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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)

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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 ÷ 7,4, depths H = 15-30 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÷15 km and stronger (M≥7.5) earthquakes located slightly deeper (H=25÷35 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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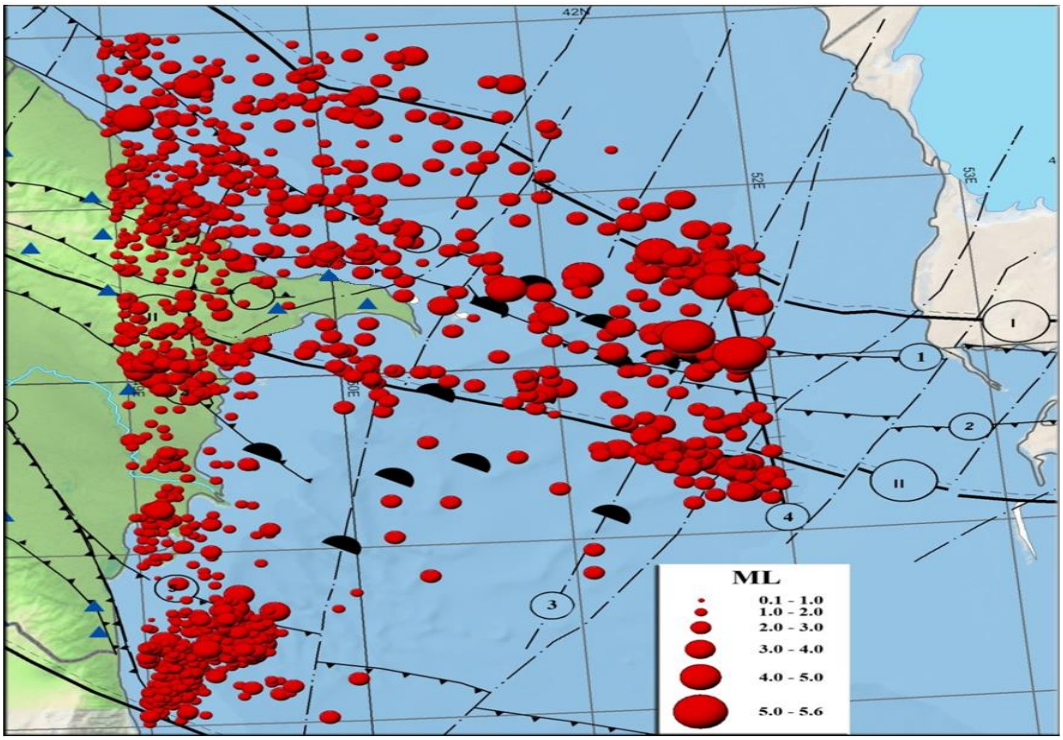

Figure 1. Map of earthquakes' epicenters occurred in the Caspian Sea and nearby regions in 2014-2016 [4].

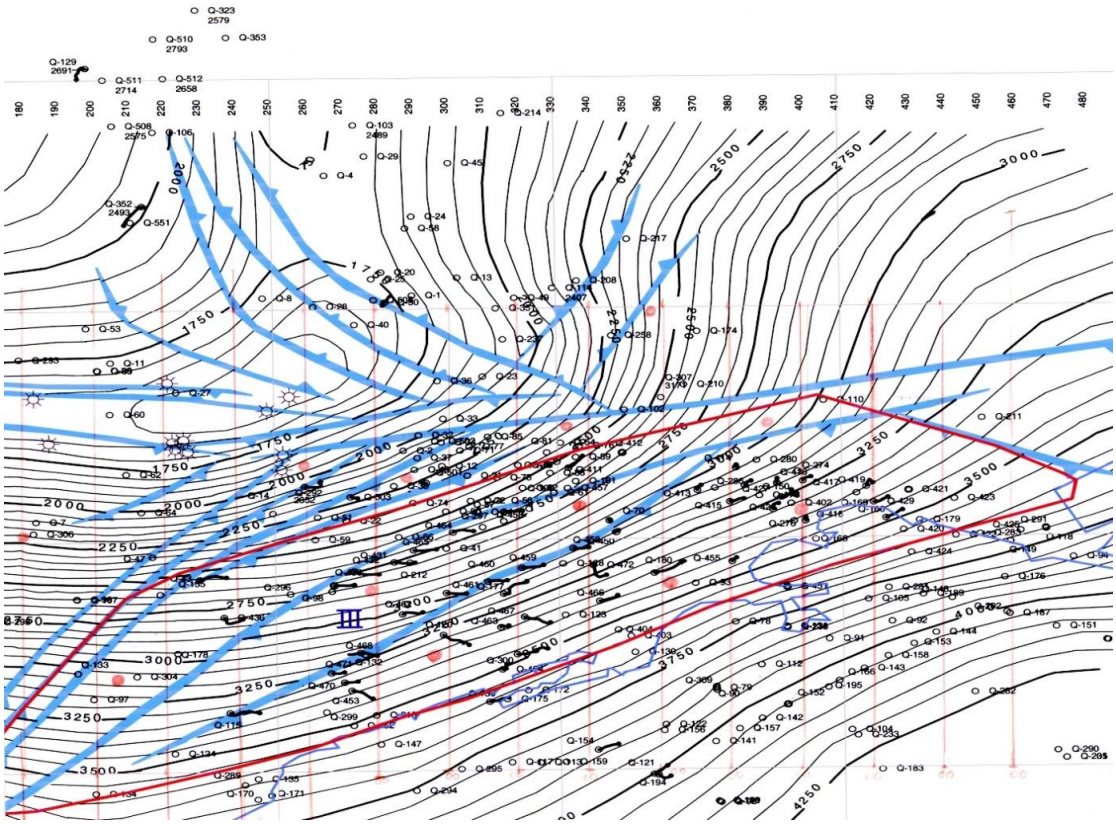

Figure 2. The layout scheme of the gravimagnometric project profiles intended for operation compatible [5]
Fasile layer detachment in the Garadagh gas reservoir facility

- Territory of Garadagh gas reservoir

- Preparation intended project profiles

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