ISMAYILLI EARTHQUAKE WITH ML=3.8 OF JANUARY 31, 2023

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Introduction. The problem of studying and predicting earthquakes has been relevant for centuries. Mankind has always tried to understand the processes of occurrence of destructive earthquakes in the past.

The Shamakhi-Balakan geodynamic polygon, covering the areas of the southern slope of the southeastern subsidence of the Greater Caucasus, is one of the most seismically active parts of the meganticlinorium, where strong seismic events occurred in the early and middle of the 20th century. The polygon covers several seismically active zones with regime forecasting observations: Shamakhi-Ismayilli, Oghuz-Gabala and Sheki-Zakatala zones (Yetirmishli et al., 2018, 2021). The seismic regime of each zone differs in its parameters and changes over time (Baghirov, Ismayilova, 2019).

The stationary network of seismic stations in the Ismayilli-Shamakhi seismic zone has registered more than a thousand earthquakes of different energy classes. The ongoing seismic events convince of the importance of the problem of studying the seismicity of the Shamakhi-Ismayilli zone in order to identify the features of the manifestation of earthquakes and assess the degree of their potential seismic hazard, as well as the feasibility of conducting geophysical studies to predict the seismic process (Baghirov, Ismayilova, 2019).

Instrumental data. Below are the instrumental data within the Shamakhi-Ismayilli seismogenic zone.

A map of epicenters of historical earthquakes in the study area is shown in Figure 1, a map of earthquake epicenters for 2022 in the Shamakhi-Ismayilli region - in Figure 2, the distribution of the number of earthquakes and the release of seismic energy in the Shamakhi-Ismayilli seismogenic zone for 2022 - in Figure 3.

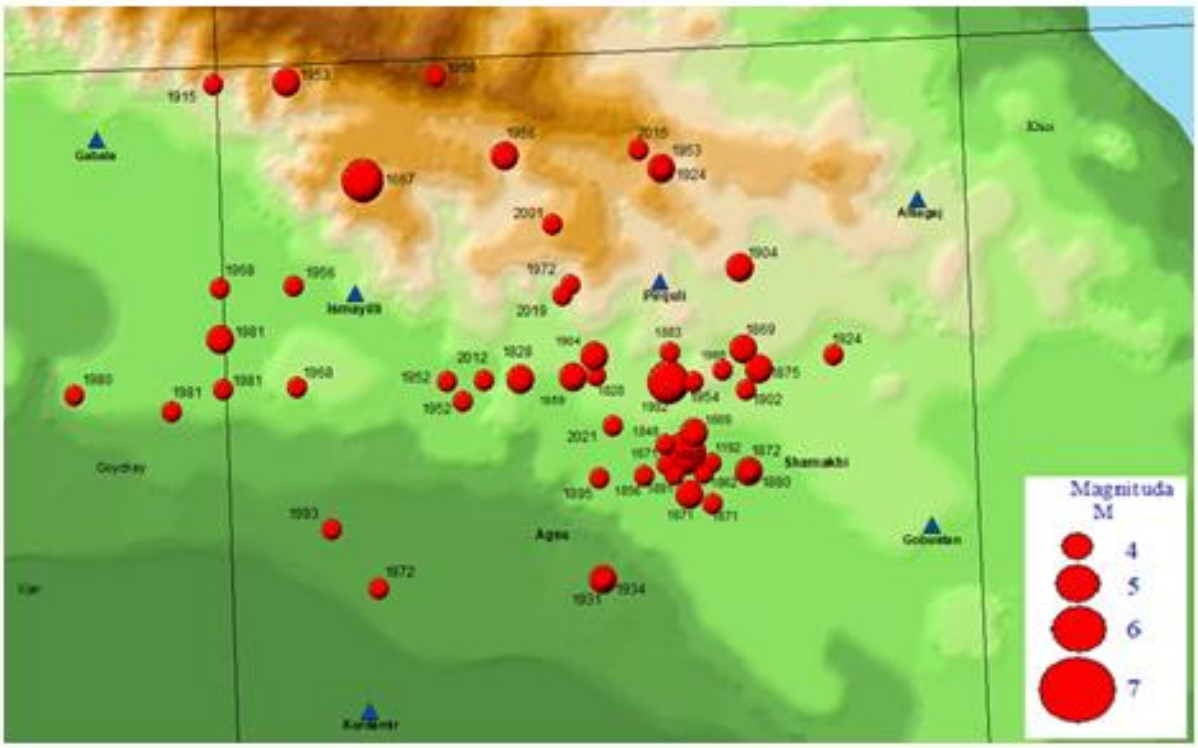

Figure 1. Map of epicenters of historical earthquakes, occurred in the study area (427-2022)

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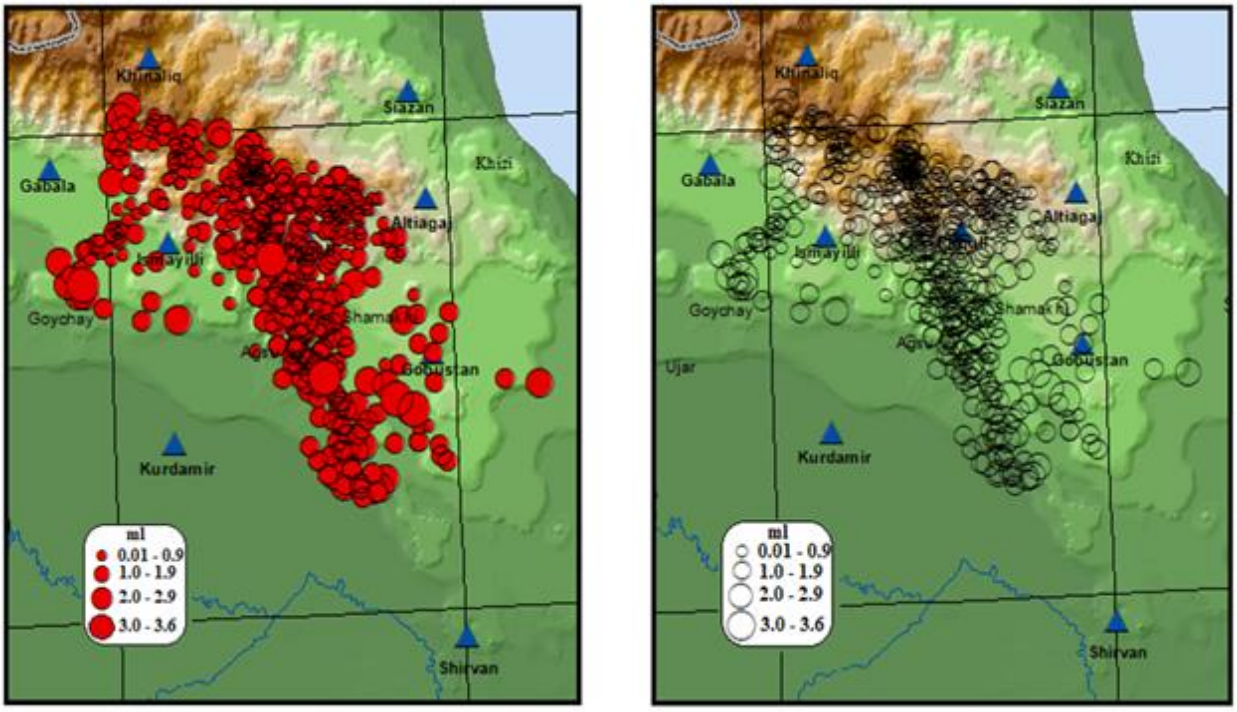

Figure 2. Map of earthquake epicenters in Shamakhi-Ismayilli region (2022)

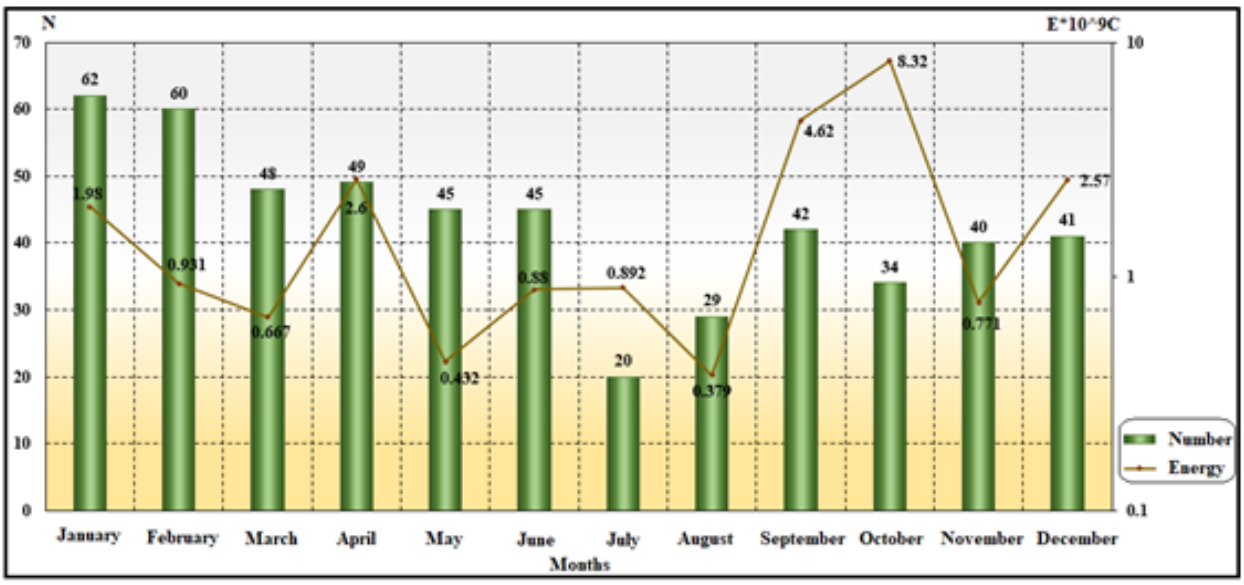

Figure 3. Distributions of the number of earthquakes and discharge of seismic energy in the Shamakhi-Ismayilli seismogenic zone (2022)

An analysis of the distribution of the number of earthquakes and the release of seismic energy in the Shamakhi-Ismayilli region in 2022 shows that the release of seismic energy in September and October is higher than in other months due to earthquakes with magnitude ≥3.0. (Table 1).

To predict the degree of seismic hazard of catastrophic earthquakes, not only the results of instrumental observations are of undoubted interest, but also the assessment of the potential energy of an earthquake for a given area, its magnitude and intensity, as well as the radius of action of an earthquake on gravimetric (Δg) parameters (seismogravimetric effect).

Research methods. The Shamakhi-Ismayilli seismically active zone is located on the southern slope of the Greater Caucasian meganticline between the Demiraparanchay and Meraz meridians. In this zone at different times V.Weber, A.Mishurin, A.Malikov, A.Alizade (1930-40), E.Khain (1939),

A.Shikhalibeyli (1940-45), I.Tsimelzon (1953), N.Yakovenko (1962), R.Hajiyev (1965), T.Kengerli (1981-1995), A.Aliyev (1981)-2007, E.Guliyev and E.Isayev (2002-2007) conducted geological and geophysical studies of different scale.

The study of geodynamic processes occurring in the area, in parallel with seismological studies based on modern geophysical instruments, is considered one of the most urgent tasks of our time. (Uspensky, 1968).

Table 1

№	Date d./m./y.	t_0, h./m./s.	Epicenter		h, km	MLH	MLH*	ML	K_p	I_0, point	Note
			φ°, N	λ°, E							
1.	10.03.2000	14:20:08	40.92	48.18	19		3.9	4.4	11.0		Ismayilli-4 points
2.	26.11.2001	05:24:19.8	40.85	48.45	19		4.0	4.6	11.3	4	Pirkuli-3-4 points, Shamakhi-4 points
3.	08.06.2007	05:54:35.1	40.72	47.87	32		3.6	4.1	10.5		
4.	12.12.2007	10:25:30.5	40.55	48.15	24		3.7	4.2	10.7	3.5	Shamakhi-4 points, Pirkuli-3-4 points
5.	19.12.2008	15:11:03.2	40.87	48.49	5		3.9	4.4	11.0	5	Pirkuli, Demirchi-4.5points Shamakhi-4 points, Ismayilli-3.5 points
6	07.10.2012	11:42:50.6	40.70	48.35	41		4.5	5.3	12.2	5	Pirkuli, Shamakhi, Ismayilli, Akhsu-5 points
7	20.04 2022	18:05:32	40.71	47.92	44			3.0			Ismayilli
8.	01.092022	18:21:50	40.75	48.48	13			3.4			Akhsu
9.	29.10.2022	13:50:45	40.45	48.83	4			3.6			Gobustan
10.	30.10.2022	04:08:12	40.43	48.88	4			3.1			Gobustan
11.	15.12.2022	19:09:28	40.50	48.62	32			3.2			Akhsu
12	16.01.2023	12:09:33	40.61	48.82	8			3.1			Gobustan
13.	31.01.2023	02:54:07	40.97	48.23	12			3.8			Ismayilli

The purpose of repeated gravimetric measurements carried out at the studied geodynamic test site is to detect seismic anomalous effects in non-tidal variations in relative gravity. Canadian gravimeters Scintrex AutoGrav CG-5 were used to study non-tidal variations in the acceleration of gravity, which are capable of providing the highest measurement accuracy during observations in the field (Fig. 4).

Figure 4. Gravimeter Scintrex CG-5

The discussion of the results. On the basis of gravimetric measurements on the southern slope of the Greater Caucasus, maps of the gravity field in 2D and 3D format were compiled. On the 2D gravimetric map (Fig. 5) in the Ismayilli region, a number of anomalous sections of the gravity field are observed.

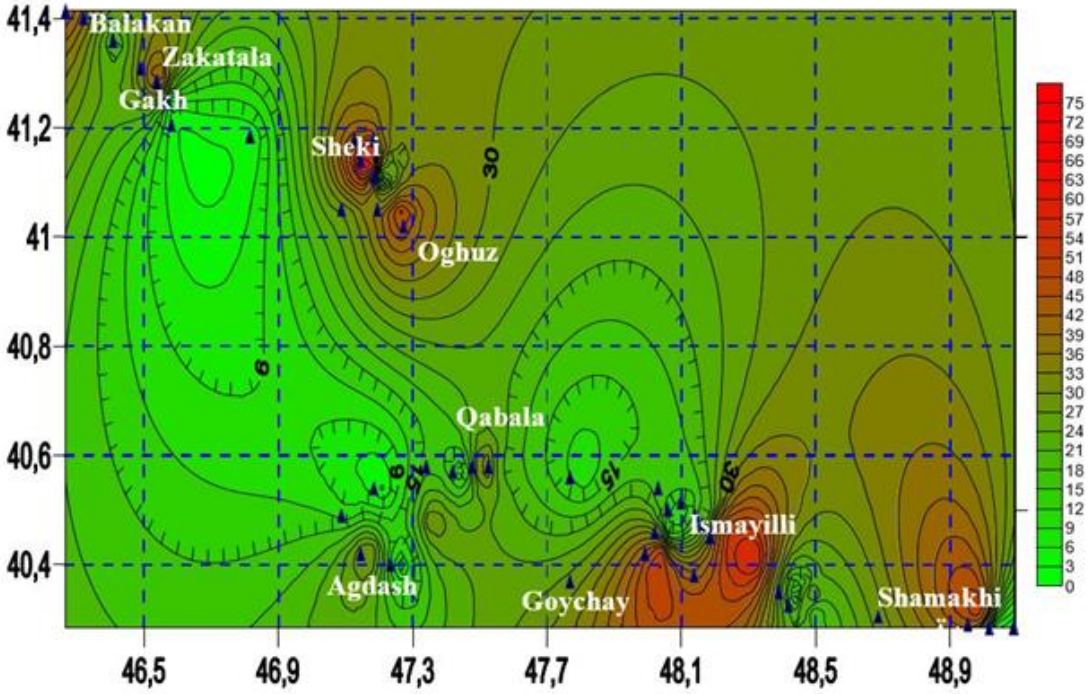

Figure 5. Map of isoanomalies of the gravity field of the southern slope of the Greater Caucasus.

Apparently, these anomalous areas are the result of the influence of intrusive masses, wedging out to the surface layers of the earth's crust.

The map of isoanomalies of the gravitational field in 2022 (Fig. 5) shows anomalous zones accompanied by an increase in the value of Δg in the seismogenic zones of Gabala, Ismayilli and Shamakhi a month before the Ismayilli earthquake.

As can be seen on the map of gravity field isoanomalies compiled in 2022 (Fig. 6), the main changes occurred in the Ismayilli and Shamakhi regions. We also observe an increase in intensity occurring here, which increased in these areas and was more pronounced locally in the Ismayilli-Karamaryam seismogenic zone. Thus, the relative strength of gravity of the entire region ranges from 0.002-0.051 mGal, in the Ismayilli region 0.018-0.050 mGal, and in the Shamakhi region 0.010-0.040 mGal. (Fig. 7).

From the conducted studies, it can be concluded that the high intensity in the Ismayilli-Karamaryam seismogenic zone at the Shamakhi-Ismayilli geodynamic polygon is on a more noticeable ascending line during the preparation of the Ismayilli earthquake of January 31, 2023. Qualitative analysis of field observations obtained during the period of the Ismayilli earthquake revealed anomalous manifestations in the gravitational field. (Fedynsky, 1967 and Nemtsov, 1962). The changes that were regularly recorded before the main earthquake were interpreted as earthquake precursors and reflected on the gravity field maps in 2D and 3D formats (Fig.6,7).

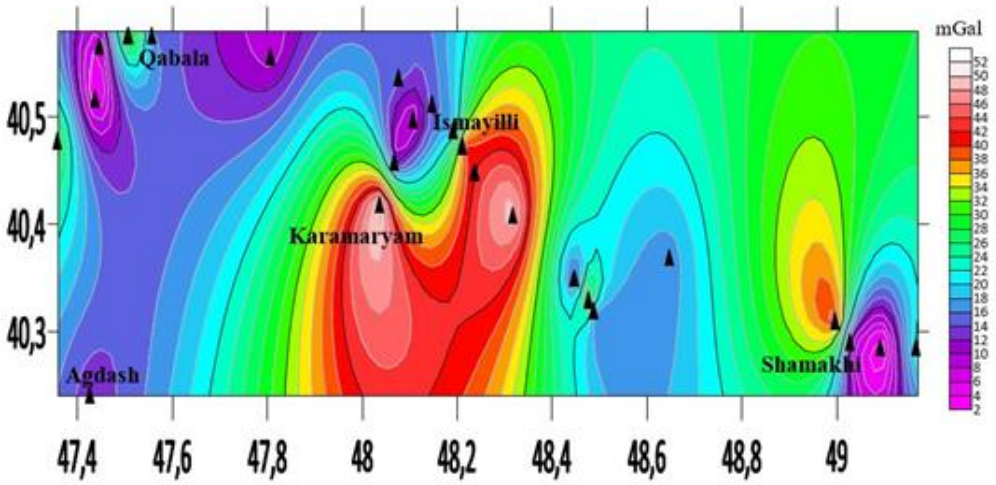

Figure 6. Map of isoanomalies of the gravitational field of the Shamakhi-Ismayilli test site before the Ismayilli earthquake (2022).

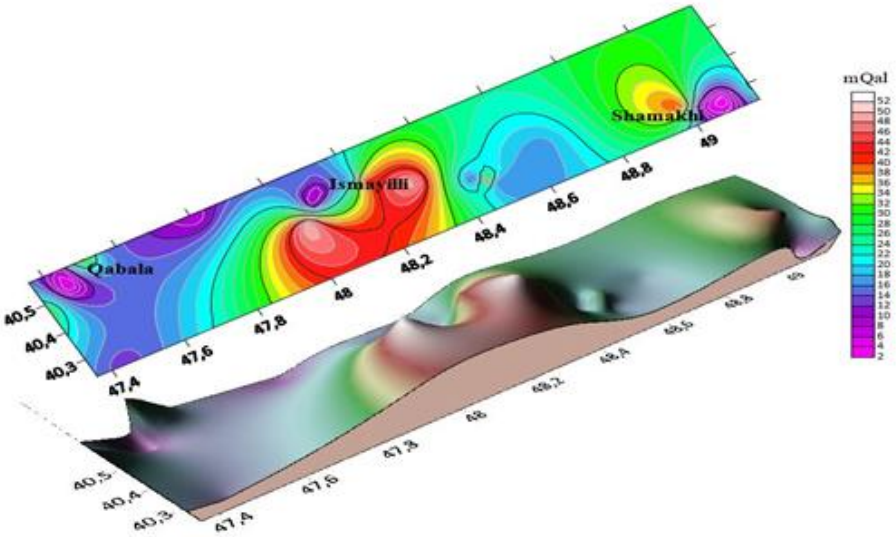

Figure 7. Map of isoanomalies of the gravitational field of the Shamakhi-Ismayilli test site before the Ismayilli earthquake (2022).

Consideration and analysis of the results of variations in gravimetric fields, comparison of these data with the seismicity and geodynamics of the region made it possible to establish the predominant

factor disturbing geophysical parameters, which may be a tectonic process due to the activation of movements along the faults of the Shamakhi-Ismayilli seismically active zone. (Andreyev and Klushin, 1965).

Conclusion

1. Anomalous changes in the gravitational field were detected on the territory of the Ismayilli zone and quantitative information was obtained on the deformations of the earth's surface during the earthquake of January 31, 2023, which makes it possible to interpret them as earthquake precursors;
2. An assessment of the stress-strain state of the geological environment of the seismogenic zone is given.
3. Systematization of anomalous effects in gravitational fields showed that they belong to a single regional seismotectonic process.

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