

## ANOMALOUS CHANGES OF MAGNETIC FIELD BEFORE THE ZAGATALA EARTHQUAKE ON 05.06.2018

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Introduction: Researchers know that the strong earthquakes in seismoactive areas are frequently accompanied by geomagnetic effect. Magnetometric investigations allow in many cases can help to clarify boundaries of geological structures (Rzayev, 2006; Yetirmishli et al. ,2013).

The accumulation of stress-strain energy at the different depths of the Earth is related to local, ionospheric and cosmogenic factors (Finkelstein et al., 2012). Mechanical, physico-chemical and the other features of the environment of the earthquake sources in the area of the north and southern slopes of the Greater Caucasus, Kura Depression and Lesser Caucasus where anomalous stress-strain energy is accumulated, changes with characteristic features. Effects of the such active processes on the surface are studied in the seismoactive regions of the world as the earthquake warning factors and geophysical areas : gravitational , electrical, magnetic and geochemical anomalous changes. [1,2,3]

The first information about earthquakes in the north-western region of Azerbaijan in the Greater Caucasus dates to 1850 year. Strong earthquake in the region occurred in 1936 and 1948 years ( $m \geq 5$ ) ( Aghamirzoyev, 1987). In the recent years, the earthquake with magnitude of 7 is occurred on 07.05.2012 in the Zagatala-Balakan zone ( $m_l = 5,6$   $h=9$  km  $\varphi = 41,50^\circ N$ ,  $\lambda = 46,58^\circ N$ ) and in the Zagatala area in 2018 year.

The earthquake with 10 km depth and magnitude of 5.5 had been occurred in the Zagatala region on 05.06.2018. In the article, the mechanism of the earthquake source is mentioned as a main factor in the occurrence of the seismic events as a warning element of anomalous seismic effects. According to the results of observations of the geomagnetic regime, there is detailed information for the interpretation and analysis of the characteristic gradient and increasing of the geomagnetic field tension , during the preparation of seismic event at the Shamakhi-Sheki-Balakan geodynamic polygon.

It can be noted that the coverage of the Zagatala earthquake area is in the southern sunset of the Greater Caucasus mega anticlinorium from a geological perspective (Pleistocene zone).

This can be evaluated as Zagatala tension zone. This zone is surrounded by the west of Gasakh-Signakh fault and to the east by the Ganjachay-Alazan fault (Shikhalibeyli et al. 1978).

The area in the magnetic field is recorded to as the Shamkhor-Zagatala transverse magnetic anomaly. Within this anomaly, two large significant positive magnetic anomalies are distinguished: Alazan and Gutan (Metaxas, 1979).

These large-scale anomalies are located in the intersection zone of the lengthwise Caucasus and transverse tectonic structure. These anomalies are considered as the elements of the Anticaucasus megazone. The Alazan and Gutan anomalies are characterized by strong magnetic field gradient, which is indicated in the south and north directions. Such zones can be considered as normal fault characteristic areas.

The depth of the upper layer of the excited magnetic mass of the Guton magnetic anomaly is 2 km, and for the Alazan magnetic anomaly is 4 km (Meraxas, 1979). Thus, these anomalies belonging to the Alpine basis area are of the highest level and this area is considered as a high risk area.

It should be noted that, the rise of the foundation up to Alpine in the transverse Shamkhor-Zagatala structure and being closer of thrust to the surface are the basis of seismic events in this area. The seismicity of this area that is characteristic of normal fault depend on the being the lengthwise blocks up to Alpine with the south-north direction and the effect of transverse movements. There are also seismogenic slip-strike structure elements in parallel with the normal

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fault in the foundation up to Alpine exposed benching grounding directed to the east from the Ganja-Alazan transverse fault. Thus, it is thought that, the earthquake occurred in Zagatala city to have a direct relationship with the presence of transverse and cross-section faults in the movements of Earth's crust along with the formation of a geodynamic regime. In addition to above mentioned, the main cause of earthquakes in this area is presence of the Gazakh-Signakh and Ganja-Alazan right-sided faults.

The purpose of the research: coordinates of the Zagatala earthquake occurred on 05.06.2018 was  $\varphi = 41.50^{\circ}\text{N}$ ,  $\lambda = 46.67^{\circ}\text{E}$ , magnitude was  $m_l = 5.5$  and the depth of the source was  $h = 10$  km.

The coordinates of this earthquake are partly consistent with the earthquake coordinates occurred in 2012 year ( $\varphi = 41.56^{\circ}\text{N}$ ,  $\lambda = 46.63^{\circ}\text{E}$ ;  $m_l = 5.7$ ;  $h = 12$  km) - (Rzayev, Metaxas, 2012).

It is advisable to provide detailed information about the earthquake with the magnitude of 5.5 in the city of Zagatala. Changes in seismomagnetic effects in Sheki city and Ismayilli city points have been continuously monitored a month before the seismic event, in the time of the event and a month after the event. Geomagnetic observations at both these sites were observed at the background level month ago.

Abnormal changes caused by strong earthquakes occurred in the Shamakhi-Sheki-Zagatala-Balakan zones, estimated by high seismic risk and geodynamic activity are recorded by modern geophysical devices installed on the seismic stations data are transmitted to RSSC. The data is operatively analyzed and the change graphs depending on the time of seismomagnetic effect are created. Changes of the seismomagnetic effect have been remarkable before and after the strong Zagatala earthquake.

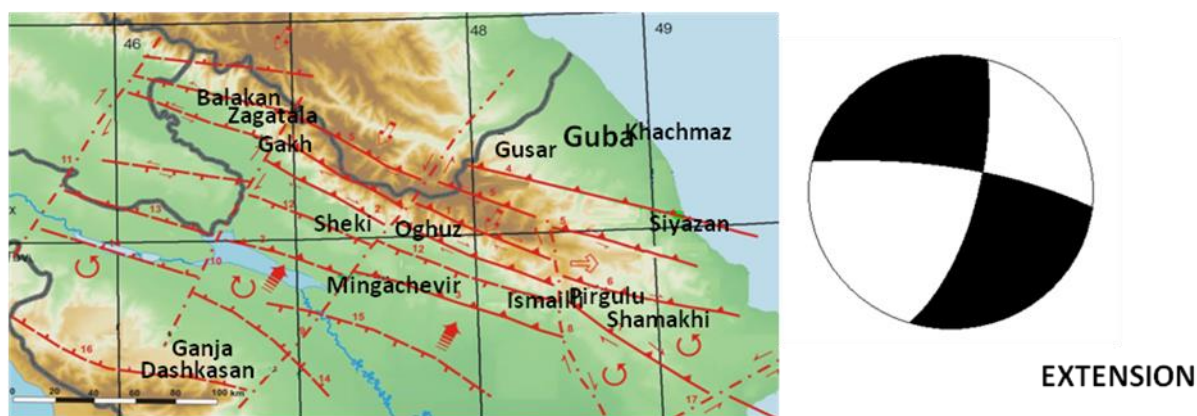


Figure 5. Mechanism of the Zagatala earthquake ( $m_l=5.5$ ) on June 5, 2018 year (with the extension character) (compiled by S.E.Kazimova)

This indication proves that the geodynamic regime of the seismogenic zone of Zagatala didn't changed which was determined by the movements of blocks on the Earth's crust in relation to the cross-section and transverse faults. The mechanism of the earthquake occurred on 05.06.2018 is estimated as a left-sided normal fault component. It is supposed that it is mainly formed by the right-sided movements of the Gazakh-Signakh and Ganjachay-Alazan zones (Rzayev and Metaxas, 2012).

Geomagnetic observations have been formed due to increments 10 days before the event and have been increased to a maximum value of  $20\div 30$  nT. This process continued 10 days after the geodynamic event.

As can be seen from the compiled curve, the seismomagnetic effect have been observed with the chaotic oscillations of  $20\div 25$  nT and it have been continued with increases. In both sites, the changes of seismomagnetic effects have been occurred during the earthquake (Fig.2).

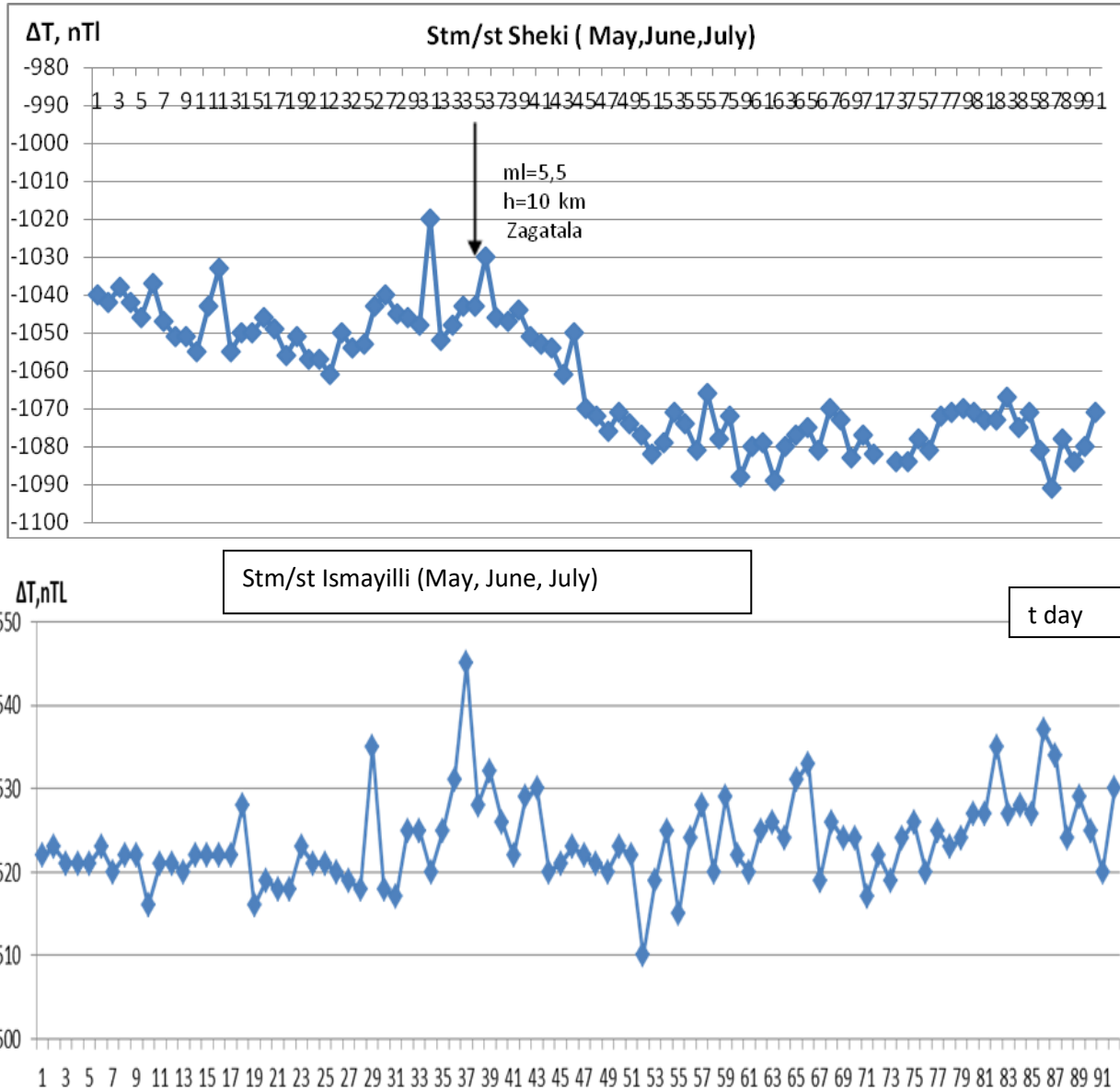


Figure 2. Manifestation of seismic effect of the Zagatala earthquake occurred in 2018 year.

The spatial-time increase in the geomagnetic field tension have been analyzed and allowed us to assess the regularity of dependence on seismic activity.

As can be seen from the created map, seismomagnetic effect is quite in the Gabala –Ismayilli geodynamic polygon, whereas the geodynamic field tension in the Balakan-Sheki is more active. The maps complement one another.

In the map created in 3D format, the increases are remarkable in the effect due to geodynamic field in the Balakan-Sheki polygon.

In the map created in 2D format, it is specifically mentioned that the complexity of the 50-100 nT values by closing of isometric line of the geomagnetic effect observed by seismic activity in the Qabala-Ismayilli zones (Fig. 3)

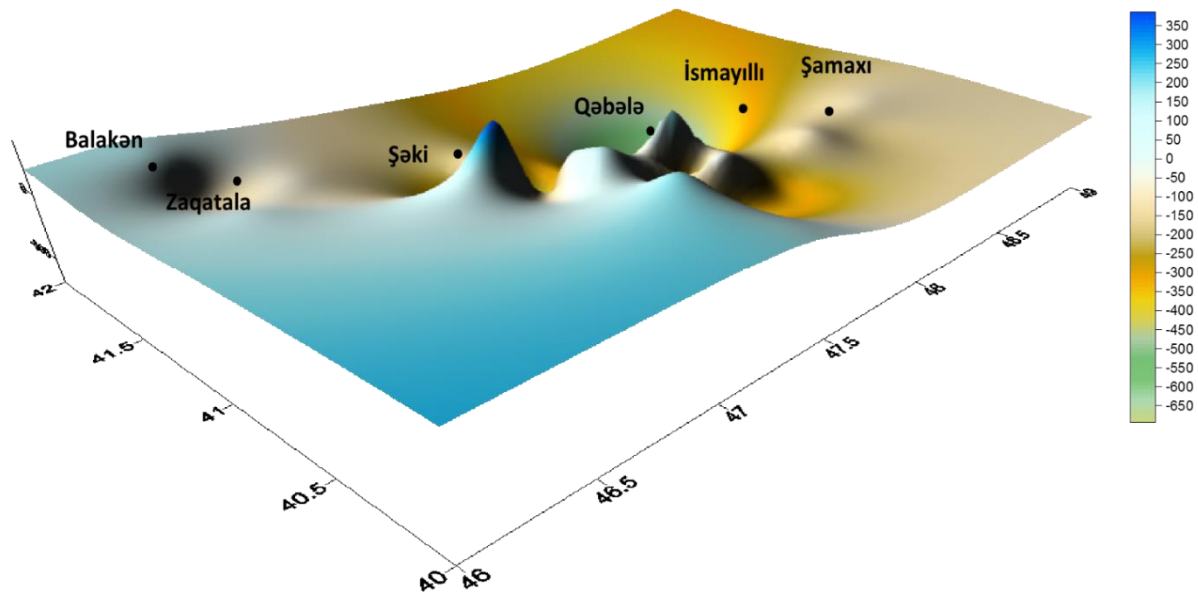


Figure 3A. Tension-deformation condition of geological environment based on the magnetic data observed in the Sheki-Shamaxi polygon (in 3D format, June 2018).

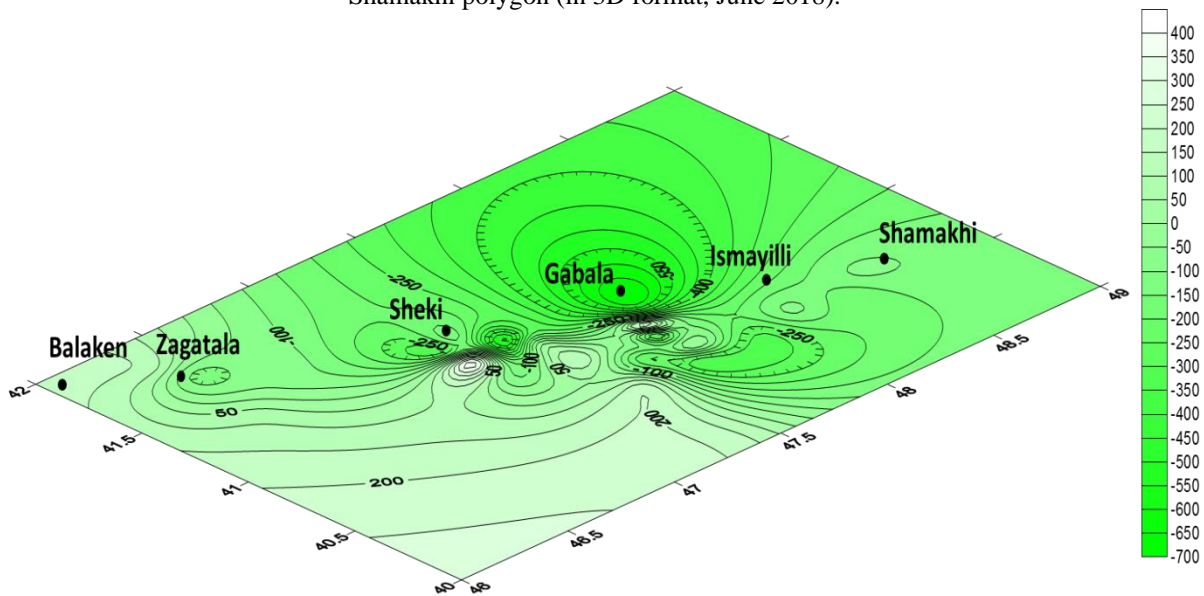


Figure 3B. Tension-deformation condition of geological environment based on the magnetic data observed in the Sheki-Shamaxi polygon (in 2D format, June 2018).

### Conclusion

Analysis of the source mechanism and the module of the full vector of T temporal variations, spatial-time variations of geomagnetic field tension gradient, the dynamics of the tension-deformation conditions generated in the Shamakhi-Sheki-Balakan polygon have been clarified. It was accepted as a warning factor of the seismoanomalous geomagnetic effects revealed before the Zagatala earthquake with  $m_l = 5.5$  occurred on 05.06.2018.

**REFERENCES**

1. Рзаев А.Г., Етирмишли Г.Д., Казымова З.Е 2013. Отражение геодинамического режима в вариациях напряженности геомагнитного поля ( на примере склона Большого Кавказа). АМЕА “Хəбərlər” Yer Elmləri, №4, с. 3-15 (рус).
2. Рзаев А.Г 2006. Связь аномальных изменений в напряженности геомагнитного поля с сейсмотектоническими процессами в литосфере Земли. АМЕА “Хəбərlər” Yer Elmləri, №3, с. 58-63 (рус).
3. Рзаев А.Г., Метаксас Х.П 2012. Загатаьские землетрясения 7 мая 2012 года; Загадки геодинамического режима и сейсмомагнитный эффект. АМЕА RSXM. Azərbaycan ərazisində seysmoproqnoz müşahidələr. Стр 362-371.
4. Метаксас, 1979. Методика и результаты интерпретации материалов магнито разведки при изучении мезозойской эпохи Средне Куринской впадины. Канд. Дис.
5. Ин-т Геофизики АН Груз. ССР, Тбилиси.
6. Шихалибейли Э.Ш. Тагиев Р.Э. Метаксас Х.П. 1978 Поперечные разрывы Западного Азербайджана. Изв. АН АзССР, Серия наук о Земле, №5, с.35-41.
7. Агамирзоев Р.А. Сейсмотектоника Азербайджанской части Большого Кавказа, «Элм» Баку 1987.