CHARACTERISTICS OF SEISMICS OF AZERBAIJAN AND AROUND REGIONS IN 2020

Yetirmishli G.J.[1], Ismayilova S.S.[1]., Kazimova S.E.[1]

Introduction.

In 2020, seismic analysis was conducted on the basis of 40 digital data. During the year, 13.295 earthquakes were recorded. A map of the epicenters of earthquakes in the adjacent territories of Azerbaijan and in the territory of Azerbaijan has been constructed (Figure 1).

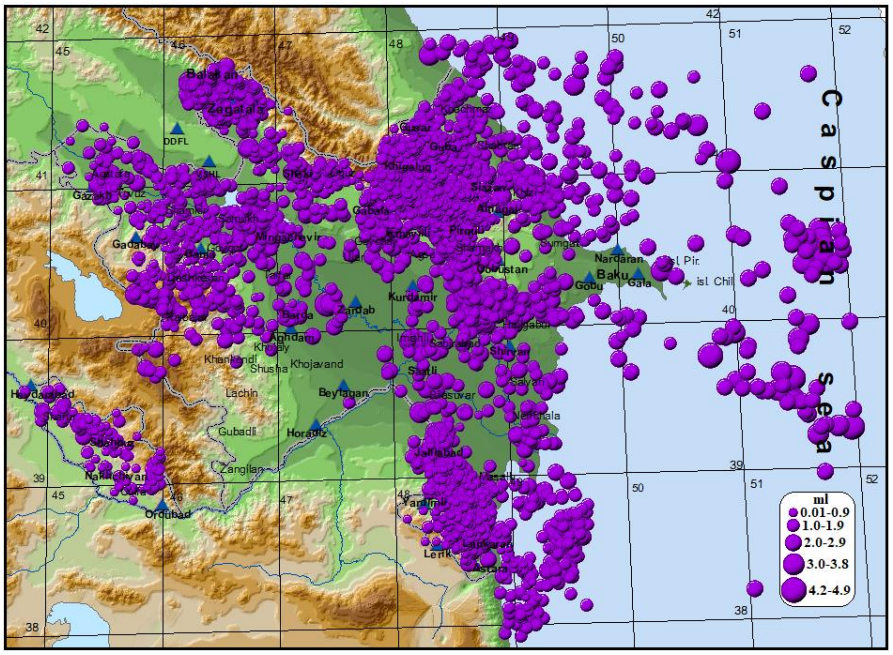

Figure 1. Map of epicenters of earthquakes in Azerbaijan

77 earthquakes with a magnitude of ml≥3 were registered in Azerbaijan. A map of the epicenters of earthquakes with a magnitude of ml ≥3 has been constructed (Figure 2).

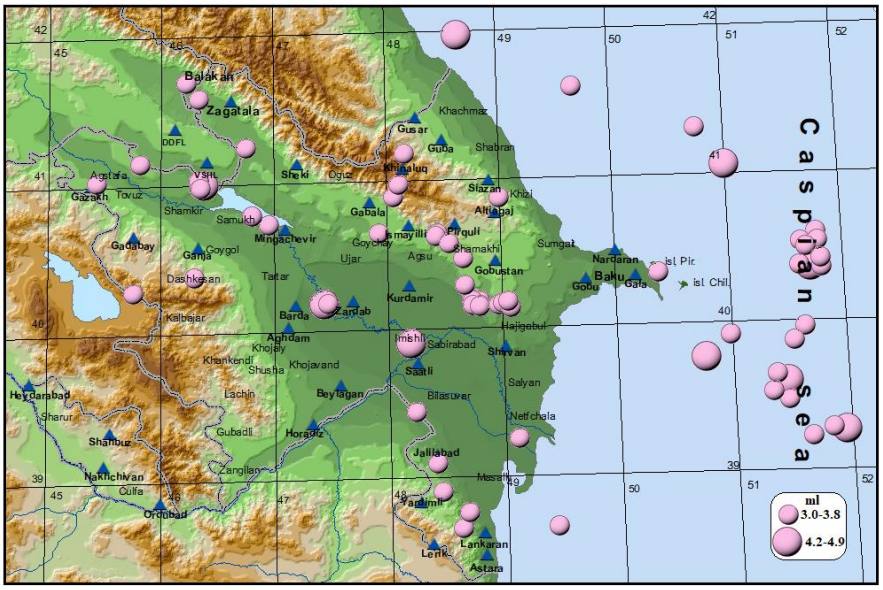

Figure 2. Map of epicenters of earthquakes of magnitude ml≥3 for the territory of Azerbaijan in 2020

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

In 2020, there were 20 tremors in Azerbaijan and adjacent areas. The map of the epicenters of earthquakes felt in Azerbaijan and adjacent areas in 2020 is shown in Figure 3.

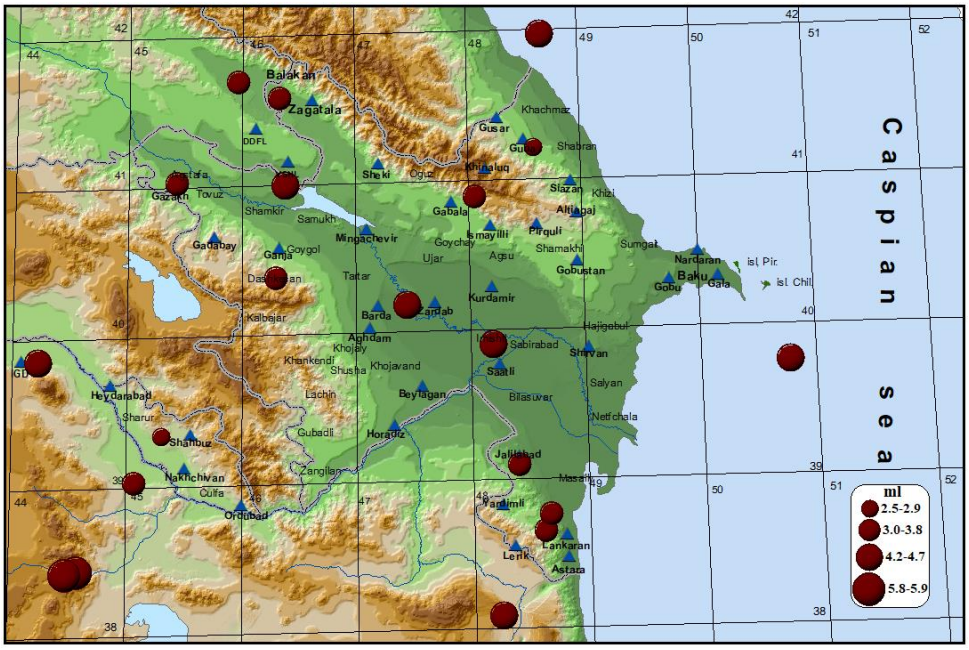

Figure 3 Map of epicenters of earthquakes in Azerbaijan and adjacent areas in 2020

Compared to 2019, the number of earthquakes and the amount of seismic energy released in 2020 decreased. Thus, the number of earthquakes in the territory of Azerbaijan in 2019 is 5442, the amount of seismic energy released is $\sum E = 31.9 \cdot 10^{11}$J, the maximum magnitude is ml = 5.2, the number of earthquakes in 2020 is 4030, the amount of seismic energy released is $\sum E = 13.1 \cdot 10^{11}$J, the highest magnitude was ml = 4.9.

Analysis of the number of earthquakes and seismic energy released over the last 10 years (Figure 4) shows that the amount of seismic energy released since 2010 has been gradually increasing. In 2012, the amount of seismic energy released reached a maximum.

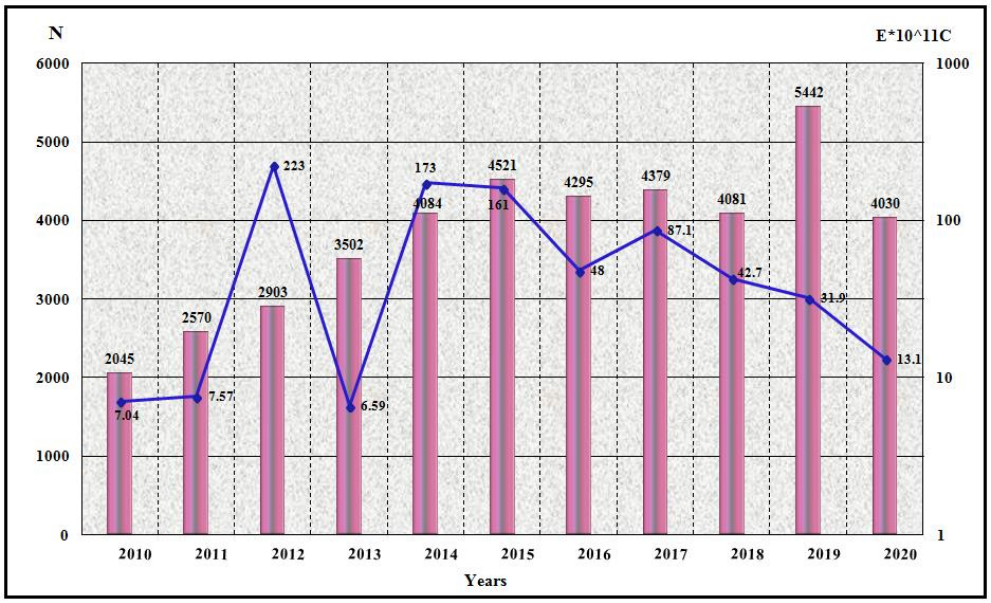

Figure 4. Histogram of the number of earthquakes and the distribution of seismic energy in the territory of Azerbaijan in 2010-2020

This is due to the strong (ml = 4.0 ÷ 5.7) earthquakes in the country. In 2012, the amount of seismic energy released increased 25 times compared to 2011. The amount of seismic energy released in 2013 decreased by about 28 times compared to 2012. The increase in the number of earthquakes since 2010 is most likely due to the operation of new stations in 2009-2013. The number of earthquakes in 2014 increased compared to 2013 and the amount of seismic energy released was 25 times higher. In 2016, compared to 2014, seismic energy decreased by 3 times. In 2017, the seismic energy released was almost twice as high as in 2016. Starting from 2018, there is a decrease in seismic energy. The number of earthquakes in 2019 is higher than in other years. In 2020, there will be a decrease in the number of earthquakes and seismic energy.

A histogram of the number of earthquakes in Azerbaijan and adjacent areas and the monthly distribution of seismic energy (Figure 5) is shown.

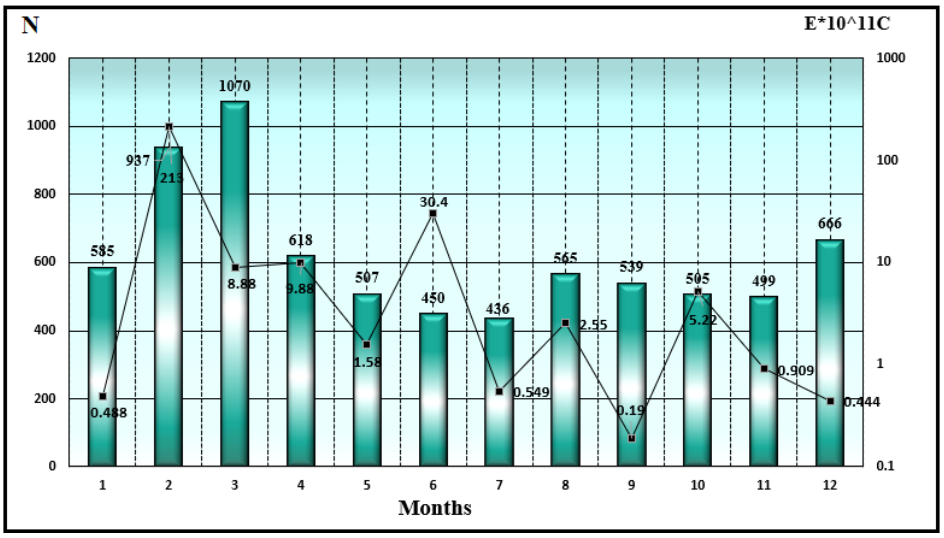

Figure 5. Histogram of the number of earthquakes in Azerbaijan and adjacent areas in 2020 and the distribution of seismic energy per month

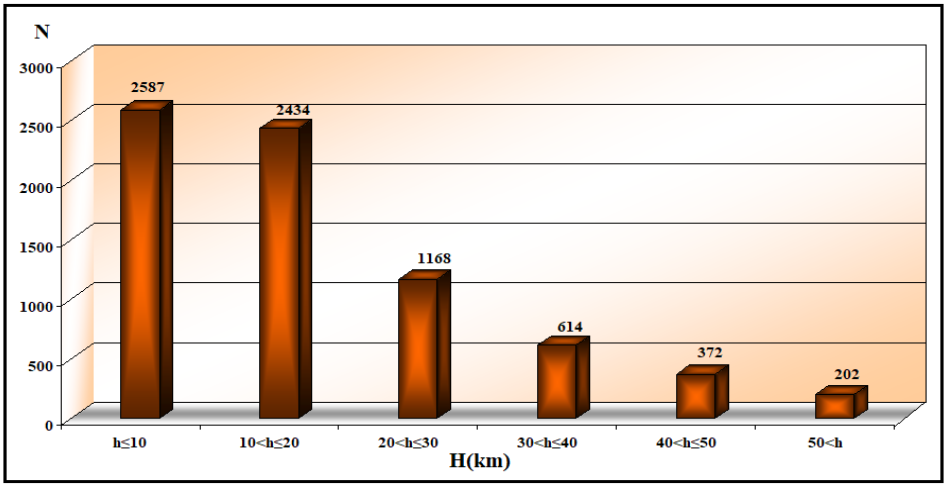

Figure 6.a. Histogram of the depth distribution of earthquakes in Azerbaijan and adjacent areas in 2020

Analysis of the number of earthquakes in Azerbaijan and adjacent areas and the distribution of seismic energy by months shows that the allocated seismic energy was higher in

February, April and June. This is due to earthquakes of magnitude 5.9 on the Turkish-Iranian border. Lets noted that, Mw-6.0 earthquake was registered on February 23, 110 km south-west of Nakhchivan station on the Turkish-Iranian border.

The number of earthquakes in February and March was higher than in other months. This is due to the aftershocks of an earthquake with a magnitude of ml = 5.9.

A histogram and map of the depth distribution of earthquakes in Azerbaijan and adjacent areas during 2020 have been constructed (Figure 6.a, 6.b.).

During 2020, in Azerbaijan and adjacent territories, 2587 with a depth of h≤10 km, 2434 with a depth of 10 <h≤20 km, 1168 with a depth of 20 <h≤30 km, 614 with a depth of 30 <h≤40 km, 40 <h≤50 372 earthquakes of km and 202 earthquakes of h> 50 km were recorded. Analysis of the depth distribution of earthquakes shows that 60% of them occurred at a depth of h≤20 km.

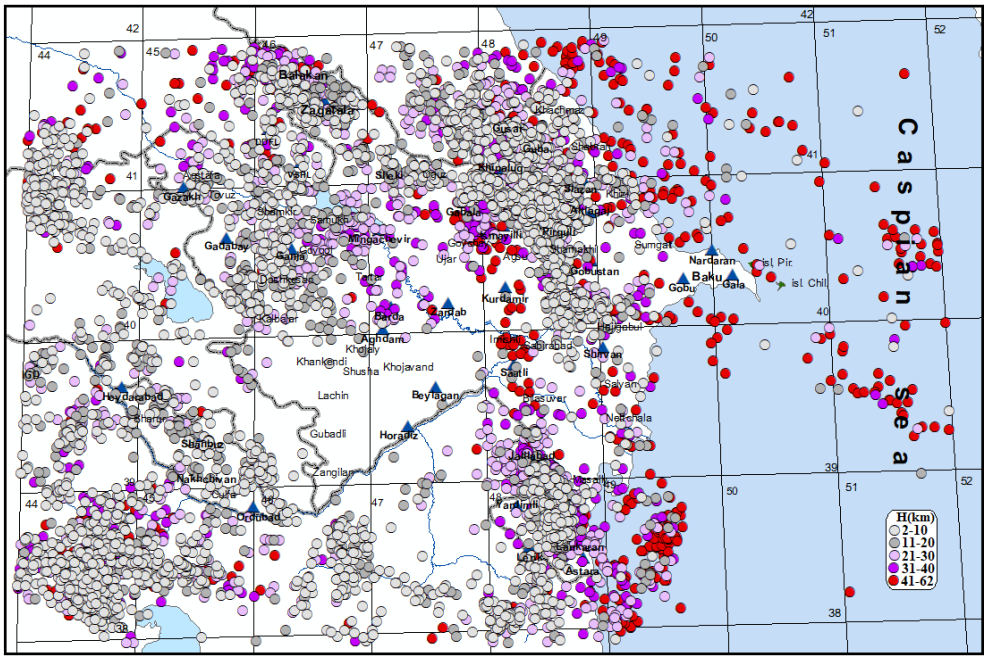

Figure 6.b. Depth map of earthquakes in Azerbaijan and adjacent areas in 2020

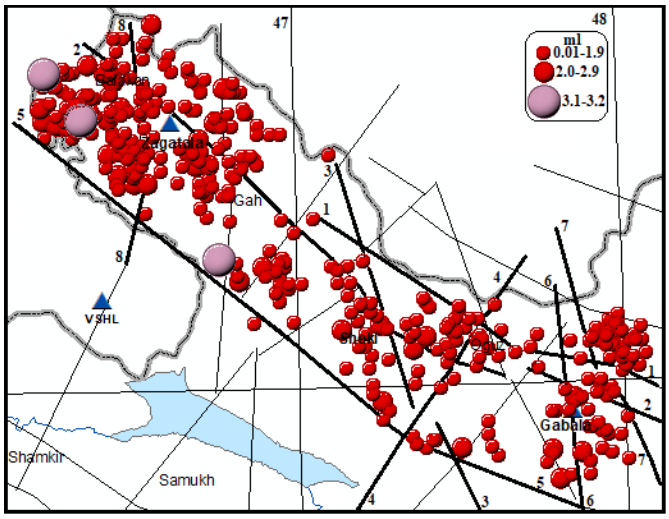

Figure 7. Occurred in Balakan-Zagatala, Sheki, Gabala districts map of epicenters of earthquakes

Fractures: 1. Dashgil-Mudrasa 2. Vandam (longitudinal) 3. Akhvay (orthogonal) 4. Tar-Tar-Oguz (transverse) 5. Alazan-Ayrichay (longitudinal) 6. Chakhirli-Gabala (orthogonal) 7. Ismailli-Sighirli (orthogonal) 8. Sharur-Zagatala (transverse) (by T.N. Kangarli)

As can be seen from the depth distribution map of earthquakes (Figure 6.b.), the depth of earthquakes in the land area of Azerbaijan varies between 2-54 km, 2-62 km in the Caspian Sea, and mainly 2-35 km in regional areas.

During the reporting year, seismicity was at the background level in Zagatala.

From the tectonic point of view, the Zagatala-Balakan seismic zone is located in the north-western zone of the Azerbaijani part of the Greater Caucasus.

Compared to 2020 and 2019, seismicity was weak in the Zagatala-Balakan area. The highest magnitude earthquake in Balakan was ml = 3.2. At 12:35 local time on September 22, an earthquake was registered in Balakan region, 23 km north-west of Zagatala station. The quake was felt at the epicenter up to 3 points.

Map of epicenters of earthquakes in Balakan-Zagatala, Sheki, Gabala regions (Figure 7.). The figure shows the location of earthquakes in the intersection zones of depth cracks in different directions.

A seismic barrier was constructed along the Balakan-Gabala I-I profile passing through the seismically active zone of Azerbaijan (Figure 8). The profile extends in the all-Caucasian direction along the Ayrichay-Alat deep fault.

Concentration of hypocenters is observed in the north-west of the intersection in the Zagatala-Balakan area. The hypocenters are clearly visible in the areas recorded at the intersection. Unlike in 2019, the number of earthquakes with a magnitude of 3.0 has decreased during the year. In the Zagatala-Balakan area, the hearths are mainly distributed at a depth of 2-40 km.

Earthquakes of magnitude 2.9 occurred in Zagatala region. Weak seismicity is observed. Compared to 2019, no earthquakes with a magnitude of ≥3.0 were recorded in the Zagatala zone.

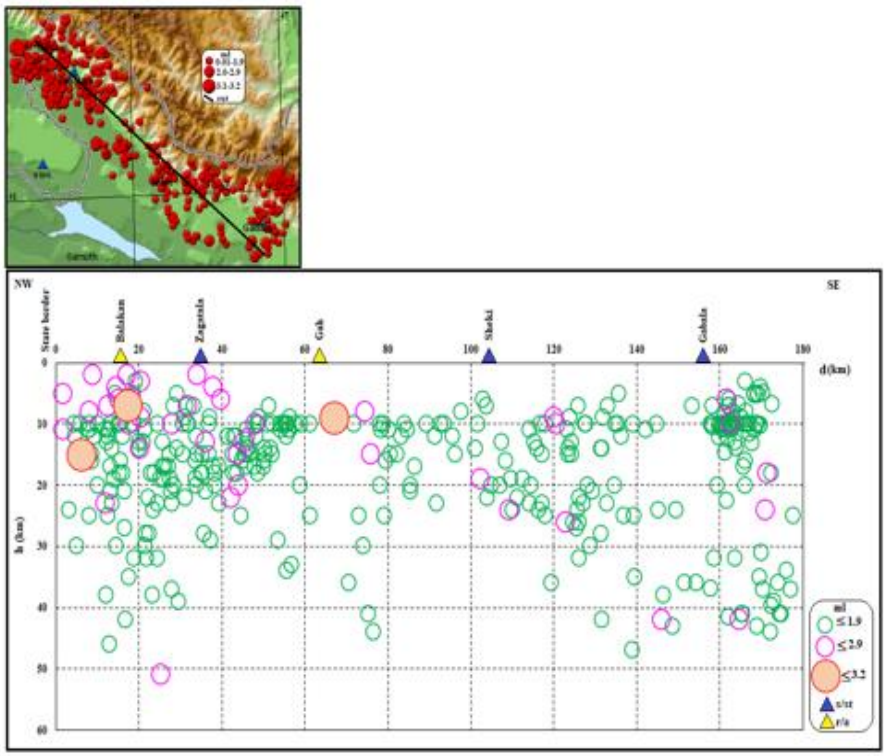

Figure 8. Seismological section of Balakan-Gabala I-I profile

Earthquakes of magnitude 3.2 occurred in Balakan at a depth of 4-7 km. As can be seen from the intersection, the epicenters were located in the zone of impact of the Alazan-Ayrichay

deep fault. An unseen tremor with a magnitude of ml=3.0 occurred in the Gakh area at a depth of 9 km. Earthquakes of magnitude 3.0 are located within the sedimentary layer.

As can be seen from the crossing, as in 2019, weak seismicity is observed in Sheki and Gabala. Earthquakes of magnitude 2.0 occurred in this zone. The outbreaks occurred at a depth of 6-30 km in Sheki and at a depth of 3-42 km in Gabala.

Seismicity is below the background level. The density of hypocenters in the Gabala area is mainly distributed at a depth of 10 km. The hearths are located within the sedimentary layer. The earthquakes in the Gabala zone are located at the intersection of the Dashgil-Mudrasa and Ismayilli-Sighirli orthogonal depth faults.

In the north-east of the country, the migration of earthquake epicenters in the meridional direction (Pirgulu-Mugan) is observed.

In order to study the geodynamic conditions of the Shamakhi-Ismayilli zone and the Lower Kura basin in 2020, a seismological section (Figure 9) was built on the II-II profile in the north-west, south-east direction.

The intersection was carried out in the area where the epicenters are located, in the zone of impact of the Taircalchay-Salyan orthogonal fracture. In the Shamakhi-Ismayilli zone in 2020, compared to 2019, seismicity fell below the background level.

As can be seen from the intersection, the hypocenters are condensing in the north-west. 2 tremors of ml≥3.0 were registered in Ismayilli region. The hypocenters are mainly distributed at a depth of 2-20 km. Let me note that an insensitive earthquake with a depth of h = 44 km and a magnitude of ml = 3.3 can be found in the territory of Ismayilli. The magnitude of the strongest earthquake in Ismayilli region was ml = 3.6. The quake was registered on October 22 at 16:52 local time in Ismayilli, 20 km east of Gabala station. The quake was felt at the epicenter up to 3 points. The outbreak occurred at a depth of 11 km within the subsidence layer. Two insensible earthquakes with a magnitude of 3.0 and a depth of 14-15 km occurred in Agsu region.

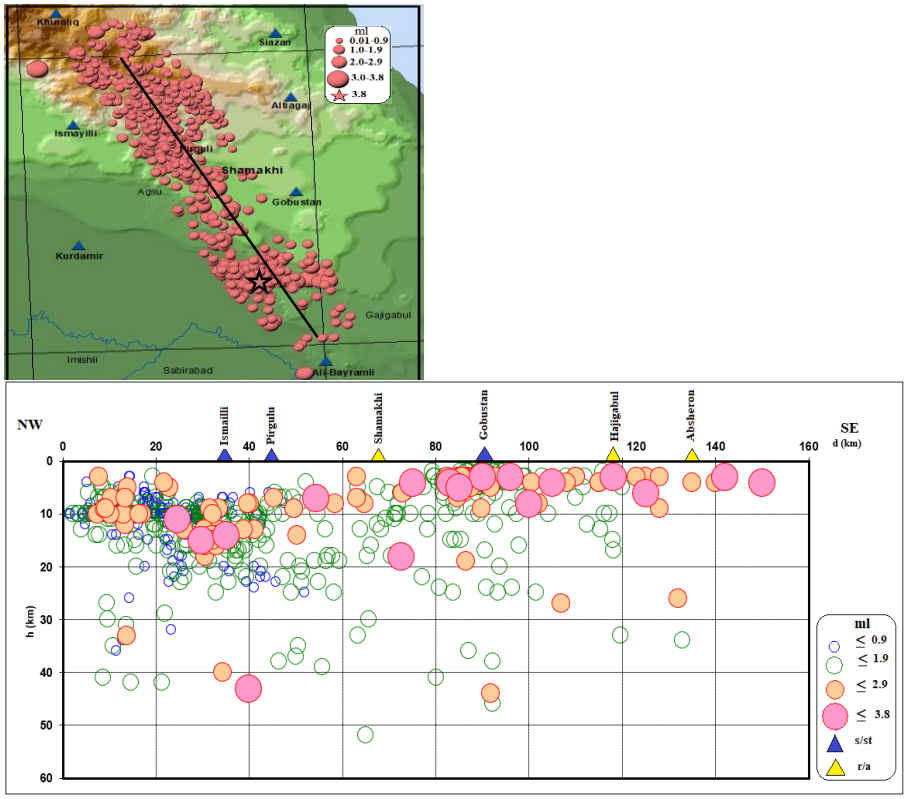

Figure 9. II-II of the Shamakhi-Ismayilli seismogenic zone seismological section on the profile

As can be seen from the crossing, the earthquakes in the Shamakhi region were mainly distributed at a depth of 2-40 km. The damage with a magnitude of ≥3.0 was spread at a depth of 2-8 km. The strongest earthquake in Shamakhi region on February 16 had a magnitude of 3.8. The quake was not felt. The quake occurred at a depth of 2 km inside the subsidence layer.

In contrast to 2019, seismicity was higher than the background level in the Lower Kura basin in the south-eastern direction of the section. An increase of magnitude 3.0 was registered. Hypocenters are mainly distributed in the area at a depth of 2-25 km. Earthquakes of magnitude 3.0 occurred within the sedimentary layer at a depth of 2-8 km. An earthquake with a depth of 43 km and a magnitude of 3.1 ml can also be found in the area. The highest magnitude earthquake recorded in Hajigabul and Absheron regions was ml = 3.8. No earthquakes were felt. The earthquakes in Shirvan are located at the intersection of the Palmir-Absheron and orthogonal Ismayilli-Sighirli (Kangarli T.N.) deep faults.

The earthquakes in the territory of Absheron are located at the intersection of the Palmir-Absheron and Sangachal-Ogurchu deep faults.

Density of hypocenters is observed in the transition to the Middle Kura basin. In 2020, unlike other years, there is an increase in seismicity in the Samukh region. Seismicity was higher than the background level. An increase of earthquakes with a magnitude of ≥3.0 was recorded in the zone. The magnitude of the strongest earthquake in Samukh was ml=4.3. The quake was registered on May 4 at 00:03 local time in Samukh region, 45 km north of Ganja station. The quake was felt at the epicenter up to 3 points. As can be seen from the intersection, the main shocks and aftershocks occurred between the consolidated layer and the subsidence layer at a depth of 10-26 km. The earthquakes in Samukh were located at the intersection of Ganjachay-Alazan and Goychay (A.S. Shikhalibeyli) deep faults.

Compared to 2019, seismicity in the Talysh zone in 2020 was below the background level. The highest magnitude earthquake in this zone was ml = 3.6. At 11:39 on May 27, local time, 19 km north-west of Lankaran station, an earthquake was registered in Lankaran. The quake was felt at the epicenter up to 3 points.

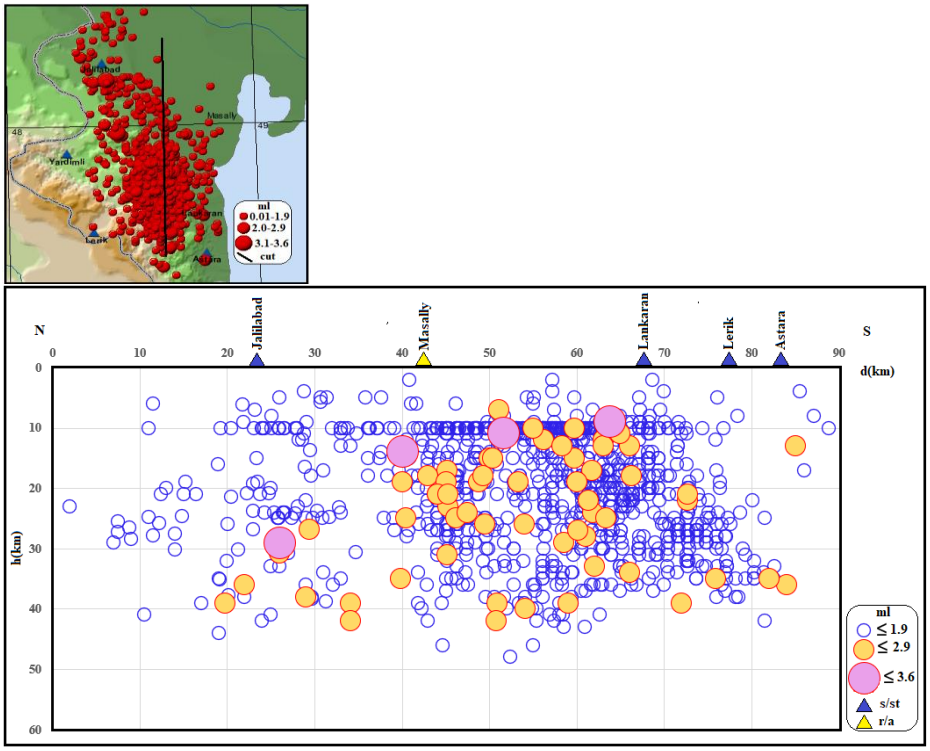

Figure 10. Seismological section of Talysh mountain zone on profile IV-IV

In order to study the depth distribution of earthquake foci in the Talysh zone, a seismological section was built on profile IV-IV passing through the north-south direction. As can be seen from the cross-section, in contrast to 2019, there is a decrease in earthquakes with a magnitude of ml≥3.0. The profile was held in the meridional direction (Figure 10). In the northern part of the intersection, the number of tremors is small in the Galilabad region. The increase of earthquakes was registered starting from Masalli region. As can be seen from the crossing, the foci in the seismogenic zone are spread at a depth of 10-40 km. Weak tremors with a magnitude of ml≤1.9 mainly occurred in the Talysh mountainous zone. As can be seen from the cross-section, earthquakes with a magnitude of ml≥3.0 were distributed within the sedimentary layer at a depth of 9-11 km. The main part of the earthquakes is concentrated in the fracture zone intersecting in different directions, in the central part of the active Astara-Derbent orthogonal and longitudinal Talysh and Ontalish fractures of the profile.

In 2020, as every year, seismic activity in the areas bordering Nakhchivan, in the Zangazur range, was below the background level.

Analysis of the number of earthquakes and the distribution of seismic energy by months in the border areas of Nakhchivan AR (Figure 11) shows that weak seismicity is observed. The number of earthquakes in September and December was higher than in other months. As can be seen from the graph, the seismic energy released was higher in September and October than in other months. On September 14, at 16:23 local time, 20 km west of Shahbuz station, an earthquake with a magnitude of ml = 2.9 was registered in Babek region of Nakhchivan AR. The quake was felt at the epicenter up to 3 points.

It should be noted that earthquakes with a magnitude of Mw≤6.0 on the Turkish-Iranian border were felt in the territory of Nakhchivan AR up to 4-3 magnitude.

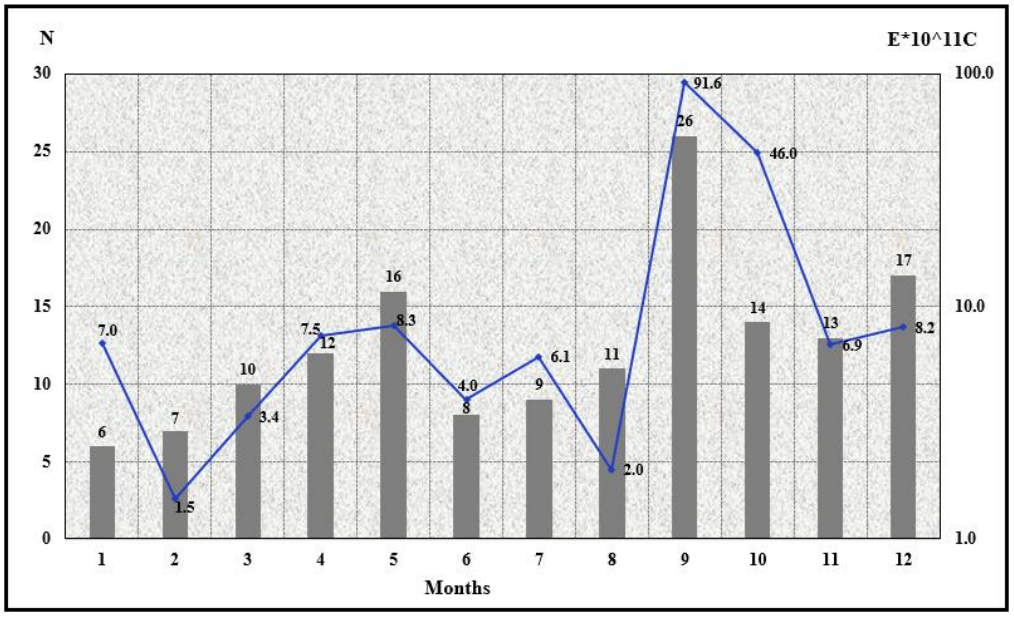

Figure 11 Histogram of the number of earthquakes in the border area of Nakhchivan AR in 2020 and the distribution of seismic energy by months.

In 2020, compared to 2019, the seismicity of the Caspian Sea was higher than the background level.

Analysis of the number of earthquakes and seismic energy released over the last 10 years (Figure 12) shows that the amount of seismic energy released in 2010-2013 is stable. The number of earthquakes in 2014 was higher than in 2013, and the seismic energy released was 23 times higher. This is due to strong earthquakes of magnitude 5 in the Caspian Sea. The

number of earthquakes in 2015 was higher than in 2014, and the amount of seismic energy released was reduced by half. The number of earthquakes in 2016 was higher than in 2015, and the amount of seismic energy released was 7 times less. While stability was observed in the seismic energy released from 2016 to 2018, in 2019 the seismic energy released was twice as much. The number of earthquakes in 2020 and the amount of seismic energy released will increase compared to 2019.

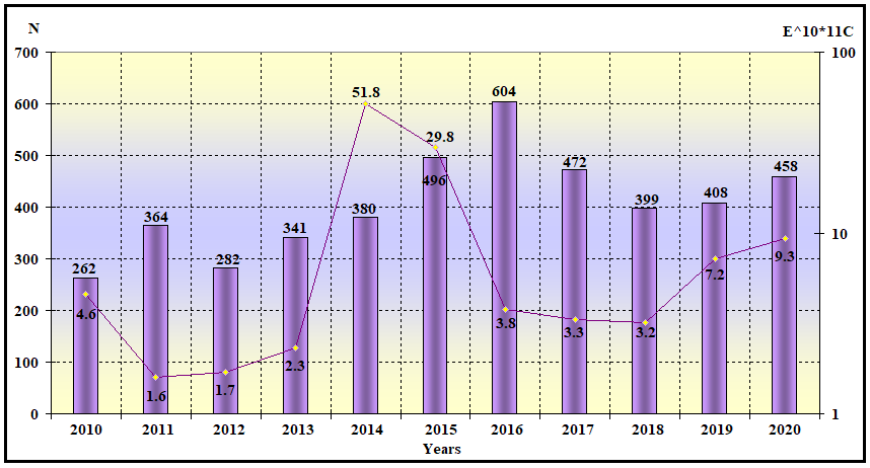

Figure 12 Histogram of the number of earthquakes in the Caspian Sea and the distribution of seismic energy over the years 2010-2020

Analysis of the number of earthquakes in the Caspian Sea in 2019 and the distribution of seismic energy by months (Fig. 13) shows that the seismic energy released in February and October was higher than in other months. The high seismic energy released in February and October is due to earthquakes with a magnitude of ≤4.9. The number of earthquakes was higher in September.

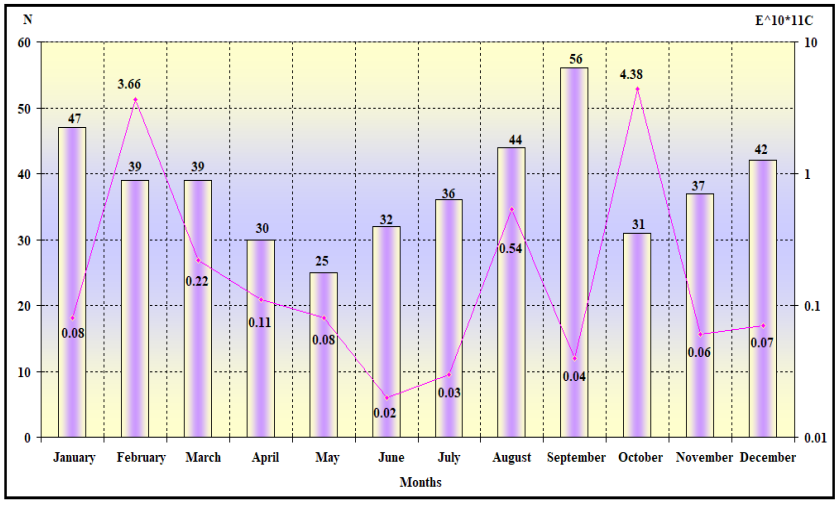

Figure 13 Number of earthquakes in the Caspian Sea in 2020 and a histogram of the seismic energy distribution over the months

During the reporting year, 24 earthquakes with a magnitude of ml≥3 occurred in the Caspian Sea. The highest magnitude earthquake recorded in the Caspian Sea was ml = 4.9. The quake was not felt.

In order to study the depth distribution of earthquakes in the northern part of the Caspian Sea, a seismic section was drawn on two profiles in the north-west and south-east directions (Fig. 14).

As can be seen from the seismological section on profile VI-VI, in the north-western direction, mainly tremors with a magnitude of ml≥1.0 occurred. Uneven distribution of earthquakes is observed. Throughout the intersection, the hearths were distributed at a depth of 2-62 km. The tremors with a magnitude of 3.0 ml were distributed at a depth of 60-62 km. The highest magnitude earthquake recorded in the North Caspian Sea was ml=4.6. The quake was recorded on November 3 at 16:16 local time in the Caspian Sea in Dagestan. The quake was felt by some people in the country. The quake occurred at a depth of 62 km.

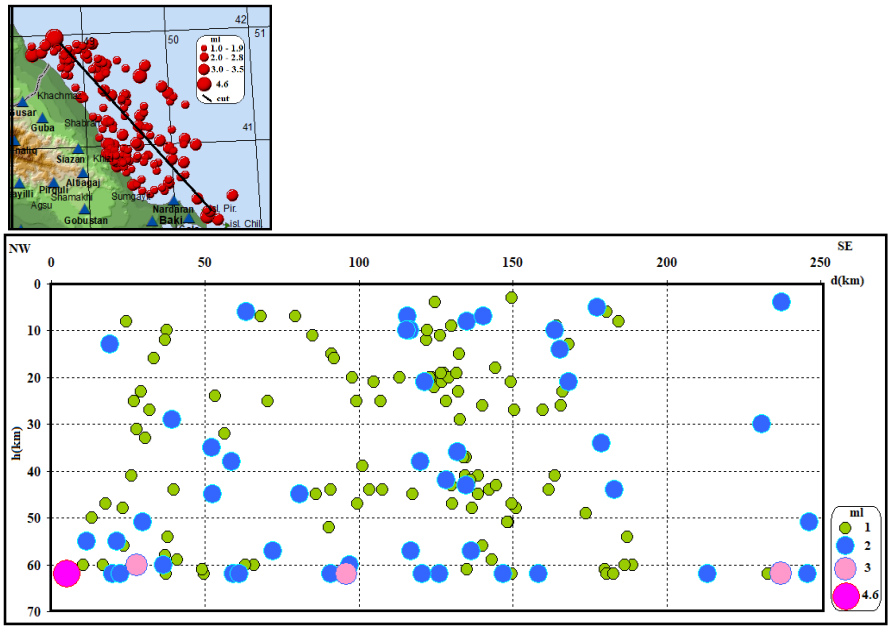

Figure 14. Seismological section of the northern part of the Caspian Sea on profile VI-VI

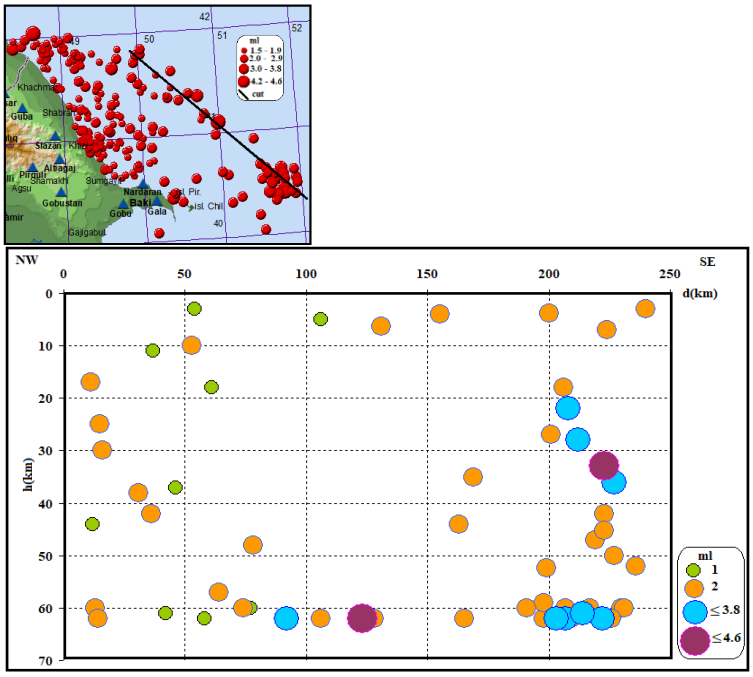

Figure 15 Seismological section of the northern part of the Caspian Sea on profile VII-VII

Another profile was passed through the North Caspian basin, a seismic section was made on profile VII-VII (Figure 15). The profile runs in a north-west, south-east direction. As can be seen from the section, earthquakes with a magnitude of ml≥1.0 occur. Most of the

earthquakes were distributed at a depth of 29-62 km. Surface foci are also observed at the intersection. In the central part of the Caspian Sea, an increase of earthquakes with a magnitude of ≥3.0 is observed. The quake with a magnitude of ml = 4.2 occurred at a depth of 33 km, and the earthquake with a magnitude of ml = 4.6 occurred at a depth of 62 km.

In 2020, compared to 2019, there was an increase in the number of earthquakes in the South Caspian Sea.

In recent years, the level of seismic activity in the Caspian Sea has increased. A map of the epicenters of earthquakes in 2020 has been constructed (Figure 16).

The occurrence of earthquakes with a magnitude of 4.6 ml in the North Caspian Sea is due to the activation of the Arpa-Samur fault.

The concentration of earthquakes in the center is observed at the intersection of Agrakhan-Krasnavodsk and transverse Garabogaz Safidrud faults. The concentration of earthquakes in the south is observed at the intersection of Sangachal-Ogurchu and transverse Garabogaz Safidrud faults. Weak seismicity is observed along the Makhachkala-Krasnavodsk deep fault.

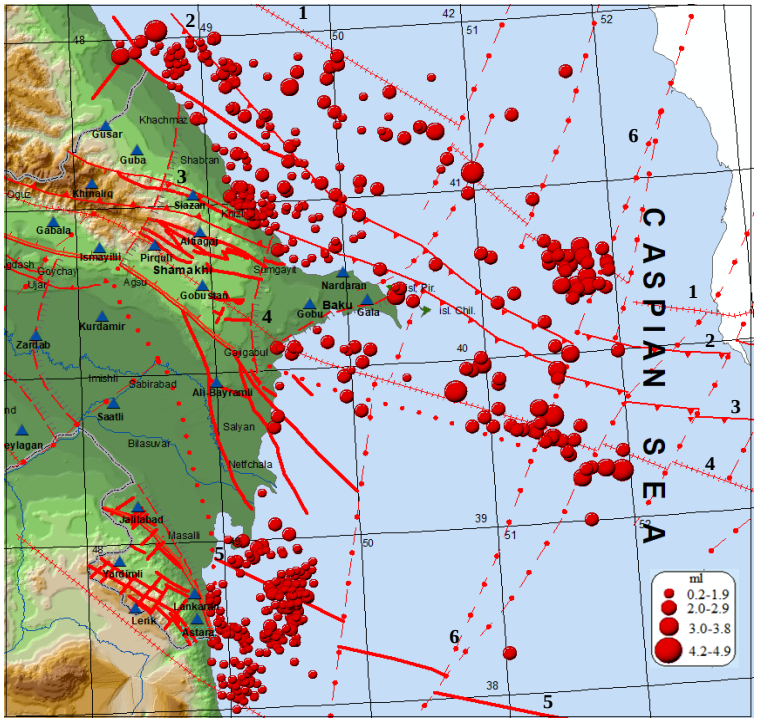

Figure 16 took place in the Caspian Sea in 2020
map of epicenters of earthquakes
Fractures: 1– Agrakhan-Krasnavodsk; 2 - Makhachkala-Krasnavodsk; 3- Absheron- Pribalkhan; 4 - Sangachal-Thief; 5- Mil-Speeches 6 - Garabogaz-Safidrud

Seismic activity of Azerbaijan and adjacent territories in 2020

The analysis of seismic activity of the surveyed area was carried out on the basis of earthquakes selected from the catalog of earthquakes in 2020, recorded without loss. In 2020, as in previous years, earthquakes were recorded in the territory of Azerbaijan without loss. A seismic activity map was compiled based on the catalog and epicenter map.

In order to monitor the change of seismic regime over time, an activity map for 2019 and a comparative analysis were made for 2020.

In 2019, the activity was high on the south-eastern slope of the Greater Caucasus - Zagatala-Balakan (A_{10}=1.6-2.0), Shamakhi-Ismayilli (A_{10}=1.6-2.0), Talish (A_{10}=1.6-2.0). In the south-northern part of the Lesser Caucasus (A_{10}=0.6-1.0) seismic activity was weak. At the

same time, in the Caspian Sea in the north (A_{10}= 0.6-1.0), in the center (A_{10}= 0.9-1.6), in the southern part of the active areas (A_{10}=1.0-1.7), in the Iranian zone (Tabriz) (A_{10}=0.6-1.8) corresponds (Figure 17).

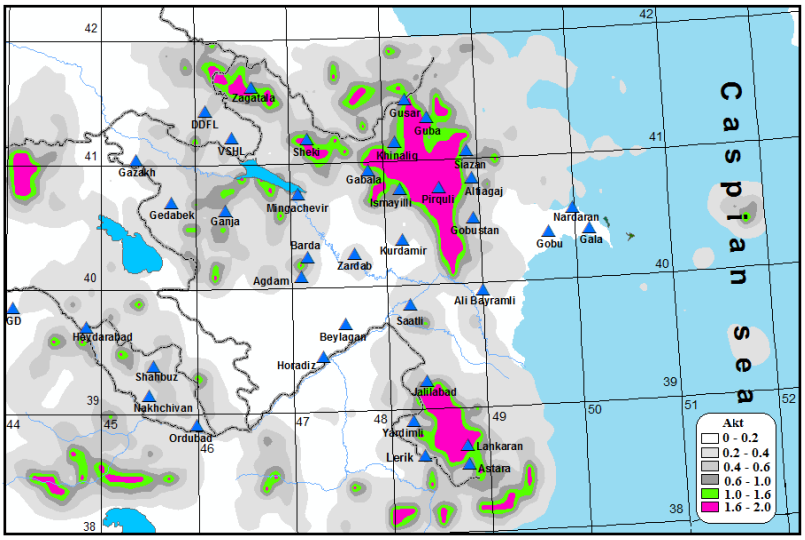

Figure 17 Azerbaijan and adjacent territories during 2019 seismic activity map

In 2020, it was on the south-eastern slope of the Greater Caucasus - Zagatala-Balakan, on the Georgian border (A_{10}=1.0-1.6). Activity was high in Shamakhi-Ismayilli (A_{10}=1.6-2.0) and Talish (A_{10}=1.6-2.0) zones. In the south-northern part of the Lesser Caucasus (A_{10}=0.6-1.0) seismic activity was weak. In 2020, it was high in the Samukh region (A_{10}= 1.6-2.0) in the Middle Kur depression. At the same time, the active areas in the Caspian Sea in the north (A_{10}= 0.6-1.0), in the center (A_{10}=0.9-1.6), and in the south (A_{10}=1.0-1.7) correspond. High activity is observed on the Iran-Turkey border (A_{10}=2.0). (Figure 18.).

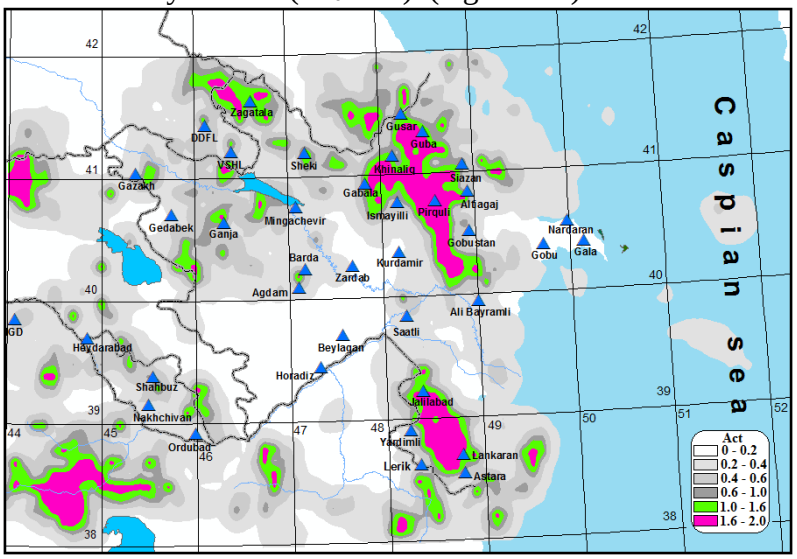

Figure 18 Azerbaijan and adjacent territories by 2020 seismic activity map

Study of the mechanisms of earthquakes.

The study of the epicenter mechanisms of strong earthquakes allows to identify the types of tectonic movements that are characteristic of different seismically active areas of the earth's

crust and to determine the maximum values of soil motion acceleration, depending on these types of movements. This plays a key role in solving the problems of seismic zoning and seismic micro-zoning. Taking this into account, in 2020, in order to study the stress and deformation areas of the Earth's crust, the mechanisms of earthquake centers, the dynamic parameters of earthquake centers, the conditions of their formation and the analysis of stress areas of the Earth's crust were conducted. Thus, in 2020, the hearth mechanism of 65 earthquakes (ml3.0.0) was developed (Fig. 19).

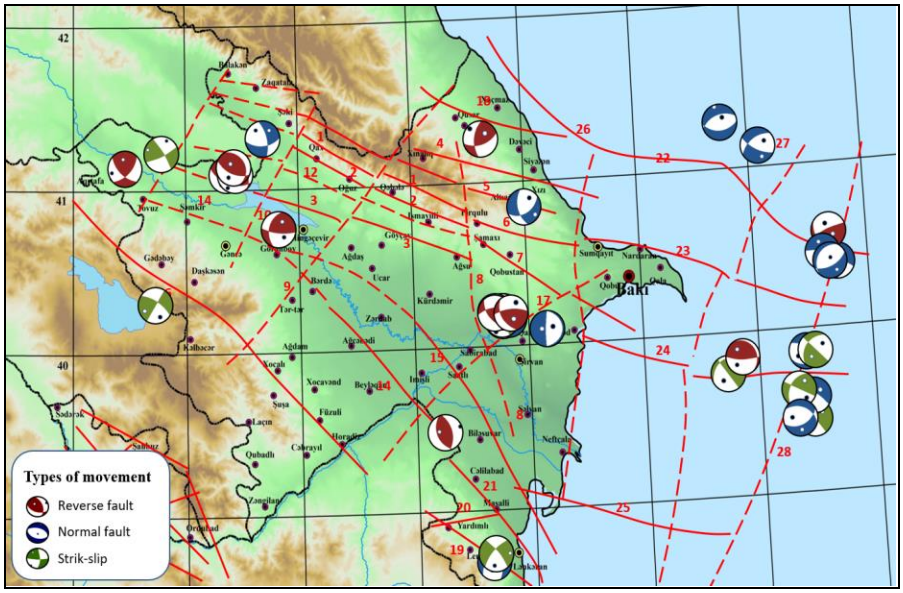

Fig. 19. Mechanisms of earthquakes of magnitude 3.0 in 2020
(Compiled the fracture map: Shikhalibeyli (1996), Kangarli (2007))
Fractures: 1-Dashgil-Mudrasa, 2-Vendam, 3-Gokchay, 4-Siyazan, 5-Zangi-Kozluchay, 6-Germian, 7-Ajichay-Alat, 8-West-Caspian, 9-Arpa-Samur, 10- Ganjachay-Alazan, 11-Gazakh-Signakh, 12-North-Acinour, 13-Iori, 14-Kur, 15-Mingachevir-Saatli, 16-Bashlibeli, 17-Palmir-Apsheron, 18-Akhti-Nugedi-Kiliziali, 19 - Talysh, 20 - Yardimli, 21 - Ontalish, 22 - Central-Khazar, 23 - Apsheron-Pribalkhan, 24 - Sangachal-Ogurchi, 25 - Chikishler, 26 - Yashma flexure, 26a - Gizilagaj, 27 - Shakhov-Azizbeyov, 28 - Garabogaz -Safidru.

Analysis of the characteristics of the distribution of earthquakes in Azerbaijan shows that they are unevenly distributed. Strong earthquakes are rare and occur in certain areas. It is known that high seismic activity is characteristic of fracture zones separating geological structures or blocks of different tectonic regimes and occurs as a result of contrasting tectonic movements in these zones. The level of contrasting movements and tectonic stress determines the level of seismic activity.

As in recent years, the seismicity of the territory of Azerbaijan, and especially the Greater Caucasus, remains high.

At 20:53:04 local time on January 20, an earthquake with a magnitude of ml=3.1 was registered in Siyazan, 12 km north-east of Altiagaj station. The value of displacement in the furnace (Slip = -35-(-152)) indicates that left-sided displacement or right-sided displacement is predominant. As a result of tension situations, the earthquake coincides with the transverse fracture of Gushchu-Dizavar. It should be noted that at 09:43:05 local time on May 10, an earthquake with a magnitude of 2.5 was registered in the territory of Guba, 11 km south-east of Guba station.

In contrast to 2019, in February 2020, an increase in seismicity is observed in the collision of Shamakhi and Hajigabul seismogenic zones. At 16:32:54 local time on February 16, earthquakes with a magnitude of ml=3.8 and at 17:21:06 on February 18 with a magnitude of ml=3.1 were registered in Shamakhi region, 33 km south-west of Gobustan station. The value

of displacement in the furnace indicates that the right-hand displacement is dominated by the fracture-type movement. For nodal planes (DP = 88-79), a sharp drop angle was determined. This area is located at the intersection of the Western Caspian and Palmyra-Absheron fractures. At 12:41:44 local time on June 3, an earthquake with a magnitude of 3.0 was registered in Gakh, 38 km south of Zagatala station. The direction of the compression axis (P) of the earthquake and the direction of the tensile stress axis (T) are oriented horizontally (PL = 32-16). For nodal planes (DP = 79-55), the acute drop angle was determined. The breaking value of the displacement in the hearth indicates that a left-sided displacement-type movement has occurred and is consistent with the Ganjachay-Alazan transverse fracture.

February 22 at 07:05:24 local time, 07:56:27, 08:22:39 and February 23 at 04:43:45 local time, Gobustan with magnitude ml = 2.6-3.8 4 more earthquakes were registered in Hajigabul area 35 km south-west of the station. The cost of displacement at the hearth indicates that right-sided displacement is predominant and is consistent with the Western Caspian fault. It should be noted that earthquakes are located in the subsidence layer (3-6 km). On March 2, at 17:33:15 local time, another earthquake with a magnitude of 3.2 was registered in Hajigabul. The value of displacement in the furnace (Slip = 47-142) indicates that a break-up movement of left-handed displacement is predominant. In general, the seismic process lasted until April. At 18:24:27 local time on April 25, 2 earthquakes with a magnitude of 3.6 and at 00:24:00 on April 26 with a magnitude of 3.8 were recorded in Hajigabul region and were characterized by tectonic movements. The nodal planes of the hearth mechanisms show that these earthquakes were directed along the Ajichay-Alat fault.

Also, unlike in 2019, the seismicity of the Middle Kura basin increased in 2020. At 05:35:58 local time on January 27, an earthquake with a magnitude of ml = 3.4 was registered in the territory of Mingachevir reservoir 10 km west of Mingachevir station. The value of displacement in the hearth (Slip = 130-11) indicates that the break-up is dominated by right-hand displacement, and is consistent with the longitudinal break of the Geokchay. At 07:58:38 local time and 03:40:27 local time on February 1, 2 earthquakes occurred in Agstafa (ml = 3) and Tovuz (ml = 3.1) regions. Both earthquakes are characterized by right-sided displacement and right-sided Gazakh-Signakh fault. 9-10 km

At 00:03:00 local time on May 4, an earthquake with a magnitude of 4.3 was recorded in Samukh, 45 km north of Ganja station. The quake was felt at the epicenter up to 3 points. At 02:00:36 local time, an aftershock with a magnitude of 3.1 was recorded that day. Another earthquake occurred on June 15 at 12:47:23 local time (ml = 3.0). The depth of earthquakes varies between 10-15 km. It should be noted that earthquakes occur as a result of compressive stress (breaking and rising) and coincide with the Chatma-Geokchay break (Fig. 20).

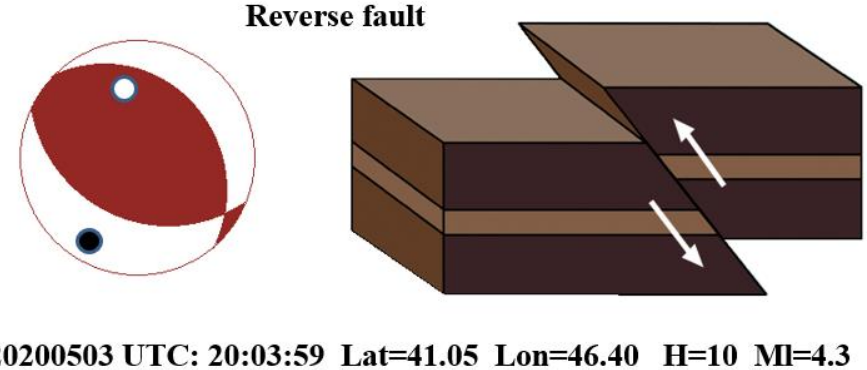

Fig. 20. The epicenter of the 4.3 magnitude earthquake in Samukh region on May 20 at 00:03:00 local time.

The Caspian Sea is the most seismically active region in 2020. The highest density of hypocentes is observed at a depth of 30-65 km. Only a small part of earthquakes occurs at a depth of 10-25 km. In the last 20 years, 19 earthquakes with a magnitude of M> 5.0 have occurred in this area and are associated with active tectonic movements at the junction of the two largest crustal structures (Turan and Kopetdag folds) (Fig. 21).

Percentage in 2020 determines the type of movement: horizontal displacement 35%, break-up 15%, break-fall 50%. The values of displacement in the furnace indicate that predominant movements are broken. However, in the area of the Central Caspian and oil fields, break-up movements are taking place. Thus, the analysis of the compression and tension axes is oriented in the direction of SW-NE.

At 11:51:21 local time on February 26, a magnitude 4.6 earthquake was recorded in the Caspian Sea. The direction of the compression axis (P) of the earthquake is vertical (PL = 55), and the direction of the tensile stress axis (T) is horizontal (PL = 15). A sharp drop angle was determined for the first nodal plane (DP = 67) and a flat drop angle for the second nodal plane (DP = 39). The value of displacement in the furnace (Slip = -57 - (- 142)) indicates the predominance of fracture-type movement. At 14:17:34 local time on February 27, another earthquake with a magnitude of 4.5 was recorded, and the eruption was characterized by right-sided displacement movements.

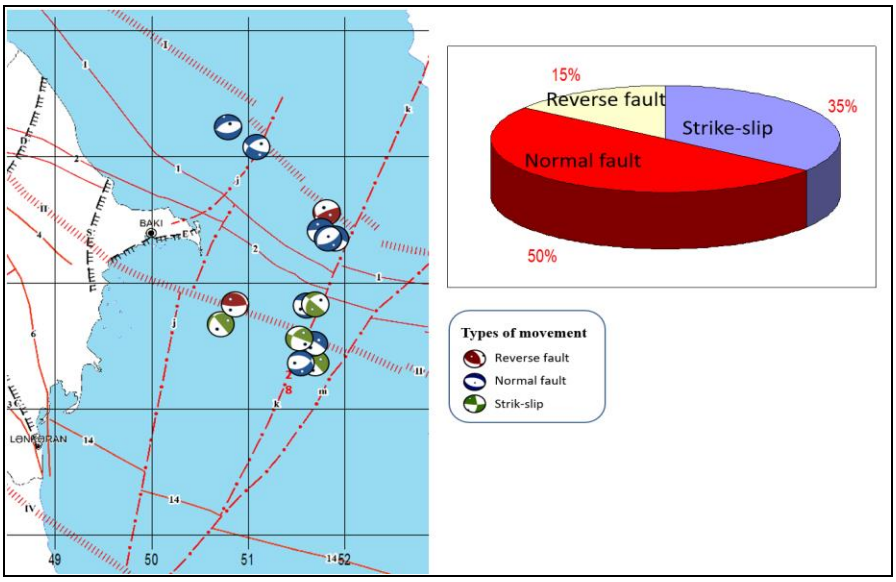

Fig.21. Focal mechanisms of earthquakes in the Caspian Sea with a magnitude of 3.0 in 2020

A total of 20 earthquakes with a magnitude of 3.0 have been developed in the Caspian Sea. The analysis showed that the earthquakes occurred mainly in the Caspian Sea at the intersection of the Agrakhan-Krasnavodsk-Shakhovo-Azizbayov and Sangachal-Ogurchu-Shakhovo-Azizbayov faults.

Conclusions

During 2020, seismicity was observed in the Greater Caucasus, the Middle Kura Basin and the Caspian Sea. Seismic activation is observed along the West-Caspian, Palmir-Absheron, Ajichay-Alat, Ganjachay-Alazan, Gazakh-Signakh, Talish, Akhvay, Sangachal Ogurju, Garabogaz-Safidrud, Agrakhan-Kasnavodsk, Khachinchay faults. In 2020, the number of earthquakes and the amount of seismic energy released will decrease.

In 2020, 20 felt (ml=2.5-5.9) earthquakes occurred. In the north-western region of Azerbaijan, an increase in seismicity is observed in the Shamakhi-Ismayilli seismogenic zone, in the Talish mountainous zone, in the Caspian Sea, on the Iran-Turkey border.

In 2020, it was on the south-eastern slope of the Greater Caucasus - Zagatala-Balakan, on the Georgian border (A_{10}=1.0-1.6). Activity was high in Shamakhi-Ismayilli (A_{10}=1.6-2.0) and Talish (A_{10}=1.6-2.0) zones. In the south-northern part of the Lesser Caucasus (A_{10}= 0.6-1.0) seismic activity was weak. In 2020, the activity (A_{10}= 1.6-2.0) was high in the territory of Samukh in the Middle Kura basin. At the same time, the active areas in the north of the Caspian Sea (A_{10} = 0.6-1.0), in the center (A_{10} = 0.9-1.6) and in the southern part (A_{10}= 1.0-1.7) correspond. High activity is observed on the Iran-Turkey border (A_{10} = 2.0).

The area of tension in the territory of Azerbaijan is divided into two areas along the Geokchay fault and the Imishli-Geokchay flexure: the north-eastern part of the republic is characterized by tension, and the south-western part by compression. Tension is observed in the Absheron region and the Caspian Sea. The southern and northern parts of the Caspian Sea are relatively calm. However, its middle part is in a highly tense situation. The largest part of hypocentes is observed in the basalt layer (45-65 km) and in the upper mantle, and coincides with the Sangachal Ogurju, Garabogaz-Safidrud, Agrakhan-Kasnavodsk faults.

Analysis of compression and tension axes based on the data of the obtained seismic hearth mechanisms was directed in the direction of NE-SW in Shamakhi-Ismayilli, Middle and Lower Kura basin, Caspian Sea and Talysh zone, and tension axes in the direction of SW-NE in each seismically active region.

References

1. Геология Азербайджана: В 7-ми т. T.IV. Тектоника. / Под ред. В.Е.Хаина и Ак.А.Ализаде. Баку: Nafta-Press, 2005, 505с.
2. Кенгерли Т.Н., Особенности геолого-тектонического строения юго-восточного Кавказа и вопросы нефтегазоносности, Elmi əsərlər, №9, Гос. Нефт. Компания Респ. Азербайджан, 2007 г., с. 3-12.
3. Рзаев А.Г., Етирмишли К.Дж, Казымова С.Э., Отражение геодинамического режима в вариациях напряженности геомагнитного поля (на примере южного склона Большого Кавказа) Известия, Науки о Земле. Баку 2013, № 4., с. 3-15
4. Шихалибейли Э.Ш. Геологическое строение и развитие Азербайджанской части южного склона Большого Кавказа. Баку: Изд-во АН Азерб.ССР,1956, 218с.
5. Brune J.N. Tectonic stress and the spectrum of seismic shear waves from earthquake // J.Geophys. Res. – 1970. – 75. № 26.- P.4997-5009.
6. Hanks T.S., Kanamore H.A. A moment magnitude scale // J.Geophys. Res. – 1979. – 84. № 135.- P.2348-2350.
7. DREGER, D.S. 2002. Time-Domain Moment Tensor INVerseCode (TDMT_INVC) University of California, Berkeley Seismological Laboratory, 18-28.