = 70^{0}. K = 11,4, α_{95} = 15, F = 61, λ = 91. The Jagrichay section, being at a paleo-latitude of 28^{0}, moved to the north by 1350±300 km at a speed of translational motion of 2.1-2.2 cm/year. The Jagrichay block turned clockwise at 41^{0} (table 1).

Conclusion

For the first time, on the basis of paleomagnetic data in the Nakhchivan Autonomous Republic, turns are studied and the kinematic parameters of the movement of the blocks of the Earth's crust are determined: clockwise turns and horizontal movements to the north.

Thus, carried out paleomagnetic studies have shown that the distinguished paleomagnetic directions are ancient, synchronous to the time of rock formation and can be used to analyze patterns associated with the ancient magnetic field, as well as for paleostratigraphic reconstructions of the region.

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Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.19-23

ROLE OF THE TECTONIC AND GEODYNAMIC ACTIVITY IN THE NORTH-WESTERN PART OF THE SOUTH CASPIAN BASIN

(in the example of the Bulla Sea structure)

E.I.Khuduzade[1], H.O.Veliyev[2], Sh.Kh.Akhundov[3], A.A.Jaferov[1]

ABSTRACT. *The South Caspian Basin is a part of the modern Azerbaijan territory of the Alpine-Himalayan active zone (AHAZ), which is formed with the oil-gas area, regions rich in carbohydrate (KH) in the active and passive outer basins of the ancient Tethys ocean.*

Basic tectonic units of Meso-Cenozoic complex the known tectonic elements, the tectonic structure of the territory of Azerbaijan which is not a huge area but has its own complex folded was formed as a result of a sharp change in the difference in the geological-tectonic connection.

Keywords: Tectonic activity, tectonic faults, mud volcanoes, composition of fluids, geodynamic tension, seismic zone, hydrodynamic activity, seismogram, screen type deposit.

Evaluation of the oil potential of the Caspian basin and correct orientation of exploration in the deep layers are one of the most actual problems of the day.To study each structure based on new data, conducting fundamental scientific researches can help to find a positive solution to all the projects implemented in the development of deep layers in the future.

Caspian basin appropriate to Plate tectonic's model covers the eastern part of the Tethys ocean which is developed by Alpine-Himalayan orogenic movements in the early Paleogenic period.

The basin area consists of three main geotectonic elements:

- Caspian (Russian platform);
- Central part (Iskit-Turan Epi-Hersin platform);
- Alpine geosynclinal zone in the south.

Three (north, middle and south) bottom basins are separated related to the basic structural elements.

Southern Caspian Basin that is studied to some extent in detail with large-scale researches is separated from the central Caspian by the Caucasus-Kopetdagh fault [1]. The Southern Caspian basin is divided into several tectonic regions: Absheron Balkhanyani anticlinal zone; - Absheron archipelago; - Beach archipelago; - The deep-sea part of the Caspian Sea.

These oil-gas-rich regions are separated by geophysical methods, according to seismic exploration and data from drilled wells, in turn, consist of structures and exploitation deposits (Fig.1). Mud volcanoes are widely spread in existing anticlinal areas of this region and play a major role in the formation of deposits and the distribution of hydrocarbons. Mud volcanoes are considered as the main factors that confirm the oil and gas prospect of the area. So that, in addition to the favorable paleotectonic and paleogeographic conditions for the formation of hydrocarbons, there is also a sedimentary complex with lithophysical properties suitable for the migration, collection and bed formation of hydrocarbons in the basin.Sedimentation of the productive layer (PL) coming with rivers has occured in several directions (Fig.2). Being the small flows in addition to large rivers as Paleo Volga, Paleo Kura and Paleo Amudarya, show the sharp variability of the lithospacial environment of the basin.

The existing tectonic regions are associated with large-deep faults recorded in the South Caspian basin. Because the sediments coming with PaleoVolga have the better reservoir, NGR

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structures situated in the distribution area of this sediments have high oil and gas potential. Contact section of Paleo Volga distribution area for MG with Paleo Kura with the weaker reservoir are compatible at the same time with the border of Baku archipelago (N.-N.W.) with the Absheron

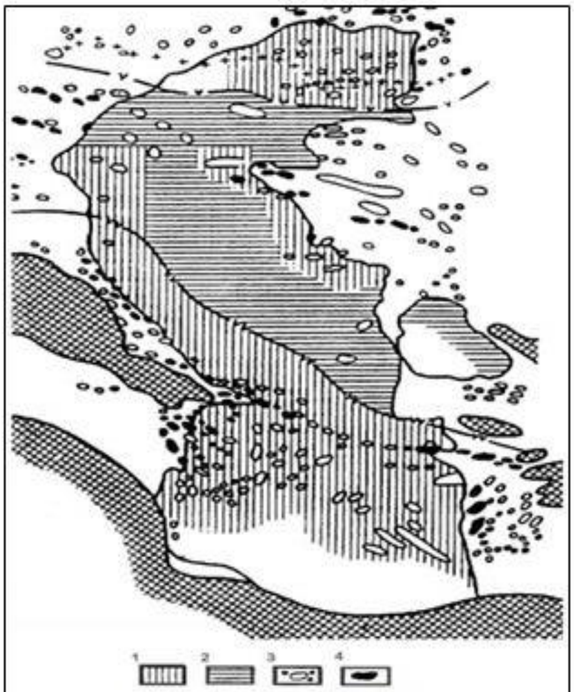


Figure 1. Oil and Gas prospect of the Caspian Sea [1].
1-very perspective areas
2-Perspective for hydrocarbons search
3 - Detected structures
4-Oil and Gas Fields

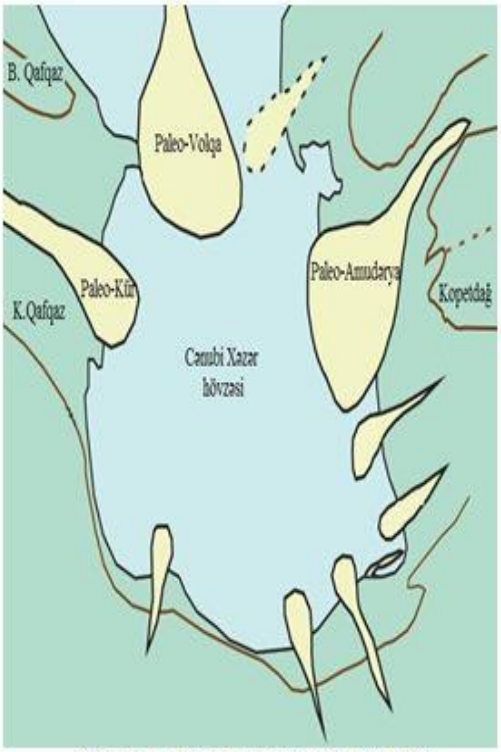


Figure 2. Lithological nutrition of SCB

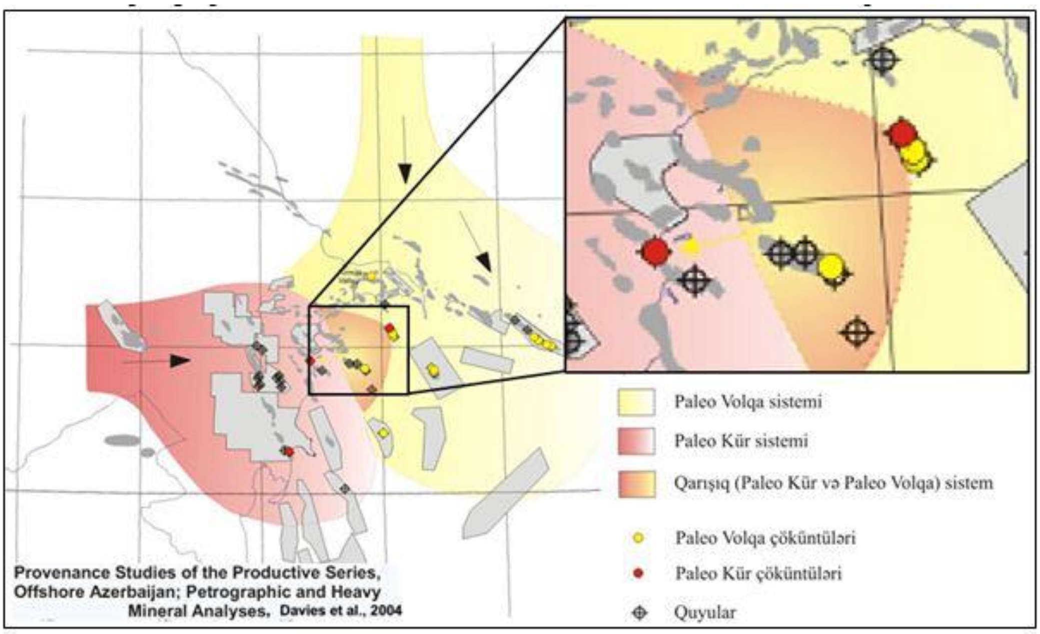


Figure 3. Sedimentation basin during breaks [2]

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.19-23

archipelago. From this point of view, the complexity of the geological-tectonic structure requires high attention in the formation of the structure located in the research area also in the direction of evaluation (Fig.3).

In recent years, the presence of tectonic movements along with sedimentological processes in the direction of the existing data specification on structures located in the north and north-eastern part of the Baku archipelago, purchase of new information allow us to formulate a certain point in this field. Works carried out with the application of new methods, delivery channels of paleo rivers, products and their petrophysical features allow you to express your ideas about the sedimentation processes and tectonic structure.

This can be explained more widely as an example of seismic exploration work the carried out with modern equipment in the Bulla-sea field.The researches specified the geological-tectonic structure of MG sediments and the deeper layers and the Bulla-sea structure are described as a complicated, slightly asymmetric brachy-anticlinal in the results. The arch part of the structure is complicated by a number of tectonic faults with slip-strike type direction of extension change related to the mud volcano. As the results of the faults, the arch part and CQ flank of the structure relative to one another was a normal fault to the south. Faults with slip-strike type are monitored throughout all field and on the whole depth of the transection and the amplitude of this reaches about 1200 m in the center of the structure starting at about 600 m in the north-west within the area and then decreasing to 100 m in the direction of south-east (Fig.4) [3]. These faults going on the north-west direction continue related to the Alat-sea structure. The materials obtained as a result of the research will help to formulate ideas about the sedimentation conditions (CTS). Followed green-colored horizont in the seismic profile, which is located in the N.W.- S.E. direction of the Bulla structure in the Fig.5 reflects the FLD ceiling . As mentioned, there have been enough changes in the sedimentation at the beginning of the Lower Pliocene. As shown in the figure, sedimentation has been stable at higher intervals. Unlike that, low intervals are characterized by a more chaotic wave area. The reason for this was a sharp change in the sea level at the same time with active tectonic movements.

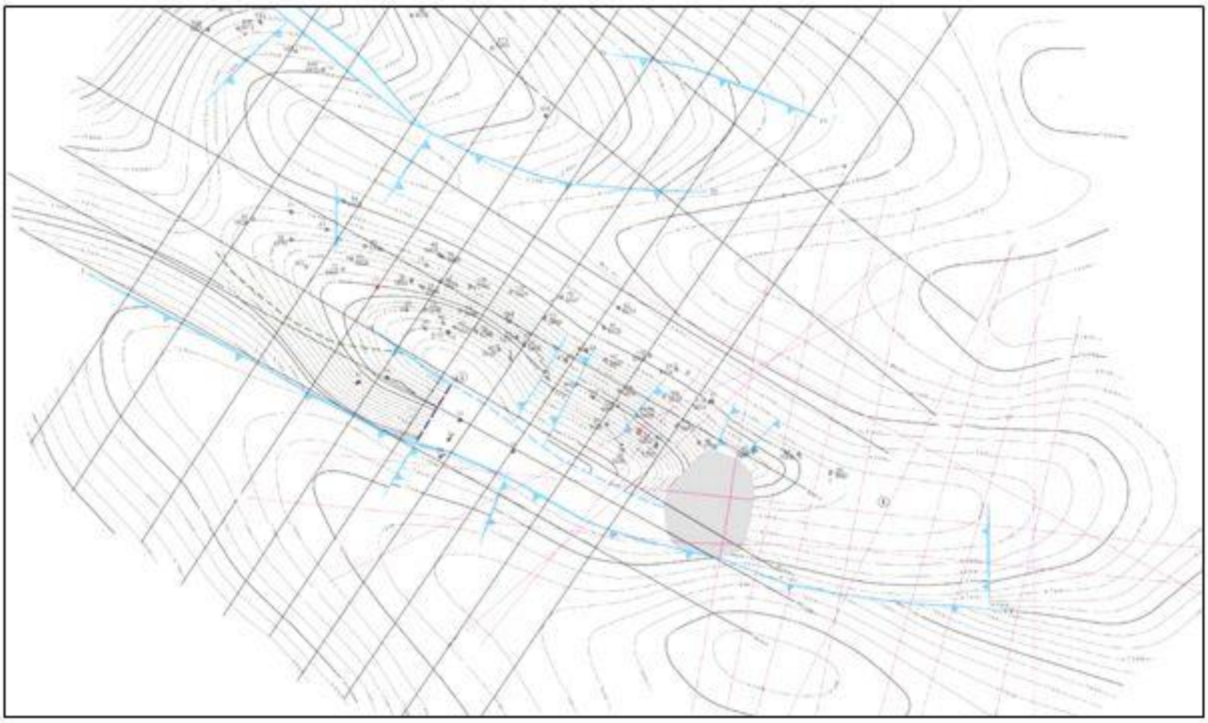


Figure 4. Structural Model of Bulla Area VII Horizon

The southern and northern wings of the Bulla-sea structure differ in their lithological and physical properties from each other. Such distinctive signs may arise related to the existing conditions on the contact line of the Paleo rivers.

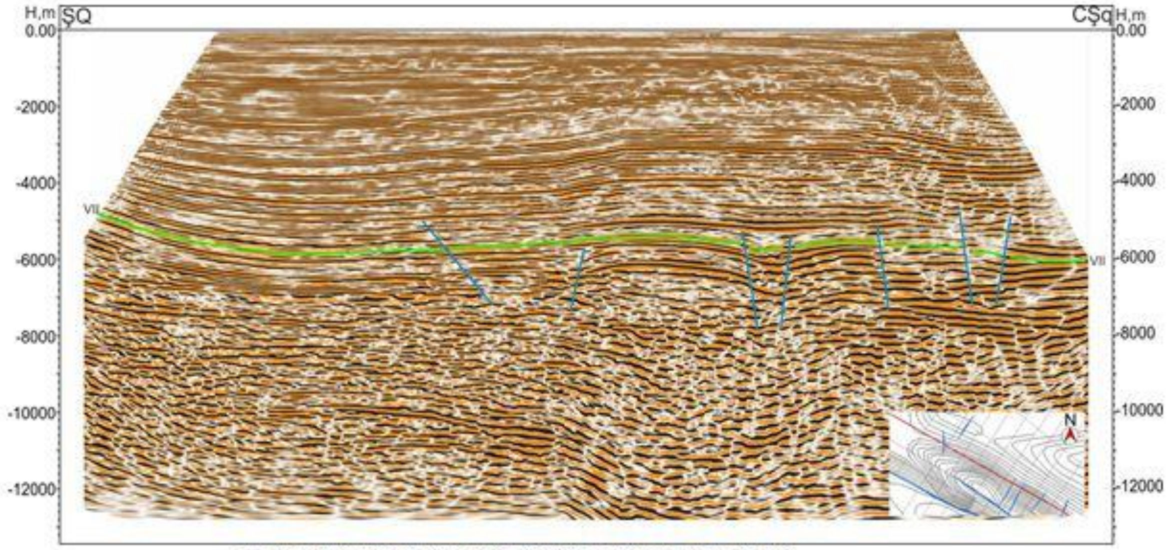
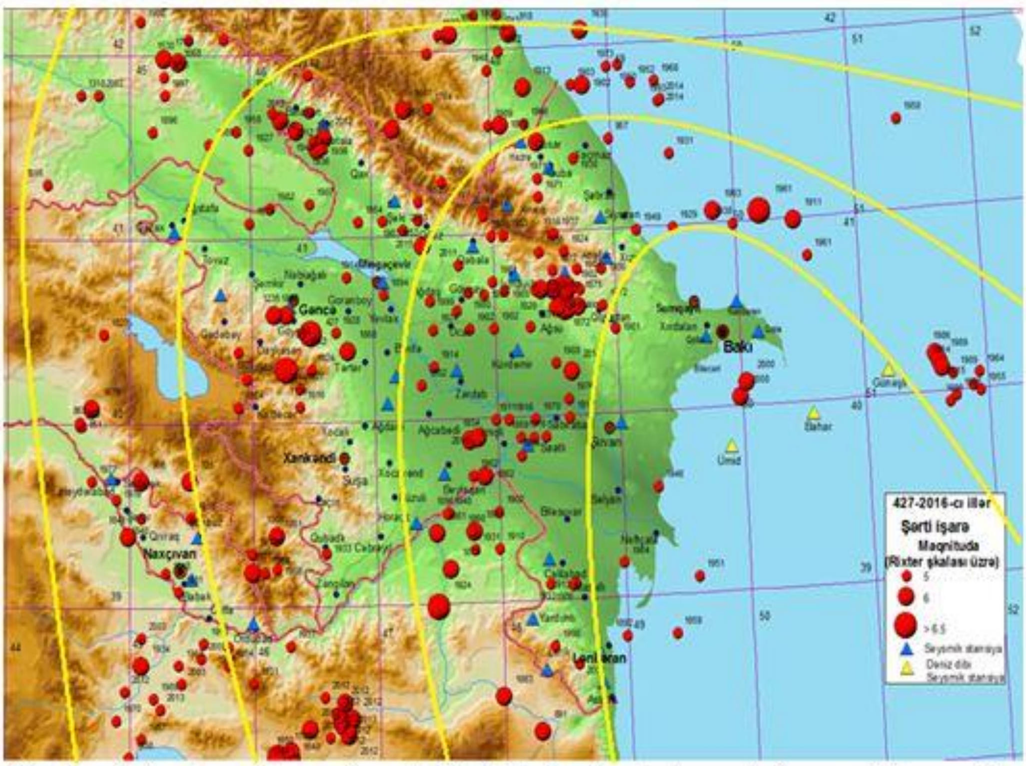


Figure 5. Seismic research results conducted in 2016



Seismic activity observed more characteristic in the Caspian basin area in the rounded zones. [5, Veliyev, 2018].

The seismogeodynamic condition observed in this area has been very active in geological periods [4, 5]. Seismic activity is stable in the seismic map of 427-2016 years in the Azerbaijan area

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.19-23

where are Bulla sea, Shah sea, Umid, Babek structures, but Geodynamic processes that have arisen from effects of earthquakes in nearby areas have resulted in the complication of sedimentary tectonic faults. Tectonic disturbances and faults create a density up to 6-7 km of sedimentary layer depending on the geodynamic tension. The number of faults decreases in the 7-20 km interval in deeper layers.There is a similar landscape on the upper and deep layers. The shape of the anticlinal structure and the stabilization of the layers have been preserved in the deeper layers, there are more favorable conditions for collecting hydrocarbons and formation of deposits.

Results

1. The geological structure of the Bulla-sea has been analyzed on the basis of newly acquired seismic and seismological data.
2. The geodynamic-tectonic structure, paleogeographical conditions of the sedimentary complex at 6-10 km interval in deeper layers are considered to be valuable for the formation of deposits.
3. It is estimated that the deep layers are perspective in terms of oil-gas.

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Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.24-29

NUMERICAL ANALYSIS OF THE EFFECT OF SEISMIC LOAD ON A FIBER-CONCRETE PIPELINE BY THE FINITE ELEMENT METHOD

T.Aliyev[1], N.Mastanzade[2], T.Rustamli[3]

ABSTRACT. Fiber concrete sewer pipes in the seismic zones are presented. The pipes in the ground massive are modelling with the help of Plaxis 2D computers program. For the definition of the necessary mechanical characteristics were conducted experimental tests.

Keywords: fiber concrete, seismic load, stress, strength, tension

Introduction

Underground water sewer pipes are made of reinforced concrete. Length of such pipes changes from 1 to 2.5 m, diameter changes within 600-3000 mm. Pipes are established underground at a depth of 4-6 m and are connected among themselves by means of bell-shaped connection. At the production of reinforced concrete pipes there are following problems. The protective layer of concrete not always meets standards. On a surface of a pipe and in it there is a set of cracks, splitting off and other defects. All this increases pipe production time. Pipes are made at the concrete plant by the method of dry pressing. The internal and outer surfaces of pipes are leveled by masters manually. A feature of underground pipelines is that the soil massif is accepted not only as external loading but also as the environment. Therefore the design of the stress-strain condition of construction comes down to the design of the "underground pipeline-the soil environment" system. The durability of underground pipelines is rather investigated. However, the influence of seismic loading and the arising reactions of pipes remain not solved [1, 2]. The numerous cases of failures of underground pipelines from seismic influence show that axial tension is a result of accidents [3]. It takes place in case of welded metal pipelines more. Reinforced concrete pipes have a simple connection; an entrance part of a pipe does not exceed 10 cm. Therefore the cross and sedimentary deformations arising at seismic influence create a danger of detachment of pipes. The uneven draft is one of the causes of the accident. For pipes of large diameter cross loading at seismic impact has a great influence.

Replacement of a steel reinforcing framework in pipes with fibers considerably reduces the arising problems [5]. Full replacement of a steel reinforcing framework reduces welding works and volume of the spent electric power. The tension concrete resistance increases, longitudinal cracks and a splitting off are as a result reduced. Depending on the type, the size and volume of fibers laboratory tests on tension, a bend and crack resistance were conducted.

Now various normative documents do not consider cross components of seismic loading in calculations of underground pipes. At big magnitudes of the earthquake and for pipes of large diameter this approach is not correct. One of the reasons for accidents of pipes is the arising ring tension [7, 8] (Fig.1).

The arising tension is widespread unevenly and depends on a tilt angle of the influence changing from 0 to 2π. The normal tension stress at top of a pipe is $\sigma_M = \frac{0.305 P_m R^2}{W}$, at the edges of a pipe is $\sigma_M = \frac{0.1684 P_m R^2}{W}$. The normal compression stress at top of a pipe is $\sigma_N = -\frac{0.02653 P_m R}{F}$, at the

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a) *b)*

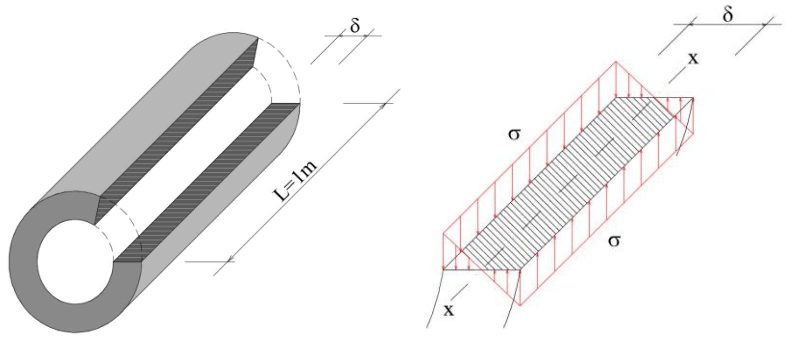


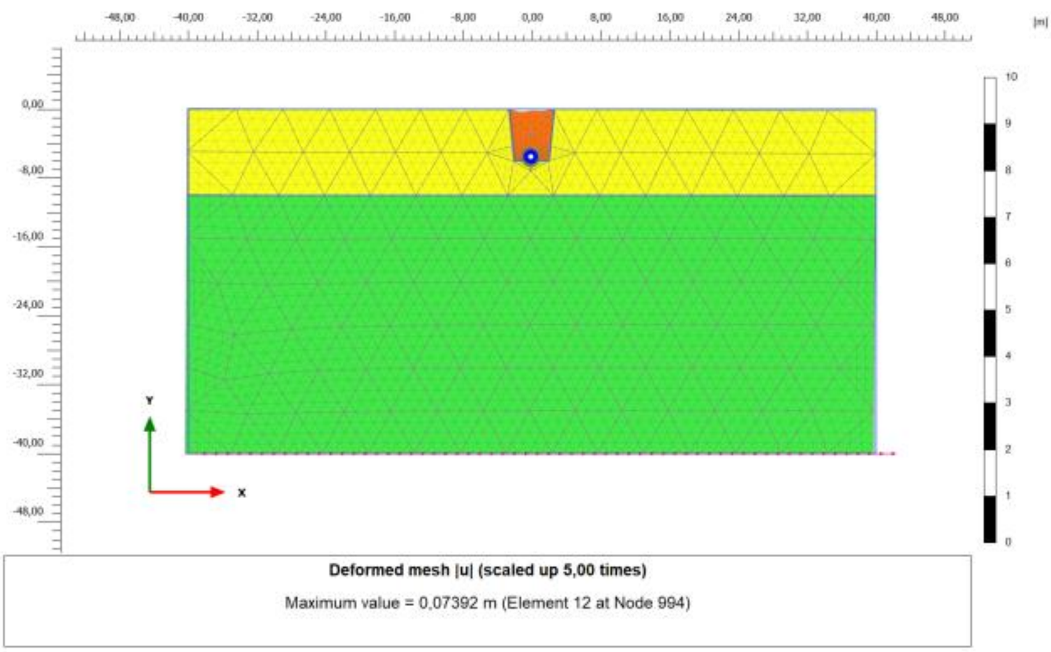
Figure 1. Cross-section of pipe *(a)* and normal stress diagram distribution *(b)*

edges of the pipe $\sigma_N = -\frac{0.5P_mR}{F}$. Here $W = \frac{d\delta^2}{6}$ is the pipe wall section strength moment; $F = \delta L$ are a pipe wall cross-sectional area. The maximum seismic compression and tension stress is calculated as $\sigma_i = \sigma_N + \sigma_M$. [8].

Modelling of the pipelines and ground massif

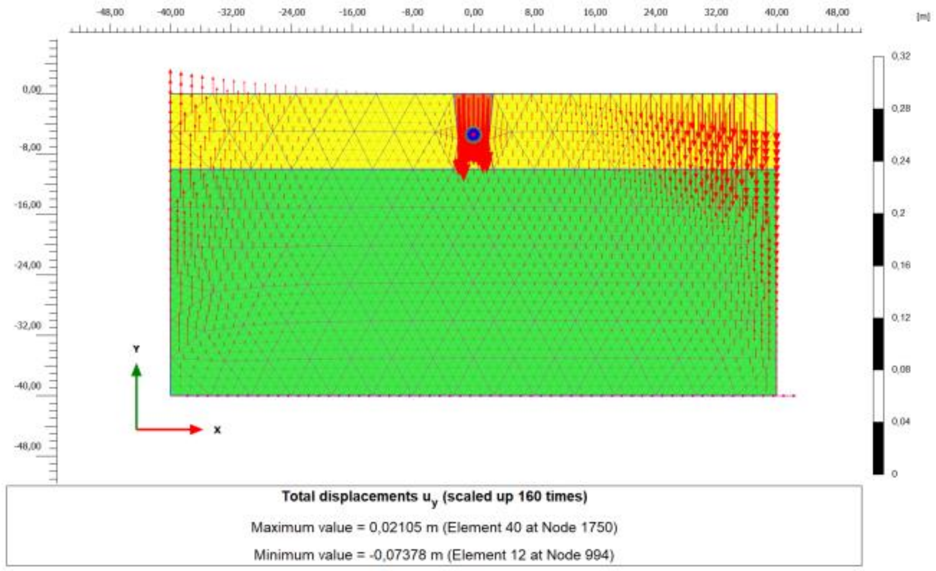
The underground pipeline and the soil massif surrounding it is accepted as a uniform object. The soil massif around the pipeline by means of the computer Plaxis 2D program is modelled according to the square and diagonal scheme on the rectangular site (Fig.2). Properties of this massif are characterized by two constants - the module of elasticity of soil (E_0) and the Poisson ratio (μ_0). Geometrical change of a system (the pipeline and the soil massif) is connected with the change of points of a grid. The cross contour of a pipe is also divided into final elements. Pipe material (fiber concrete) is characterized by the module of elasticity (E) and the Poisson ratio (μ). Such an approach to a solution of a problem of design a pile soil by means of the Plaxis 2D program was applied by the Holland engineers at the design of new Baku International trade port [9].

a)



Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.24-29

b)



c)

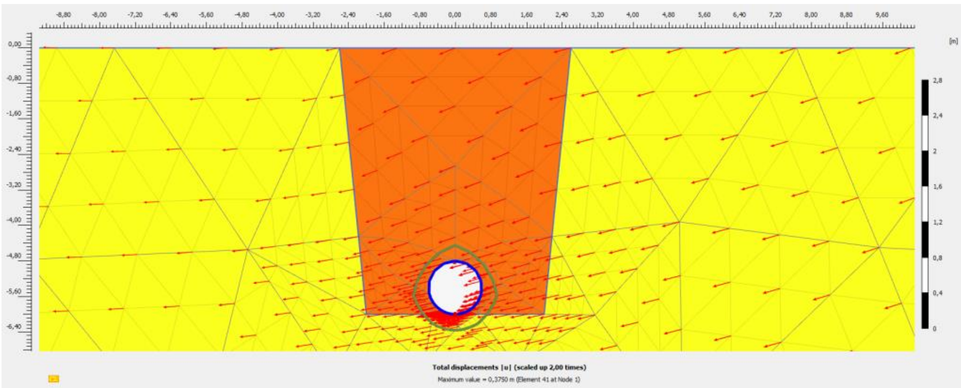


Figure 2. Plaxis 2D computer program for solution pipe-ground system modelling *(a)* and displacement on the Y- axis *(b);* General movements *(c)*

Here bulk soil is marked by orange color; clay is shown by yellow color; stony dense sandy loam is shown by green color. Movement of the lower part of a pipe on axis X makes U_x= - 0.1977 m. Movement of the lower part of a pipe on axis Y makes U_y= - 0.05077 m. The general movement of the lower part of a pipe makes |U|=0.2041 m. The pipe consists of 8 final elements. The quantity of elements of soil is 280 units. The average size of elements is 4.835 m. The maximum size of elements is 8.117 m. The minimum size of elements is 0.01006 m. The sequence of calculation following. At first parameters of the movement of knots are defined. Then deformations and efforts in cores from the movement of knots are specified. These values of efforts are transferred to knots. Displacements of knots are defined by the solution of a system of the equations of the movement of these knots. For seismic information of the territory the accelerogram of an earthquake was admitted to Kochaeli (Turkey) in 1999 (Fig.3). Calculations were carried out on earthquake action by the acceleration of 8 points by MSK 64 scale. Force of an earthquake is estimated measuring 7, acceleration is accepted 0.2g.

The modelled seismic loading is distributed on X and Y axes. From the action of seismic loading in walls of the pipeline there are compression and ring bend. In the perpendicular direction of

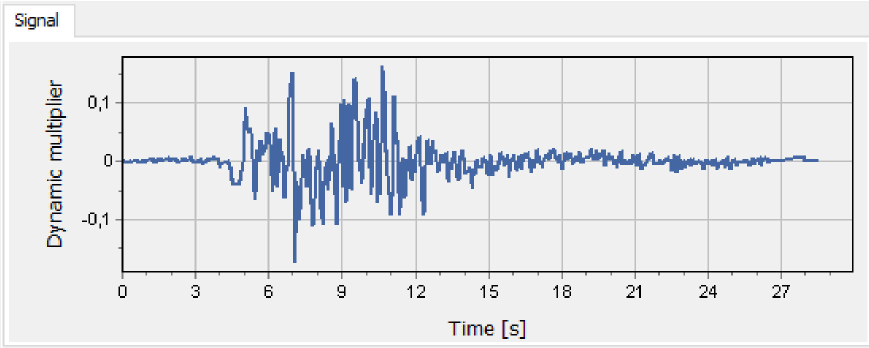


Figure 3. The accelerogram of an earthquake was admitted to Kochaeli (Turkey) in 1999.

an axis of the pipeline, the maximum tension of a bend and compression are calculated. The arising longitudinal forces *F(t)* and the bending moments *M(t)* from the action of seismic loading are calculated on formulas:

$$\left.\begin{aligned} F_k(t) &= \frac{EAv(t)}{\alpha_k V_k} \le F_\tau(t) \\ M_k(t) &= \frac{EIa(t)}{(\beta_k V_k)^2} \end{aligned}\right\} \quad (1)$$

Where E is elasticity modulus of pipes materials (fiber concrete), Mpa; A is a pipe cross-section, m^2; $v(t)$ is a ground particles velocity speed, m/s ; V_k is a seismic wave velocity, m/s ; α_k , β_k are coefficients by wave type; k is a type of seismic wave (*1* is longitudinal wave, *2* is lateral wave); I is a moment of inertia of pipe, m^4 , $I = \frac{\delta^3}{12}$; δ is pipe wall thickness, m; $a(t)$ –seismic acceleration by accelerogram, m/s^2; $F_\tau(t) = \frac{\lambda_k f_\tau}{4}$ is a maximal cohesive force between pipe and ground; λ_k is a wavelength; T_0 is a seismic dominant period; $f_\tau(t)$ is a friction force. The velocity of a seismic wave $\mathbf{v_m}$ depends on the category of soil, $v_m = \frac{v_0 a(t)}{g}$. In this g is the acceleration of gravity. For soil of the first category is v_0=0,91m/s. For soil of the second category is v_0=1.2m/s. Deformations of diametrical expansion δ_x and shortening δ_y of a pipe can be defined as [4]:

$$\delta_x = \frac{0{,}1228\, P_m R^4}{EI_b} \quad , \quad \delta_y = \frac{0{,}122\, P_m R^4}{E\, I_b} \qquad (2)$$

where P_m is a seismic acceleration in the XY area;$I_b = \frac{\delta^3}{12}$ is a moment of inertia of the pipe. Various mechanical characteristics of soil depending on the type of soil are shown in table 1. Knowing a real geological section of the soil massif it is possible to determine actual speeds of a seismic wave. For bulk soil the speed of a seismic wave it is possible to accept 80 m/s .

Table 1

Soil type	**Density of soil, ρ, kg/m^3**	**Deformation moduls of ground, E_0, MPa**	**Poisson ratio of ground μ_0**	**Angle of internal friction of soil, φ, grad**	**Speed of distribution of a seismic wave in soil, v , m/s**
Sand	2300	40	0,3	35	150
Sandy loam	1970	21	0,35	20	350
Loam	1700	35	0,42	57	600
Rock	2600	100	0,2	40	800

Test of fiber concrete samples and pipes

For the test of mechanical characteristics of fiber concrete pipes laboratory tests in the test hall of the research institute of building materials named after S. Dadashev were conducted [5]. Here tests on longitudinal tension (*a*), a bend (*b*), crack strength (*c*) and a splitting test (*d*) were carried out (Fig.4).

a) *b)* *c)* *d)*

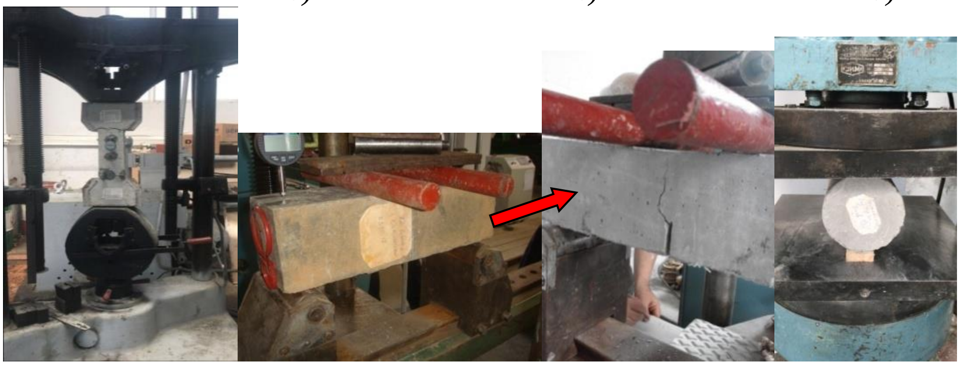


Figure 4. Fiber concrete tests: tension (a), bend (b), crack strength (c) and splitting test (d)

Here the steel and polypropilene fibers were tested. As a result of test the following indicators are received: for a steel fiber the module of elasticity *E*=60000 MPa, and Poisson ratio μ= 0,214; for polypropilene fiber the module of elasticity *E*= 25000 MPa, and Poisson ratio μ= 0,248. Tests of pipes were carried out according to the International Standards [1, 11, 12]. Pipes with a diameter of 600 mm and 1200 mm after production of 28 days contained in the territory of the plant for typesetting of durability. Together with reinforced concrete pipes, a pipe with steel and polypropylene fibers were prepared for the test. Tests were carried out at the testing laboratory of Institute of Building materials in Baku and at the concrete plant in Afgan TTS Consortium in Sheki (Fig.5).

a) *b)* *c)*

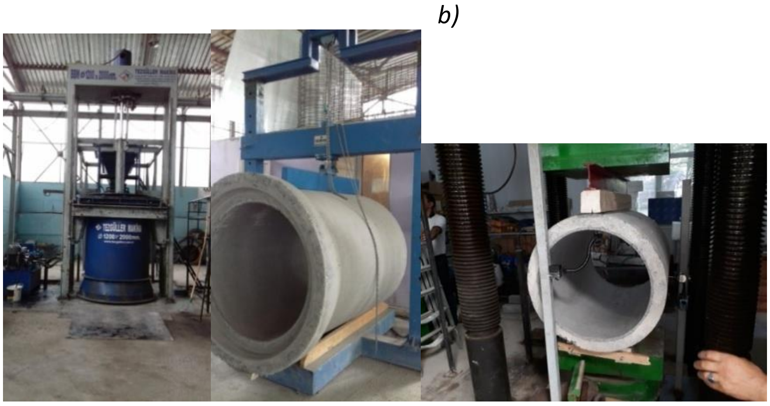


Figure 5. Production of the Ø1200mm diameters pipe in Sheki *(a)*; test of pipe *(b);* test of the Ø600mm diameters pipe in Baku (*c*).

Loading step by step on 400 kgf (4 kN) was transferred to a pipe. Each stage of loading kept 2-5 minutes for consideration and fixing of deformation and a crack in a pipe. Deformations were fixed by electronic sensors. Results of Ø1200mm and Ø600mm diameters pipe tests from class C30/37 are shown in Figure 6. It is possible to see that fiber concrete pipes without reinforcing framework show good results.

a) *b)*

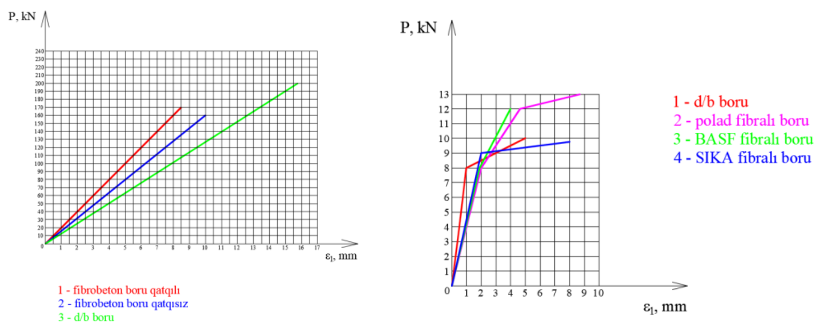


Figure 6. The *P-ε* stress-strain graphs of the tests from C30/37 class concrete of fiber concrete pipes: *a)* for Ø1200mm diameters pipes; *b)* for Ø600mm diameters pipes

Conclusion

As a result of researches the following conclusions are received:

1) The design model of the underground pipeline on seismic influence according to the Plaxis 2D program is developed;

2) With the increase in diameter of a pipe cross seismic loading increases. For example, for pipes with a diameter of 600 mm by 1.25 times and for pipes with a diameter of 1200 mm in 1.5 times in comparison with longitudinal seismic loading;

3) The tension of fiber concrete pipes from the action of seismic loading is 1.2-1.4 times less than in reinforced concrete pipes. It makes 10-15% of deformation of shift of a pipe. It is an indicator of high values of the module of elasticity and Poisson ratio for fiber concrete pipes.

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Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.30-33

FEATURES OF THE CHANGE OF SEISMOMAGNETIC EFFECT BEFORE THE LERIK EARTHQUAKE IN 2018

N.B.Khanbabayev[1], M.K.Mammedova[1]

ABSTRACT. Time-dependent variations of seismic effect in the area evaluated with high seismic risk and geodynamic activity are studied in the article. An analysis of geomagnetic field tensions in the Kura -Talish geodynamic polygons shows that the tension was equally distributed on the field.
Keywords: *Republican Seismic Survey Center – RSSC, Seismomagnetic affect – SMA, Nano Tesla – nTI*

The geodynamic effect with anomalous changes impact of strong earthquakes in seismically active areas is known by researchers. Such collected information is studied continuously with modern magnetometric devices in the geodynamic polygons of the world and in Azerbaijan as a warning factor of the earthquake.

The magnetometry method allows defining more precisely the boundaries of the geological structures, monitoring of the tectonic faults in the different depth intervals, effective separation of the tectonic blocks.

Experience of previous studies and comparative analysis of available information indicate to the perspectivity of the magnetometric observation method as one of the warning factors in the polygons established in other regions of the world – in China, Uzbekistan, Russia, Kyrgyzstan and Tajikistan.

The relevance of the topic: Geomagnetic field variations are studied in seismic regions of the Azerbaijan Republic since the late 1980 years. Magnetometric Variation Stations (MVS) operate in seismically active zones in Zagatala, Sheki, Ismayilli, Shamakhi, Absheron (Nardaran) and Lankaran, there have been conducted and carried out the observations non-stop continuos.

These devices are G-856 proton-type magnetometers manufactured by US – Kinemetrics, a modern and latest modification.

These high-precision devices (**Fig.1**) serve to measure the magnetic field tension continuously.

All dimensions of earth magnetic elements are associated with absolute and relative variations. The variations of the vertical organizer of tension are studied by relative selections.

Changes in the geomagnetic field are monitored every 15 minutes with installed magnetometers in the mentioned stations and the data is transmitted to the RSSC. The seismomagnetic effect of the time-dependent relative variations calculate analyzed data in detail and its graphs are built properly.

Abnormal changes mentioned in geomagnetic variations are directly related to formations of the intense deformation condition in the geological environment related to natural events occurring in active geodynamic zones of the Republic.

One of the main reasons for the anomalous changes in the are Earth's magnetic field is the occurrence of catastrophic earthquakes with strong vibrations.

The study of the age-old magnetic field changes in the crust has proven that strong and often occurring changes in this area occur mainly in places where the Earth's crust is weaker, accompanied by numerous faults and folded. Such zones are seismic areas and are frequently accompanied by earthquakes.

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One of such zones in our Republic is the Talısh Mountains and foothill areas of the Lesser Caucasus.

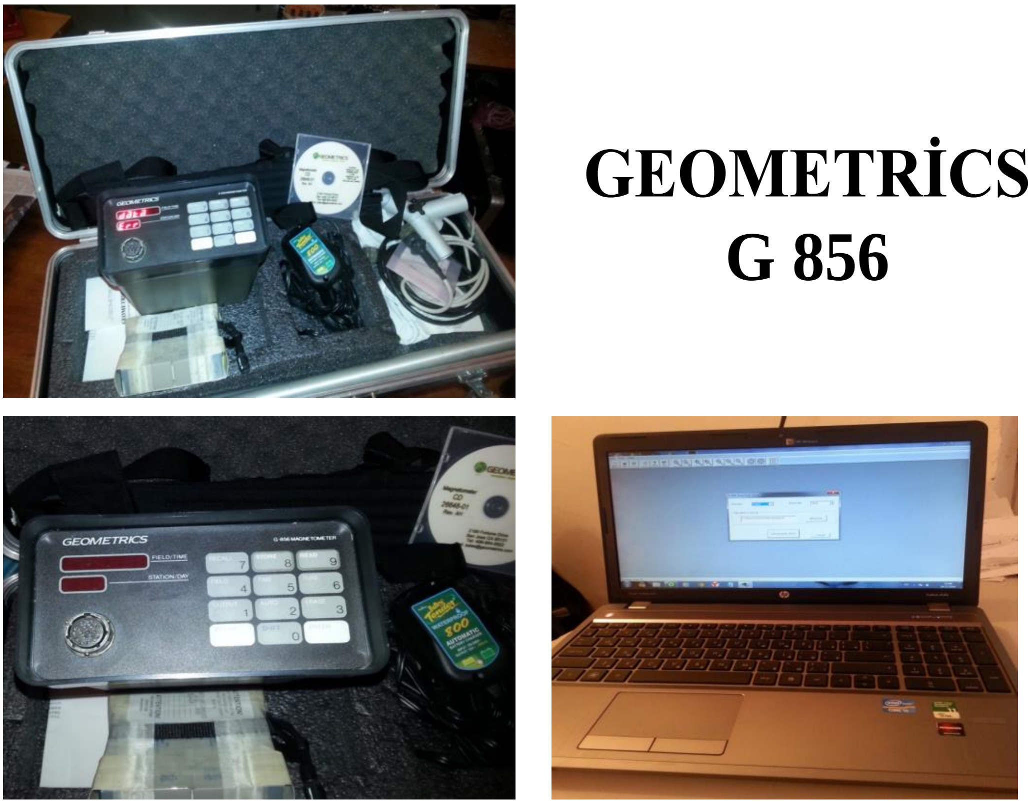


Figure 1. G 856 Memory-MAQ Proton Preccession Maqnetometer (Geometrics, USA)

Seismomagnitometric researches are conducted in two directions to determine seismomagnetic effect (SME) and to evaluate the tension-deformation condition of seismic zones.

The experience of many years has shown that the nature of the SME depends on the mechanism of the earthquake's source.

During the preparation and realization of earthquakes, the spreading area of the seismomagnetic effect calculated using the formula of $R=10^{0,5M-1,27}{}_{km}$. .

Here, statistical quantities are ρ = 0,87.This shows that cause-and-effect connection between seismomagnetic effect and earthquakes indicate the seismotectonically conditioned.

It was accepted that T tension is manifested itself in the normalized background in the form of the bay. The duration of the bay (long-term) abnormal changes is 120 ÷ 360 hours. The confident continuation is about 180 hours. SME amplitude increases by 20 ÷ 40 nTl. The radius of the SME detection zone is within the R = 100.5M-1.27km (Rzayev at al, 2013).

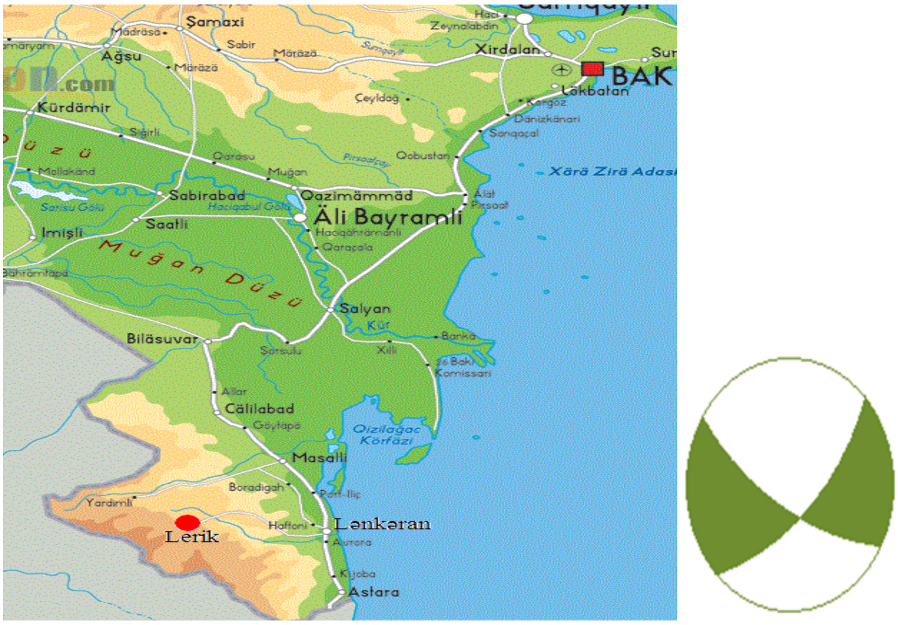
At the same time, confident intervals of SME short-term (peak) anomalies may take several hours.

Anomalous changes in SME may be positive or negative, depending on the mechanism of the earthquake source (compression and extension) (Rzayev, 2006).

There were two strong earthquakes in the Lerik region (26.06.2018 and 28.08.2018) around Talish and the Lesser Caucasus (**Fig.2)**.

For the first time in the territory of Lerik region, there was an earthquake in 26.06.2018 (ml = 4.5, h = 12 km). However, no seismo-abnormal variations are observed at any station.

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.30-33



Extension

Figure 2. The epicenter of Lerik earthquake near Talish in 2004-2017.

An earthquake occurred again in the Lerik region 2 months later, on 28.08.2018 (ml = 5.1, h = 15km). Geomagnetic observation assessment has sharply changed in the stations before the occurrence of the earthquake. As you can see from the map, 30-40 nTI (nanotesla) decreasing to a minimum valuation are recorded 10-15 days before seismomagnetic effect (**Fig.3**).

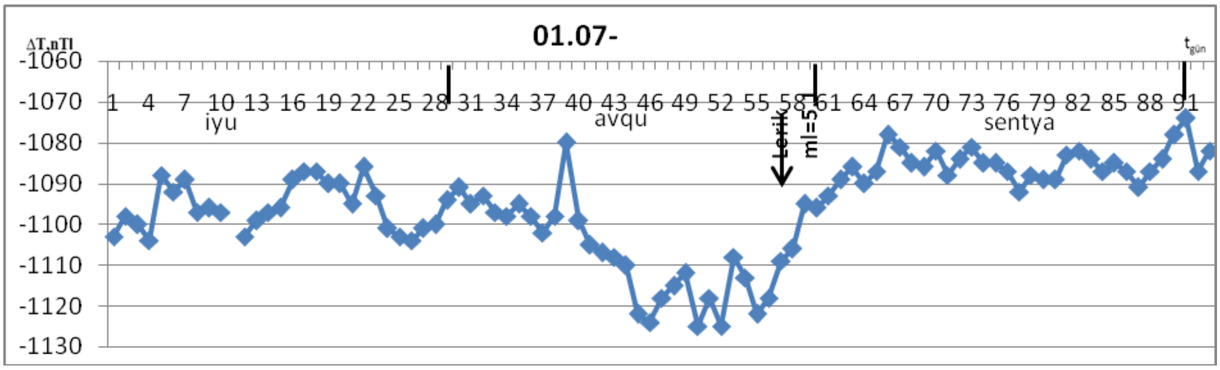


Figure 3. Seismic effect of the Lerik earthquake (ml = 5.1, 28.08.2018)

As can be seen from the created map, 15 days before the earthquake the value of the seismic effect is in the background, decrease to a minimum of 30-40 nTl during the earthquake and return to the background value after the earthquake.

It is supposed that the tension mechanism characteristic processes in the earthquake source according to the SME's abnormal changes have occurred. Looking at the Dynamics department's data, we see that there are tension characteristic processes in the source (Annual report of the Dynamics department of the RSSCof ANAS, Baku-2018) (**Fig. 2**).

An analysis of the geomagnetic field tension in the Kura side area - Talish geodynamic polygon shows that the tension in the mentioned polygon was distributed equally on the area.

Geomagnetic field full tension prices are almost gradually changed, with a range of 48900-49500 nTl. However, this feature is different in the Lerik-Lankaran-Astara districts of the Front Talish Zone. Thecondition of the observed high tension-deformation zone indicates that the increments of ΔT tension gradient are more than 100 nTI/km (I-zone).

II tension deformation zone located north of I zone is monitored there about high tension gradient ΔT 70 ÷ 100nTl in the Masalli-Jalilabad area.

The epicenter of the Lerik earthquake was recorded in the merging section of the above-mentioned tension zones. This territory is located in the intersection of Astara-Devechi transverse (Shabran) and the Talish lengthwise depth fault. The formation of the tension-deformation zone was discovered two or three years before the Lerik earthquake, as a result of discrete magnetometric observations.

At present, the tension of the zone continues to remain high and we would like to note that, the continuing process of re-accumulation of tension in the Talish zone despite the process of partly emptying the collected energy (**Fig.4).**

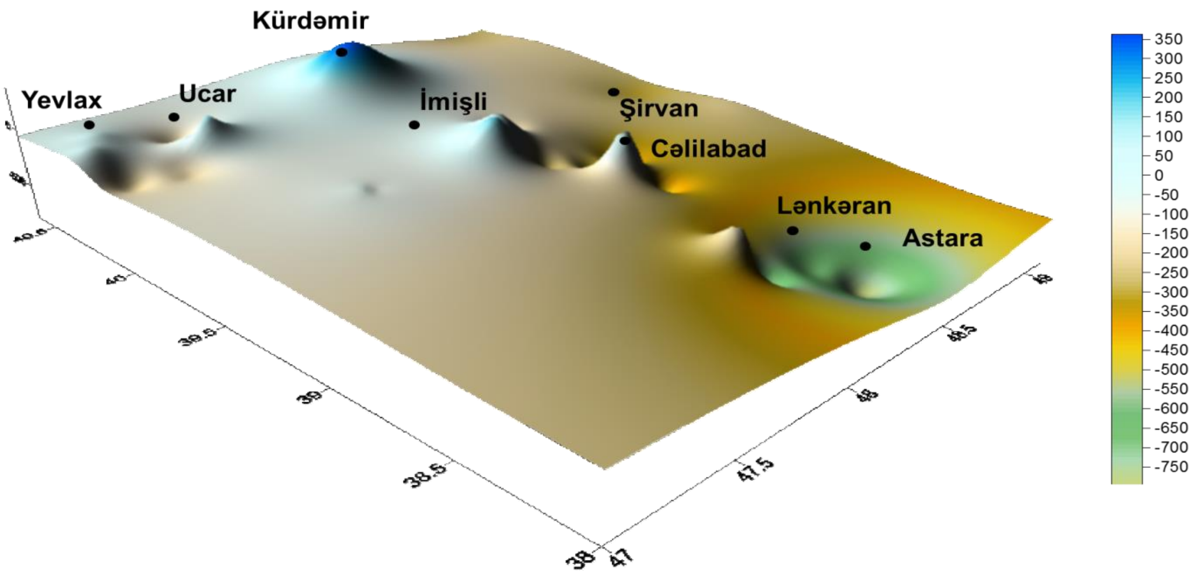


Figure 4. The tension-deformation condition of the geological environment based on magnetic data in the Kura side area-Talish polygon (3D format 2018).

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Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.34-37

EVALUATION OF THE TENSE SITUATION OF THE GEOLOGICAL ENVIRONMENT WITH THE GRAVIMETRIC STUDIES IN GOBU MASSIF

Baghirov E.M[1]., Ismayilova A.T.[1]

ABSTRACT. Evaluation of geodynamic conditions and the study of the fault-block structure of the consolidated layer according to non-tidal variations of the gravitational field to carry out construction work in Gobu massif.
***Keywords**: Gobu massif, gravity force, non tidal variations, gravimetric field.*

The gravimetric investigations were carried out on a polygon dedicated to the Gobu massif that the perimeter of 15282 meters (Fig.1) .

Figure 1. Scheme of the polygon on the Gobu massif

Re-measurement according to the relief of non-tidal variations of relative gravity force in the area was carried out using GC-5 Autograph device (Fig. 2) on 12 profiles that reflect 36 observation stationS in itself.

Figure 2. CG-5 AutoGraph gravimetry

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Gravitational acceleration was released on observation (scheme 1) of its differences between two stations. This method allows to increase the accuracy of measurement and it is estimated one of the leading methods for detecting depth faults, gradient zones, displacements occurring in the internal structure of the gravity force. This creates an opportunity to estimate the geological processes occurring in deeper layers of the Earth's crust and to analyze comprehensively the direct relationship between seismic activity in the research field.

A_1----B_1----A_2----B_2----A_3----B_3----A_4----B_4----A_5

Table 1

№ s/s	Observation point	g (м qal)	midline
1	2	3	4
1	1 ----- 2	2,446	0.0328
2	2 ----- 3	4,558	0.0299
3	3 ----- 4	7,892	0.0343
4	4 ----- 5	0,7833	0.0218
5	5----- 6	10,608	0.3031
6	6-----7	0,567	0.3095
7	7-----8	3,215	0.2980
8	8----- 9	0,537	0.2562
9	9 ----- 10	5,885	0.0274
10	10 ----- 11	21,492	0.0358
11	11 ----- 12	14,942	0.0382
12	12 ----- 13	2,752	0.0394
13	13 ----- 14	0,962	0,0213
14	14 ----- 15	4,356	0,0310
15	15 ----- 16	3,453	0,0309
16	16 ----- 17	11,898	0.0301
17	17 ----- 18	20,112	0.0277
18	18 ----- 19	3,673	0.0276
19	19 ----- 20	8,683	0.3193
20	20 ----- 21	5,318	0.0324
21	21 ----- 22	0,082	0.2430
22	22 ----- 23	3,894	0.2167
23	23 ----- 24	0,134	0.3200
24	24 ----- 25	2,111	0.3014

Table 1's extension

№ s/s	Observation point	g (м qal)	midline
1	2	3	4
25	25 ----- 26	1,947	0.0318
26	26 ----- 27	10,652	0.0272
27	27 ----- 28	10,339	0.0303
28	28 ----- 29	3,737	0.0294
29	29 ----- 30	0,432	0,0316
30	30 -----31	12,361	0,0319
31	31 -----32	2,134	0,0218
32	32 -----33	3,588	0.0317
33	33----- 34	3,692	0.0334
34	34----- 35	7,87	0.0341
35	35 ----- 36	3,401	0.0329

Seismoprogn. Observ. Territ. Azerb. V.15, №1, 2018, pp.34-37

Scheme 1.

The main purpose of the research work is to study the fault-block structure of consolidated crust according to non-tidal variations of the gravity force for construction works in the Gobu massif and on the basis of this to evaluate the geodynamic conditions occurring during the formation of structures attracting by geophysical data complex in that area. Thus, the results of the gravitational re-measurements of the gravity force observed during the 2013-2014 period are given in Table 1.

Speaking about the changing character of gravity force variations according to time between the observation points, it means the results obtained in the research area have been described in the form of a map and three-dimensional model (Fig.3-4).

Zones, profiles, observation points and hazardous areas accompanied by Δg are precisely covered in the isoanomal map of the gravitational field (Fig. 3).

As seen from observations, the increase in the relative gravitational force between the stronghold practice point is a changeable character in the III, IV,V,VI and IX, X profiles addition to other profiles. Most of all, it is more profitable in the III and VI profiles.

It changes from 0.076 to 5.36 mGal in the I and II profiles. Gravity force variations is observed from 5,885 to 21, 492 in the 10-11 observation points in III profiles with intensive changes of gravity force , in the IV profile in 12 points, to 11,898 in the V profiles in 12 observation points, to 20,112 mGal in VI profils in the 18th point, from 0,432 to 12,361 mGal in IX profil in the 27-28th points and it is reflected incompatibility of the gravity force assessment in itself in dimensions (Fig. 3).

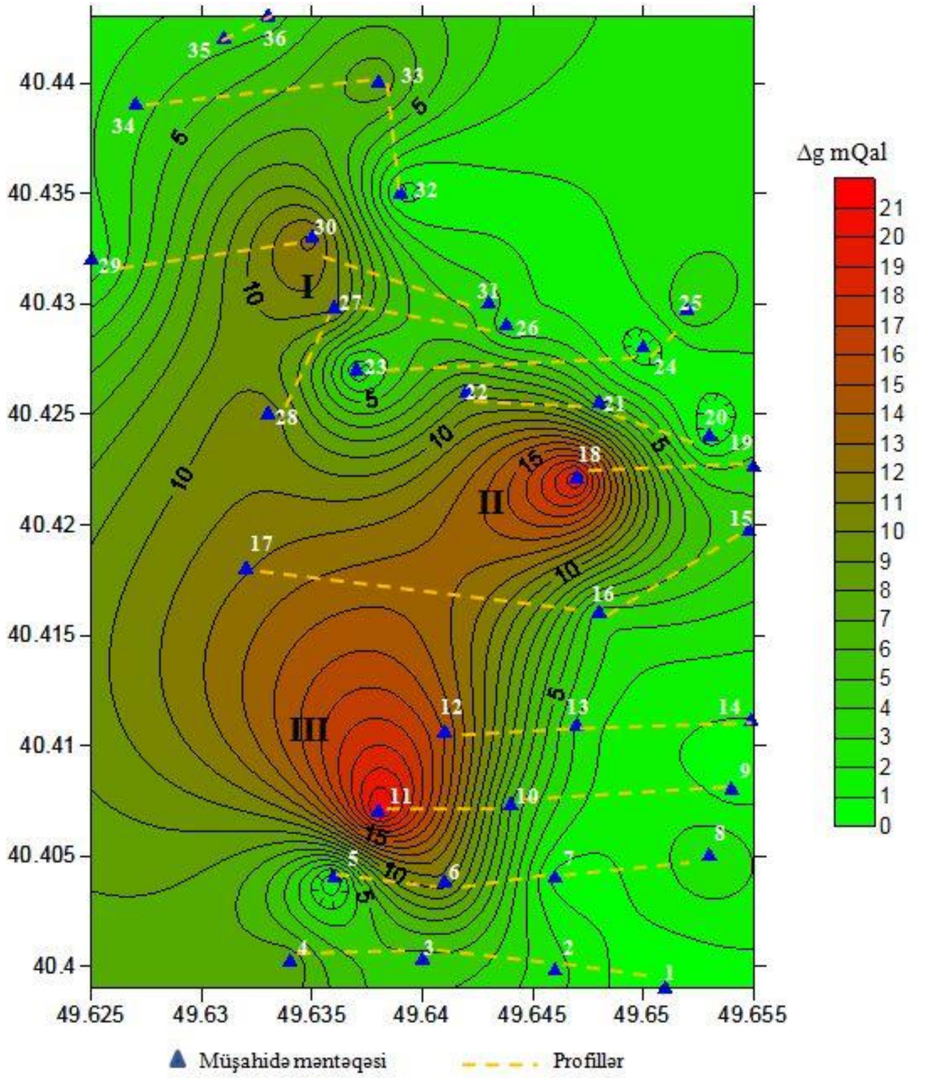

Figure 3. Isoanomal map of the gravity field at the research polygon

As can be seen from the descriptions, the studied area which will function as a living place in the future has a generally relative, calm geodynamic situation but we can not say it in different areas.

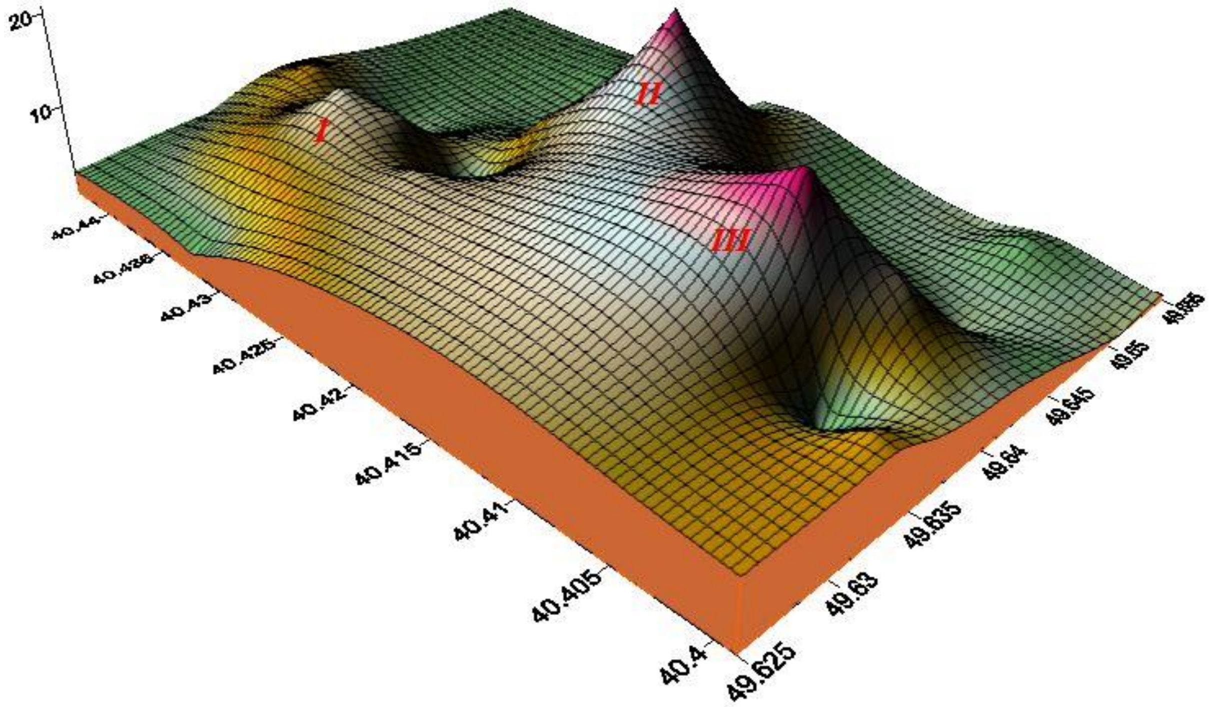

Figure 4. 3D model of the gravitational field at the research polygon

Thus, in the local anomalous areas (I, II, III areas) in the northern and southern parts, the mass of mountain rocks can create a basis for formation the cracks according to tense situation of geological environment the expense of gravitational landslide on the upper layers and the results of the repeated gravimetric measurement works confirm it. Construction of multi-storey residential buildings in the mentioned local anomalies area is unacceptable. In these areas, construction of parks for residental areas, entertainment small town for children, stadium and other objects can be built.

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CONTENTS

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