

ASSESSMENT OF SEISMIC HAZARD IN THE TERRITORY OF “TAKHTAKORPU” RESERVOIR OF AZERBAIJAN

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Takhtakorpu reservoir and the relevant dam complex's territories are located in the Darachay valley (Takhtakorpu), 3.5 km south-west of Shabran. The area of the dam and reservoir is characterized by smooth heights that are not too high, numerous ravines, complicated hills and sloping plains. The absolute height of the surface is within 60-2500 m, here. There is Gaynarcha mud volcano with an absolute height of 180 m in the abyssal mountain shore of Takhtakorpu river, 2 km from the dam. The volcano is located on the northern wing of the anticline with the same name.

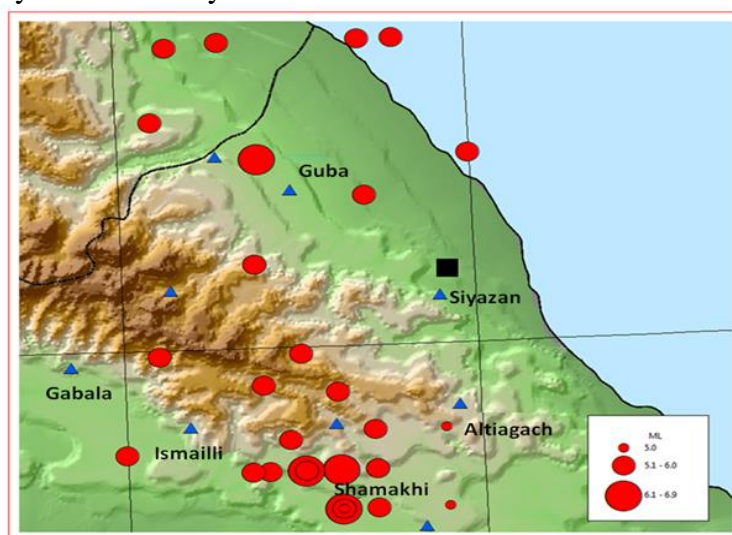
The tectonic elements of the northern part of the large Tangin-Beshbarmag anticline are observed in the area 1.5-2.0 km south of the Takhtakorpu reservoir.

The territory of the dam is within the north-eastern wing of the Gaynarcha anticline of the Gusar-Davachi synclinorium. Gaynarcha anticline extends from north-west to south-east being 7 km width and 70-80 km length. The east extremity of the anticlinal folded have been exposed to fault within the research area. The formation of the Gaynarcha mud volcano that is located 2 km south-west of dam axis on the right bank of the Takhtakorpu river is associated with this fault.

The fault cannot harm the durability of the dam because the fault direction of the folding is consistent with its way that means the fault is directed parallel at a great distance to the dam.

The Takhtakorpu reservoir is located in the north-eastern extremity of the Greater Caucasus and this area isn't seismically characterized by high activity. However, regularly occurrence of relatively weak seismic shocks are observed here.

Directly, strong and destructive earthquakes have not been recorded in the research area till now (Fig. 1). The strongest earthquakes occurred mainly in the north, west and south from the Shabran region (Takhtakorpu reservoir) [1,2,3]. These earthquakes that are quite strong were felt at high intensity certainly in the territory of Shabran district.



■ - The Takhtakorpu reservoir

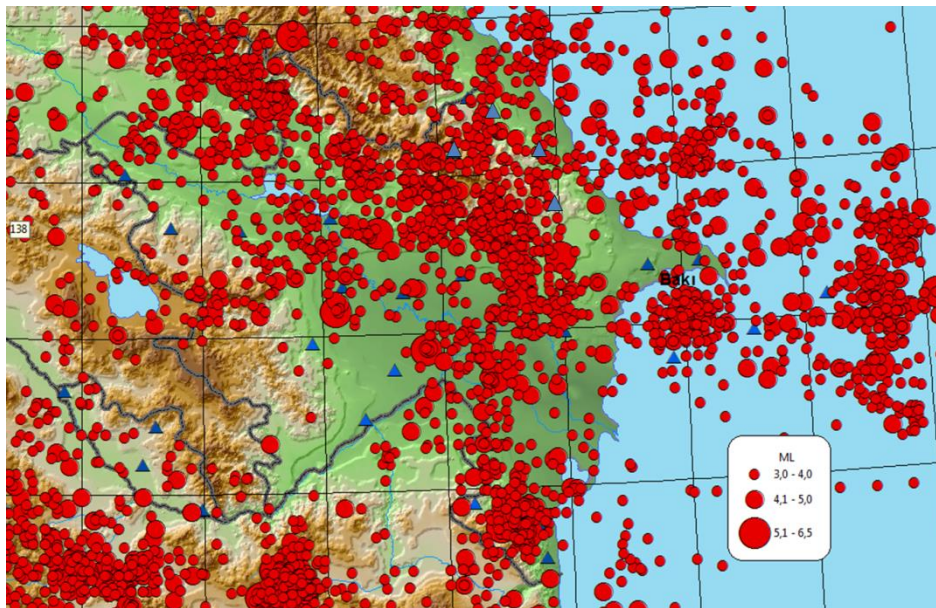
Figure 1. Map of the strong earthquakes epicenters in the north-east of Azerbaijan during of 1427-2018 years.

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An analysis of the isoside schemes of the strongest earthquakes in Azerbaijan shows that an earthquake with an intensity of 6 points on the MSK-64 scale has not been recorded in the Takhtakorpu reservoir area of Shabran district until now. Seismic vibrations with this intensity is mainly result of the earthquakes occurred in Shamakhi region. It should be noted that, only the strong earthquake occurred in 1963 in the Caspian Sea was felt by the 7 point intensity in the narrow territory along the coast of Shabran.

At first glance in Figure 1, the research area presents an asymmetric zone. But it is not so.

Epicenter map of earthquakes with $M \geq 3,0$ recorded in Azerbaijan and adjacent territories during 1980-2018 [3] years indicates that there are small but weak seismic shocks in the research area (Fig.2). Note that, recording of the large number of weak seismic shocks in Azerbaijan is associated with the operation of digital seismic stations with very wide frequency-dynamic range in Azerbaijan mainly since 2003, produced by the US , "Kinometrics" company.



- Seismic stations

Figure 2. Earthquakes with $m_l > 3$ recorded in Azerbaijan and adjacent territories during the period 1980-2018 years.

As mentioned above, earthquakes maximum with magnitude intensity 6 on the scale MSK-64 has been recorded in the territory of Shabran district till now. Seismic vibrations with this intensity are mainly result of the earthquakes in Shamakhi region. Just the strong ($M=6.2$) earthquake [4] occurred in the Caspian Sea in 1963 year had been felt at the 7-point intensity in the narrow area along the seashore of the Shabran district.

However, the result obtained by these observations doesn't mean that the earthquakes with the more intensity will not occur in the Shabran region in the future. To determine the spatial position of potential source zones in the territory of Azerbaijan, abundance (both lateral and vertical) of the strong and weak earthquakes on the point of this area and relation of the large depth faults with the zones of the tense concentration of the seismic shocks have been investigated [5,6].

It is clear from research that, strong earthquakes occur not everywhere but in the areas where weak earthquakes are concentrated. Based on this factor, T. Mammadli developed a method for identifying source zones of strong earthquakes based on weak earthquake concentrations [5,6]. This method, unlike the methods used so far in seismoactive areas, allows for the detection of potential seismic hazards in seismoactive areas before any fault zone and seismic data of strong earthquakes, in advance, without pre-adapting to any fault zone and seismostatistic data of strong earthquakes. The application of the method revealed that there are numerous and various sizes of active fault zones (or potential source zones) in the territory of Azerbaijan (Fig.5).

The spatial position of these fault zones shows that the seismic area of Azerbaijan Republic has a mosaic structure.

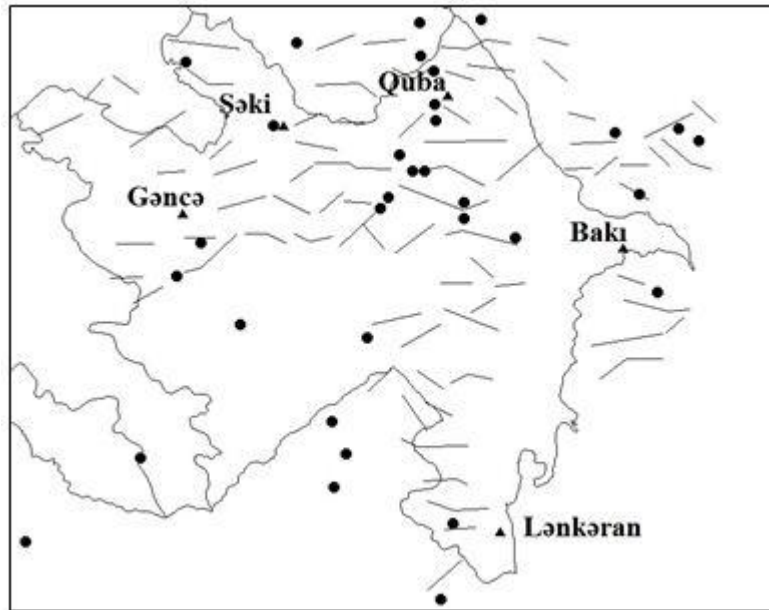


Figure 3. Scheme of seismic and strong earthquake zones of the Azerbaijan Republic

Conventional signs:

- - epicenter of earthquake; ▲ - Seismic stations;
 ——— - active fault or potential source zones;

In order to identify the characteristics of the earthquakes distribution on depth, the seismic sections on II-II profiles with the south-west and north-east directions and I-I profiles with the west-east directions have been compiled in the research area (Fig.5 and 6)

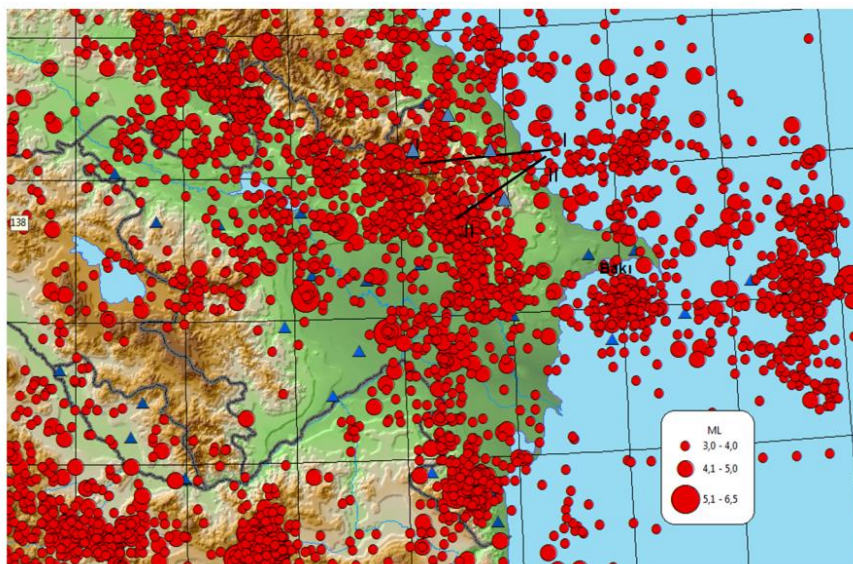


Figure 4. Location map of profiles I-I and II-II

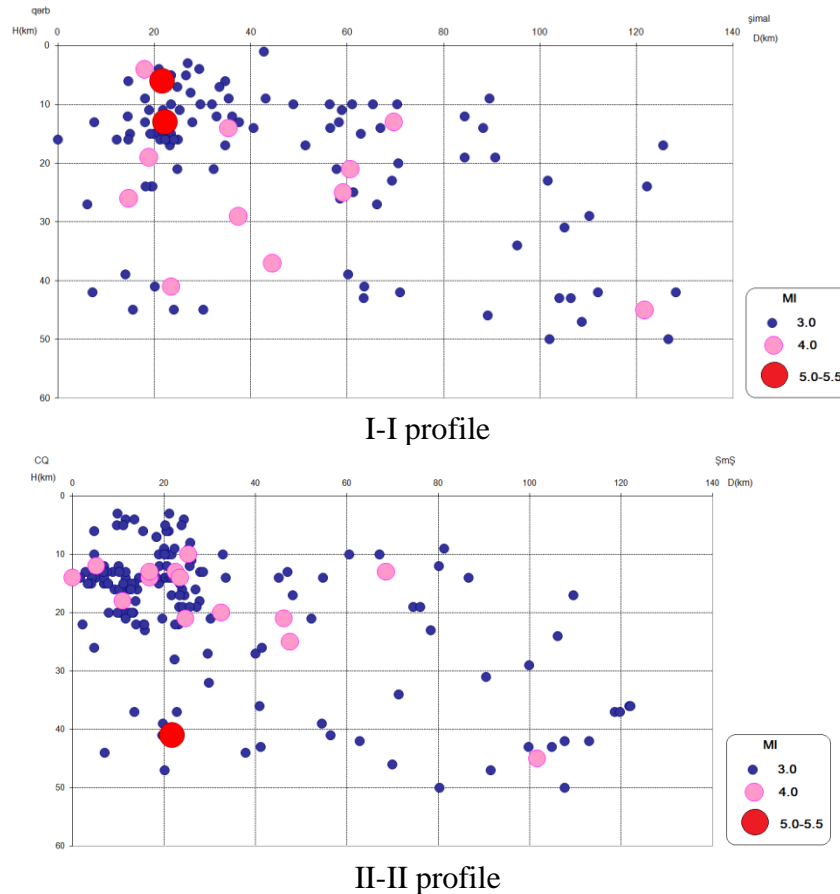


Figure.5. Seismological transects by profiles

As can be seen seismic transects, seismic shocks are densely concentrated mainly in the west and south-west part which corresponds to the Shamakhi-Ismayilli zone of transects. Although these hypocenters are from 3km to 20-25 km depth but the depth of some shocks is 40-45 km. Strong earthquakes ($M \geq 5.0$) occur in the depth (10-15 km) near the surface of the crystalline foundation here, as in other parts of the Greater Caucasus. Note that, the number of weak seismic shocks is low in 40km depth in these parts even though it is observed that they tend to occur frequently. The strong ($M = 5.3$) earthquake ($M=5.3$) had been occurred on October 7, 2012 in Ismayilli, at this depth. Interestingly, the strong earthquake ($M = 5.8$) occurred on February 10, 2014 in Hajigabul at the same depth. For this reason, it is considered expedient that investigate more extensively the manifestation features of seismicity at such depth in these areas in future.

Although the number of seismic shocks decreasing gradually to the east and north-east by section, it is observed that they tend to occur frequently at the 10-15 km and 40-45 km depth in separate parts of the area.

As you can see from Fig.4, active faults with Caucasian direction that is larger than the surrounding source zones and anti-Caucasian direction or potential source zones is different from others. The maximum magnitude (M_{max}) of probable earthquakes in these source zones have been determined in [6] and they are $M_{max} = 7.4$ and $M_{max} = 6.7$, respectively. near the research area active

It is possible to determine the macroseismic effect created by the probable strong earthquakes in these source zones on the surface using the assessments of coefficients of macroseismic field equation [8] that assigned by F.T.Guliyev for this region and macroseismic field equation that assigned by N.V.Shebalin [7].

The conducted calculations show that, if maximum magnitude earthquakes occur in the above-mentioned potential source zones, seismic hazards with an intensity of 8-9 points on the

MSK-64 scale may occur in the “Takhtakorpu” reservoir area where the research is being conducted.

Conclusion

1. The Takhtakorpu reservoir area is not seismically characterized by high activity. No earthquake with a magnitude greater than 6 on the MSK-64 scale has been recorded so far ,here. The seismic vibrations with this intensity are mainly spread by earthquakes in Shamakhi region.
2. Researches show that, there are two sufficiently large-sized active faults (or potential source zones) in the area near the reservoir. According to calculations, the probable earthquakes with maximum magnitude in the such source zones can create seismic hazard with 8-9 point intensity on the MSK-64 scale in the territory of Takhtakorpu reservoir.

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