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SEISMOPROGNOSIS OBSERVATIONS IN THE TERRITORY OF AZERBAIJAN

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Republican Seismic Survey Center of
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SEISMOPROGNOSIS OBSERVATIONS IN THE TERRITORY OF AZERBAIJAN

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STUDY OF ABNORMAL CHANGES OF GEODYNAMIC TENSION BY GRAVIMAGNOMETRIC INVESTIGATIONS AND ECOGEOPHYSICAL RISK ASSESSMENT
(On the example of Garadagh gas reservoir)

G.J. Yetirmishli[1] , H.O. Veliyev[1] , N.B. Khanbabayev[1]

President of the Azerbaijan Republic Mr. İlham Aliyev instructed SOCAR to bring the capacity of Garadagh and Qalmaz gas reservoir to a level of 6 billion m^3. Currently, scientific and practical research is being carried out in this direction. In order to not being ecologically hazardous in the future operation of expanded and capacity-increasing gas storage facilities, seismic risk and seismic zoning works and activation of tectonic fractures should be constantly monitored. Proper assessment of environmental risk and study of factors to prevent the danger of anomalous geodynamic tension of energy increase in gas-bearing layers are one of the most pressing problems of the day.

The Garadagh gas reservoir is located 30 km south-west of Baku. There are mud volcanoes such as Korgoz (396 m), Baku Gulagh (383 m), Garagush (389 m) and Osmanbozdag (392 m) and these volcanoes are activated at certain times. The Garadagh gas storage area is one of the regions with high seismic activity, and there are some major depth fractures.

Recent years seismic activity maps have shown that activity in the mentioned areas has increased (Fig.1). Strong earthquakes in the fault of Adjıchay-Alyat, Kura Palmir-Absheron create a high intensity seismic hazard for Garadagh and Galmaz gas reservoirs [4]. The Baku earthquake occurred on 25 November 2000, consisted of two seismic shocks (M =5,8 and M=6,2) and was accompanied by numerous aftershocks. An earthquake in the Garadagh gas storage area was felt intensely at 6-7 points on the MSK-64 scale. Increasing the capacity of the warehouse, taking into account the above, should be adjusted so that the changes of depth geodynamic-tectonic changes do not cause anomalous activation of the mentioned mud volcanoes and also do not activate these tectonic faults. The maximum magnitude of the probably earthquakes in potentially powerful earthquake sources in fault zones within Garadagh gas reservoir area are $M = 6{,}6 \div 7{,}4$, depths $H = 15\text{-}30$ km and their seismic effect on the ground surface is estimated between I = 8-9 depending on the depth of the sources. It is clear from the analysis that the investigation research of manifestation properties of numerous powerful earthquakes on the Earth's surface, being the low depth and high magnitude of earthquakes results in the formation of fracture on the surface of the pleystoseist zones. Earthaquakes with magnitude of M=6.5 and depth of $H=10\div15$ km and stronger ($M\geq7.5$) earthquakes located slightly deeper ($H=25\div35$ km).

Great Garadagh group of mud volcanoes being a total uplift located on the bed area is made up of breccias erupted in ancient times and extensive cones of volcanoes Pilpile, Akhtarma - Torpagli and Akhtarma volcanoes. Pilpile volcano is located on the central axis of the folded area and it consists of a crater with a diameter of 42 meters and 5 griffins, which are oil and gas separated in the period. Searching with soil mud volcano is located in the center of the folded area and consists of 6 griffin seperating gases, gas, water and mud inside. The largest Akhtarma mud volcano in this area is located in the eastern part of the folded area .It consists of 35 different sizes of griffin separating gas, water, mud inside with a diameter of 100-150 m .

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Absheron, Aghchagil floors, Productive layer, Maykop layer detachment opened in deep wells, Chokrak, Diatom and Pont sediments are involved in the geological structure of the Garadagh oil field.

Garadagh area is located in the south of the Absheron secondary sedimentary. Depending on productive sediments layer, the Garadagh anticlination is a laying folded area in the direction of width-circle. The eastern part of its northern wing extends by cranked rotating in relative meridional direction. The folded area is asymmetrical. The northern wing is small and less tendecy and the major part stretched in the width direction of Garadagh anticlinal sourthern wing is larger. Ruptural deformation with amplitude of 200-300 m is recorded along the length of the structure. A a result of the tectonic faults, the southern wing of the structure which is wider, sustainable and lying underneath the acute angle has been normal fault. The size of the structure is 15×6÷8km.

Re-specification of the geo-tectonic structure of underground gas reservoir (UGS), which is of exceptional importance in the development of the oil and gas industry of the Republic is one of the major problems and this is always in the spotlight of geologist-geophysics. Garadagh deposit was commissioned as a reservoir that pumped gas for the first time in 1986 (VII Horizon). This horizon covers the southern wing of the deposit and it is known that this deposit had a large gas reserve in the past. Therefore, depending on the volume of gas injection into the reservoir, conducting of the geophysical (gravimagnometric) research regularly is very important in this area.

Seismic hazard should be monitored regularly at expanded and capacity-increasing gas reserves in order to avoid irresistible hazards in its environmental activities in the future .One of the most actual issues is prevention of danger in advance that may arise from increasing of anomalous geodynamic tension energy. The territory of Azerbaijan is one of the regions with high seismic activity and there are some major depth faults that are seismically active. There is a sharp increase of seismic activity in the areas of seismic activity maps recorded in recent years (Fig. 1). Strong earthquakes in the fault zones of Adjichay-Alyat,Kura, Palmir-Absheron create seismic hazard with high intensity for gas reservoir.

It is clear from the analysis of investigation and results of the complications of many powerful earthquake mechanisms and parameters on the Earth's surface,the earthquakes have high magnitude and their depth is relatively low and this causes the formation of cracks in the various levels in pleystoseist zones. The violation of hermeticity and the process of migration of gas into the ground surface (leakage) may occur at this time in the gas reservoir. To avoid environmental disaster, possible impact effects on earthquakes that may occur in research areas and nearby areas to gas reservoir should be investigated in detail. Taking into consideration the geological-tectonic structure of the gas reservoir, Gravimagnometric regime observation works should be performed in the area and adjacent areas. It is necessary to create a gravimagnometric practice support point 10-12 observatory taking into account faults and blocks found in the field of research till now according to seismic and gravimagnometric data. To solve geological and technical issues in the reservoir and adjacent areas, carrying parallel gravimetric profiling works with magnetometric regime observation works (Fig. 2), creation of the local anomaly(tension) maps for different levels taking into account the change in the density effect increasing or decreasing of the gas volume injected and extracted and environmental risk assessment are recommended.

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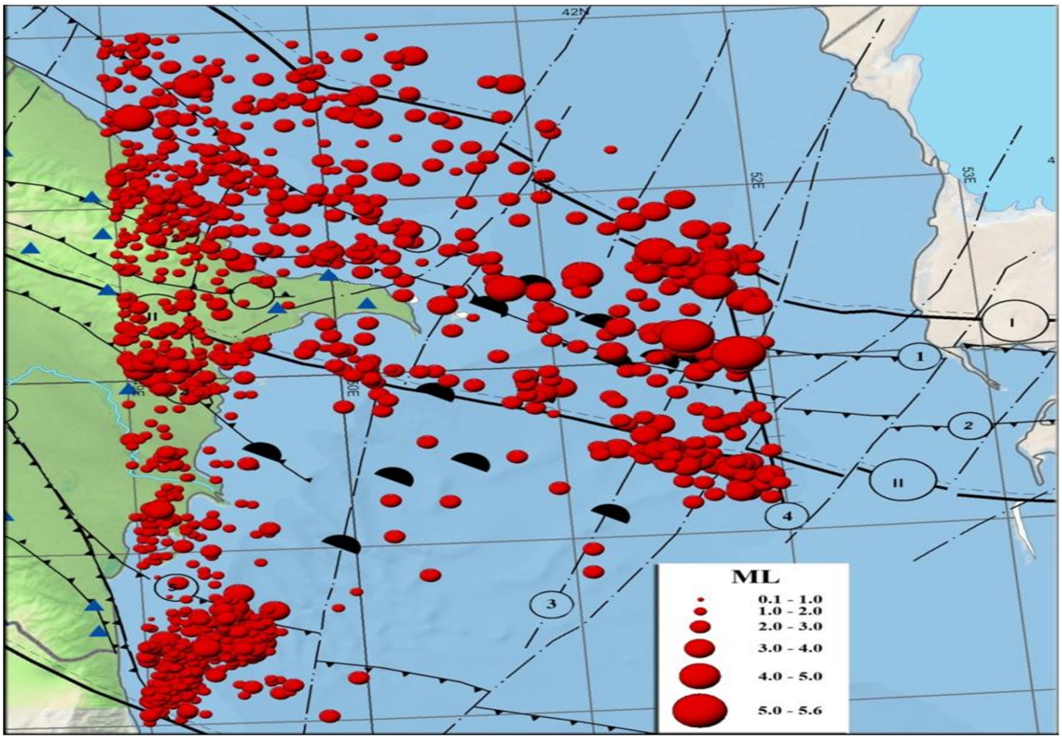

Figure 1. Map of earthquakes' epicenters occurred in the Caspian Sea and nearby regions in 2014-2016 [4].

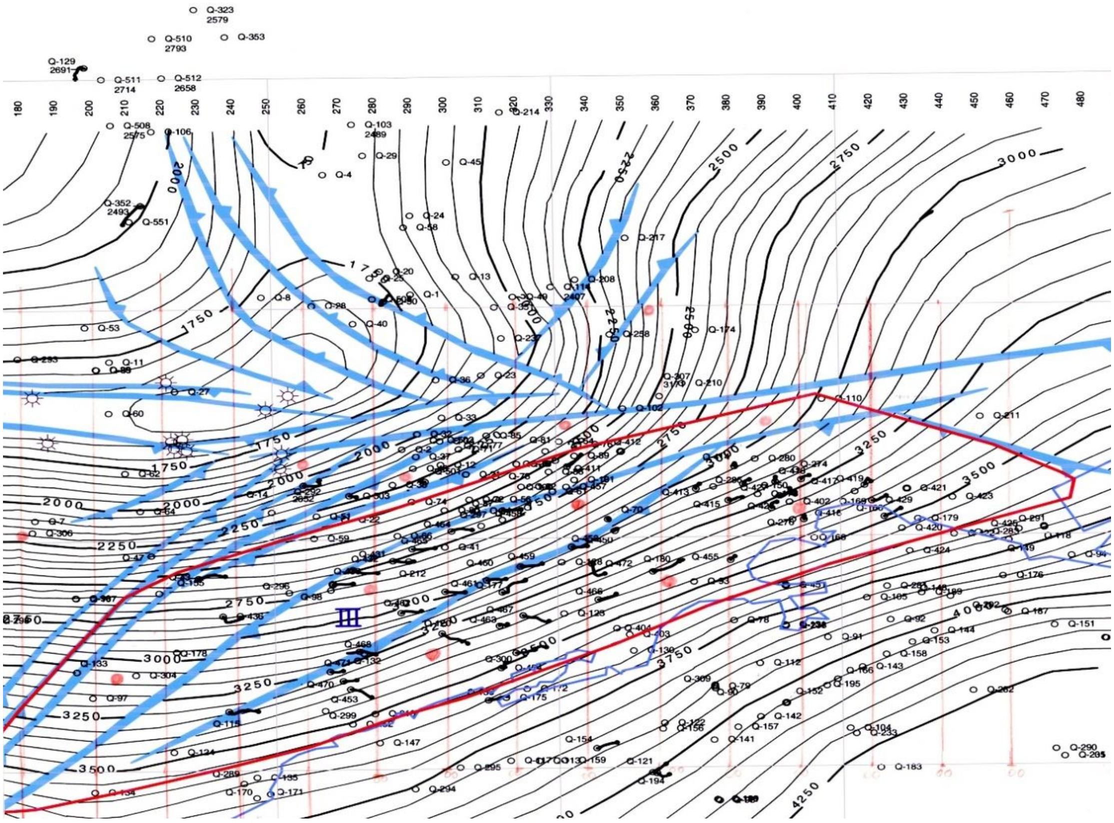

Figure 2. The layout scheme of the gravimagnometric project profiles intended for operation compatible [5] Fasile layer detachment in the Garadagh gas reservoir facility

- Territory of Garadagh gas reservoir

- Preparation intended project profiles

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REFLECTION OF THE GEODYNAMIC REGIME OF THE SHAMAKHI-ISMAYILLI SEISMOGENIC ZONE IN LOCAL ANOMALIES OF THE GEOMAGNETIC FIELD

A.G.Rzayev[1], N.B.Khanbabayev[1], M.K.Mammadova[1], L.A.Ibragimova[1]

Introduction

The Shamakhi-Ismayilli earthquake of February 5, 2019 (ml = 5.2, h = 8km, φ = 40.78, λ = 48.46) is confined to the well-known Shamakhi-Ismayilli seismically active zone, the pleistoseist region of which is located within the south-east segment of the Greater Caucasus.

The zone is characterized by a complex step-block structure, complicated by a series of steeply dipping transverse and longitudinal faults. These faults, characteristic of the pre-Alpine base, transform into sloping upthrusts and thrusts during the transition to the Meso-Cenozoic complex (Ahmedbeyli et al., 2010).

In this article, on the basis of daily monitoring of the full vector of the geomagnetic field intensity, an attempt has been made to isolate violations of the course of the lunar-solar Sq variations of the T intensity of the geomagnetic field, the nature of the manifestation of the seismomagnetic effect and the spatio-temporal changes in the T gradient of the geomagnetic field before the tangible Shamakhi-Ismayilli earthquake 05.02.2019 (ml=5.2).

Seismo-tectonic characteristics of the Shamakhi-Ismayilli zone

The seismotectonic feature of the Shamakhi-Ismayilli seismogenic zone lies in the confinement of the main number of earthquakes to the Adjichay-Alyat and Germain upthrust-overlap. The West Caspian and North Ajinour strike-slip fault also have a great influence on the seismicity of the zone. The Zangi-Kozluchay, Goychay, Vandam and Dashgil-Mudrese upthrust-overlap structures located to the west of the West-Caspian Fault, confined to the Shamakhi-Ismayilli seismogenic zone, exert a rather high seismic activity within the Shamakhi-Ismayilli seismogenic zone (Shikhalibeyli et al., 1978). Deep penetration of the roots of the Adjichay-Alyat and Germain faults to depths of 15-25 km, i.e. before the Alpine base, forms their thrust structure. As for the source mechanisms within the zones of influence of the Adjichay-Alyat and Germain thrusts, the nodal planes of which are oriented in the NNW or NNE strike, i.e., perpendicular to the strike of the faults themselves and having a fault or strike-slip fault character, this can be explained by active dynamic influence of the West-Caspian fault in its close proximity to the Shamakhi-Ismayilli zone (Sherman S.I. et al., 1991).

The sources of earthquakes in the Shamakhi-Ismayilli zone are associated, as was shown in (Metaxas et al., 2011), both with overlaps-upthrusts of the NW-SE direction, as well as with the strike-slip fault movements along the West Caspian fault.

It should be noted that faults in the Shamakhi-Ismayilli seismogenic zone (both longitudinal and transverse) are in the stage of high activity characteristic of the preparation cycle of strong seismic events. At the same time, according to the degree of activity, the West Caspian and Adjichay-Alyat to the east of it can be considered the most active faults, then the Vandam thrust and less active - Dashgil-Mudrese and Germain thrusts (Metaxas et al., 2011).

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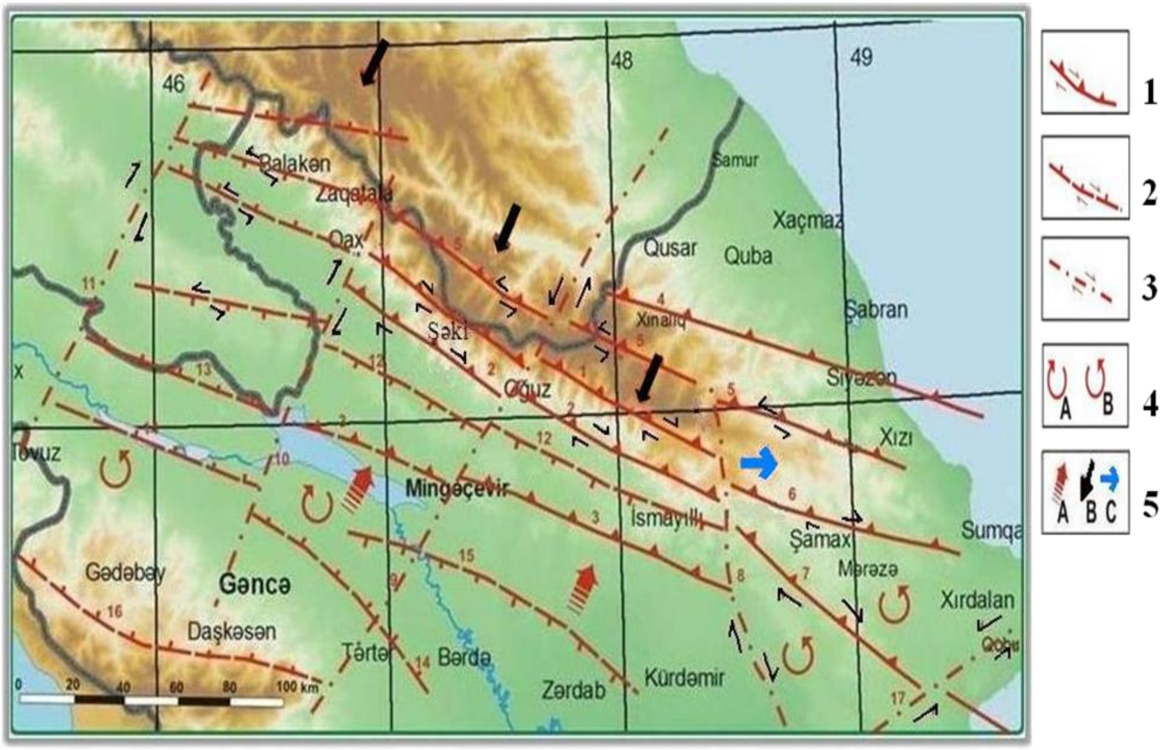

Figure 1. Scheme of the fault structure and features of the geodynamic regime of the southern slope and the southeast immersion of the Greater Caucasus

The main seismogenic faults that determine the features of the geodynamic regime of the Earth's crust: 1-upthrusts, 2-faults, 3-shifts (arrows indicate the direction of horizontal movements). Up thrusts: 1-Dashgil-Mudrese, 2-Vandam, 3-Geokchay, 4-Siyazan, 5-Zangi-Kozluchay, 6-Germain, 7-Adjichay-Alyat. Shifts: 8-West Caspian, 9-Arpa-Samur, 10-Ganjachay-Alazan, 11-Gazakh-Signakh. Faults: 12-North-Ajinour, 13-Ior, 14-Kura, 15-Mingachevir-Saatli, 16-Bashlybel, 17-Palmir-Absheron. Elements of geodynamics: 4- Torsion of blocks: A-clockwise, B-counterclockwise.5. Horizontal movements: A-under thrusts, B-thrust, C-shift.

Monitoring network of geomagnetic observations

The monitoring network of variations in the intensity of the geomagnetic field at the RSSC ANAS covers the zone of the south-eastern immersion of the Greater Caucasus, the middle and lower parts of the Kura depression, and the Near Talysh zone of the Lesser Caucasus (Fig.1). Actually, the Shamakhi-Ismayilli seismogenic zone is confined to the Sheki-Shamakhi geodynamic site.

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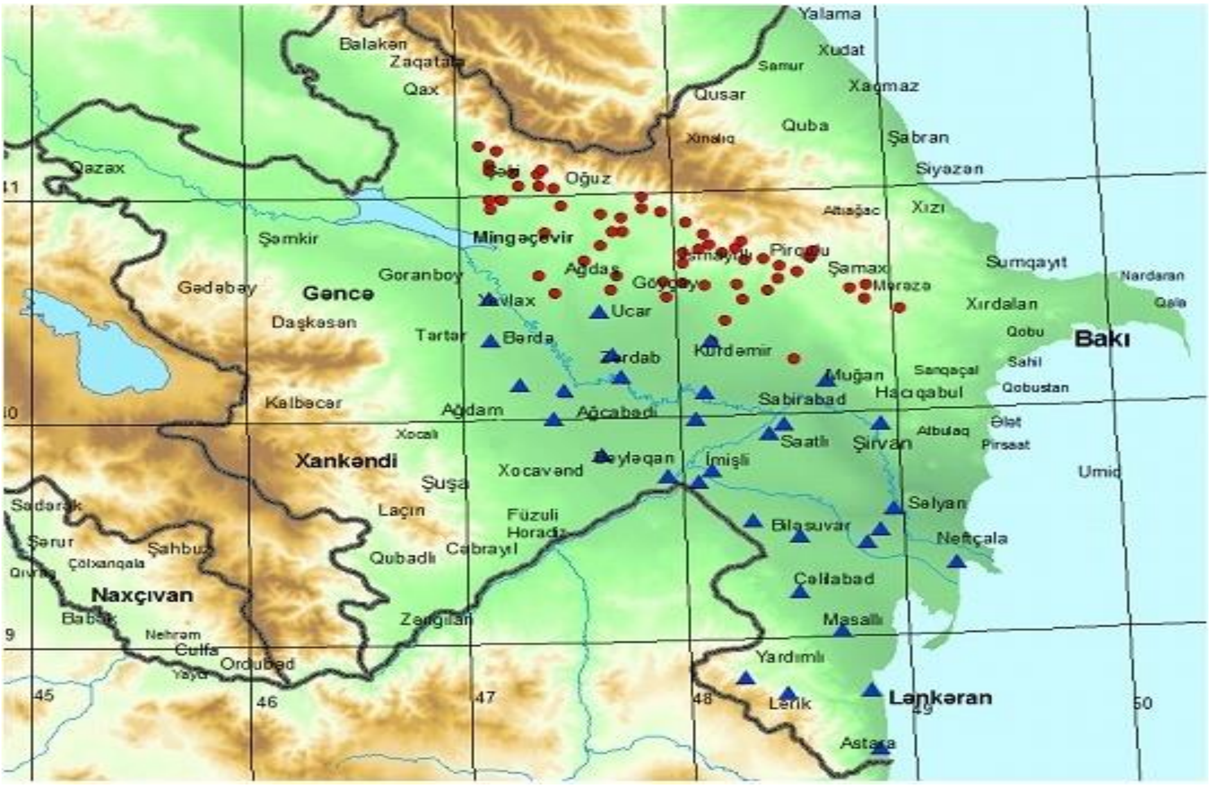

Magneto-variation stations

Magnetic points of repeated visits at the Sheki-Shamakhi prognostic site

Magnetic points of repeated visits on the Near-Talysh prognostic site

Figure 1. Map of location of magnetic variation stations and magnetic strong points of repeated visits at Sheki-Shamakhi and Near Talysh-Kura geodynamic sites.

In the framework of this work, magnetometric studies of the seismomagnetic effect (SME) and evaluation of the stress-deformed state of the earth's crust in seismogenic zones were carried out at the Sheki-Shamakhi geodynamic site in two directions:

1. Round-the-clock monitoring of variations in the total vector of the geomagnetic field strength T ~ f (t) (including daily solar Sq~f (t) variations).

2. Monitoring of spatio-temporal changes in the gradient of the geomagnetic field intensity on the area of the site (ΔT ~ f (t)).

The work was carried out on the basis of G-856 magnetic variation station (MVS) (Geometrics) in the amount of 8 MVS and 70 rigidly fixed points of repeated visits to the site area using the G-856 Geometrics hand-held proton magnetometer (Fig.1).

The discussion of the results

In order to establish the uniformity of the geomagnetic variations in the Shamakhi-Ismayilli zone, the daily solar diurnal Sq-variations due to the daily rotation of the Earth and almost motionless relative to the "Center of the Earth-Sun" line were analyzed. Most of the Sq-variations are due to external ionospheric factors and can be attributed to noise interference in the analysis of seismomagnetic effects in the magnetic layer of the earth's crust (Rasulov, 2007).

Figure 2 presents examples of time diagrams of Sq variations of Sq~f (t) at Ismailly, Pirgulu, Lankaran, Sheki, and Zagatala magneto variation stations.

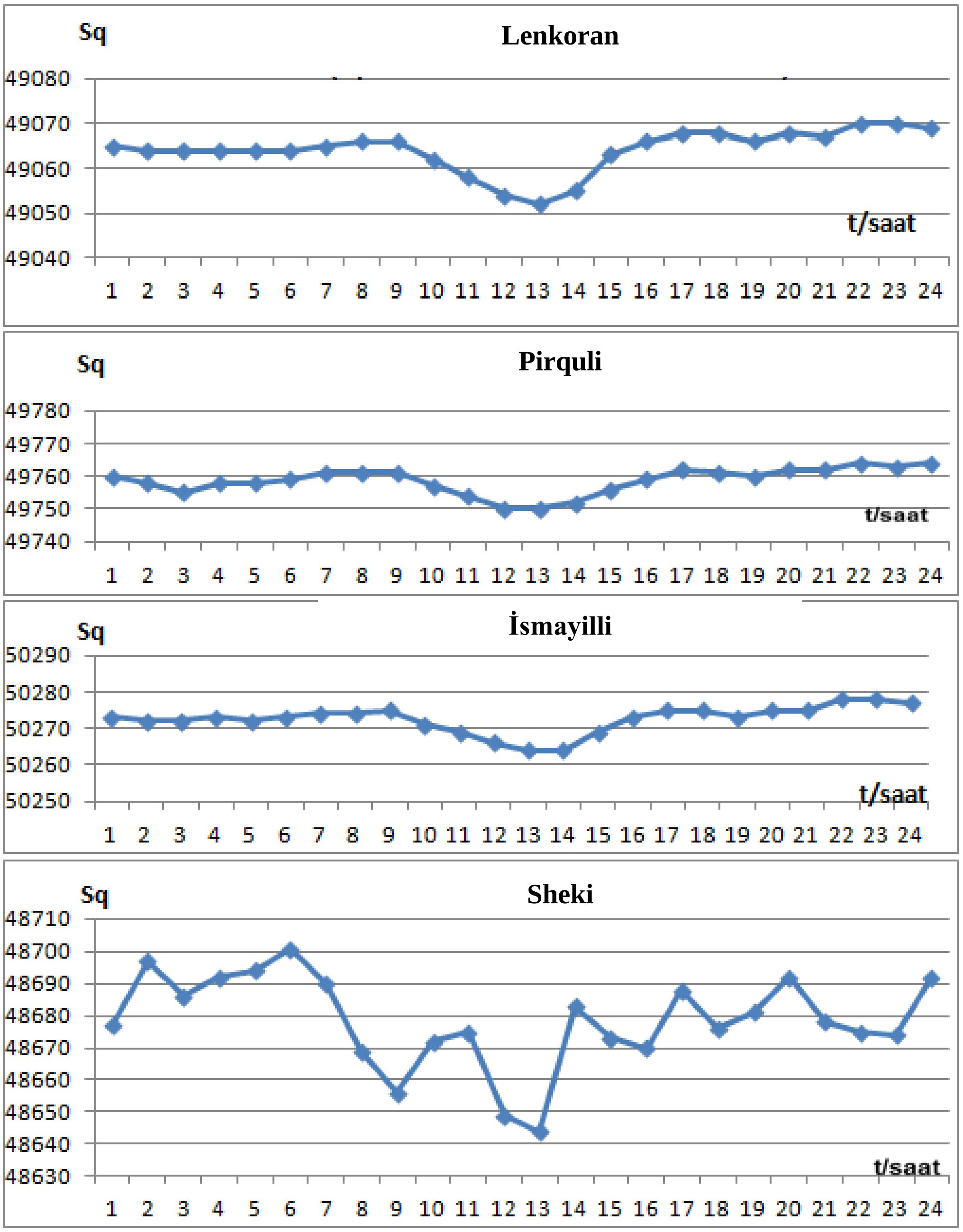

Figure 2. An example of the normal course of Sq variations in the Shamakhi-Ismayilli seismogenic zone and in the Near Talysh zone of the Lesser Caucasus

As can be seen from Fig.2, variations have a quasi-sinusoidal character with distinct local minima of tension in the period of 12-13 hours and long-period maxima of tension at night in the period from 22 hours to 08 hours of the morning.

The uniformity of the flow of Sq-variations over the entire observation area indicates the uniformity of the fall of the front of an external electromagnetic wave. Any visible disturbances in the ionosphere do not appear.

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A month before the earthquake of February 5 2019 (ml=5.2, h=8), there is a violation in the uniformity of the flow of solar-diurnal Sq-variations (Fig.3).

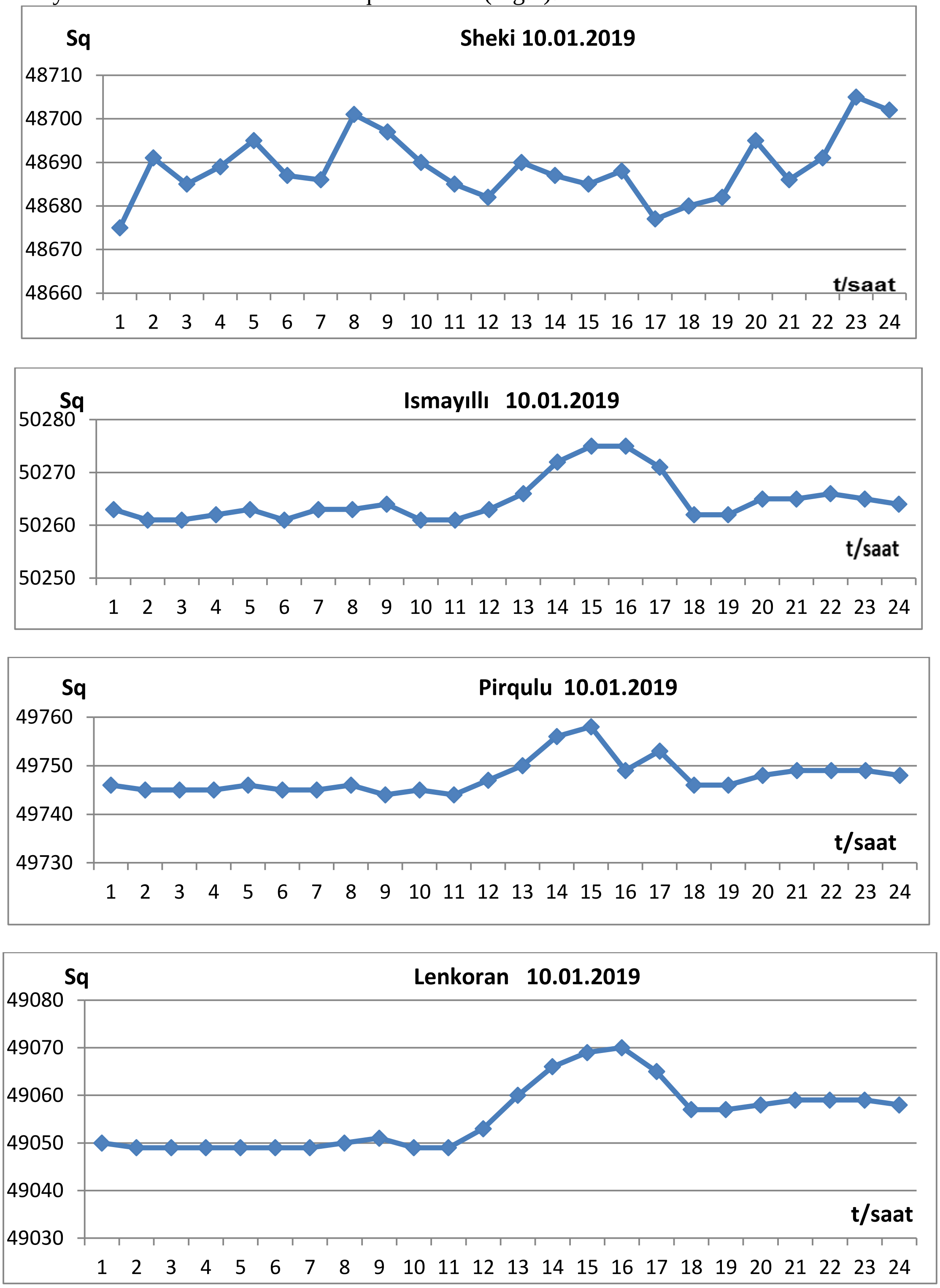

Figure 3. Disruption of the normal course of Sq - variations before the earthquake of February 5, 2019 (ml=5.2)

Taking into account the fact that Sq-variations are mainly caused by external causes, it can be noted that at the final stage of preparing the Shamakhi-Ismayilli earthquake source, there was an active emanation of electro-magnetic energy from the source to the atmosphere, which caused the ionospheric disturbance in the focal zone and, as a result, disturbances in the normal course of the external component of the Sq-variations.

In Fig.4 the time series of the ΔT ~ f (t) intensity values of the geomagnetic field normalized to synchronous field measurements at the Sheki base station is presented. The values of ΔT ~ f (t) are filtered from the influence of the ionospheric factor and are mainly determined by the geodynamic (seismotectonic) process in the earth's crust and the transformation of the residual magnetization of rocks in the earth's crust under their influence.

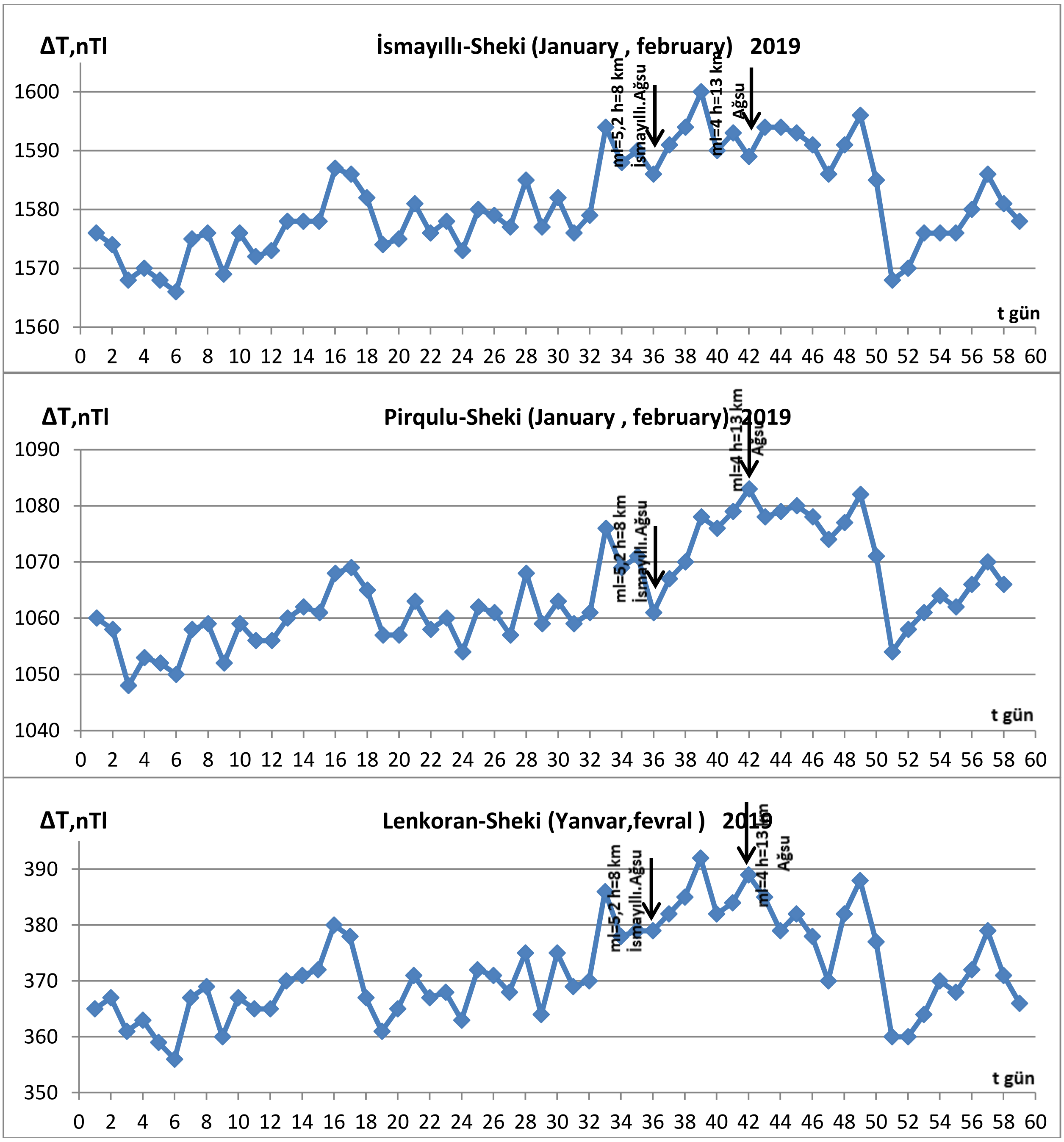

Figure 4. Magneto-variational curves of the increment of the geomagnetic field strength ΔT ~ f (t)

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The seismic anomalous effect is clearly traced on the graphs, anticipating the main impetus of February 5, 2019. The amplitude of the precursor anomaly is about 20 nT. There is a positive increment in the intensity gradient of the geomagnetic field indicating the predominance of compressive stresses in the focus. Taking into account the location of the earthquake source in the geodynamic influence zone of the West Caspian right-sided shift fault and the Adjichay-Alyat right-sided up thrust fault, and also taking into account the nature of the increment of the geomagnetic field intensity gradient, it is possible to assert the formation of compressive elastic stresses in the source zone to the direction of the main geomagnetic field (N-NE) and shift right-sided stresses along the seismogenic fault line.

The formation of a long-period seismomagnetic maximum under the action of compression deformations observed after the main shock indicates that excessive stresses remain until the end of the implementation of the aftershock activity in the source zone, after which the background level of the geomagnetic field tension relaxes.

Analyzing the space-time changes in the geomagnetic field intensity gradient $\Delta T \sim f(t)$, we can come to the following conclusion. The accumulation of compression deformations occurred north-west of Shamakhi city, near the border of the Ismayilli region in the junction zone of the Adjichay-Alyat and West-Caspian faults. This is indicated by the maximum gradient of the intensity of the geomagnetic field in the vicinity of the city of Ismayilli (Fig.5).

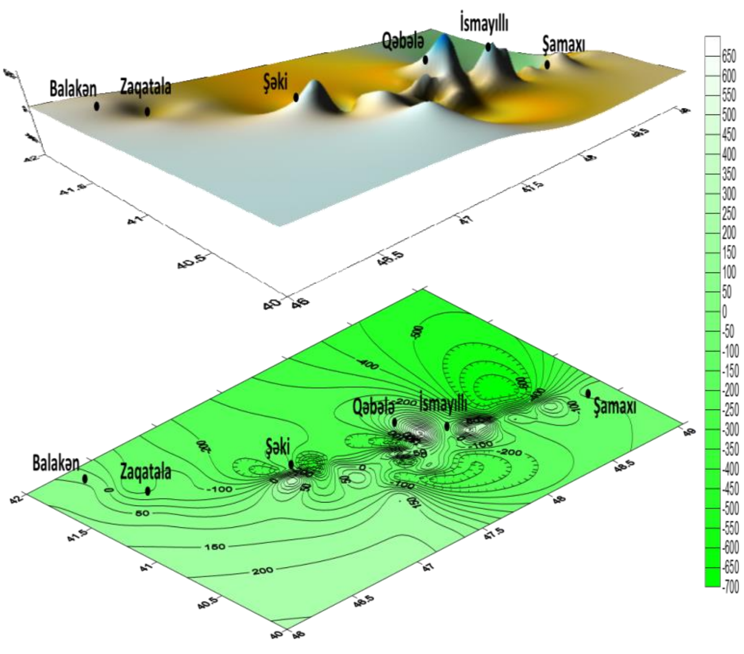
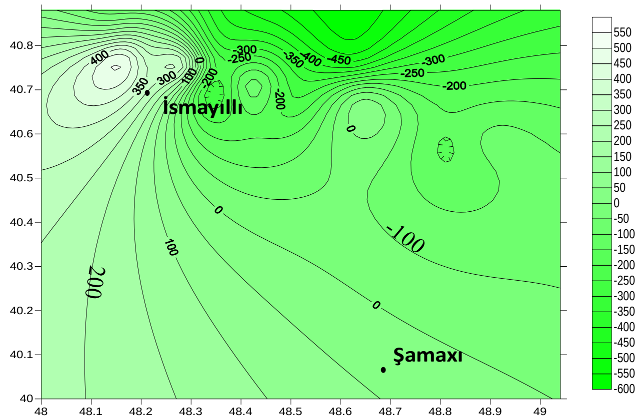


Figure 5. Stress-strain state of the geological environment during the preparation of the Shamakhi-Ismayilli earthquake of 05.02.2019 in 2D and 3D formats

In February 2019, after the Shamakhi-Ismayilli earthquake, elastic stresses near the town of Shamakhi (to the right of the West Caspian fault) are compensated (disappear). In this case, the compression deformation (the maximum of the intensity gradient ΔT) is redistributed to the zone of the Vandam offshore fault to the west of the West-Caspian fault-shift.

At the same time, no visible geodynamic activity is observed to the east of the West-Caspian fault in the vicinity of Shamakhi city (Fig.6).



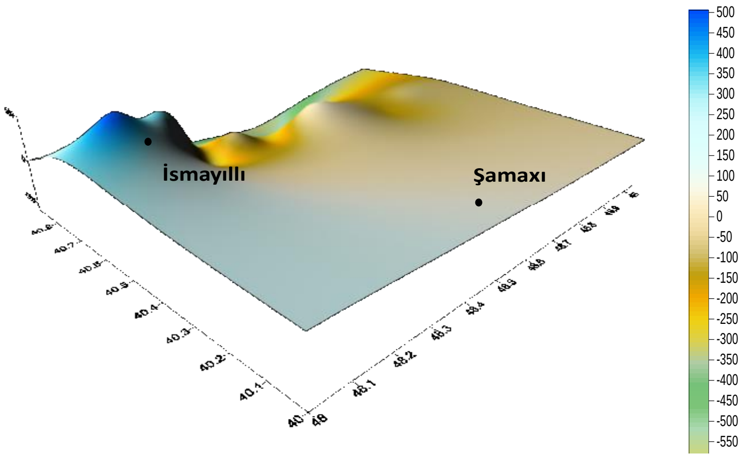


Figure 6. The stress-strain state of the geological environment of the Shamakhi-Ismayilli seismogenic zone in 2D and 3D formats (February 2019)

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This effect, namely the increased compression deformation in the Vandam Fault zone, is likely due to the intensification of translational movement of under thrust blocks of the Kura depression between the Arpa-Samur and Western Caspian faults under the upthrow-thrust structures of the south-eastern immersion of the Greater Caucasus, as was earlier stated in the work (5).

Conclusion

Based on the analysis of temporal and spatial-temporal features of the distribution of the full vector of the geomagnetic field strength in the Shamakhi-Ismayilli seismogenic zone, it was possible to simulate the features of the redistribution of stress deformations due to the geodynamic features of the crustal blocks and active faults developed both along the periphery and inside the Shamakhi-Ismailli seismogenic zone.

A picture of the connection of local geomagnetic anomalies with the stress-deformed state of the earth's crust in the Shamakhi-Ismayilli seismogenic zone is presented, namely, the geodynamic influence of the West-Caspian and Adjichay-Alyat faults on the formation mechanism of the Shamakhi-Ismayilli earthquake of February 5, 2019 (ml=5,2); the reflection of this influence in the features of local anomalies of the gradient of the increment of the intensity of the geomagnetic field.

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FOCAL PARAMETERS OF ISMAYILLI EARTHQUAKE OF OCTOBER 7, 2012

S.S.Ismayilova[1], S.E.Kazimova[1], G.I.Muradova[1], Sh.N.Khadidji[1], E.Kh.Muradova[1]

Introduction

Analysis of the results of seismic studies of the Azerbaijan part of the southern slope of the Greater Caucasus in recent years has shown that there is a tendency of the distribution of seismogenic zones along the borders of all-Caucasian structures. That is, with a general activation along the junction zone of the Kura depression and the Greater Caucasus (or the zone of underthrust), longitudinal faults occur along the transverse faults. As the analysis shows, in most cases, the hypocenters of earthquakes are located in the upper part of the Earth's crust, which indicates elastic deformations of the stresses of the Earth's crust.

Seismic information obtained from 35 seismic stations allows us to investigate the seismic regime of the considered territory, identify areas of seismic activity, establish focal zones, as well as the mechanisms of earthquake sources. The sources of earthquakes, as a rule, are confined to the boundaries of the tectonic blocks of the Earth's crust, squeezed in a band of collisional interaction of the Arabian and Eurasian plates, and are associated with their movements. Beginning in 2012, an outbreak of seismicity was observed on the southern slope of the Greater Caucasus, which was accompanied by the occurrence of a number of strong earthquakes with a magnitude higher than 5.0, one of which was the Ismayilli earthquake.

Macroseismicity

The macroseismic field was studied using the ELER v3.0 program. The intensity at the epicenter of this earthquake on a 12-point scale was estimated at 6 points (Fig. 1), in the nearby settlements of Pirkulu, Shamakhi, Ismayilli, Akhsu, the earthquake was felt up to 4-2 points. According to instrumental observations, the coordinates of the earthquake are: φ = 40.70ºN, λ= 48.35º E and the depth is 41 km.

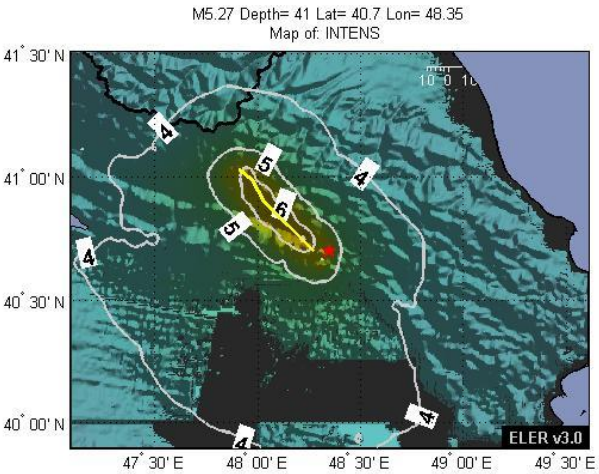

Figure 1. Isoseist map-scheme of the Ismayilli earthquake of 07.10.2012

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

According to the data obtained for the Ismayilli earthquake by RSSC ANAS were compiled schemes of distribution of accelerations (PGA) and velocities (PGV) of the soil (Fig.2). The PGA value was 0.25 g, and the PGV value was 10 cm/sec.

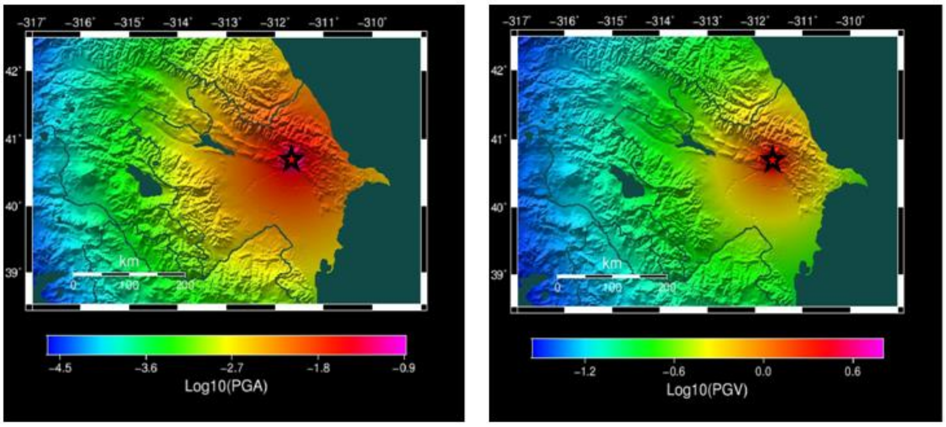

Figure 2. Schemes of the distribution of accelerations (PGA) and velocities (PGV) of the soil of the Ismayilli earthquake

Seismicity

The Shamakhi-Ismayilli focal zone is located within the south-eastern segment of the Greater Caucasus and is characterized by a complex step-block structure. It is supposed [Ahmedbeyli et al., 2010] that the tectonic steps in the pre-Alpine basement are complicated by a series of steeply dipping, forming lowered and elevated blocks of transverse and longitudinal faults, which in the Mesozoic-Cenozoic complex were transformed into gentle upthrusts and thrusts. Based on the works [Kerimov, Shikhalibeyli, 1992 and Kengerli, 2007], a diagram of the main elements was compiled, on which the epicenters of earthquakes within the study area with ml≥0.5 for 2012 of the discontinuous tectonics of the Shamakhi-Ismayilli focal zone (Fig. 3) are applied. For the 2012 year, 298 shocks were recorded within the Ismayilli seismogenic zone. Of these, 7 earthquakes were with the magnitude ml≥3.0, 2 of which were felt. Figure 5 shows the wave record of the Ismayilli earthquake on the HHZ component.

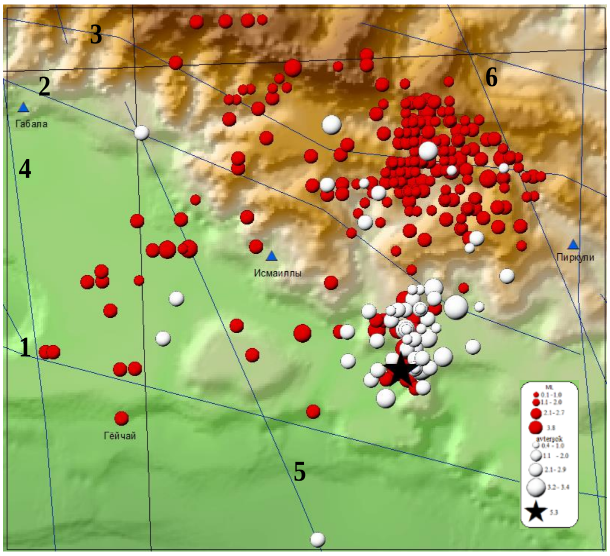

Figure 3. Map of the epicenters of the main shock and aftershocks of the 2012 Ismayilli earthquake.
Faults: The All-Caucasian Direction: 1 - Alazan-Agrichay-Alyat; 2 - Vandam;
3 - Dashgil-Mudrasa; Orthogonal faults: 4 – Chakhirli-Gabele; 5 - Ismayilli-Gabele; 6 - Tairaljachay-Salyan

On October 7, after a strong shock, 23 aftershocks were registered on the first day (Fig. 4).

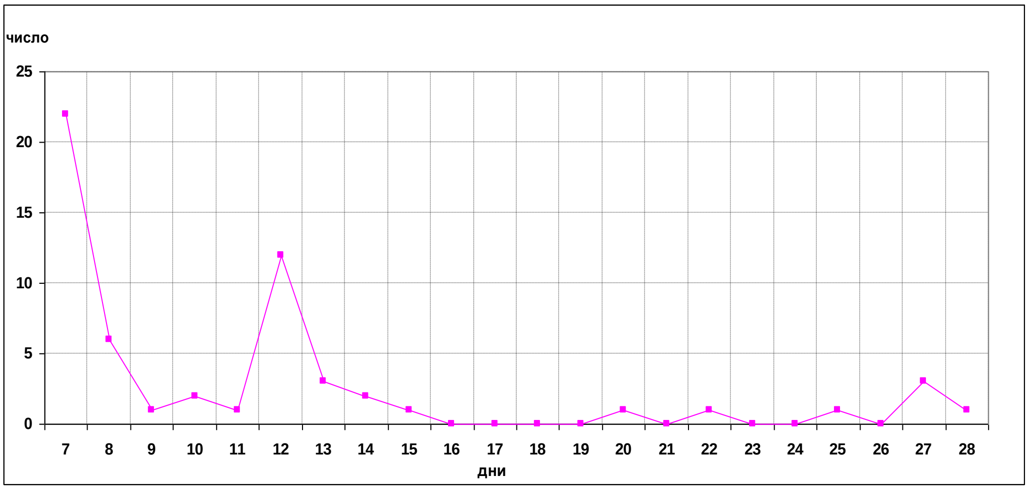

Figure 4. Histogram of the aftershocks of the Ismayilli earthquake of October 7, 2012

Analysis of aftershocks in the focal zones shows that, starting from October 28, a sharp decrease in the number of earthquakes is observed. Seismicity decreased to background level. Chart 5 shows that starting from April (except for July), seismic activity decreases, and already in September, seismic energy from $0.001 \cdot 10^{11}$J increased to $0.065 \cdot 10^{11}$J and reached its maximum in October equal to $14.8 \cdot 10^{11}$J.

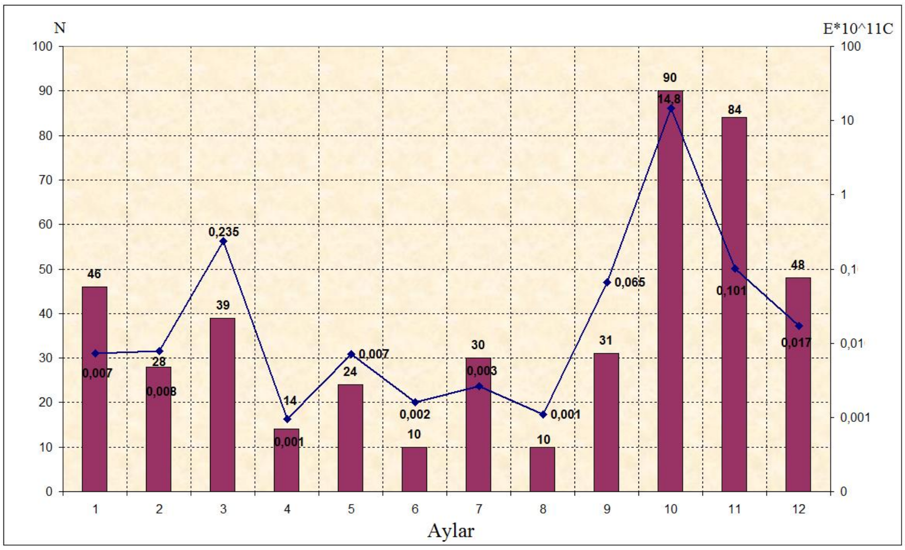

Figure 5. Histogram of the distribution of the number of earthquakes and seismic energy released in Ismayilli region

According to archive macroseismic data, in this zone since 1915, 34 (not more than 7 points) strong earthquakes (Fig.6) were recorded [2].

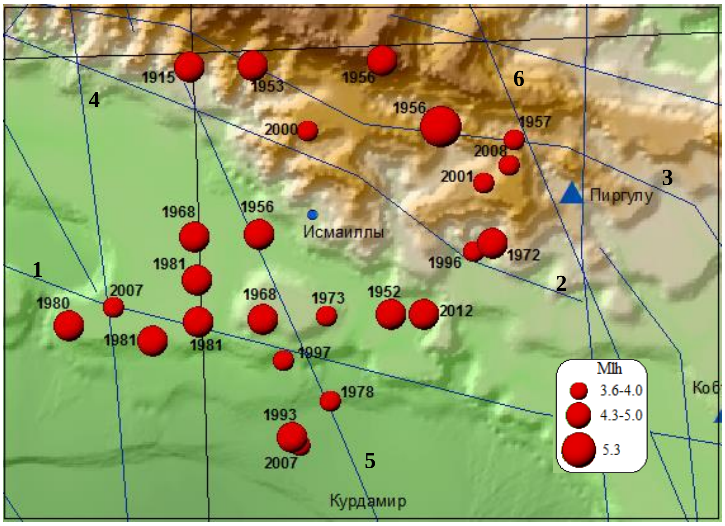

Figure 6. Map of epicenters of historical earthquakes in the Ismayilli seismogenic zone.
Faults: The All-Caucasian Direction: 1 - Alazan-Agrichay-Alyat; 2 - Vandam;
3 - Dashgil-Mudrasa;
Orthogonal faults: 4 - Chakhirli-Gabele; 5 - Ismayilli-Gabele;
6 - Tairaljachay-Salyan

The strongest of these earthquakes was the earthquake of 1956 with a magnitude of ml = 5.8 and an intensity of 7 points. Table 1 shows the parameters of historical earthquakes of the Ismayilli zone for 1915-2012.

Table 1. Parameters of epicenters of historical earthquakes occurred within the region under study.

№	Date д м год	t_0 ч мин с	Epicenter φ^0, N $\pm\delta\varphi^0$	 λ^0, E $\pm\delta\lambda^0$	h, км	ML h	ML h*	ML	K_P	I_0, балл $\pm\delta$ I_0	Notes	Source
1	06.10.1915	00-59 -27 ±10c	41.00 ±0.5	48.00 ±0.5	15 5-50	4.6 ±0.5			12.3			[11]
2	11.07.1952	05-35-08 ±5c	40.70 ±0.1	48.30 ±0.1	4 2-5	4.3 ±0.5			11.7	7 ±0.5	Shamakha-7	-“-
3	11.07.1952	06-18-59 ±5c	40.70 ±0.1	48.30 ±0.1	3 2-5	4.3 ±0.5			11.7	7 ±0.5	Shamakha -7	-“-
4	30.04.1953	15-45-24 ±5c	41.00 ±0.1	48.10 ±0.1	20 14- 30	5.0 ±0.2			13.0	6 ±0.5	Gabala- 5	-“-

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5	18.03.1956	03-55-39 ±2c	40.80 ±0.1	48.10 ±0.1	11 5-22	4.5 ±0.5			12.1	5-6 ±0.5		-“-
6	20.03.1956	16-19-20 ±2c	41.00 ±0.2	48.30 ±0.2	11 5-22	4.5 ±0.5			12.1	5-6 ±0.5		-“-
7	21.03.1956	04-54-48 ±1c	40.92 ±0.1	48.39 ±0.1	8 5-12	5.3 ±0.3			13.5	7-8 ±0.5	Shamakha-7	-“-
8	08.06.1957	16-45-42 ±2	40.90 ±0.1	48.50 ±0.1	10 7-15	4.0 ±0.5			11.2	5 ±1		-“-
9	05.02.1968	13-34-10.0 ±1c	40.80 ±0.2	48.00 ±0.2	7 3-14	4.4 ±0.5			11.9	5-6 ±1	foreshock	-“-
10	17.06.1968	04-59-02.0 ±1c	40.70 ±0.2	48.10 ±0.2	7 5-10	4.6 ±0.2			12.3	6-7 ±0.5	Ismayilli-6	-“-
11	03.02.1972	02-29-19.0 ±1c	40.78 ±0.1	48.46 ±0.1	5 ±5	4.9 ±0.2			12.8	6 ±1		-“-
12	26.10.1973	13-11-49.0	40.70	48.20			3.9	4.5	11.0			-“-
13	09.06.1978	00-13-38.0	40.60	48.20			3.9	4.5	11.0	3-4	Shamakha – 3. J_0 = 4	[22]
14	01.04.1980	07-33-41.0	40.70	47.80			4.3	5.0	11.8	4-4.5	Gabala- 3-4.5	-“-
15	29.11.1981	23-37-30.0	40.75	48.00	10		4.8	5.6	12.6			-“-
16	02.12.1981	00-51-36.0	40.68	47.93	15		4.7	5.5	12.4			-“-
17	04.12.1981	02-35-36.0	40.70	48.00	10		4.3	5.0	11.8			-“-
18	09.12.1981	18-54-38.0	40.80	48.00	10		3.9	4.5	11.0			-“-
19	14.12.1981	05-01-52.0	40.80	48.10			3.9	4.5	11.0	3-5	Ismayilli-3-5	-“-
20	12.07.1982	05-04-35.0	40.70	48.30	10		3.9	4.5	11.0	3	Ismayilli-Lagich- 3-4б. Shamakha – 3. Pirkulu – 4б	-“-
21	13.11.1987	02-51-10.0	40.70	47.80	13		3.8	4.3	10.8	3	Ismayilli-3б	-“-
22	15.10.1993	22-37-14.2	40.56	48.14	19		4.3	4.9	11.7	5.5	Ismayilli-5б	-“-

23	09.05.1996	10-58-37.8	40.77	48.43	14		3.9	4.4	11.0	3.5	Guba. Shamakha - 3-5б	-“-
24	19.10.1997	07-51-06.8	40.65	48.13	49		3.7	4.2	10.7	3.5-4.5	Ismayilli -3.5-4.0б	-“-
25	10.03.2000	14-20-35.6	40.92	48.18	19		3.9	4.4	11.0		Ismayilli-4б	-“-
26	26.11.2001	05-24-19.8	40.85	48.45	19		4.0	4.6	11.3	4	Pirkulu -3-4б. Shamakha -3б	-“-
27	08.06.2007	05:54:35.1	40.72	47.87	32		3.6	4.1	10.5			-“-
28	12.12.2007	10-25-30.5	40.55	48.15	24		3.7	4.2	10.7	3.5	Shamakha-3.5. Pirkulu -3б	-“-
29	19.12.2008	15:11:3.2	40.87	48.49	5		3.9	4.4	11.0	5	Pirkulu. Demirchi-4.5. Shamakha-4б. Ismayilli-3.5б	-“-
30	07.10.2012	11-42-50.6	40.70	48.35	41		4.5	5.3	12.2	4-5	Pirkulu. Shamakha. Ismayilli. Akhsu-5б	-“-

Note. Information for the years 1980-2012 borrowed from the annual catalog of earthquakes in Azerbaijan; in parentheses are calculated by the formula M = (Cr-4) /1.8 [2] values of M and Cr.

Considering that large thrusts have specific angles of incidence, as, incidentally, faults, it is difficult to draw conclusions about the connection between earthquake sources with certain discontinuous dislocations from the Fig.4 shown in the epicenter map. For this reason, a seismological section was made along the NW-SE profile of the strike through the study area (Fig. 7.).

As can be seen in the Figure, two groups of earthquake hypocenters are distinguished here — the Ismayilli ones characterized by deeper foci of 30–40 km and the Shamakhi foci [Kengerli., 1988]. The surface of the consolidated crust clearly stands out. From the north-west to the south-east there is a horizontal occurrence of the basement surface, and from the Shamakhi meridian there is a tendency of gradual immersion of the basement surface to 15 km in the Maraz region.

The main number of aftershocks of the Ismayilli earthquake is concentrated in the zone of intersection of multidirectional faults in the central part of the profile. Analyzing the distribution of hypocenters in depth, it can be noted that a large number of earthquakes are associated primarily with the North Ajinour strike-slip fault. The characteristic hypocenters to the plane of the North-Ajinour fault, traced in the interval of depths of 5-10 km and 30-45 km, suggest that the roots of this fault are in the Pre-Alpine basement.

As for the earthquake focal mechanisms of this zone, they first of all confirm the strike-slip fault and shift component of the movements along the West Caspian fault, further characterizing its high seismic activity and deep penetration to depth, noted in work of [Aslanov, 2005]. The source of the Ismayilli earthquake was characterized by horizontal (PL_T=0°) tensile south-west orientation (AZM = 212 °) and near vertical compressive (PL_R=83°) south-east orientation (AZM=122°) stresses (Fig.8). The type of motion along both (DP=45°) planes is a fault. The NP1 plane has a south-east strike (STK_1=128°), and NP2 has a north-west strike (STK_2=295°). Comparison of the strike of the nodal planes with the fault lines shows the agreement of both nodal planes with the strike of the North Ajinour strike-slip fault (Table 2).

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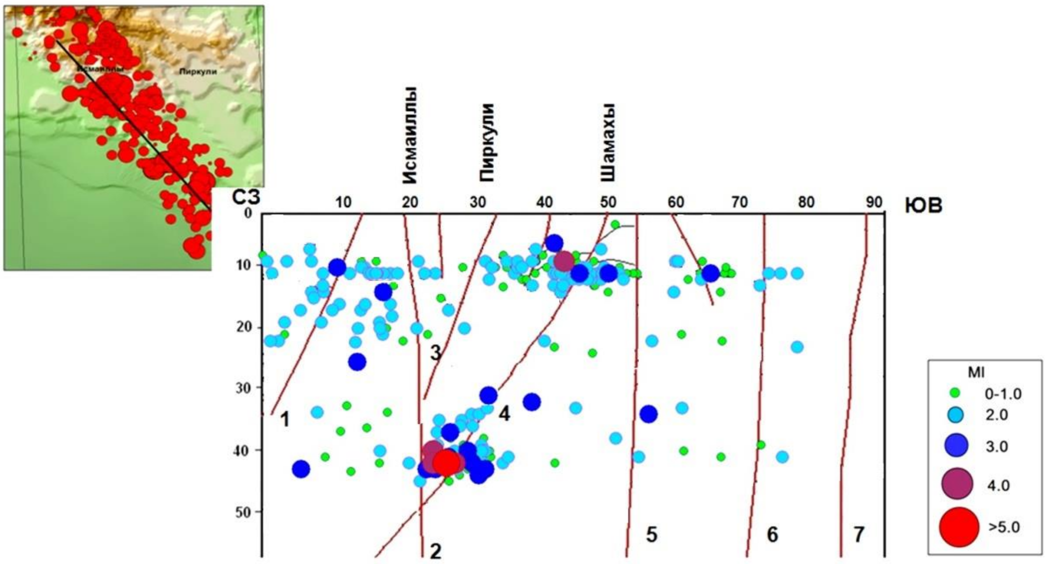

Figure 7. Seismological section along profile I - I of the Shamakhi-Ismayilli seismogenic zone
Faults: 1- Dashgil-Mudrasa; 2-Girdmanchay; 3- Vandam; 4-North Ajinour; 5- Astara-Derbent; 6-Kelbajar-Jiloy; 7-Palmir-Absheron

Table 2. Parameters of the source mechanism of the Ismayilli earthquake 07.10.2012

№	Data, d m y	t_0, h min s	h, km	ml	Mw	Coordinates of the sources		Nodal planes					
						latitude	longitude	NP1			NP2		
								STK	DP	SLIP	STK	DP	SLIP
4	20121007	11-42-50	41	5.3	5.1	40.70	48.35	128	45	-81	295	45	-98

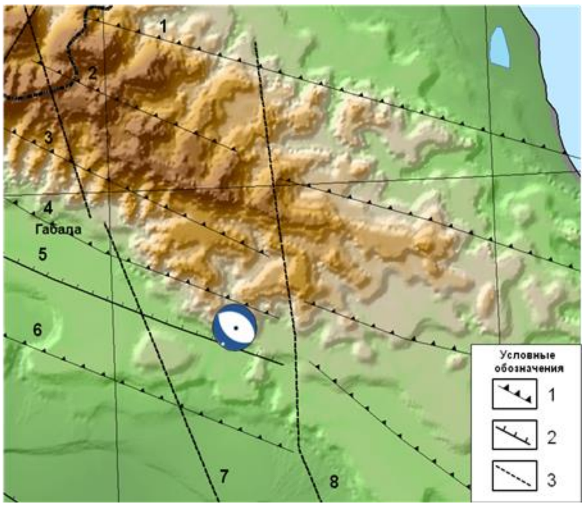

Figure 8. Focal mechanism of the Ismayilli earthquake on October 7, 2012

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VARIABLE FEATURES OF THE SEISMOMAGNETIC EFFECT CONNECTED WITH STRONG EARTHQUAKES IN THE ZAGATALA-BALAKAN ZONE IN 2012

N.B. Khanbabayev[1], M.K. Mammadova[1], M.G. Zeynalov[1], V.R.Huseynova[1]

The first information about the earthquake in the north-western zone of the Azerbaijani part of the Greater Caucasus coincides with the 1850s. Strong earthquakes in the region occurred in 1936 and 1948 years (ml≥5 Aghamirzoyev 1987). Earthquakes were felt up to 7 points in residential areas. On May 7, 2012, a strong earthquake occurred in the Zagatala-Balakan zone (mL = 5.6 h = 9 km φ = 41.50 λ = 46.58). After the earthquake, the aftershock processes in the region were quite active and lasted for several days. An earthquake was felt up to 7 points in 16 residential areas of the region.

There were 170 aftershocks in the first day after a major shock.

Shocks with Ml≥4 are presented:

1) 07.05.2012 ml=5.6 h= 9 km *φ*=41,50 λ=46,58
2) 07.05.2012 ml=5,7 h=12 km *φ*=41,56 λ=46,63
3) 07.05.2012 ml=4,8 h=10 km *φ*=41,56 λ=46,67
4) 07.05.2012 ml=4,4 h=5 km *φ*=41,37 λ=46,52
5) 07.05.2012 ml=4,2 h=16 km *φ*=41,53 λ=46,67
6) 07.05.2012 ml=5,7 h=12 km *φ*=41,56 λ=46,63
7) 07.05.2012 ml=4,3 h=19 km *φ*=41,55 λ=46,60

The effects of such active seismic processes occurring on the Earth surface are observed in geophysics: magnetic, gravitational, electrical and geochemical fields, and are used for long and medium-term warning factors of earthquakes.

Anomalous changes caused by strong earthquakes in the Shamakhi-Shaki-Zagatala-Balakan zone, which are assessed by high seismic risk and geodynamic activity, are recorded through modern geophysical equipment installed on the seismic stations operating in the area and the data is transmitted over the day to RSSC.When the data is analyzed, the time-dependent variety graphs of the seismomagnetic effect are established. The change in the seismic activity before and after the powerful Zagatala earthquake was noticeable. As a result of the analysis of the constant part of the ΔT ~ f (t) magnetic variation curves, effects that created 3-5 days before and after powerful eartquakes (ml≥4) with the direct connection of the source's mechanism and parameters. Before the earthquake, the seismic activity changes in Shaki and Ismayilli magnetometric variation stations operating regularly during the earthquake and one month after the seismic event were continuously monitored.

At both stations, time dependent variety values of the geomagnetic field are clear from the graphs presented at the background level of the month before the earthquake. (Fig.1) If we take a look at the change curve of seismomagnetic effect in Ismayilli station, effect noted before and after earthquake continued in the form of chaotic movements. As can be seen from the recorded curve at Shaki station, geomagnetic observation values 4-5 days before the earthquake were formed at the expense of minor increases. The character of the seismomagnetic effect shows that, during the earthquake in Zagatala, normal fault displacement action was a leading process. As a result, the deformation has occurred in the environment and the tension gradient in the geodynamic field has increased to positive 8-10 days after earthquake [1; 2; 3; 4]

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

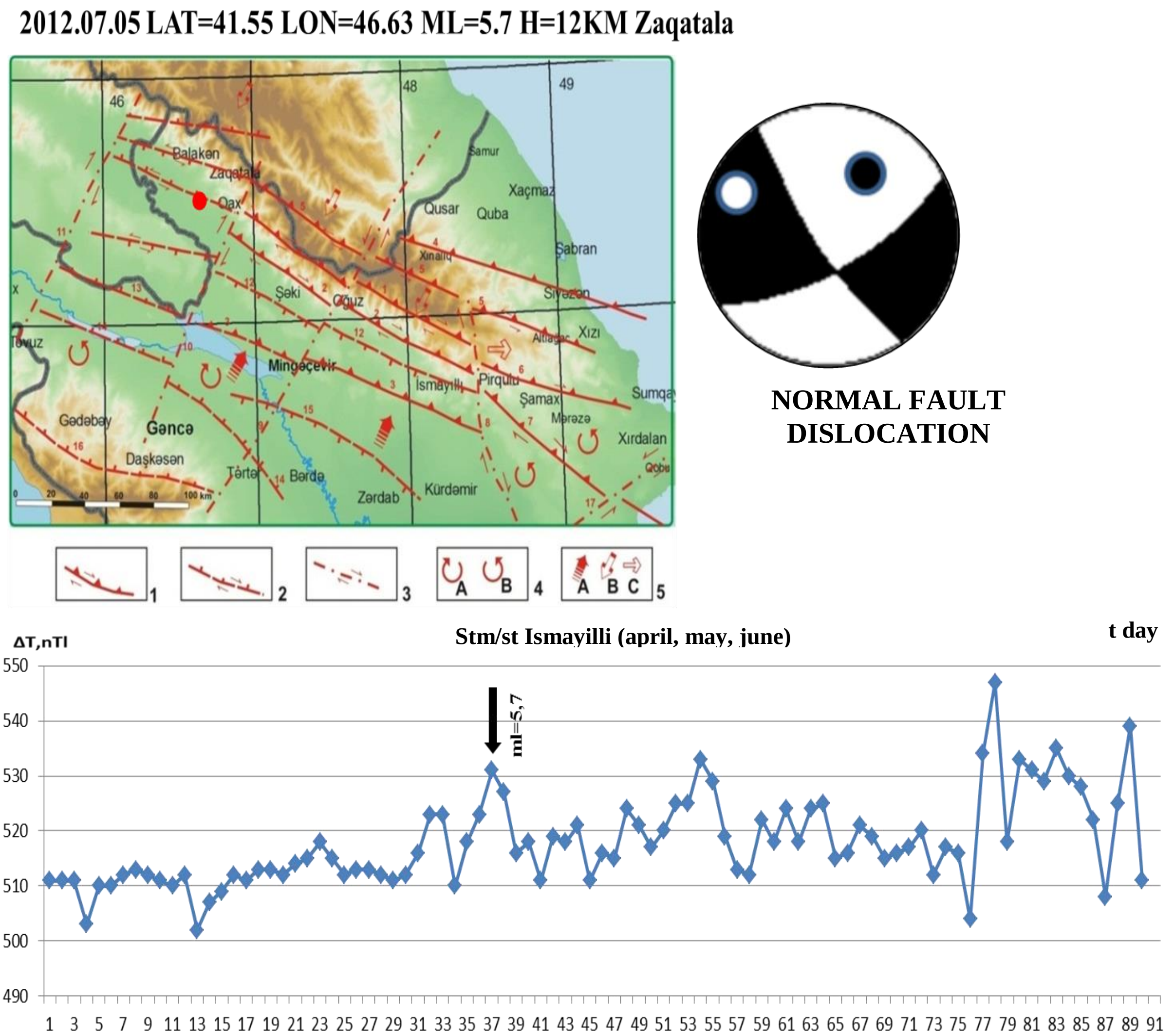

Figure 1. Before the Zagatala earthquake in 2012 spatio-temporal and after seismomagnetic manifestation effect

As it is known from the statistical data of long years, the seismic activity in the geomagnetic field is formed by positive increases if the compression movement dominated in the source while the tension is in the active phase [5].

As you can see from the created curves, the seismomagnetic activity was observed with chaotic movements, with 20 ÷ 30 nTl and then this subsequently formed at the expense of increases. As seen from the curves, changes of seismomagnetic effect were observed during the earthquake at both stations.

After the powerful earthquake in Zagatala, another earthquake occurred on 14.05.2012 in Sheki region. An earthquake measuring several aftershocks in Sheki, mL = 4.1; h = 11 km and ml = 3.8; h = 6 km was felt in several settlements. During the earthquake, re-magnetometric observations were performed at 63 points in the area and according to space-time analysis, distribution of the full vector of the geomagnetic field and magnetic anomalies are closely related to geodynamic and active faults of the Earth’s crust blocks [5].

Two more powerful earthquakes in Balakan-Zagatala region (mL = 4.5 h = 5 km; ml = 5.6 h = 8 km) were felt in the surrounding settlements on October 13and 14 , 2012.

13.10.2012 ml=4,5 h=5 km φ=41,62 λ=46,28

14.10.2012 ml=5,6 h=8 km φ=41,66 λ=46,27

The impact of the strong earthquake in the Balakan region on October 14, 2012 was estimated at 7 points by the 12-point MSK-64 seismic schedule in more than 10 settlements in the region.

Both shocks were recorded by geophysical devices established on stationary seismomagnetometric variation stations located in Zagatala and Sheki region (Figure 2, 3).

Thus, the results of the observations made by G-856 proton type magnetometers (US Kinematics) installed in Zagatala and Shaki, noted that the seismomagnetic effect is at the background level from 01.09.2012 to 10.10.2012. 3-4 days before the earthquake, effect mentioned in Zagatala has been determined by its decreases and during the second earthquake that took place on October 14, 2012, the effect was determined by the increase in Shaki station after the earthquake. During both earthquakes, extension and normal fault type actions are assumed to have occurred during tension in the source [5].

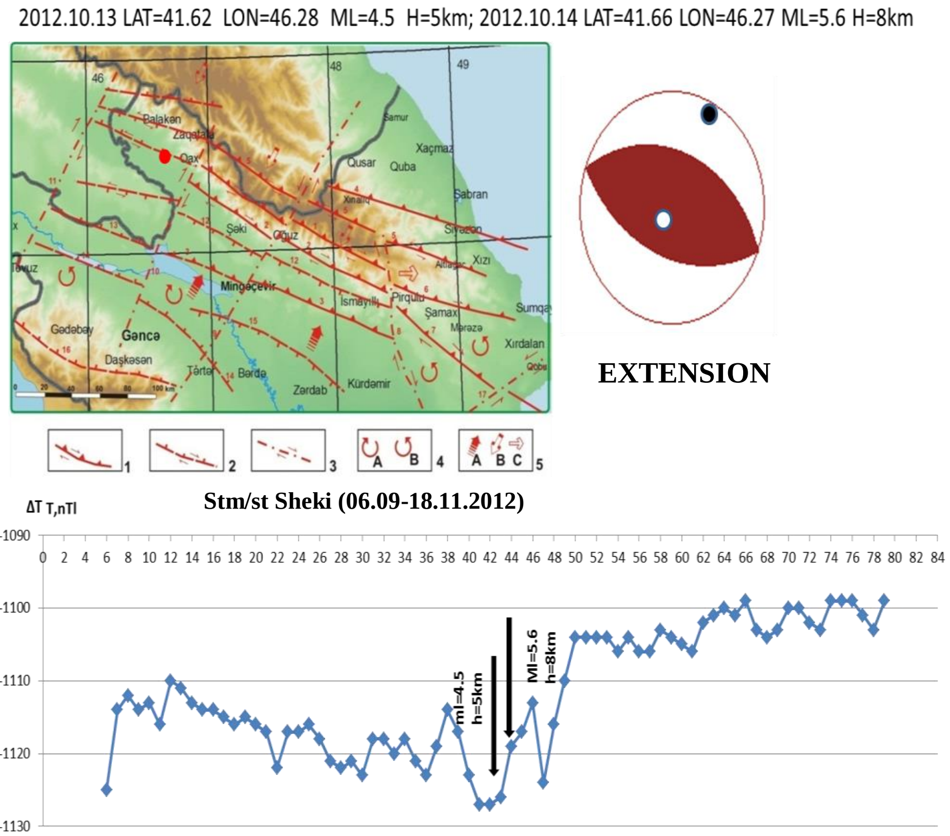

Figure 2. Variation curve of seismomagnetic effect before, in time and after the Balakan, Zagatala earthquakes (ml=4.5, 13.10.2012; ml=5.6 14. 10.2012)

2012.10.13 LAT=41.62 LON=46.28 ML=4.5 H=5km; 2012.10.14 LAT=41.66 LON=46.27 ML=5.6 H=8km

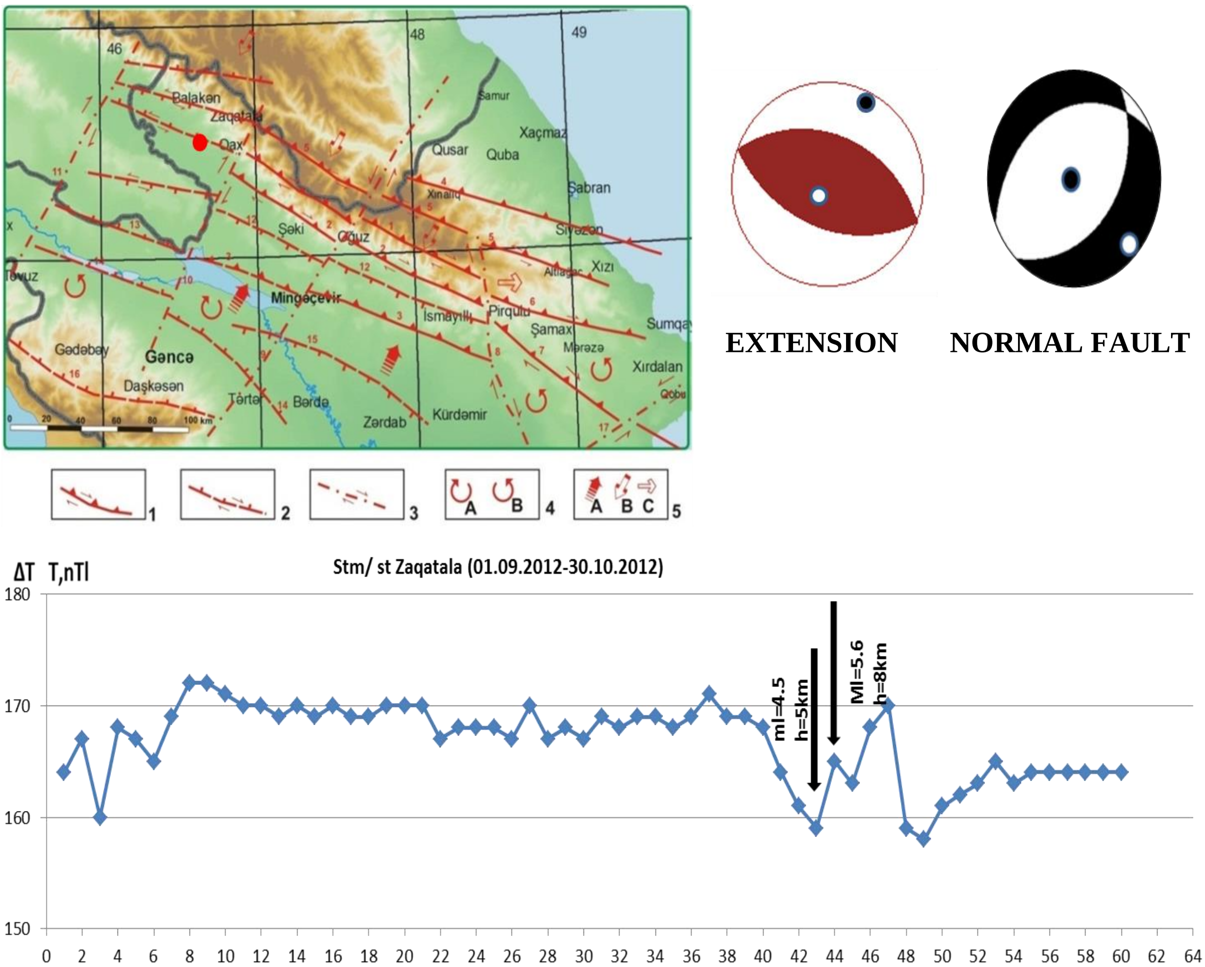

Figure 3. Variety curve of seismomagnetic effect before, in time and after Balakan, Zagatala earthquakes (ml=4.5, 13.10.2012; ml=5.6 14. 10.2012),

If we pay attention to the geomagnetic field tension distribution map created in 2D format in April 2012 in the Shamakhi-Sheki geodynamic polygon, the geomagnetic effect is compounded by closing down to 100-150 nTl and is pointed at the north-west direction at 200-250 nTl (Fig.4).

Tension deformation condition in the geological environment is directed to Shamakhi - Ismayilli zone from Gabala- Shaki region (600-700 nTl) and seismomagnetic effect is in the active phase [6].

Studies have shown that, the tension deformation condition in the region is unstable and must always be under the control of seismologists-geophysicists.

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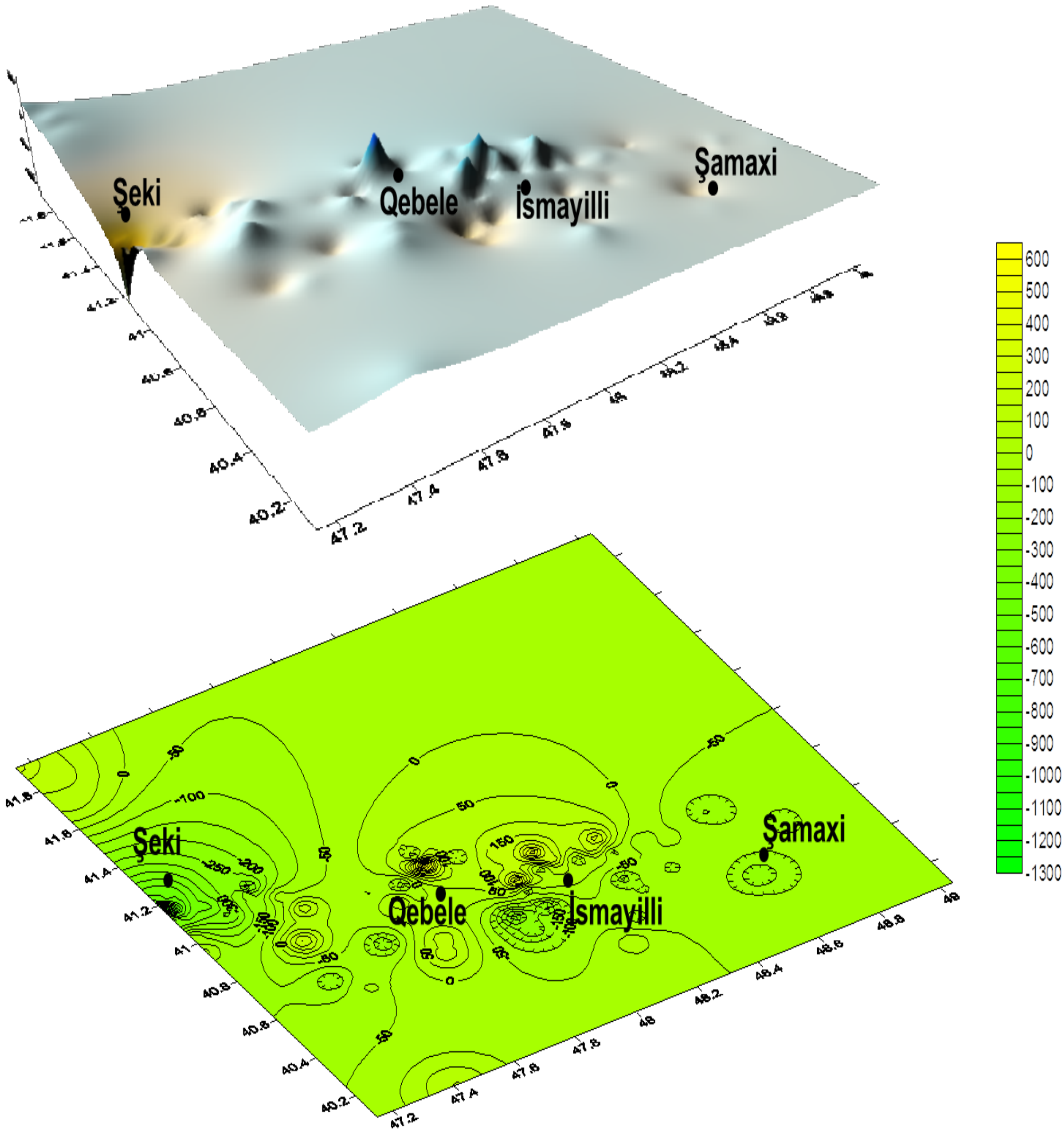
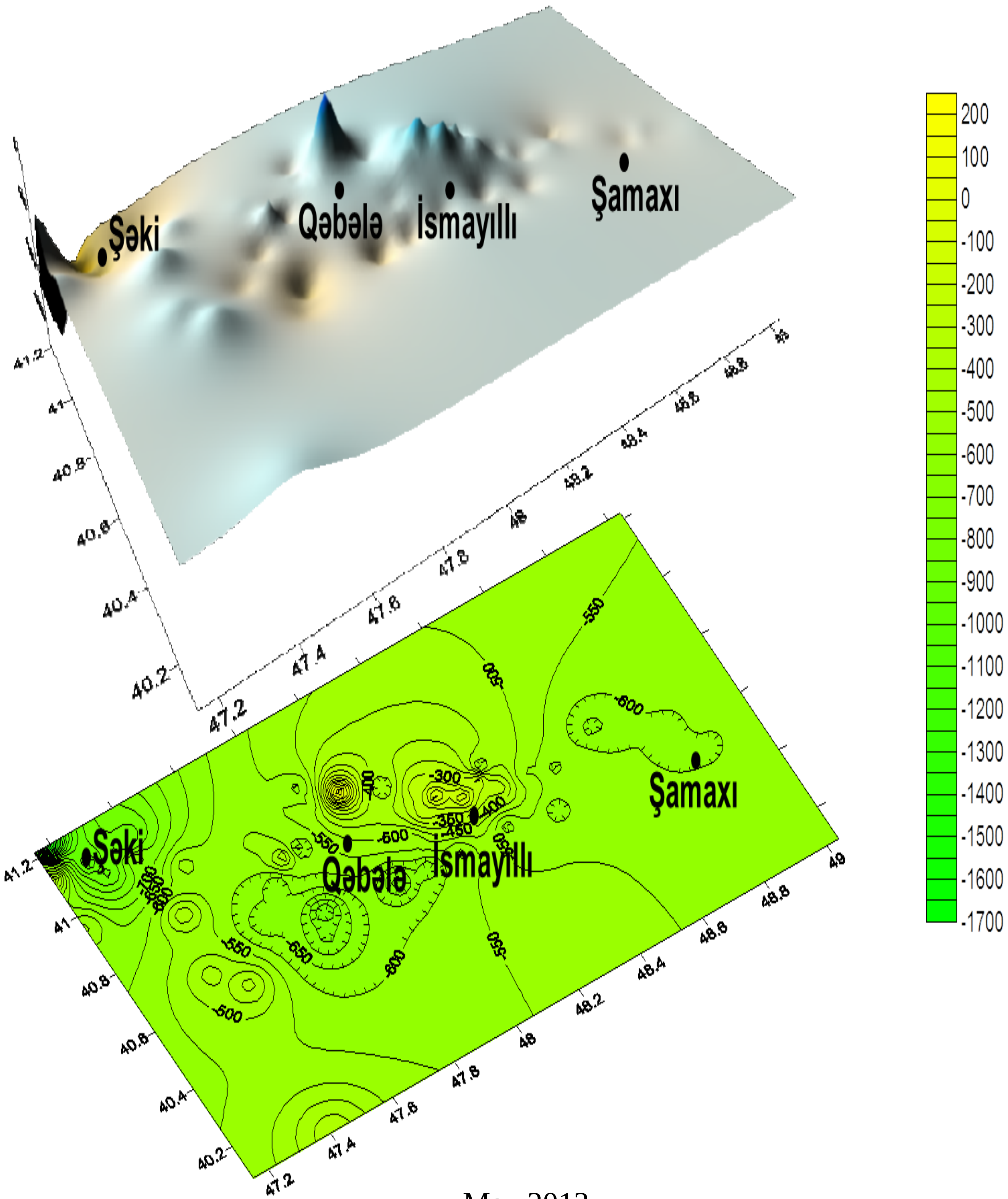


April 2012

Figure 4. Tension deformation condition of geological environment based on magnetic data in Shaki-Shamakhi geodynamic polygon in 3D, 2D format



May 2012

Figure 5. Tension deformation condition of geological environment based on magnetic data in Shaki-Shamakhi geodynamic polygon in 3D, 2D format

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IMPACT OF ENGINEERING GEOLOGICAL CONDITIONS ON SEISMIC HAZARD IN BAKU CITY, YASAMAL DISTRICT

Z.S.Aliyeva[1], A.B.Guliyeva[1], L.I.Veliyeva[1], L.A.Yaqubova[1] , I.N. Jalilova[1]

Introduction: The territory of Azerbaijan is characterized by high seismic intensity. It is known that after the occurrence of strong earthquakes, collateral natural and technogenic dangers, avalanches, landslides, sediments, dilution of the soil and other events can occur. In this regard, the investigation of the physical-mechanical properties of soils and other engineering-geophysical seismic factors indicators during the seismic hazard assessment in the construction areas is important.

Baku is divided into several administrative districts. Geological and lithological conditions are different in those regions.

Yasamal district is one of the central districts of Baku. The region is bordered by Sabayil in the south, Garadagh in the west, Binagadi in the north and Nasimi in the east. The territory of the district is 16.22 km^2. The population density in the district is 15 160 people per square kilometer.

The increase in population density increase the demand for reasidental buildings in Baku city. In this regard, it is important to study the seismicity in the area and to assess the impact on the seismic hazard.

As a result of seismotectonic investigations, there are several fault zones in the Absheron peninsula that determining seismic hazard (Shikhalibeyli, 1970-1996 yy.):

1) Makhachkala-Turkmenbashi; 2) Gaynar Zengi; 3)Siyezen: 4)Vandam: 5)Adjichay-Alyat: 6)Western Khazar (Fig.1.)

The zone of the depths faults Makhachkala-Krasnovodsk (Turkmenbashi) separates the Middle Caspian from the south-Caspian sediments. It was determined that, the block on the north has risen along this fault in the Caspian Sea and the Caucasus, the geosynclinal block is down deeper in the west.

Amplitude dislocations are observed up to 15 km at the foundation and on the surface of “Moho” in some places. The depth of seismic tensions in the zone increases from the north-west to the south-east just as it moves towards the middle of the sea, from 10-25 km to 30-35 km and in some cases it increases more than 60-70 km. Earthquakes magnitude with M~6,0 occurred in this area.

Siyazan fault has a long enough length. Seismic shocks can spread up to 20-25 km deeper in this fault. The continuation of Siyazan fault is followed in the sea.

Gaynar-Zengi fault bordering from north the Vandam anticlinarium of Greater Caucasus extends in the west from Mazimchay to Aghsuchay river.

The results of the geophysical research show that the Gaynar-Zengi fault is completely cut off the surface. An earthquake with a high intensity (M = 7.0) occurred in the Shamakhi part of the fault. Shamakhi was completely destroyed in the earthquake that occurred in 1667 and repeated aftershocks and disturbances in relief, changes in springs were taken into account. Earthquakes are spread with depth intervals (H =10-25 km) observed across of the southern slope of the Greater Caucasus.

Vandam depth fault. Weak shocks spread to a depth of 25-30 km, here. One of the strongest earthquakes in Azerbaijan (M = 6.9), destroying the Shamakhi city, has taken place in this fault zone.

The continuation of the Adjıchay-Alyat fault in the sea is considering Sangachal- Ogurchu fault. The event occurred on November 25, 2000 in this zone and entered to the seismological chronology as the Baku earthquake consisted of two seismic shocks (M=5,8 və M=6,2) and was accompanied by numerous aftershocks.

V.E.Khain attaches great importance to the Palmir-Absheron depth fault and shows that it separates the Turkmen-Iranian and Caucasus-Eastern Anatolian segments. Seismic shocks are spread in some parts of zone at a distance of 15-25 km and some parts in the depth of 30-35 km.

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West- Caspian transverse depth fault has been determined by many experts (Belenovich T.Y., 1983 и Gadjiyev A.N., Popkov V.İ., 1988) based on geophysical data but V.E.Khain (Khain V.E., Lamize M.G., 1995) and others have described the fault in more detail. This fault zone separates the southern Caspian (Transcaucasia) depression from the southern Caucasus depression. In the areas of the Greater Caucasus, where the fault occurs, earthquakes are spreading to a relatively small (10-25 km) depth, which is characteristic of the mountainous zone, while seismic shocks in the Kura sediments of fault reach to greater depths (15-45 km).

Seismic shocks occurring in these faults caused an earthquake with magnitude of maximum 7 in the Absheron peninsula.

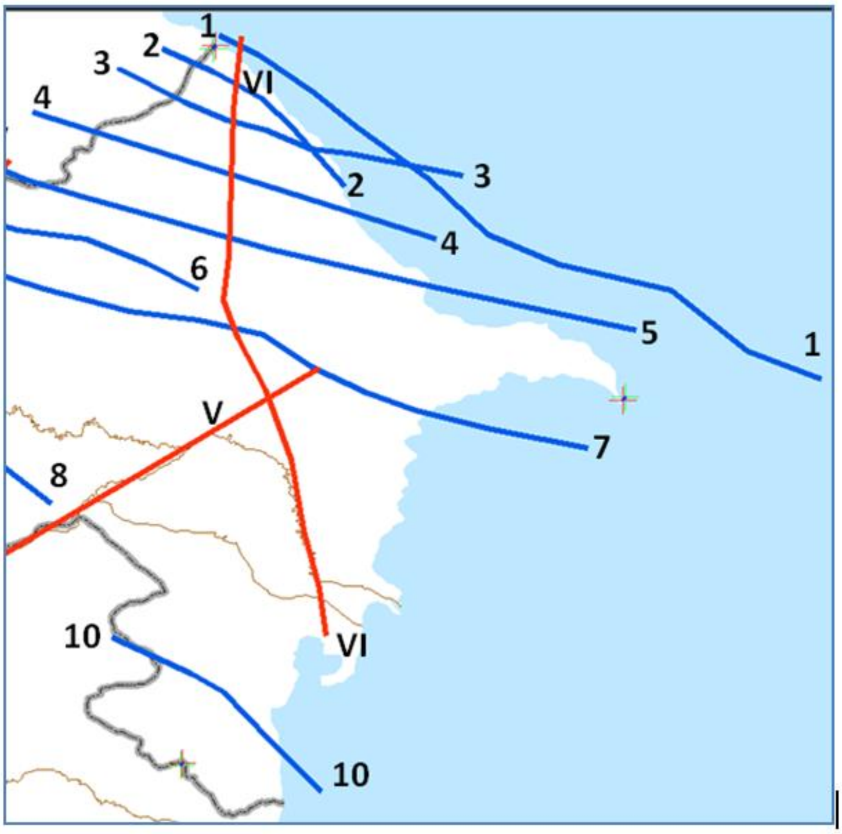

Figure 1. Tectonic fault zones in East Azerbaijan

1-1	Makhachgala - Turkmenbashı	7-7	Adjıchay-Alyat
2-2	Khudat - Gilezi	8-8	Kura
3-3	Akhtı-Nugedi-Gilezi	9-9	Front Lesser Caucasus
4-4	Siyezen	10-10	Front Talish
5-5	Gaynar - Zengi	6-6	Vandam
V-V	Palmir – Absheron	VI-VI	West – Caspian

In order to assess the impact of the geological conditions on the seismic hazard in the Yasamal region, along with active depth faults (Fig.1), the earthquake epicenter map (Fig.2) was created, geological-lithological structure of the earthquake, hydrogeological conditions, physical and mechanical properties of soils and other information was collected.

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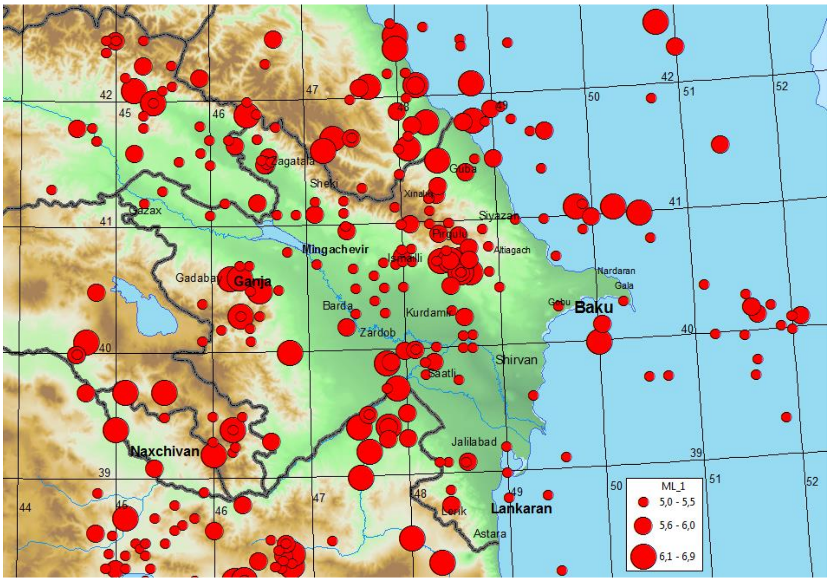

Figure 2. Epicenter map of strong earthquakes in Azerbaijan and adjacent territories($M \geq 5.0$) during 427-2018 years.

The geological-lithological section of the area has been studied as a result of drilling in the construction areas of the Yasamal district. Their thickness varies from 10 to 30 m. These sediments are of continental origin and have different lithological contents. Most of the geological sections up to 30.0 m depth with the exception of technogenic rocks forming the upper part of the faults consist of clays, sandy clays, clay sands, low-clay sands with small-size seashells, moistened limestone and sorting of the loam layers. The exposure of rocks to moisture is due to hydrogeological conditions. During the study of engineer-geological conditions, it has been known that the rocks in the Yasamal district were separated into 3 (three) engineers-geological elements (geological- engineering elements).

These engineering-geological elements are weakly durable limestone with a thickness of 3 meters under the foundation with a horizontal and large depth and more semi-solid clay and semi-solid loam.

While conducting geological works, consistence from information on some properties of rocks (JL), density (ρo, ρd) and other parameters are used and the calculations are carried out. One of the significant parameters for the assessment of seismic hazard is to determine the velocity of seismic waves propagation in longitudinal (Vp) and transverse (Vs) in groundwaters. Using GEODE-24 engineer-seismic station at the RSSC of ANAS, these speeds are determined with the greatest possible accuracy. The physical and mechanical properties of the widespread geological-engineering elements that are separated are as follows.

1) The most common average values for the consistency, density and the consistency of the semi-solid loam soil are JL = 0.14; it density is ρ_d= 1,62 q/sm^3 in case of dry; the spreading velocity of transverse seismic waves in ground is V_s= 360-430 m/min.

2) The consistency of the semi-solid clay soil are J_L= 0,02-0,34; it density is ρ_d=1,47-1,66 q/sm^3 in case of dry; the spreading velocity of transverse seismic waves in ground varies between V_s= 380-550 m/ min.

3) The most commonly encountered prices for softness coefficient, density and speed of weakly durable limestone are $K_{yum.}$ = 0,60-0,66; ; it density is ρ_d= 1,85-1,97 q/sm^{3}in case of dry; the spreading velocity of transverse seismic waves in ground varies between V_s= 580-660 m/min.

Three of the separated soils suitable for II class as a result of the research according to the normative document the construction in seismic zones AzDTN 2.3.-1. There were underground waters in most wells drilled in the field.

The various groundwater are mainly formed in the loam and limestone ground. That is, the porosity coefficients of the grounds are not more than e = 0.7 and the velocity of seismic waves propagation speeds are rarely below 400m/min.

The density is also within the normal range ρ_d=1,50-1,65 q/sm$^{3.}$

Based on the above and on the results of the research, Yasamal district has been attributed to the 8-point zone.

Conclusion

1. The Absheron Peninsula, as well as the seismicity of Baku, is related to the strong earthquakes in the depth faults near the area.
2. The seismic hazard of the Yasamal region of Baku city is influenced by the physical-mechanical and seismic properties of the soils in the area. Three engineer-geological elements have detected here. All three engineer-geological elements belong to the II class.
3. In the Yasamal district of Baku, underground waters are encountered at different depths. Basically, ground water is encountered at a level, rarely found in two horizons, and it is negligible affected by the composition of soils.
4. The seismicity of the Yasamal district of Baku is estimated at 8_2 (eight) magnitude on the MSK-64 scale based on the analysis of hydrogeological observation materials and seismological researches, engineer-geological and tectonics of the area, "Temporary schematic seismic zoning map of the territory of the Republic of Azerbaijan" (1991 years) and Az DTN-2.3.-1 normative document.

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MODERN GEODYNAMICS OF AZERBAIJAN ON GPS STATION DATA FOR 2017-2018 YEARS

I.E.Kazimov[1], A.F.Kazimova[1]

Introduction

As is known, Azerbaijan is part of the Alpine-Himalayan mountain belt formed in Cenozoic on the southern edge of the East European Platform as a result of the collision of the Eurasian and Arabian plates, which over the past five million years has experienced a rapid uplift.

The study of the dynamics of the movement and interaction of the plates (i.e., the primary forces acting on the plates), as well as the rheology of the continental lithosphere, is one of the important fundamental problems of active geotectonics [9]. At present, the concept of lithospheric plate tectonics dominates in Earth sciences. According to this concept, the formation of the internal tectonic structure of the moving belts (of the Alpine-Himalayan belt type) and the mobile structures is determined by the approach of the lithospheric plates. It is assumed that as a result of these horizontal displacements, the Caucasian segment of the Alpine-Himalayan mobile belt shrinks, the layers of sedimentary and volcanic rocks collapse, the base blocks experience multidirectional displacements, and the upper crustal horizons are disturbed by upsets and thrusts. Some researchers believe that the impact of the northern drift of the Arabian Plate affects the distribution of horizontal stresses within the Eurasian Plate at a distance of one and a half to two thousand kilometers from the southern edge of the latter [4, 5, 7].

In recent years, the Azerbaijani part of the Greater Caucasus is characterized by active seismic activity, during which the stresses accumulated in the collision zone are unloaded. Over the past 10 years, the seismicity of the republic’s territory has been uneven both in terms of the number of earthquakes and the total seismic energy released in their sources. The number of earthquakes reached an anomalous value in 2015 due to an increase in weak seismicity. The greatest energy during this period was allocated in 2012. ($E=122.8 \cdot 10^{11}$J). This indicates that seismic-tectonic events are activating, there are shifts in individual tectonic structures, which are realized in the form of tangible 5-6 magnitude earthquakes that occurred in Zaqatala-Balaken, Sheki, Oguz-Gabala and Ismayilli regions.

Calculation Technique

One of the methods currently widely used in the world is the method based on the technologies of global navigation satellite systems (GNSS). With the advent of GPS technology, which is the first of the technologies implemented by GNSS, it has become possible to carry out high-precision (3-10 mm in all dimensions) geodesic monitoring on large areas with relatively small expenditures and time. For monitoring the changes in the earth's surface caused by geodynamic processes, over the course of a number of years, GPS devices have been used successfully, as indicated above. High-precision GPS measurements of almost any lines are carried out on the basis of the differential method using the so-called basic GPS stations (this method is also called the method of relative kinematics).

The first studies of modern geodynamics of Azerbaijan using GPS receivers were conducted in the early 1998s of 20th century. In 1991, within the framework of Azerbaijan (SGI) - American (MIT) agreement on joint research in the field of calculating the velocity field of modern horizontal displacements of the earth's crust in Azerbaijan.

Starting from 2012-2017 a network of permanent GPS/GLONASS observation stations has been established on the territory of Azerbaijan RSSC. Regular observations have been conducted since 2013. The stations are equipped with Choke Ring (10), Zephyr geodetic2 (14) antennas and TrimbleNetR9 (24) L1/L2 GPS/GLONASS/Galileo receivers (Fig. 1, Table 1). The current work of the stations is serviced by employees of the Geodynamics of the RSSC, in whose territory they are

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

installed. Data from GPS receivers are transmitted via the Internet to the HP Proliant DL308P Gen8 server storage and processing complex with a total volume of 7 TB.

Thus, the formed geodetic network makes it possible to solve regional problems of studying the basic laws of modern movements of the earth's crust in the territory of Azerbaijan.

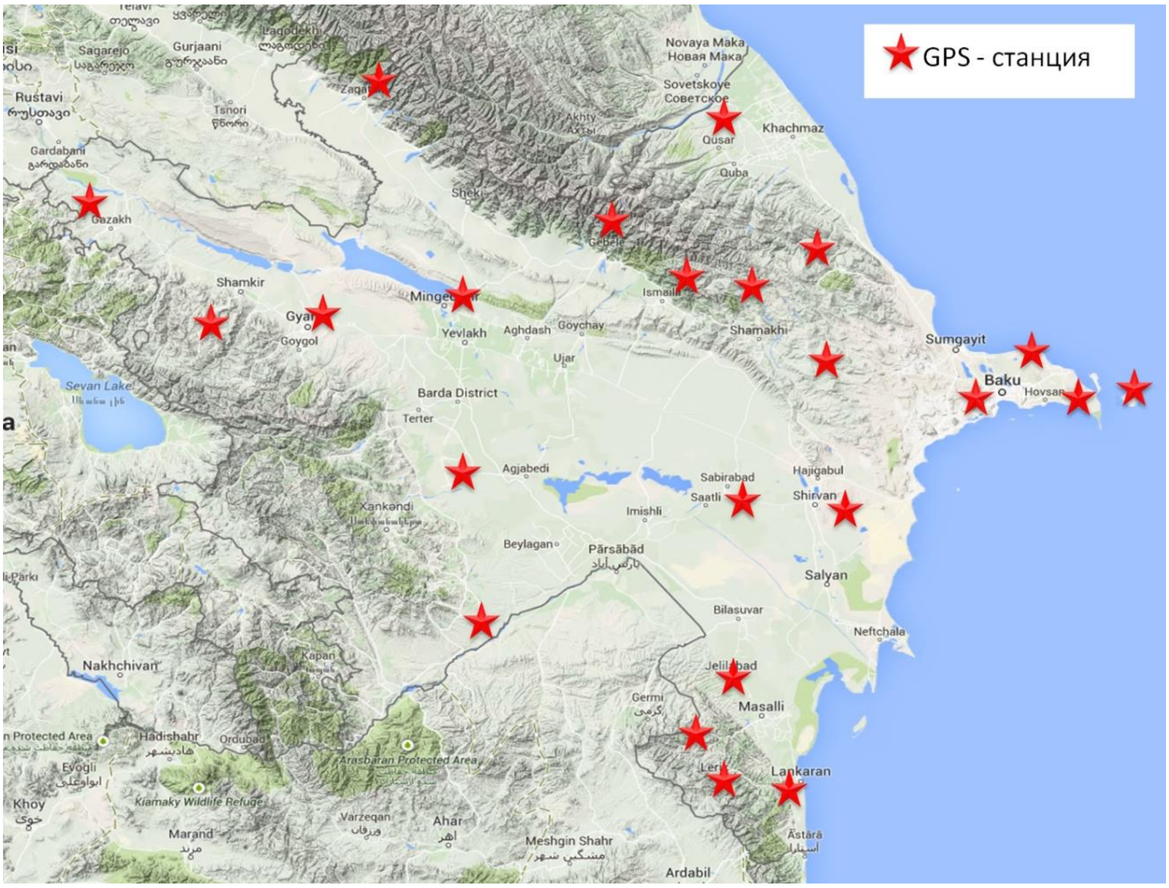

Figure 1. Location map of 24 stationary GPS stations of the RSSC geodetic network

The speed estimates are based on the analysis of the time series of the coordinates of GPS stations, calculated from primary data, which are sets of phase and code measurements at two frequencies lasting 24 hours with a recording interval of 15 s. To estimate the speeds of the designated stations, it is necessary to have at least one reference point in the network, and preferably several. In the case of several strong points, it is necessary to take into account their mutual displacement. Therefore, in this study, data from 11 closely located IGS reference stations were added to the measurement set at 24 GPS stations: ARTU (Arti, Russia), CRAQ (Simeiz, Ukraine), TEHN (Tehran, Iran), POLV (Poltava, Ukraine), MDVJ (Mendeleevo, Russia), ANKR (Ankara, Turkey), NICO (Nicosia, Cyprus) DRAG), POL2 (Bishkek, Kyrgyzstan), YIBL (Ibal, Oman), BZGN (Bazergan, Iran). The selected reference stations with the specified coding are included in the implementation of the International Terrestrial Reference Frame ITRF2008. The geographical position of the reference and observed stations is shown in Fig.2. and in Table 2.

The GPS data processing was performed using the GAMIT / GLOBK software package (Kalman filter) 10.6 and TRACK. The software was developed by the Massachusetts Institute of Technology (MIT), the Scripps Institute of Oceanography and Harvard University.

N	Region	Station Code	X (m)	Y (m)	Z (m)	Latitude (DMS)			Longitude (DMS)			Ellipsoid Height (m)	Geoid Height(m)
1	Nardaran	NRDG	3119055.948	3715314.543	4127222.667	40	34	52.31451	49	59	9.94004	16.273	34.411
2	Fizuli	FZLG	3342798.47	3625229.739	4031992.562	39	27	35.70574	47	19	15.8445	194.81	184.858
3	Qabal	GBLG	3238748.817	3576505.841	4158306.728	40	56	44.96223	47	50	13.9154	650.262	644.708
4	Jalilabad	GLBG	3284509.365	3698554.434	4013286.652	39	14	32.97715	48	23	35.70606	132.644	127.658
5	Qobustan	GBSG	3188768.885	3660854.732	4123878.617	40	32	7.3605	48	56	33.61957	818.935	825.842
6	Ismailli	IMLG	3224613.934	3604281.844	4145449.633	40	47	32.51041	48	10	55.96458	698.248	695.212
7	Lenkaran	LKRG	3283996.283	3748509.69	3967257.971	38	42	35.38228	48	46	44.50897	41.85	37.568
8	Lerik	LRKG	3316454.423	3727630.942	3962441.31	38	38	35.30915	48	20	26.41819	1583.49	1572.143
9	Pirgulu	PQLG	3199224.826	3628012.366	4145591.493	40	47	17.31828	48	35	37.55605	1458.592	1459.43
10	Qazakh	QZXG	3383719.736	3428021.928	4167688.659	41	3	30.90197	45	22	21.48573	544.279	528.555
11	Qusar	QSRG	3184300.286	3569363.63	4205835.452	41	30	54.56194	48	15	47.56704	607.451	608.115
12	Saatli	SATG	3251874.798	3661664.493	4072626.363	39	56	13.46178	48	23	31.74968	-6.758	-6.808
13	Khinaliq	XNQG	3209492.547	3582005.799	4178112.71	41	10	18.81933	48	8	22.28621	1976.321	1970.712
14	Yardimli	YRDG	3309925.057	3707435.158	3985537.505	38	54	53.46976	48	14	31.74117	908.915	898.921
15	Zaqatala	ZKTG	3278994.716	3470076.273	4215884.2	41	38	13.73493	46	37	18.26641	475.072	465.023
16	Aqdam	AGDG	3324852.13	3579182.996	4087161.078	40	6	24.31295	47	6	24.31295	158.853	150.159
17	Altiaqach	ATGG	3173815.153	3642979.747	4151433.23	40	51	36.97923	48	56	13.78399	1120.995	1126.179
18	Shirvan	ALİG	3211519.896	3695157.594	4074452.543	39	57	29.5227	49	0	20.0829	36.411	45.181
19	Qala	GALG	3115950.034	3733978.297	4112771.964	40	24	36.71078	50	9	19.79342	-0.153	19.012
20	Qedabek	GDBG	3378500.83	3468626.736	4140107.742	40	43	17.48563	45	45	14.82147	1645.107	1627.83
21	Qobu	GOBG	3143976.029	3711500.588	4112089.297	40	24	2.39557	49	43	56.60168	190.123	206.224
22	Island Jiloy	JLVG	3092713.445	3762131.794	4104635.665	40	18	51.68114	50	34	39.37446	-42.139	-21.113
23	Mingechevir	MNGG	3293693.765	3542605.227	4143345.084	40	46	20.08635	47	5	6.84026	66.251	60.328
24	Ganja	GANG	3347100.121	3505285.859	4133076.947	40	38	47.69473	46	19	20.72954	542.303	529.264

Table . The coordinates of the GPS stations of the Azerbaijan geodetic network

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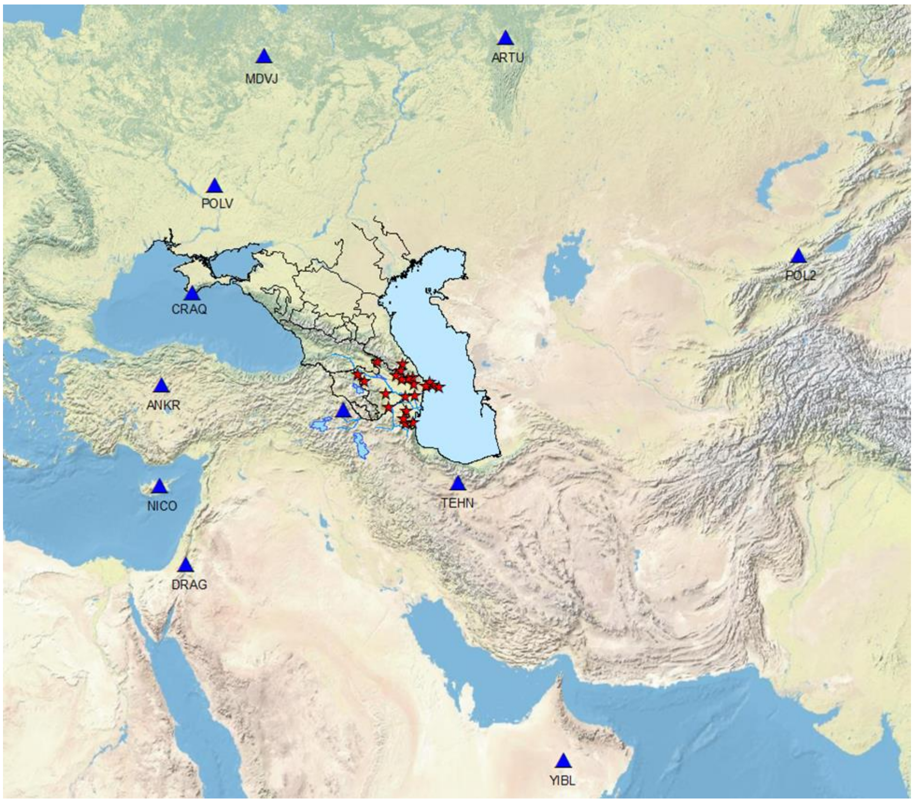

Figure 2. Map of permanent RSSC_GPS map (24) stations and IGS network (ARTU, CRAQ, TEHN, POLV, MDVJ, ANKR, NICO, DRAG, POL2, YIBL, BZGN)

Table 2. Parameters of global reference stations of the IGS network: (ARTU, CRAQ, TEHN, POLV, MDVJ, ANKR, NICO, DRAG, POL2, YIBL, BZGN)

Code	Region	Country	φ°	λ°	receiver	antenna	Regional satellites
ANKR	Ankara	Turkey	39,88	32,75	LEICA GR30	LEIAR10 + NONE	GPS GLONASS Galileo BeiDou SBAS
ARTU	Arti	Russia	56,43	58,56	ASHTECH Z-XII3	ASH700936D_ M + DOME	GPS
CRAO	Simeiz	Ukraine	44,41	33,99	ASHTECH UZ-12	ASH701945C_ M + SCIS	GPS
DRAG	Metzoke	Israel	31,59	35,39	JAVAD TRE_3 DELTA	ASH700936D_ M + SNOW	GPS GLONASS
MDVJ	Mendelee vo	Russia	56.02	37.21	TPS NETG3	JPSREGANT_ DD_E1 + NONE	GPS GLONASS
NICO	Nicosiya	Cyprus	35,14	33,4	LEICA GR25	LEIAR25.R4 + LEIT	GPS GLONASS

POL2	Bishkek	Kyrgyzstan	42,68	74,69	ASHTECH UZ-12	TPSCR.G3 + NONE	GPS
POLV	Poltava	Ukraine	49,6	34,54	LEICA GR10	LEIAR10 + NONE	GPS GLONASS Galileo
TEHN	Tehran	Iran	35,7	51,33	TRIMBLE NETR9	TRM57971.00 + NONE	GPS GLONASS
YIBL	Ibal	Oman	22,18	56,11	TRIMBLE NETR9	ASH701945C_M + NONE	GPS
BZGN	Bazergan	Iran	39,37	44,39	ASHTECH UZ-12	TRM57971.00 + NONE	GPS GLONASS

Calculations and data analysis

Thus, maps of vectors of horizontal movements of the geodetic network of GPS stations of Azerbaijan for 2017 and 2018 years were constructed. (Fig.3). As the analysis of the distribution of velocities shows, the average values of the velocities of horizontal displacements of points to the north and east are not constant, and the processes of shortening the surface of the earth's crust in the study region are also not constant.

The error in determining the velocity varies mainly in the limit of less than 0.6 mm/year and makes it possible to fairly accurately estimate the convergence of plates across the Caucasian mountain system (that is, the error is 5% of the total convergence rate). The high-speed field of GPS observations quite clearly reflects the movement of the north-northeast (NNE) direction in the territory of Azerbaijan and in the adjacent regions of the Lesser Caucasus relative to Eurasia.

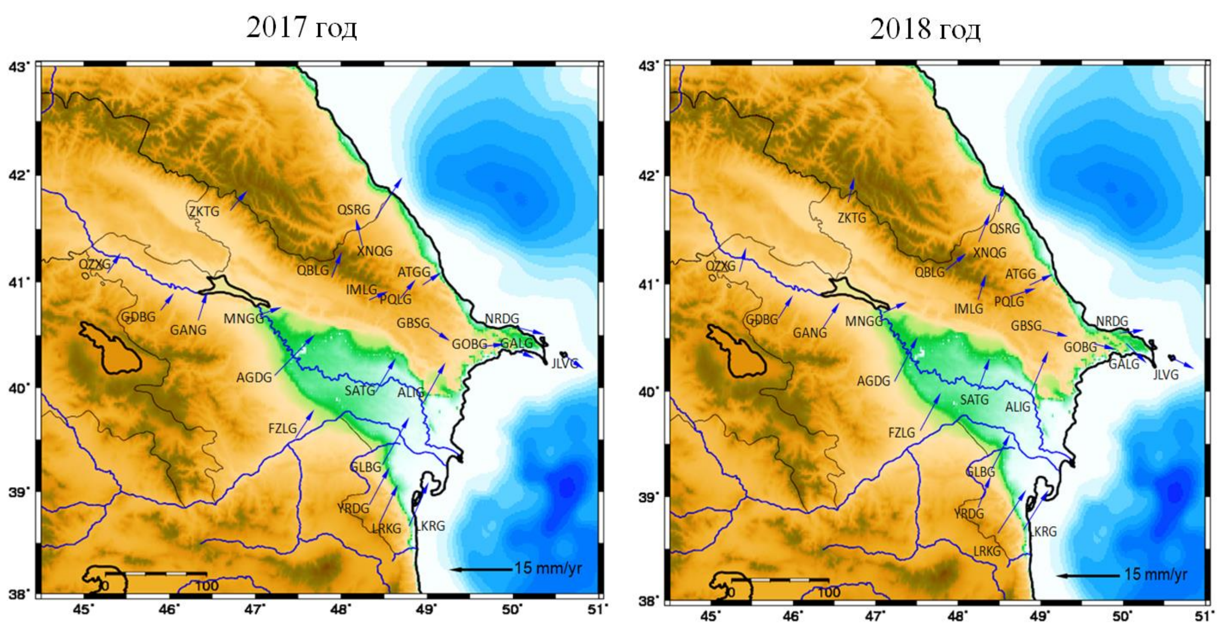

Figure 3. Vectors of horizontal movements of the geodetic network of GPS stations in Azerbaijan for 2017 and 2018

The observed decrease in speed in 2018 at Lerik, Lankaran, Jalilabad, Agdam and Saatli stations as compared to 2017 is the most significant feature of the high-speed field in the study region. Reductions in the size of the earth's crust across the eastern segment of the main Caucasian thrust (longitude 48), determined by the velocity difference between the observation points of Saatli and Altyagach in 2017, is 8.7 mm / year, and in 2018 3.7 mm / year. In western Azerbaijan, the crust in the Greater Caucasus is shrinking between the MCT and the southern wing of the North Caucasus Thrust (NCT), located along the northern edge of the mountain range in Dagestan.

In order to clarify the nature of GPS velocities in the seismic zones of the Kura depression, profiles 1-1 ', 2-2' and 3-3 'were built in the direction from the Talysh region to the Absheron Peninsula to the cross of the stretch of the Greater and Lesser Caucasus (Fig.4).

On the 1-1 ’profile (Fig. 5), along the Kura depression in the direction from the Middle Kura depression to the Lower Kura depression, there is a gradual increase in the speeds of horizontal movements from 7.3 to 11.3 mm / year, which in turn creates a stretching condition. Note that in the last 3 years, the zone of the Lower Kura depression is characterized by a manifestation of high seismic activity, expressed in several earthquakes with a magnitude greater than 5. On profile 2-2 'to the strike cross of the Greater and Lesser Caucasus, there is a noticeable decrease in horizontal movement speeds at an epicentral distance of 65 km (Fig. 6), which confirms the advancement of the Lesser Caucasus on the Kura depression at a speed of 10-12 mm / year and the gradual advancement of the Kura depression under the Greater Caucasus 10].

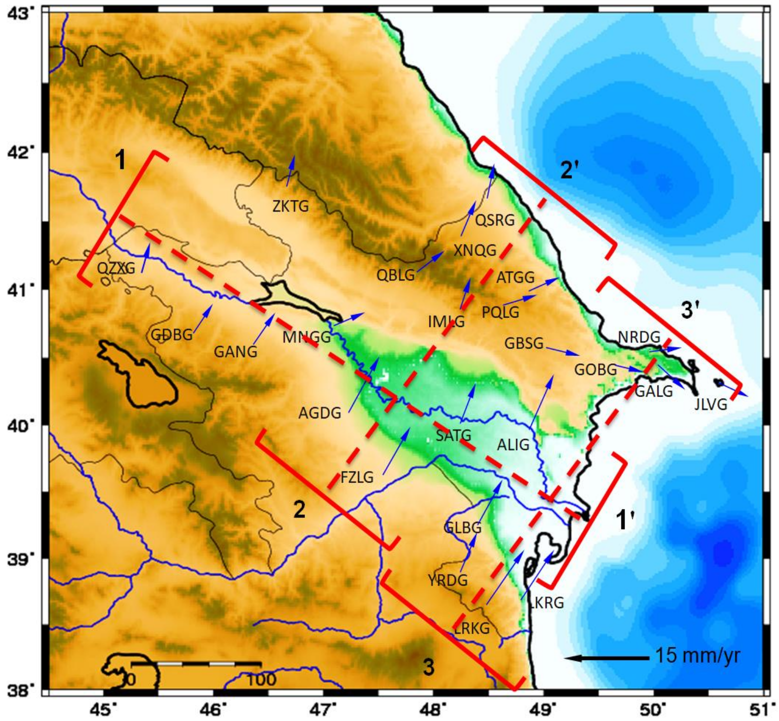

Figure 4. Vectors of horizontal movements of the geodetic network of GPS stations in Azerbaijan for 2018

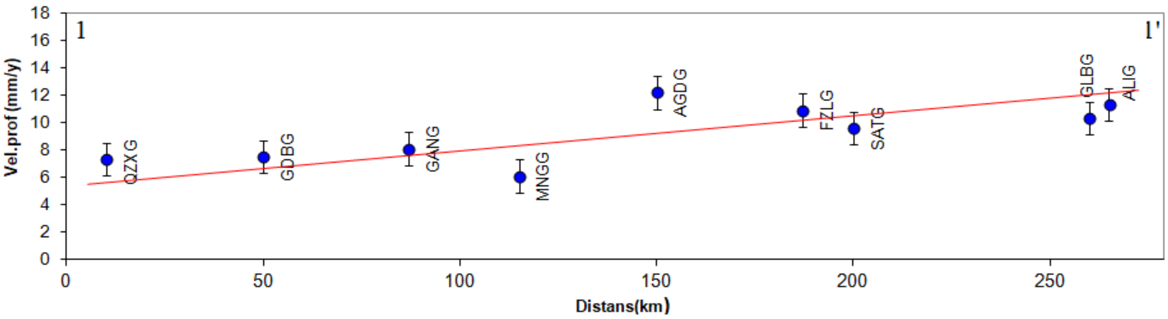

Figure 5. Components of the speeds of horizontal movements of GPS observation points along the profile 1-1

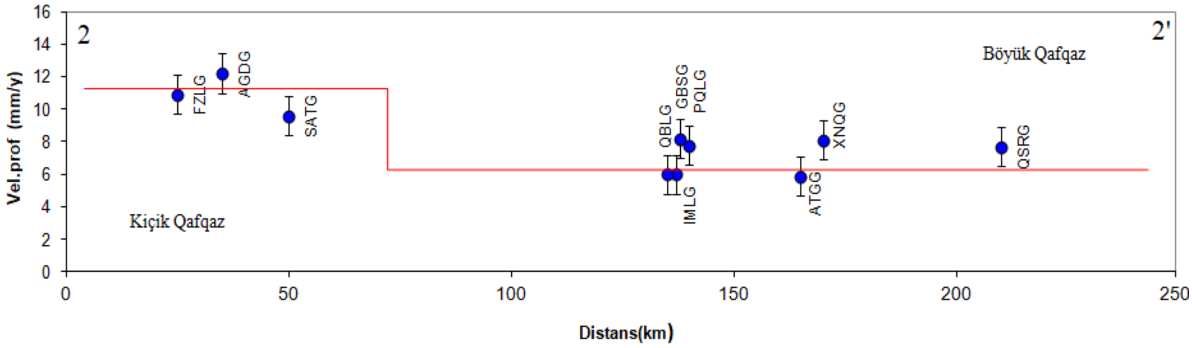

Figure 6. Components of the horizontal displacement rates of GPS observation points along the 2-2 ’profile

Fig. 7 shows the profile in the direction from the Talysh region to the Absheron Peninsula (SW-NE direction) as well as the orientation of the azimuth angles. The speeds of the Nardaran, Gobu, Gala stations and Island Jiloy, which are part of the Absheron zone, are characterized by almost similar values of displacement rates (4.0 mm/year, 4.7 mm/year, 4.5 mm/year, 4.9 mm/year respectively). The profile shows a noticeable decrease in the northern component of the displacement velocities compared with the high values of points located in the southwestern part of the selected profile (LKRG_GPS = 14.9 mm / year, GLBG_GPS = 19.8 mm / year, YRDG_GPS = 13.0 mm / year). It should be noted that in 2018 in the Talysh region there was a strong tangible earthquake with a magnitude of 5.3. In addition, there is a noticeable increase in the azimuth angles of the Absheron stations indicating movement clockwise in the east-south-east direction to 140º.

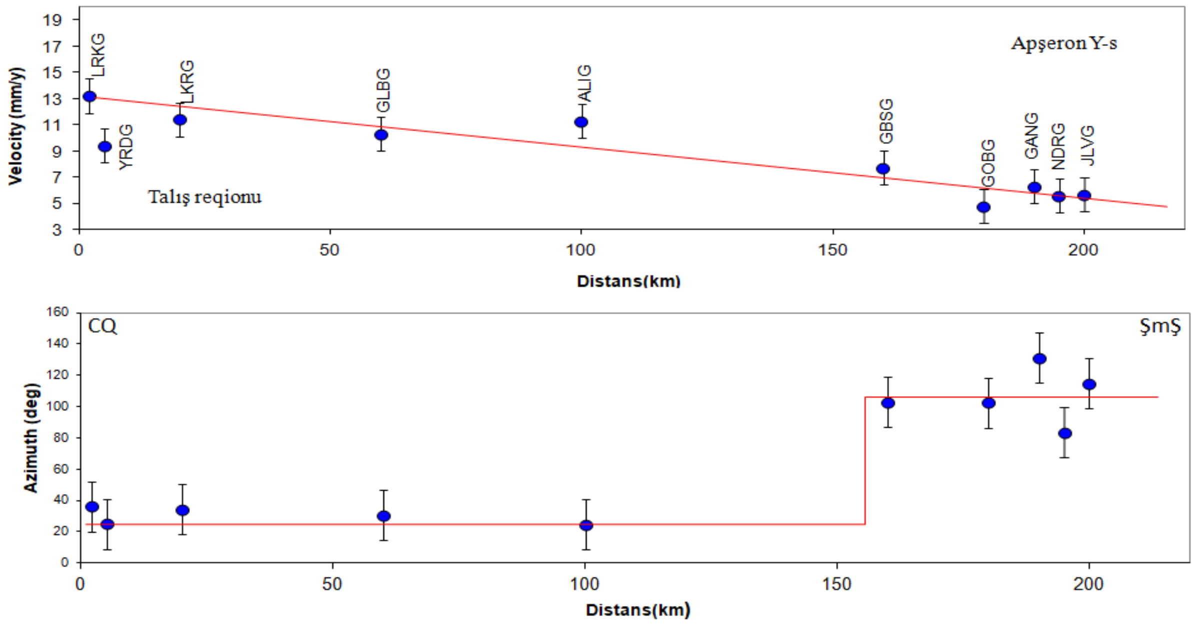

Figure 7. Components of the velocities of horizontal movements of GPS observation points and orientation of azimuth angles along a 3-3 ’profile

Conclusion

Thus, we can conclude that GPS measurements in the intra-plate regions of Azerbaijan allow obtaining, close to the real, a picture of the stress-strain state at their borders.

According to the research, it is interesting that for different tectonic structures of the territory of the republic there is a difference in the direction of modern horizontal surface movements as measured by satellite geodesy (GPS) measurements. With the general trend of measurement points

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shifts in the northeast direction in the south-eastern part of the Greater Caucasus, some stations are oriented to the north, and on the Absheron peninsula to the east-southeast.

The axes of decreasing and increasing velocities obtained from GPS data confirm the fact that the crust shrinks in the north-north-east direction.

Areas of high seismicity are confined to areas of high speeds deformation (mainly shortening) and a high gradient of strain rates (mainly shear).

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ANNOTATIONS

1. STUDY OF ABNORMAL CHANGES OF GEODYNAMIC TENSION BY GRAVIMAGNETOMETRIC INVESTIGATIONS AND ECOGEOPHYSICAL RISK ASSESSMENT

(On the example of Garadagh gas reservoir)

G.J. Yetirmishli , H.O. Veliyev , N.B. Khanbabayev

It is noted that, geologists-geophysics are always in the spotlight according to the being one of the most important problems of the re-specification of geological-technical structure of the underground gas storage facilities (UGSF) that is the exceptional importance in the development of the oil and gas industry.

Predictive assessment of the environmental risk and setting the local anomaly maps for the different levels are offered taking into account the change of the density effect as the variation of the volume of injected and extracted gas.

2. REFLECTION OF THE GEODYNAMIC REGIME OF THE SHAMAKHI-ISMAYILLI SEISMOGENIC ZONE IN LOCAL ANOMALIES OF THE GEOMAGNETIC FIELD

A.G. Rzayev, N.B. Khanbabayev, M.K. Mammadova, L.A. Ibragimova

According to the results of monitoring the variations of the modulus of the total vector of the geomagnetic field intensity and the spatial-temporal distributions of the magnetic field gradient conducted at the RSSC of ANAS, is considered the connection between local seismomagnetic effects and the geodynamic regime of the Shamakhi-Ismayilli seismogenic zone during the preparation and implementation of an earthquake of 05.02.2019 (ml=5.2). It is established that local magnetic anomalies reflect the stress-strain state of the earth's crust, due to the peculiarities of the geodynamic influence of faulting tectonics elements.

3. FOCAL PARAMETERS OF ISMAYILLI EARTHQUAKE OF OCTOBER 7, 2012

S.S.Ismayilova, S.E.Kazimova, G.I.Muradova, Sh.N.Khadidji, E.Kh.Muradova

The features of the seismic distribution of the south-eastern part of the Greater Caucasus are considered. The connection of seismic events and their mechanisms with fault tectonics of the region is analyzed. The interpretation of the source mechanism of the Ismayilli earthquake is given. The mechanism of a general Caucasian fault with a left-sided shift component was established. Were constructed distribution schemes of accelerations (PGA) and velocities (PGV) of the soil. The PGA value was 0.25 g, and the PGV value was 10 cm/sec.

4. VARIABLE FEATURES OF THE SEISMOMAGNETIC EFFECT CONNECTED WITH STRONG EARTHQUAKES IN THE ZAGATALA-BALAKAN ZONE IN 2012

N.B. Khanbabayev, M.K. Mammadova, M.G. Zeynalov, V.R.Huseynova

Time dependent change variations of the seismomagnetic effect are studied in the areas assessed with high seismic risk and geodynamic activity in this article. Analysis of geomagnetic field tension in the Shamakhi-Shaki-Balakan geodynamic polygon shows that the tension is equally distributed across the area.

Keywords: RSSC-Republican Seismic Survey Center, SME- seismomagnetic effect, nTI – nano Tesla.

5. IMPACT OF ENGINEERING GEOLOGICAL CONDITIONS ON SEISMIC HAZARD IN BAKU CITY, YASAMAL DISTRICT

Z.S.Aliyeva, A.B.Guliyeva, L.I.Veliyeva, L.A.Yaqubova, I.N. Jalilova

Tectonics, engineering-geological, seismological, hydrogeological conditions of the area were investigated in connection with seismic hazard assessment in Yasamal district. Detail seismic zoning of this area was carried out on the basis of engineering and geological data obtained from numerous construction areas. İn this article, seismicity was assessed in faults covering the Absheron peninsula, including Baku.

Keywords: geological, seismological, faults, hydrogeological, groundwater, clay, limestone, loam.

6. MODERN GEODYNAMICS OF AZERBAIJAN ON GPS STATION DATA FOR 2017-2018 years

I.E. Kazimov, A.F. Kazimova

The article presents a method for calculating the velocity field of modern horizontal displacements in the Earth's crust of Azerbaijan, obtained from observations at 24 stationary GPS_RSSC stations, a characteristic aspect of which is a noticeable horizontal displacement in the north-east direction at a speed of 5-18 mm / year. Relatively stationary Eurasia revealed a general compression of the region at a rate of 4–7 mm / year, which is the source of modern geological and seismic activity in the border area of Azerbaijan and the Arabian platform.

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ANNOTASIYALAR

1. GEODİNAMİK GƏRGİNLİYİN ANOMAL DƏYİŞMƏLƏRİNİN QRAVİMAQNİTOMETRİK TƏDQİQATLARLA ÖYRƏNİLMƏSİ VƏ EKOGEOFİZİKİ RİSKİN QİYMƏTLƏNDİRİLMƏSİ (QARADAĞ QAZ ANBARI TİMSALINDA)

Q.C.Yetirmişlı, H.Ö.Vəliyev, N.B.Xanbabayev

Qaradağ və Qalmaz qaz anbarlarının tutumunun 6 milyard m^3 həcm səviyyəsinə gətirilməsinə dair, Azərbaycan Respublikasının Prezidenti Cənab İlham Əliyev SOCAR-a tapşırıq vermişdir. Hazırda bu istiqamətdə elmi və praktiki tədqiqat işləri aparılır. Genişləndiriləcək və tutumu artırılan qaz anbarlarının gələcək fəaliyyətində ekoloji təhlükənin yaranmaması üçün mütəmadi olaraq seysmik riskə və seysmik rayonlaşma işlərinə və tektonik qırılmaların aktivləşməsinə daim nəzarət olunmalıdır. Qaz vurulan laylarda anomal geodinamik gərginlik enerjisinin artmasından yarana biləcək təhlükənin qarşısının alınması amillərinin öyrənilməsi və ekoloji riskin düzgün qiymətləndirilməsi günün ən aktual problemlərindən biridir.

2. ŞAMAXI-İSMAYILLI ZONASININ GEOMAQNIT SAHƏSININ LOKAL ANOMALYALARINDA GEODINAMIK REJIMININ ƏKS OLUNMASI

A.Q. Rzayev, N.B. Xanbabayev, M.K. Məmmədova, L.A. İbrahimova

AMEA nəzdində RSXM tərəfindən yerinə yetirilən geomaqnit sahəsinin tam vektor modulunun variasiyası və gərginlik qradiyentinin məkan-zaman dəyişmələrinin monitorinqinə əsasən Şamaxı-İsmayıllı seysmoaktiv zonasında 05.02.2019-cu il (ml=5,2) zəlzələsinin hazırlıq və başvermə dövründə lokal seysmomaqnit effektin geodinamik rejimlə əlaqəsi qiymətləndirilir.

Müəyyən olunmuşdur ki, Yer qabığında gedən gərginlik deformasiya prosesləri lokal maqnit anomalarda əks olunur və qırılma tektonikasının elementləri ilə əlaqəlidir.

3. 7 OKTYABR 2012-CI IL İSMAYILLI ZƏLZƏLƏSININ FOKAL PARAMETRLƏRI

S.S. İsmayılova, S.E. Kazımova, G.İ. Muradova, Ş.N. Xədici, E.X. Muradova

Məqalədə Böyük Qafqazın cənub-şərqi hissəsinin seysmik paylanma xüsusiyyətləri nəzərə alınaraq seysmik hadisələrin və onların mexanizmlərinin bölgənin qırılma tektonikası ilə əlaqəsi təhlil edilir. İsmayıllı zəlzələsinin ocaq mexanizminin təfsiri verilir. Ümumi Qafqaz qırılmasının sol tərəfli keçid komponenti ilə çalışan mexanizm yaradılmışdır. Torpağın aklerasiya (PGA) və sürətlərinin (PGV) paylanma sxemləri qurulmuşdur. PGA dəyəri 0.25 q PGV dəyəri isə 10 sm/s-dir.

4. 2012-CI ILDƏ ZAQATALA-BALAKƏN ZONASINDA BAŞ VERMIŞ GÜCLÜ ZƏLZƏLƏLƏRNƏN BAĞLI SEYSMOMAQNIT EFFEKTIN DƏYIŞMƏ XÜSUSIYYƏTLƏRI

N.B. Xanbabayev, M.K.Məmmədova, M.G.Zeynalov, V.R.Hüseynova

Məqalədə yüksək seysmik riskliyi və geodinmamik aktivliyi ilə qiymətləndirilən ərazilərdə seysmomaqnit effektin zamandan asılı dəyişmə variasiyaları öyrənilir. Şamaxı-Şəki-Balakən geodinamik poliqonlarda geomaqnit sahə gərginliyinin təhlili göstərir ki, gərginlik sahə üzrə bərabər paylanmışdır.

Açar sözlər: RSXM-Respublika Seysmoloji Xidmət Mərkəzi, SME-seysmomaqnit effekt, nTl- nano Tesla.

ANNOTATIONS

5. BAKI ŞƏHƏRİ YASAMAL RAYONU ƏRAZİSİNDƏ MÜHƏNDİS GEOLOJİ ŞƏRAİTİN SEYSMİK TƏHLÜKƏYƏ TƏSİRİ

Z.S.Əliyeva, A.B.Quliyeva, L.İ.Vəliyeva, l..A.Yaqubova, İ.N. Cəlilova

Yasamal rayonunda seysmik təhlükəliliyinin qiymətləndirilməsi ilə əlaqədar həmin ərazinin tektonika, mühəndisi-geoloji, seysmoloji, hidrogeoloji şəraiti araşdırılmışdır. Çoxsaylı tikinti sahələrindən alınmış mühəndisi-geoloji məlumatlar əsasında həmin ərazinin detal seysmik rayonlaşdırma işləri aparılmışdır. Abşeron yarımadasını, o cümlədən Bakı şəhərini əhatə edən qırılmalarda seysmiklik qiymətləndirilmişdir.

Açar sözlər: geoloji, seysmoloji, qırılmalar, hidrogeoloji, qrunt, gil, əhəngdaşı, gilcə.

6. 2017-2018- CI ILLƏRDƏ AZƏRBAYCANDA GPS STANSIYA MƏLUMATLARININ MÜASIR GEODINAMIKASI

E.İ, Kazımov, A.F. Kazımova

Məqalədə, Azərbaycanın yer qatında xarakteristik cəhəti 5-18 mm/il sürətində şimal-şərq istiqamətində nəzərəçarpacaq dərəcədə üfüqi bir yerdəyişmə təşkil edən, RSXM-nin 24 müvəqqəti GPS stansiyalarının müşahidələrindən əldə edilən müasir üfüqi yer dəyişdirmələrinin sürət sahəsinin hesablanma metodu təqdim olunur. Nisbətən hərəkətsiz Avroasiya-Ərəb platformasında və Azərbaycanın sərhəd zonasında müasir geoloji və seysmik aktivliyin mənbəyi olan 4-7 mm / il səviyyəsində ümumi sıxılmanı meydana çıxarır.

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АННОТАЦИИ

1. ИЗУЧЕНИЕ АНОМАЛЬНЫХ ИЗМЕНЕНИЙ ГЕОДИНАМИЧЕСКОЙ НАПРЯЖЁННОСТИ ГРАВИМАГНИТНЫМИ МЕТОДАМИ И ОЦЕНКА ЭКОГЕОФИЗИЧЕСКОГО РИСКА (на примере Гарадагского газохранилища)

Г.Дж.Етирмишли, Г.О. Велиев, Н.Б. Ханбабаев

В статье отмечается важность проблемы уточнения (детализации) геолого-тектонического строения в районе подземных газовых хранилищ, актуальность которой всегда находится в центре внимания геологов-геофизиков нефте-газовой промышленности.

Предлагается оценивать напряженное состояние и экологический риск локальных участков вокруг газовых хранилищ путем мониторинга плотностных свойств геологической среды в период наполнения и расхода объемов газа с применением гравимагнитных методов оценки.

2. ОТРАЖЕНИЕ ГЕОДИНАМИЧЕСКОГО РЕЖИМА ШАМАХЫ-ИСМАИЛЛИНСКОЙ СЕЙСМОГЕННОЙ ЗОНЫ В ЛОКАЛЬНЫХ АНОМАЛИЯХ ГЕОМАГНИТНОГО ПОЛЯ

А.Г. Рзаев, Н.Б. Ханбабаев, М.К. Мамедова, Л.А. Ибрагимова

По результатам мониторинга вариаций модуля полного вектора напряженности геомагнитного поля и пространственно-временных распределений градиента напряженности магнитного поля, проводимого в РЦСС НАНА, рассматривается связь локальных сейсмомагнитных эффектов с геодинамическим режимом Шамахы-Исмаиллинской сейсмогенной зоны в период подготовки и реализации землетрясения 05.02.2019 (ml=5.2). Установлено, что локальные магнитные аномалии отражают напряженно-деформированное состояние земной коры, обусловленное особенностями геодинамического влияния элементов разломной тектоники.

3. ПАРАМЕТРЫ ОЧАГА ИСМАИЛЛИНСКОГО ЗЕМЛЕТРЯСЕНИЯ 7 ОКТЯБРЯ 2012 Г.

С.С.Исмайлова, С.Э.Казымова, Г.И. Мурадова, Ш.Н. Хадиджи, Е.Х. Мурадова

Рассматриваются особенности распространения сейсмичности юго-восточной части Большого Кавказа. Анализируется связь сейсмических событий и их механизмов с разломной тектоникой района. Дана интерпретация механизма очага Исмаиллинского землетрясения. Установлен механизм общекавказского сброса с левосторонней сдвиговой компонентой. Были построены схемы распределения ускорений (PGA) и скоростей (PGV) грунта. Значение PGA составило 0,25 g, а значение PGV 10 см/сек.

ANNOTATIONS

4. ОСОБЕННОСТИ ПРОЯВЛЕНИЯ СЕЙСМОМАГНИТНОГО ЭФФЕКТА, СВЯЗАННОГО С СИЛЬНЫМ ЗЕМЛЕТРЯСЕНИЕМ В ЗАКАТАЛО-БАЛАКЕНСКОЙ ЗОНЕ 2012 Г.

Н.Б.Ханбабаев, М.К.Мамедова, М.Г.Зейналов, В.Р.Гусейнова

Изучены характер проявления сейсмомагнитного эффекта в зоне высокого сейсмического риска и геодинамической активности. Показано, что напряженность геомагнитного поля распределена не однородно по площади Закатало-Балакенского геодинамического полигона.

Ключевые слова: РЦСС-Республиканский центр сейсмологической службы, СДЭ - сейсмодинамический эффект, nTl-nano Tesla.

5. ВЛИЯНИЕ ИНЖЕНЕРНО-ГЕОЛОГИЧЕСКИХ УСЛОВИЙ НА СЕЙСМИЧЕСКУЮ ОПАСНОСТЬ ТЕРРИТОРИИ ЯСАМАЛЬСКОГО РАЙОНА, Г.БАКУ

З.С. Алиева, А.Б. Гулиева, Л.И. Велиева, Л.А. Ягубова, И.Н. Джалилова

С целью оценки сейсмической опасности территории Ясамальского района, на основе анализа имеющегося тектонического, инженерно-геологического, гидрогеологического и других материалов, было проведено детальное сейсмическое районирование указанной территории и установлена возможная сейсмическая угроза, исходящая от разломов, окружающих Абшеронский полуостров, в том числе г. Баку и генерирующих землетрясения.

Ключевые слова: геологические, сейсмические, разрывы, гидрогеологические, подземные воды, глина, известняк, суглинок.

6. СОВРЕМЕННАЯ ГЕОДИНАМИКА АЗЕРБАЙДЖАНА ПО ДАННЫМ GPS СТАНЦИЙ ЗА 2017-2018 гг.

И.Э. Казымов, А.Ф. Казымова

В статье представлена методика расчета поля скорости современных горизонтальных смещений земной коры Азербайджана, полученная по результатам наблюдений на 24 стационарных GPS_РЦСС станциях, характерным аспектом которой является заметное горизонтальное смещение в северо-восточном направлении со скоростью 5–18 мм/год. Относительно неподвижной Евразии выявлено общее сжатие региона со скоростью 4–7 мм/год, которое является источником современной геологической и сейсмической активности в пограничной области Азербайджана и Аравийской платформы.

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25, Nigar Rafibeyli str., AZ1001, Baku, Azerbaijan
Republican Seismic Survey Center
of Azerbaijan National Academy of Sciences
Phone: +994 12 492-34-37;
Fax: +994 12 492-31-65;
E-mail: seys@azeurotel.com;
science@azeurotel.com

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