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Recent Geodynamics

RECENT GEODYNAMICS, ACTIVE FAULTS AND EARTHQUAKE FOCAL MECHANISMS OF THE ZONE OF PSEUDOSUBDUCTION INTERACTION BETWEEN THE NORTHERN AND SOUTHERN CAUCASUS MICROPLATES IN THE SOUTHERN SLOPE OF THE GREATER CAUCASUS (AZERBAIJAN)

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Abstract: Our study was focused on the active tectonics of the southern slope of the Greater Caucasus within Azerbaijan. The study area is the zone of under-thrusting (pseudosubduction) interaction between Southern and Northern Caucasus continental microplates, which caused the tectonic stratification of the Alpine formations into various allochthonous and parauthochthonous thrust slices of southern vergency between the Middle Bajocian and Quaternary periods. These slices are grouped into the nappe complexes that form the modern structure of the trough in the study area. The large linearly stretched tectonic units (megazones) correspond to the axis of the Alpine marginal sea basin, the consolidated crust of which is subjected to destruction and thinning. The trough's Alpine cover was compressed in the underthrust zone and pushed southwards. As a result, an accretionary prism formed allochthonously overlapping the northern side of the Southern Caucasus microplate by the system of gently dipping overthrusts. During the continental stage of Alpine tectogenesis (starting from the end of Miocene), intensive lateral compression process was caused by intrusion of the frontal wedge of the Arabian indenter into the buffer structures of the southern frame of Eurasia. This is evidenced by the GPS monitoring data on modern geodynamic activity, which demonstrates the Southern Caucasus block's intensive (up to 29 mm/year) intrusion in the northern rhumbs as compared to the relative stability of the Northern Caucasus microplate (0–6 mm/year). This, in turn, is a reflection of the ongoing pseudosubduction regime (continental subduction or S-subduction) at the band of collision junction of these microplates. It is suggested that this process caused historically observed seismic activity in the study area, wherein the earthquakes occurred mainly in the southern slope's accretionary prism area and the adjacent strip of the Southern Caucasus microplate. In this article, we analyze and correlate the whole range of seismic events that occurred in the study area until 2017 and the focal mechanisms of the recently recorded earthquakes (2012–2016). It is established that earthquake foci are confined either to the intersection nodes of variously trending ruptures with the faults of different directions or to the planes of deep tectonic ruptures and lateral displacements along the unstable contacts between the material complexes with different competence. The focal mechanisms of seismic events reveal various, mostly

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near-vertical, planes of normal and strike-slip faults. However, the earthquake foci are generally confined to the intersection nodes between the Caucasus and anti-Caucasus-striking rupture dislocations. The results of our studies are interesting in terms of their real-time application for drawing a regional summary of causes for both geodynamic and seismic activity of the Greater Caucasus system and the adjacent areas of Alpine-Himalayan fold belt.

Key words: earthquake; seismotectonic zone; focal mechanism; geodynamics; accretion; nappe complex

Геодинамика, активные разломы и механизмы очагов землетрясений в зоне псевдосубдукционного взаимодействия континентальных микроплит Южного и Северного Кавказа (южный склон Большого Кавказа, Азербайджан)

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Аннотация: Изучалась активная тектоника южного склона Большого Кавказа на территории Республики Азербайджан. Район исследований представляет собой зону поддвига (псевдосубдукции), где взаимодействуют континентальные микроплиты Южного и Северного Кавказа, что приводит к тектоническому расслоению альпийских формаций на разнообразные аллохтонные и параавтохтонные надвиговые пласты южной вергентности между средним байоским и четвертичным периодами. Эти пласты сгруппированы в покровные комплексы, образующие современную структуру прогиба в изучаемом районе. Большие линейно растянутые тектонические единицы (мегазоны) соответствуют оси альпийской краевой морской впадины, консолидированная кора которой подвергается разрушению, утрачивает свою мощность (т.е. утоняется). Альпийский покров подвергался сжатию в зоне поддвига и сдвинут в южном направлении. В результате этого аккреционная призма сформировалась как аллохтон, перекрывающий северную сторону Южно-Кавказской микроплиты в виде системы полого падающих взбросо-надвигов. На протяжении континентальной стадии альпийского тектогенеза (начиная с конца миоцена) процесс интенсивного латерального сжатия был вызван вторжением фронтального клина Арабского индентора в буферные структуры южной окраины Евразии. Об этом свидетельствуют данные мониторинга современной геодинамической активности посредством технологий GPS: установлено интенсивное (до 29 мм/год) вторжение Южно-Кавказского блока в северных румбах в сравнении с относительной стабильностью Северо-Кавказской микроплиты (0–6 мм/год). Это, в свою очередь, является отражением режима псевдосубдукции (континентальной субдукции или S-субдукции), который продолжает действовать в полосе, где сталкиваются и взаимодействуют Южно-Кавказская и Северо-Кавказская микроплиты. Предполагается, что этот процесс являлся причиной сейсмической активности в период исторических наблюдений в изучаемом районе, где землетрясения происходили главным образом в зоне аккреционной призмы южного склона и прилегающей полосе Южно-Кавказской микроплиты. В данной статье проведен анализ и корреляция всего спектра сейсмических событий, произошедших в изучаемом районе до 2017 г., а также фокальных механизмов недавно зарегистрированных землетрясений (2012–2016 гг.). Установлено, что очаги землетрясений приурочены либо к узлам пересечений разрывов разного простирания с разломами разных направлений, либо к плоскостям глубоких тектонических разрывов с боковыми смещениями вдоль неустойчивых контактов материальных комплексов разного залегания. По фокальным механизмам сейсмических событий установлены разнообразные, в основном субвертикальные, плоскости сбросов и сдвигов. При этом выявлено, что очаги землетрясений, как правило, приурочены к узлам пересечения между разрывными дислокациями, простирающимися в «кавказском» и «противокавказском» направлениях. Результаты наших исследований интересны в плане их применения в реальном времени для регионального обзора причин как геодинамической, так и сейсмической активности системы Большого Кавказа и прилегающих районов Альпийско-Гималайского складчатого пояса.

Ключевые слова: землетрясение; сейсмотектоническая зона; фокальный механизм; геодинамика; аккреция; покровный комплекс

1. Introduction

According to established ideas [*Khain, 1984, 2001; Akhmedbeyli et al., 2002; Khain, Alizadeh, 2005; Kangarli, 2012*], the present tectonic setting of the Caucasus has formed during the Alpine stage of tectogenesis within the south side of the Eurasian continent, the Lesser Caucasus offset Meso-Tethys and the northern side of the Central Iranian microcontinent (Fig. 1). It's widely believed that compression of the Caucasus neck's territory in a collisional zone of mentioned lithosphere plates determines its' modern geodynamics and seismic activity. Wherein, the southern slope of the Greater Caucasus system remains one of the most seismically active areas with periodically occurring large seismic events accompanied by spontaneous large-scale energy release. The area's seismic activity is connected with an ongoing intensive structural plan reconstruction with considerable amplitudes of latest and modern movements. Earthquake focuses are normally confined to boundaries of the earth crust's large geotectonic elements and to the intersections of differently striking faults. Seismological and paleoseismotectonic studies as well as seismic and seismotectonic zonation activities carried out in different seismic regions of the Caucasus (including the territory of Azerbaijan), all stand for the assumption that a core zone of the earthquakes is controlled by a network of "general-Caucasus" and "anti-Caucasus" striking faults with different types of displacements. However, modern seismic activity is generally caused by the horizontal movements of the different-scale tectonic blocks compressed in a collisional interaction zone between Afro-Arabian and Eurasian continental plates[1].

[1] Presently, a group of researchers (E.A. Rogozhin, A.V. Gorbatikov, V.B. Zaalishvili, M.Yu. Stepanova, N.V. Andreeva, Yu.V. Kharazova, A.N. Ovsyuchenko and others) on the basis of the results of the application of microseismic sounding method in combination with other geological and geophysical methods, the essential role of internal causes in the processes of orogenesis and folding in the Greater Caucasus without taking into account the processes of lateral compression under the influence of lithosphere plates motion is defended. Such interpretation is based on the position of the now departed V.V. Belousov on the generation of internal deformations and orogenesis under the influence of the processes of differentiation of matter in the earth interior and advective movements in the upper layers of the lithosphere. However, a large amount of geological and geophysical information (at least, for the whole territory of Azerbaijan and the Caspian Sea, seismic exploration data from MOGT (Fig. 9) and recent GPS data (Fig. 15) clearly defend) allow one to defend the plate-tectonic nature of the formation of the Greater Caucasus, and the entire Alpine-Himalayan folded belt.

2. Methods

Geological-tectonic structure of the Azerbaijani part of Greater Caucasus was studied using the well-known geological mapping methods of complexly built nappe-thrust structures in combination with deep geological mapping through geophysical methods (CMRW – Correlation Method of Refracted Wave, RWM – Reflected Waves Method, MSDP – Method of Separate Deep Point, MEEW – Method of Earthquake Exchange Wave, MTS – Magneto-Telluric Sounding, DS – Dipole Sounding and transformation of the geophysical fields), and the deep well and remote sensing data. This allowed us to precisely describe the structure and composition of the Alpine complex, characterize behavior of the pre-Jurassic basement's surface, and trace correlation between structural elements from different levels of the earth crust [*Kangarli, Akhundov, 1988; Khain, Alizadeh, 2005; Kangarli, 2012*].

Horizontal present day crustal motion velocities were determined according to records of the stationary GPS surveying network through using the software package of GAMIT-GLOBK. Velocities were assessed within the framework of global reference frame, supported by the International Reference Frame (ITRF) as applied to the Eurasian plate.

In recent years, it became possible to build focal mechanisms by using specially developed software. In this paper, we used the outcomes of earthquake focal mechanism calculations, registered by a network of digital seismic stations. These focal mechanisms were calculated at the Republican Centre of Seismological Survey, using «FPIT» Software developed by "Kinemetrics". This software used the signs of initial P-wave arrivals to the digital stations located within the epicenter distance interval of 15–350 km with fairly even azimuthal distribution [*Rzayev et al., 2013; Yetirmishli et al., 2016*].

3. Results

Critical analysis of the space-time distribution of violent earthquake focuses during the instrumental monitoring period in Azerbaijan leads to a conclusion that the hypocenters have concentrated mainly within the exocontact parts of the seismotectonic zone of the Southern slope of Greater Caucasus. Being a part of the Alpine-Himalayan fold belt, the zone had formed during the Alpine stage of tectogenesis under the geodynamic environment of lateral compression peculiar to the area of pseudo-subduction interaction between the Northern and Southern Caucasus continental microplates. Its' present structure was formed as a result of the horizontal movements of different phases and subphases of the Alpine tectogenesis (Late Cimmerian –

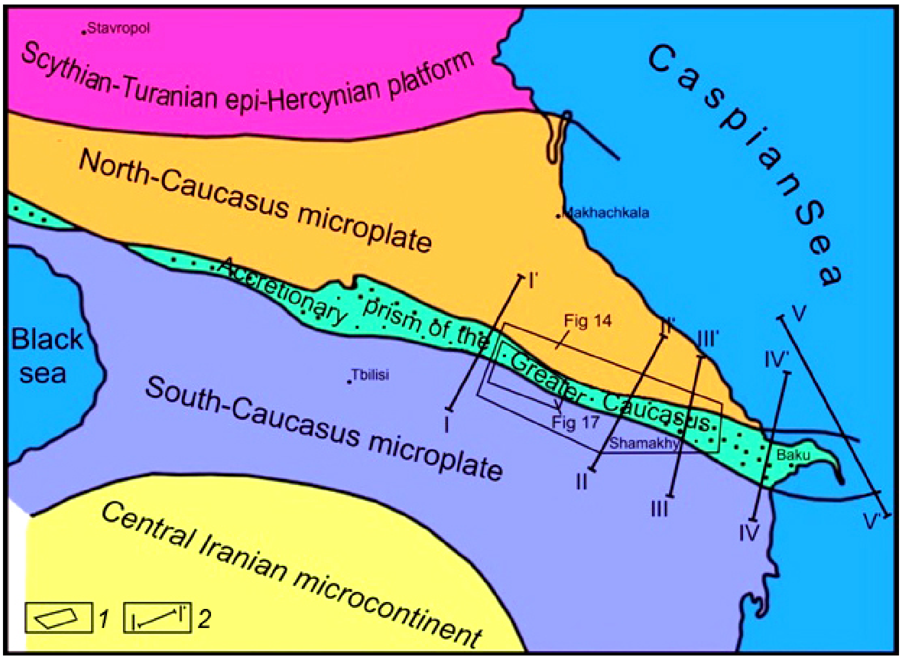

Fig. 1. Location of the accretion prism within the structure of the Greater Caucasus of the Caucasus Isthmus. Compiled by S.I. Dotduyev; modified after [*Dotduev, 1986*]. *1* – boundaries of the territories shown in Fig. 14 and 17; *2* – locations of the sections shown in Fig. 2, 3, 4, 9, and 10.

Рис. 1. Местоположение аккреционной призмы в структуре Большого Кавказа Кавказского перешейка (составитель: С.И. Дотдуев; по [*Dotduev, 1986*] с изменениями). *1* – границы территорий, показанных на рис. 14 и 17; *2* – местоположение разрезов, показанных на рис. 2, 3, 4, 9 и 10.

Wallachian), and is generally regarded as a zone where, along Zangi (Kbaad-Zangi) dislocation (to eastern part of Krasnopolyansk thrust in North-East Caucasus), the insular arc formations of the northern edge of Southern Caucasus microplate have underthrusted beneath the Meso-Cenozoic substantial complex contained in the facies of Greater Caucasus marginal sea [*Dotduev, 1986, 1989; Baranov et al., 1990; Kangarli, 1999, 2005, 2012; Khain, Alizadeh, 2005; Kangarli et al., 2018*]. The latter was in turn thrusted under the Northern Caucasus continental margin of the Scythian-Turanian plate (epi-Hercynian platform) along the Major Caucasus fault, forming an accretionary prism jammed between the aforesaid dislocations (Fig. 2).

Outcomes of geology-geophysical investigations of the territory of Azerbaijan and its' Caspian Sea sector, conducted in the last quarter of the past – the beginning of this century [*Kangarli et al., 1994, 2018; Kangarli, 1999, 2012; Khain et al., 2007; Mamedov, 2008, 2010*]; say for a pseudosubduction (C-subduction) interaction between the Southern and the Northern Caucasus microplates, resulting in tectonic stratification of the Alpine formations of continental slope, marginal sea and insular arc into different south-vergent scale plates combined into the nappe complexes (Fig. 3, 4).

Thus, the Northern Caucasus edge of the Scythian-Turanian plate (Daryal-Shahnabad-Jimi complex of the Side range of Greater Caucasus) presents itself as an allochthonous cover, while the Alpine complex of the northern side of Southern Caucasus microplate appears as an autochthonous (parautochthonous) basement of the accretionary prism. Autochthonous bedding of the Southern slope's accretionary prism is represented by a Meso-Cenozoic complex of the northern Kakheti-Vandam-Gobustan margin (megazone) the Southern Caucasus microplate. Mentioned complex is in turn crushed and lensed into the southward shifted tectonic slices which gently overlap the northern flank of Kur depression along Ganikh-Ayrichay-Alat overthrust.

Tectonic stratification of the accretionary prism is clearly revealed in structure of the Azerbaijani part of Greater Caucasus mountains, which consists of the different-scale and heterochronous nappe slices detected and studied in different years by a number of domestic scientists [*Khain, 1937; Vassoyevich, Khain, 1940; Shardanov, 1953; Voskresensky, 1958; Voskresensky et al., 1963; Shurygin, 1967; Mirchink, Shurygin, 1972; Isaev et al., 1981; Kangarli et al., 1994, 2018; Khain, Alizadeh, 2005; Kangarli, 2006, 2007, 2011, 2012*]. According to latest compilations, these slices included into five (Tufan, Sarybash, Talachay-Duruja, Zagatala-Dibrar and Govdagh-Sumgayit) nappe complexes [*Khain, Alizadeh, 2005; Kangarli, 2006, 2007, 2011, 2012*]. In general, these complexes correspond to the eastern fragments

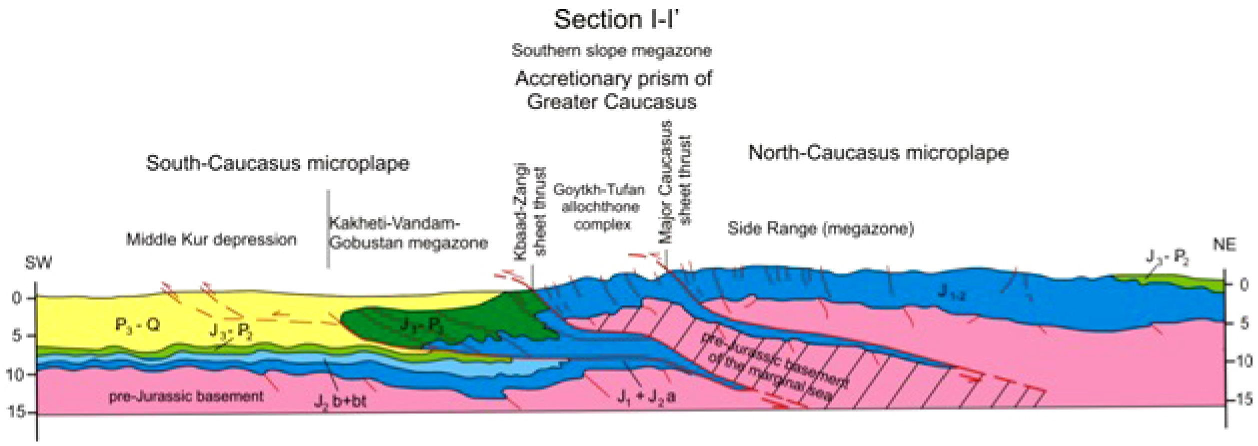

Fig. 2. Transfrontier profiles across the Greater Caucasus, and sections of the assumed deep structure by Georgia-Dagestan (I-I' in Fig. 1). Compiled by S.I. Dotduyev; modified after [*Dotduev, 1986*].

Рис. 2. Трансграничные профили через Большой Кавказ и предполагаемая глубинная структура разрезов Грузия–Дагестан (I-I' на рис. 1) (составитель: С. И. Дотдуев; по [*Dotduev, 1986*] с изменениями).

of transregional tectonic slices, western segments of which were mapped in the territories of Georgia and Northern Caucasus region of Russia [*Vassoyevich, 1940; Gamkrelidze P.D., Gamkrelidze I.P., 1977; Dotduyev, 1986; Baranov et al., 1990; Panov, 2002*]. Their position in the regional structure is shown a tectonic scheme (Fig. 5) and synthesized geology-geophysical sections (Fig. 3, 4, 6, 7) of the Azerbaijani part of Greater Caucasus. Brief characteristics of slices are provided in Table.

The accretionary prism of Greater Caucasus extends naturally into the territory of Absheron Peninsula and the Caspian Sea, gets buried in the structure of Absheron threshold and possibly the Near-Balkhanian zone of uplifts in the Transcaspian region [*Khain et al., 2007; Green et al., 2009; Kangarli, 2011, 2012*]. This statement is evidenced by results of latest seismic surveys implemented in the Azerbaijani sector of Caspian Sea, geological interpretation of which clearly reflects

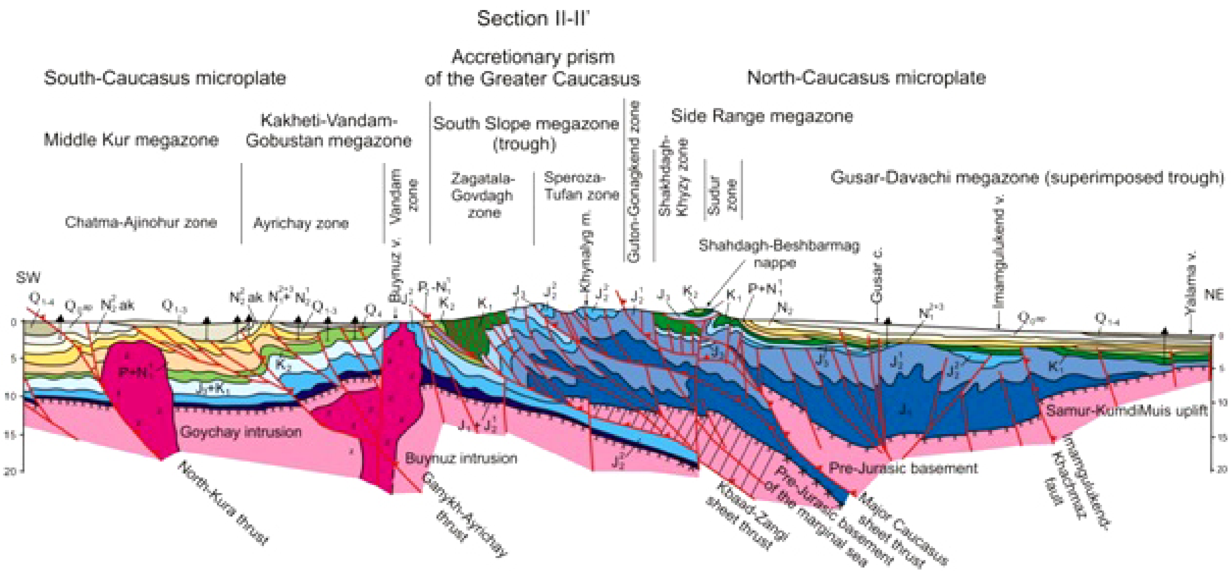

Fig. 3. Synthesized geological-geophysical section of the crust along the Goychay-Yalama traverse (II–II' in Fig. 1 and 5). Compiled by T.N. Kangarli; modified after [*Kangarli et al., 1994; Kangarli, 2007*].

Рис. 3. Синтезированный геолого-геофизический разрез земной коры по Гёйчай-Яламинскому траверсу (II– II' на рис. 1 и 5) (составитель: Т.Н. Кенгерли; по переработанным данным [*Kangarli et al., 1994; Kangarli, 2007*]).

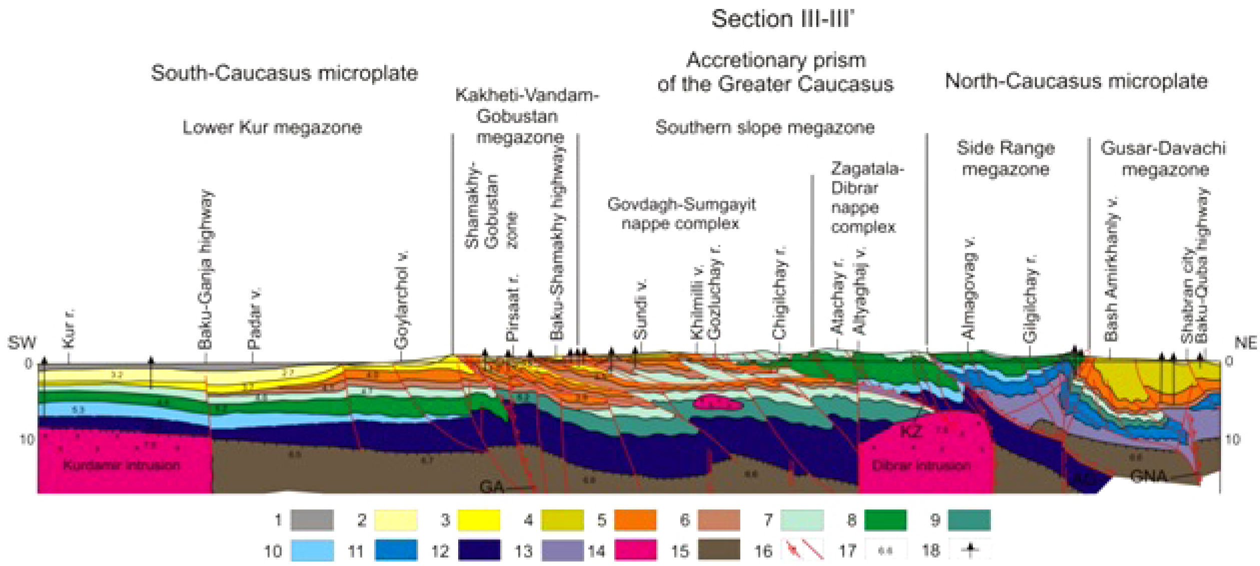

Fig. 4. Synthesized geological-geophysical section of the crust along the Padar-Shabran traverse (III–III' in Fig. 1 and 5). Compiled by T.N. Kangarli; modified after [*Kangarli et al., 1994*].

1 – Pleistocene – Holocene; *2* – Upper Pliocene – Eopleistocene (Akchagil and Absheron regiostages); *3* – Middle Miocene – Lower Pliocene; *4* – Middle – Upper Miocene; *5* – Oligocene – Lower Miocene; *6* – Paleocene – Eocene; *7* – Upper Cretaceous; *8* – Lower Cretaceous; *9* – Upper Jurassic and Lower Cretaceous; *10* – Upper Jurassic; *11* – Middle Jurassic; *12* – Lower – Middle Jurassic; *13* – Lower Jurassic; *14* – intrusions; *15* – pre-Jurassic basement; *16* – fractures: a – on the tectonic step, boundaries of the consolidated crust (IKh – Imamgulukend-Khachmaz; AG – Axty-Nugadi-Gilazi (Major Caucasus); KZ – Kbaad-Zangi; GA – Ganykh-Ayrichay-Alat); b – other dislocations; *17* – boundary velocity of seismic waves; *18* – wells.

Рис. 4. Синтезированный геолого-геофизической разрез земной коры по Падар-Шабранскому траверсу (III–III' на рис. 1 и 5) (составитель: Т.Н. Кенгерли; по переработанным данным [*Kangarli et al., 1994*]).

1 – плейстоцен – голоцен; *2* – верхний плиоцен – эоплейстоцен (акчагильский и апшеронский региоярусы); *3* – средний миоцен – нижний плиоцен; *4* – средний – верхний миоцен; *5* – олигоцен – нижний миоцен; *6* – палеоцен–эоцен; *7* – верхний мел; *8* – нижний мел; *9* – верхняя юра и нижний мел; *10* – верхняя юра; *11* – средняя юра; *12* – нижняя – средняя юра; *13* – нижняя юра; *14* – интрузии; *15* – предъюрский фундамент; *16* – разломы: а – на тектонических уступах, границах консолидированной земной коры (IKh – Имамгулукенд–Хачмазский; AG – Ахты–Нугеди–Гилязийский (Большой Кавказ); KZ – Кбаад–Зангинский; GA – Ганых–Айричай–Алятский); b – другие дислокации; *17* – граничная скорость сейсмических волн; *18* – скважины.

the process of intercontinental accretion accompanied by underthrusting (pseudosubduction) of the Southern Caucasus microplate (Southern Caspian megazone as its' offshore extension) under the Scythian epi-Hercynian platform (Fig. 8–10).

The autochthonous complex, northern wing of which is buried beneath the accretionary prism, consists of complexly interrelated Mesozoic-Cenozoic sedimentary and volcanic formations. In surface structure the complex is represented by two structural zones: Kakheti-Vandam zone in the west, and Shamakhy-Gobustan zone in the east [*Khain, Alizadeh, 2005*].

First zone corresponds to a marginal uplift of the Southern Caucasus microplate – contemporaneous with the Gagra-Java zone of Georgia. Within the boundaries of Azerbaijan, revealed are the fold-complicated crest and near-crest part of the northern limb of the uplift built by Middle Jurassic volcano sedimentary to Paleogene terrigenous formations. In its' remaining parts in the west, the uplift gets leveled by Eopleistocene-Quarternary continental molasse of Ganikh (Alazani)-Ayrichay superimposed depression, while in the east it buries under the Shamakhy-Gobustan zone's Paleogene deposits. Further in the west (Kakheti, Eastern Georgia), parautochthone pack of tectonic slices protrudes in front of the accretionary prism (Fig. 11) formed by Middle Jurassic-Eocene deposits in the "vandam" facies [*Gamkrelidze P.D., Gamkrelidze I.P., 1977*].

Shamakhy-Gobustan zone is revealed on the eastern plunge of Kakheti-Vandam Mesozoic complex and mainly composed of Paleogene-Neogene clayey formations. It is characterized by complex fold-nappe structure and represented on surface by three packs of the differently rooted thrust sheets [*Khain, Alizadeh, 2005; Kangarli, 2005, 2012*]. Parautochthonous slices of the northern strip are represented by homologues of the Kakhetian parautochthonous pack of tectonic sheets protruding in front of Govdagh-Sumgayit nappe complex of the accretionary prism (see Fig. 4).

Thus, the presented information speaks for an allochthonous nature of the region's alpine structure, with predominantly southward displacement of rock mass.

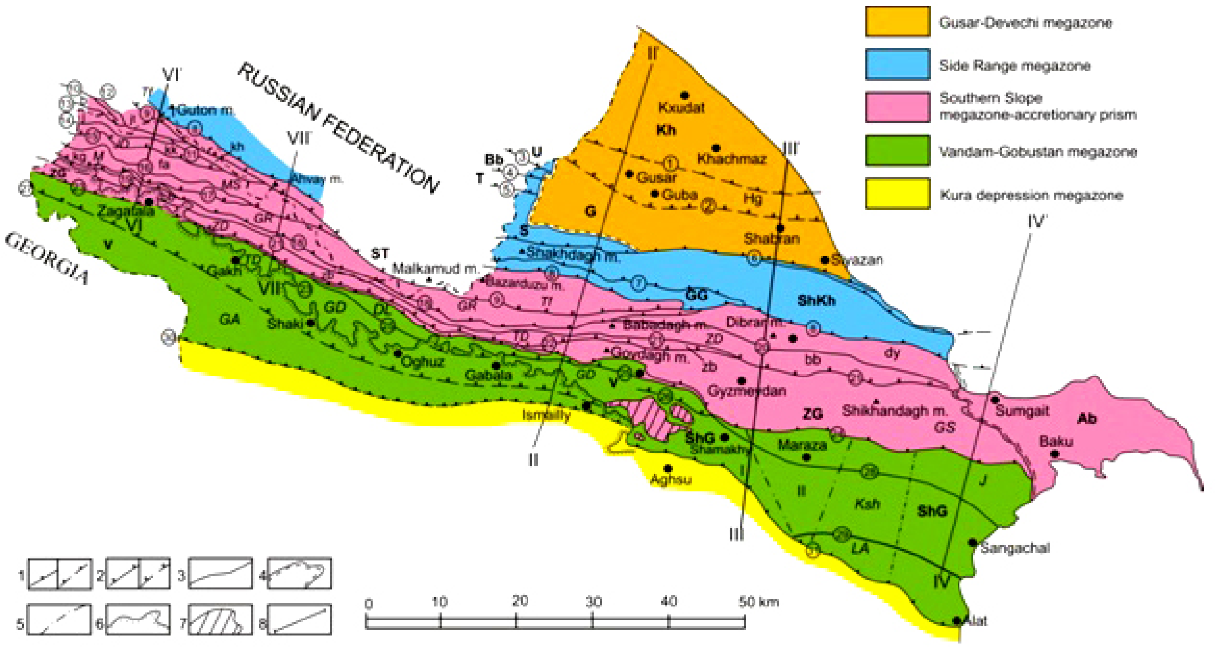

Fig. 5. Schematic tectonic map of the Azerbaijan part of Greater Caucasus. Compiled by T.N. Kangarli [*Kangarli, 2005*].

Boundaries between the structures: *1* – tectonic boundaries between zones (a – traced on surface; b – buried); *2* – tectonic boundaries between subzones (a – traced on surface; b – buried); *3* – boundaries of tectonic slices; *4* – stratigraphic boundaries; *5* – assumed boundaries; *6* – distribution boundary of modern sediments in the Ganykh-Ayrichay superposed depression; *7* – Basgal nappe; *8* – synthesized geological-geophysical sections (see Fig. 3, 4, 6, 7, and 8).

Structures: ***Gusar-Davachi megazone***, including zones: **Kh** – Khachmaz; **G** – Guba. ***Side range megazone***, including zones: **U** – Ulluchay; **Bb** – Baybulag; **T** – Tahirjal; **S** – Sudur; **ShKh** – Shahdagh-Khizy; **GG** – Guton-Gonagkend. ***Southern slope megazone (accretionary prism)***, including zones: **ST** – Speroza-Tufan; **ZG** – Zagatala-Govdagh; **Ab** – Absheron (western segment of the Absheron-Pribalkhan zone); subzones: *Tf* – Tufan; *JD* – Jikhikh-Dindidagh; *MS* – Mazim-Saribash; *M* – Megikan; *GR* – Galal-Rustambaz; *ZD* – Zagatala-Dibrar; *TD* – Talachay-Duruja; *GS* – Govdagh-Sumqayit; tectonic slices: *jt* – Jurmut-Tunsaribor; *kh* – Khalakhol; *r* – Rokhnor; *b* – Boskal; *j* – Jikhikh; *kk* – Kasdagh-Kasmala; *fa* – Filizchay-Attagay; *kg* – Katekh-Gumbulchay; *dy* – Dibrar-Yashma; *bb* – Balakan-Babadagh; *zb* – Zagatala-Burovdal. ***Kakheti-Vandam-Gobustan megazone,*** including zones: **V** – Vandam; **ShG** – Shamakhy-Gobustan; subzones: *DL* – Dashaghil-Lahij; *GD* – Gulluk-Dadagunash; *A* – Ayrichay; *J* – Jangichay; *KSh* – Keyvandi-Shahgaya; *LA* – Langabiz-Alat.

Faults: 1 – İmamgulukend-Khachmaz; 2 – Khazra-Guba-Kuchay; 3 – Ashagy Maku; 4 – Tendi-Keydi; 5 – Tahirjal; 6 – Uruj-Khnov-Siyazan; 7 – Shahdagh-Gonagkend; 8 – Bash Qafqaz (Major Caucasus); 9 – Khuray-Malkamud; 10 – Joakhor-Gudurdagh; 11 – Khalakhol; 12 – Kasmaldagh; 13 – Machkhalor; 14 – Jikhikh-Chugak; 15 – Kohnamadan; 16 – Hamzagor-Saribash; 17 – Suvagil; 18 – Gamarvan; 19 – Megikan; 20 – Altyagaj; 21 – İlisu-Aladash; 22 – Gaynar-Gozluchay; 23 – Mamrux-Galajig; 24 – Zangi-Garajuzlu; 25 – Dashaghil-Mudrisa; 26 – Muju; 27 – Shambul-İsmayilly; 28 – Galabughur-Jangichay; 29 – Sangachal; 30 – Ganikh-Ayrichay; 31 – Ajichay-Alat.

Рис. 5. Тектоническая схема азербайджанской части Большого Кавказа. Составитель: Т.Н. Кенгерли [*Kangarli, 2005*].

Границы между структурами: *1* – тектонические границы между зонами (a – прослеживаемые на поверхности, b – погребенные); *2* – тектонические границы между подзонами (a – прослеживаемые на поверхности; b – погребенные); *3* – границы тектонических пластов; *4* – стратиграфические границы; *5* – условные границы; *6* – граница распространения современных осадков в Ганых–Айричайской наложенной впадине; *7* – Басгальский покров; *8* – местоположение синтезированных геолого-геофизических разрезов (см. рис. 3, 4, 6, 7 и 8).

Структуры: *Гусар–Девечинская мегазона*, в том числе зоны: Kh – Хачмасская; G – Губинская. *Мегазона бокового хребта*, в том числе зоны: U – Уллучайская; Bb – Байбулакская; T – Таирджальская; S – Судурская; ShKh – Шахдаг–Хызы; GG – Гутон–Гонагкендская. *Мегазона южного склона (аккреционная призма)*, в том числе зоны: ST – Спероза–Туфанская; ZG – Загатала–Говдагская; Ab – Апшеронская (западный сегмент Апшерон–Прибалханской зоны); подзоны: *Tf* – Туфанская; *JD* – Йихик–Диндидагская; *MS* – Мазым–Сарыбашская; *M* – Мегиканская; *GR* – Галал–Рустамбасская; *ZD* – Загатала–Дибрарская; *ТД* – Талачай–Дуруджинская; *GS* – Говдаг–Сумгаитская; Тектонические пласты: *jt* – Юрмут–Тунсариборский; *kh* – Халахольский; *r* – Рохнорский; *b* – Баскальский; *j* – Джихихский; *kk* – Кагдаг–Космалинский; *fa* – Филичай–Аттагайский; *kg* – Катех–Гумбулчайский; *dy* – Дибрар–Яшминский; *bb* – Балакен–Бабадагский; *zb* – Загатала–Буровдалский. *Кахетия–Вандам–Гобустанская мегазона*, в том числе зоны: V – Вандамская; ShG – Шамахы–Гобустанская; подзоны: *DL* – Дашагыл–Лахичская; *GD* – Гуллук–Дадагюнешская; *A* – Айричайская; *J* – Джангичайская; *KSh* – Кейванди–Шахгайская; *LA* – Ленгебиз–Алятская.

Разломы: 1 – Имамгулукенд–Хачмазский; 2 – Хазра–Губа–Кучайский; 3 – Ашаги-Макунский; 4 – Тенди–Кединский; 5 – Таирджальский; 6 – Урудж–Хнов–Сиязанский; 7 – Шахдаг–Гонагкендский; 8 – Главнокавказский; 9 – Хурай–Малкамудский; 10 – Джоакхор–Гудурдагский; 11 – Халахольский; 12 – Казмалдагский; 13 – Мачхалорский; 14 – Джихих–Чугакский; 15 – Кохнамаданский; 16 – Хамзагор–Сарибашский; 17 – Сувагильский; 18 – Гамарванский; 19 – Мегиканский; 20 – Алтягайский; 21 – Илису–Аладашский; 22 – Гайнар–Гозлучайский; 23 – Мамрукс–Галаджигский; 24 – Занги–Гараджузлуйский; 25 – Дашагил–Мудрийский; 26 – Муджуйский; 27 – Шамбул–Исмаиллийский; 28 – Галабугур–Джангичайский; 29 – Сангачальский; 30 – Ганих–Айричайский; 31 – Аджичай–Алатский.

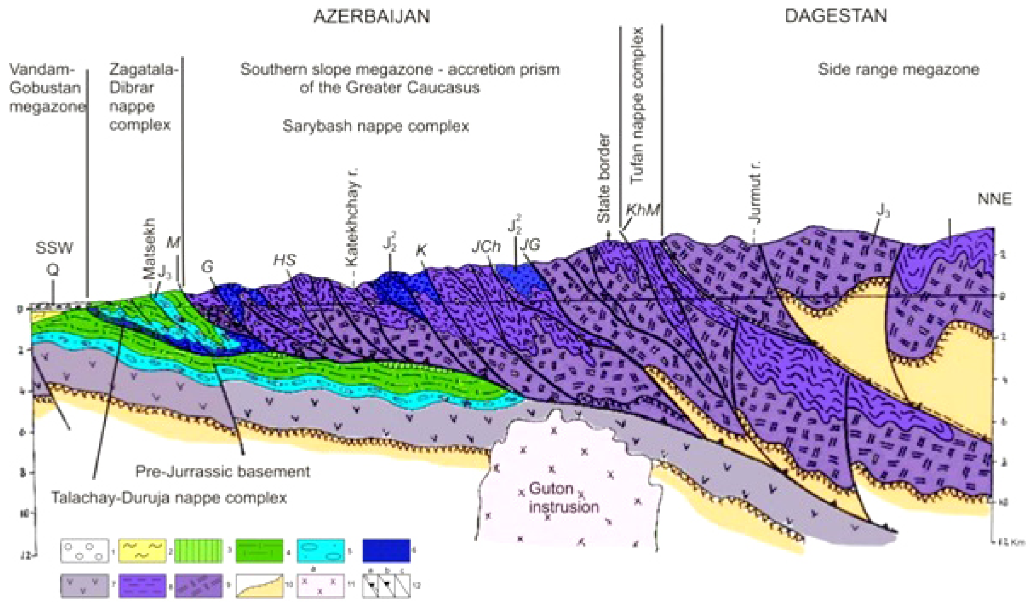

Fig. 6. Synthesized geological-geophysical section (along the Matsekh-Jurmut rivers' traverse passing through the nappe complexes of North-Western Azerbaijan (VI-VI' in Fig. 5). – Compiled by T.N. Kangarli [*Kangarli, 2012*].

1 – Pleistocene-Holocene; *2* – Eopleistocene (Absheron regiostage); *3* – Upper Cretaceous; *4* – Lower Cretaceous; *5* – Upper Jurassic; *6* – Middle Jurassic (Aalenian stage); *7* – Lower-Middle Jurassic (volcanogenic-sedimentary formation of the Vandam zone); *8–9* – Lower Jurassic: *8* – Toarcian stage; *9* – Sinemurian and Pliensbachian stages; *10* – surface of the pre-Jurassic basement; *11* – Guton intermediate-basic intrusion (according to the geophysical field interpretation); *12* – faults: a – Major Caucasus thrust; б – Kbaad-Zangi (Mamrukh-Galajig) thrust; в – other faults, including overthrusts: M – Megikan; G – Gamarvan; HS – Hamzagor-Saribash; К – Kokhnamadan; JCh – Jikhikh-Chugak; JG – Joakhor-Gudurdagh; KhM – Khuray-Malkamud.

Рис. 6. Синтезированный геолого-геофизический раздел по траверсе рр. Мацех-Журмут, проходящей через покровные комплексы Северо–Западного Азербайджана (VI–VI' на рис. 5). Составитель: Т.Н. Кенгерли [*Kangarli, 2012*].

1 – плейстоцен–голоцен; *2* – эоплейстоцен (апшеронский региоярус); *3* – верхний мел; *4* – нижний мел; *5* – верхняя юра; *6* – средняя юра (ааленский ярус); *7* – нижняя–средняя юра (вулканогенно-осадочное образование Вандамской зоны); *8–9* – нижняя юра: *8* – тоарский ярус; *9* – синемюрский и плинсбахский ярусы; *10* – поверхность предюрского фундамента; *11* – Гутонская средне-основная интрузия (в соответствии с интерпретацией геофизических полей); *12* – разломы: а – Главный Кавказский надвиг; б – Кбаад–Зангийский (Мамрух–Галаджигский) надвиг; в – другие разломы, в том числе надвиги: М – Мегиканский; G – Гамарванский; HS – Хамзагор–Сарибашский; К – Кохнамаданский; JCh – Джихих–Чугакский; JG – Йоахор–Гудурдагский; ХМ – Хурай–Малкамудский.

This fact is confirmed by results of deep geological mapping by geophysical methods (CMRW, RWM-MSDP, MEEW, MTS, zoning and transformation of the geophysical fields), indicating that the observed tectonic zonality is reflected in the structure of region's alpine cover and pre-Jurassic basement, but with well pronounced southern vergence of the structural zones and their framing deep faults. This is particularly evidenced by spatial location of the foundation's blocks that correspond to the structural zones of surface: when projected onto the horizontal plane, they become located far north of the observed position of zones on erosional truncation [*Kangarli, Akhundov, 1988; Khain, Alizadeh, 2005; Kangarli, 2012*].

The fault tectonics, that constructs a structural plan of the region, like for the entire Caucasus, is extremely complex. According to the morphology and type of displacements, fault dislocations are divided into: 1 – deep faults at the boundaries of structural megazones; 2 – faults at the boundaries of structural zones and subzones; 3 – longitudinal thrusts, upthrust-overthusts, thrusts, (in some cases with a strike-slip component), complicating the internal structure of structural zones as branches of disjunctive dislocations of the first and second order; 4 – transverse and diagonal flexures, normal faults and strike slip faults, rarely thrust-strike-slip faults, controlling the transverse block divisibility of the Earth's crust.

1. Deep faults at the boundaries of structural megazones represent large disjunctive dislocations that penetrate to the pre-Jurassic basement and deeper horizons of the earth's crust (up to the Moho surface) and are expressed on the surface by zones of closely spaced subparallel, often mutually replacing each other sharp upthrusts and upthurst-overthrusts of south vergency. Within the study area, they include the Main Caucasian, Kbaad-Zangin and Ganikh-Ayrichay-Alat dislocations.

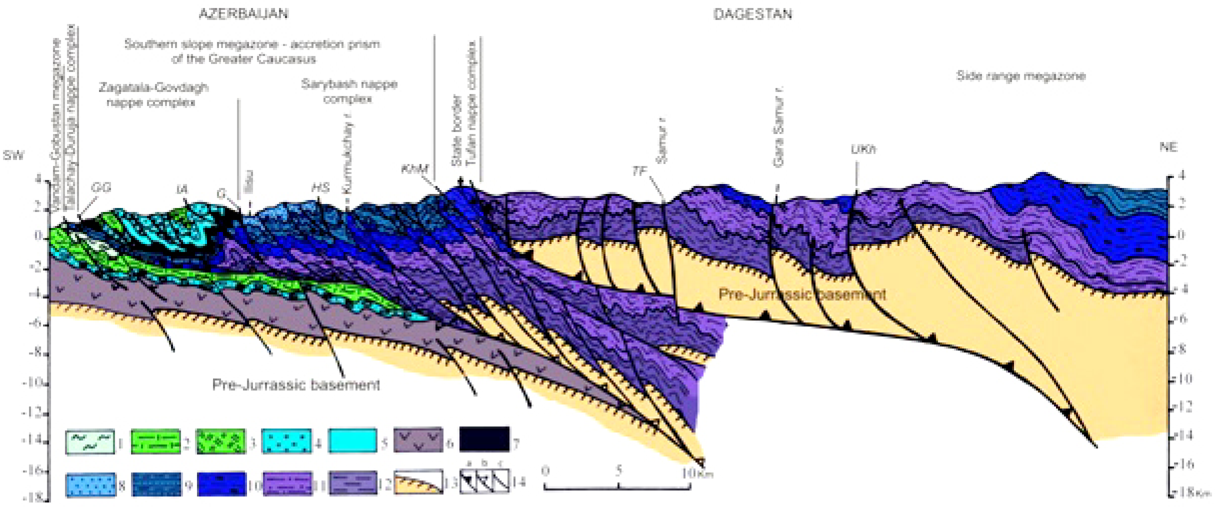

Fig. 7. Synthesized geological-geophysical section along the Ilisu-Gara Samur rivers' traverse passing through the nappe complexes of North-Western Azerbaijan and Mountainous Dagestan (VII–VII' in Fig. 5). Compiled by T.N.Kangarli [*Kangarli, 2012*].

1 – Upper Cretaceous (Vandam zone); *2* – Lower Cretaceous (Vandam zone); *3* – Lower Cretaceous (Berriasian and Valanginian stages); *4–5* – Upper Jurassic: *4* – upper substage of the Oxfordian stage, Kimmeridgian and Tithonian stages; *5* – lower substage of the Oxfordian stage; *6* – Lower-Middle Jurassic (volcanogenic-sedimentary formation of the Vandam zone); *7–10* – Middle Jurassic: *7* – Callovian stage; *8* – upper substage of the Bajocian stage; *9* – Upper Aalenian stage and the lower substage of the Bajocian stage; *10* – lower Aalenian stage; *11–12* – Lower Jurassic: *11* – Toarcian stage; *12* – Sinemurian and Pliensbakhian stages; *13* – surface of the pre-Jurassic basement; *14* – faults: a – Major Caucasus thrust; b – Kbaad-Zangi (Mamrukh-Galajig) thrust; c – other faults, including overthrusts: GG – Gaynar-Gozluchay; IA – İlisu-Aladash; G – Gamarvan; HS – Hamzagor-Saribash; KhM – Khuray-Malkamud; TF – Tlagda-Falfan; UKh – Uruj-Khnov.

Рис. 7. Синтезированный геолого-геофизический раздел по траверсе рр. Илису-Гара – Самур, проходящей через покровные комплексы Северо-Западного Азербайджана и Горного Дагестана (VII–VII' на рис. 5) Составитель: Т.Н. Кенгерли [*Kangarli, 2012*].

1 – верхний мел (Вандамская зона); *2* – нижний мел (Вандамская зона); *3* – нижний мел (берриасский и валанжинский ярусы); *4–5* – верхняя юра: *4* – верхний под-ярус Оксфордского яруса, киммериджский и титонский ярусы; *5* – нижний под-ярус Оксфордского яруса; *6* – нижняя–средняя юра (вулканогенно–осадочное образование Вандамской зоны); *7–10* – средняя юра : *7* – келловейский ярус; *8* – верхний под-ярус байосского яруса; *9* – верхний ааленский ярус и нижний под-ярус байосского яруса; *10* – нижний ааленский ярус; *11–12* – нижняя юра: *11* – Тоарский ярус; *12* – синемюрский и плинсбахский ярусы; *13* – поверхность предюрского фундамента; *14* – разломы: a – Главный Кавказский надвиг; b – Кбаад–Зангийский (Мамрух–Галаджигский) надвиг; c – другие разломы, в том числе надвиги: GG – Гайнар–Гозлучайский; IA – Илису–Аладашский; G – Гамарванский; HS – Хамзагор–Сарибашский; KhM – Хурай–Малкамудский; TF – Тлагда–Фальфанский; UKh – Урудж–Хновский.

2. Faults at the boundaries of structural zones and subzones represent large disjunctive dislocations, often penetrating into the pre-Jurassic basement and expressed by upthrust-overthrust and upthrust type zones having south vergency. Within the study area, they include Khuray-Malkamud, Gamarvan, Dashaghil-Mudrisa and Shambul-Ismayilly dislocations.

3. Longitudinal ruptures that complicate the internal structure of structural zones and subzones are presented by elementary upthrusts at the base of the tectonic wedge scales of the accretionary prism, and also complicate the structure of folded dislocations of various orders in a form of axial and wing upthrusts, upthrustes-overthrusts, rarely strike-slip and normal faults.

4. Disjunctive dislocations of the "anti-Caucasian" direction reflect the transverse and diagonal zoning of the study area. They are also well expressed in geophysical anomalies at considerable depths, probably controlling the divisibility of the crystalline basement at deeper levels than longitudinal dislocations. Forms of manifestation and the direction of the "anti-Caucasian" disjunctives differ with huge variety and complexity. These are usually ruptures of normal, rarely upthrust nature faulting type with a right-, less often, left-lateral component. In separate, each rupture usually has a short length, but enters a long-length echelon-like row. Single discontinuities of considerable length are also observed.

Disjunctives of the north-eastern stretch have clearly expressed displacement planes or are closely spaced fracture zones, often accompanied by ruptured microfolding, narrow crushing and limonization zones, veins of calcite.

The north-west and north-north-west disjunctives, clearly expressed in space images, control the rocking

Characteristics of nappe complexes of the accretionary prism of the Greater Caucasus

Характеристики покровных комплексов аккреционной призмы Большого Кавказа

Allochthone		Autochthone		Neoautochthone – age of the folded fossils	Phases of the nappe formation	
Napping complexes and sub-complexes	Age of the folded fossils	Structure confine	Age of the folded fossils (according to phases)		Main	Repeated
Tufan complex (amplitude 30–35 km)	Lias – Lower Bajocian	Sarybash zone of the central area of the Southern slope megazone	1st phase – Lias – Lower Bajocian; 2nd phase – Malm	1st phase – Upper Bajocian – Lower Bathonian; 2nd phase – Neokomian	Adigeyan – before Late Bajocian	Andian – beginning Late Tithonian
Saribash complex (amplitude 40–45 km), subcomplexes: Jikhikh-Dindidagh, Mazim-Saribash, Megikan, Galal-Rustambaz	Lias – Lower Bathonian	North side of the Kakheti-Vandam-Gobustan megazone	Lias – Bajocian	Upper Callovian – Lower Tithonian	Chegemian – starting of the Late Bathonian	
Talachay-Duruja comlex (amplitude up to 30 km), subcomplexes: Talachay and Duruja	Lias – Aalenian	North side of the Kakheti-Vandam-Gobustan megazone	1st phase – Lias –Lower Bajocian; 2nd phase – Upper Jurassic – Cretaceous	1st phase – Upper Callovian – Lower Tithonian; 2nd phase – Cretaceous – Lower Paleocene	Chegemian – starting of the Later Bathonian	Laramian – border of the Early – Later Paleocene
Zagatala-Dibrar complex (amplitude 25–30 km), subcomplexes: Balakan-Babadagh, Zagatala-Burovdal, Ilisu-Aladash	Malm – Senonian	North side of the Kakheti-Vandam-Gobustan megazone	1st phase – Upper Jurassic – Cretaceous; 2nd phase – Paleocene – Middle Miocene; 3rd phase – Paleocene – Miocene (excluding Pontian)	Upper Paleocene – Middle Miocene	Laramian – border of the Early – Later Paleocene	1. Styrian – middle of the Sarmatian; 2. Attic – Later Meotian
Govdagh-Sumgayit complex (amplitude 20–25 km)	Barremian – Miocene	North side of the Kakheti-Vandam-Gobustan megazone	1st phase – Paleocene – Miocene (without Pontian); 2nd phase – (setting of the Basgal nappe) Pontian – Lower Pliocene	1st phase – Upper Miocene (Pontian) – Lower Pliocene; 2nd phase – Upper Pliocene – Pleistocene	Attic – Later Meotian	Rodanian – Early Pliocene (middle of the age of Productive strata)

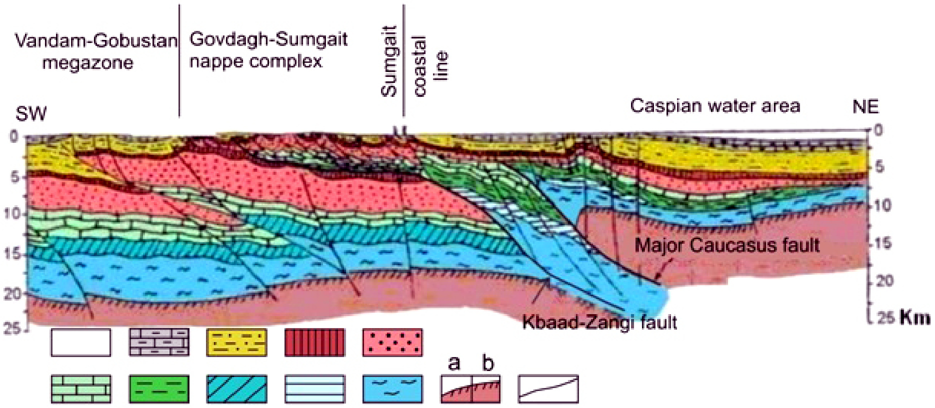

Fig. 8. Synthesized geological-geophysical section along the Shahgaya-Sumgayit traverse (IV-IV' in Fig. 1 and 5). – Compiled by T.N. Kangarli [*Kangarli, 2012*].

1 – Pleistocene-Holocene; *2* – Eopleistocene (Absheron regiostage); *3* – Upper Miocene (Pontian regiostage) – Pliocene (except Pontian regiostage on the offshore); *4* – Tarkhanian, Chokrakian stages and Diatomian suit (including Pontian regiostage on the offshore); *5* – Paleocene-Lower Miocene; *6* – Upper Cretaceous; *7* – Lower Cretaceous; *8* – Lower Cretaceous and Upper Jurassic; *9* – Upper Jurassic; *10* – Lower-Middle Jurassic; *11* – surface of the pre-Jurassic basement: a – geophysically determined; b – assummed; *12* –faults.

Рис. 8. Синтезированный геолого-геофизический разрез (IV–IV' на рис. 1 и 5) по Шахгайя–Сумгаитской траверсе. Составитель: Т. Н. Кенгерли [*Kangarli, 2012*].

1 – плейстоцен–голоцен; *2* – эоплейстоцен (апшеронский региоярус); *3* – верхний миоцен (понтийский региоярус) – плиоцен (за исключением понтийского региояруса на шельфе); *4* – тарханский, чокракский ярусы и диатомская свита (включая понтийский региоярус на шельфе); *5* – палеоцен–нижний миоцен; *6* – верхний мел; *7* – нижний мел; *8* – нижний мел и верхняя юра; *9* – верхняя юра; *10* – нижняя–средняя юра; *11* – поверхность предюрского фундамента: а – установленная по геофизическим данным; b – предполагаемая (условная); *12* – разломы.

arrangement and closure of individual folds and allochthonous scales in the geological structure, as well as flexure curves in the general strike of folding and are represented by extended right shifts or their zones intersecting diagonally study area. The largest of zones of right-lateral dislocations one of the northwest strike in the South-Eastern Caucasus is the West-Caspian fault zone with 35–40 km wide, which is clearly mapped by a complex of geological and geophysical methods [*Khain et al., 1966; Kangarli, Akhundov, 1988*] and continues within East-Dagestan diagonal flexures zone.

Near longitudinal discontinuous dislocations occupy an intermediate position between NE and NW disjunctives and are usually represented by right-lateral strike-slip faults of significant amplitude.

Formation of a fold-nappe structure of the Greater Caucasus accretionary prism was studied in the context of geodynamic models which were based on a primacy of tangential forces and thrust fault mechanism during the formation of modern orogenes [*Khain, 2001; Khain, Alizadeh, 2005; Kangarli, 2011, 2012; Kangarli et al., 2018*] i.e in direct relation with the process of intracontinental C-subduction (pseudosubduction). Forming of the described nappe complexes is directly confined to a time interval of Late Bajocian – Quaternary, corresponding to transitional (Late Aalen – Middle Miocene) and continental (Late Miocene – Quaternary) stages of the Caucasia's Alpine Geology, marked by Late Cimmerian and following phases of tectogenesis [*Gamkrelidze P.D., Gamkrelidze I.P., 1977; Khain, 1984; Dotduyev, 1986; Baranov et al., 1990; Kangarli, 1999, 2005, 2012; Khain, Chekhovich, 2006; Khain, Alizadeh, 2005; Kangarli et al., 2018*].

Continental stage of tectogenesis is directly related to injection of the frontal wedge of Afro-Arabian indenter to the south and, as a consequence, reanimation of the lateral compression process in the pseudosubduction interaction zone of Southern and Northern Caucasus microplates at the territory of Caucasus neck. This process is accompanied by secondary stretching efforts occurred on the intender's eastern and western flanges, generating strike-slip dislocations with an anti-Caucasian orientation. Such orogeny formation mechanism is proposed by different researchers for the Greater Caucasus and the entire Caspian-Caucasus-Black Sea region [*Aliyev, 2014; Allen et al., 2004; Philip et al., 1989, Kopp, 1997, 1999; Khain, 2001; Akhmedbeyli et al., 2002; Jackson et al., 2002; Khain, Chekhovich, 2006; Vincent et al., 2007; Kangarli, 2012; Kadirov et al., 2015; Aliyev et al., 2018*]. Namely, the process of C-subduction defines geological-tectonic and geodynamic background for the southern slope's seismic activity within and outside of the Azerbaijan's territory.

This phenomenon reflects a consecutive accumulation of the elastic deformations within the zones of pseudo-subduction interaction between structures of

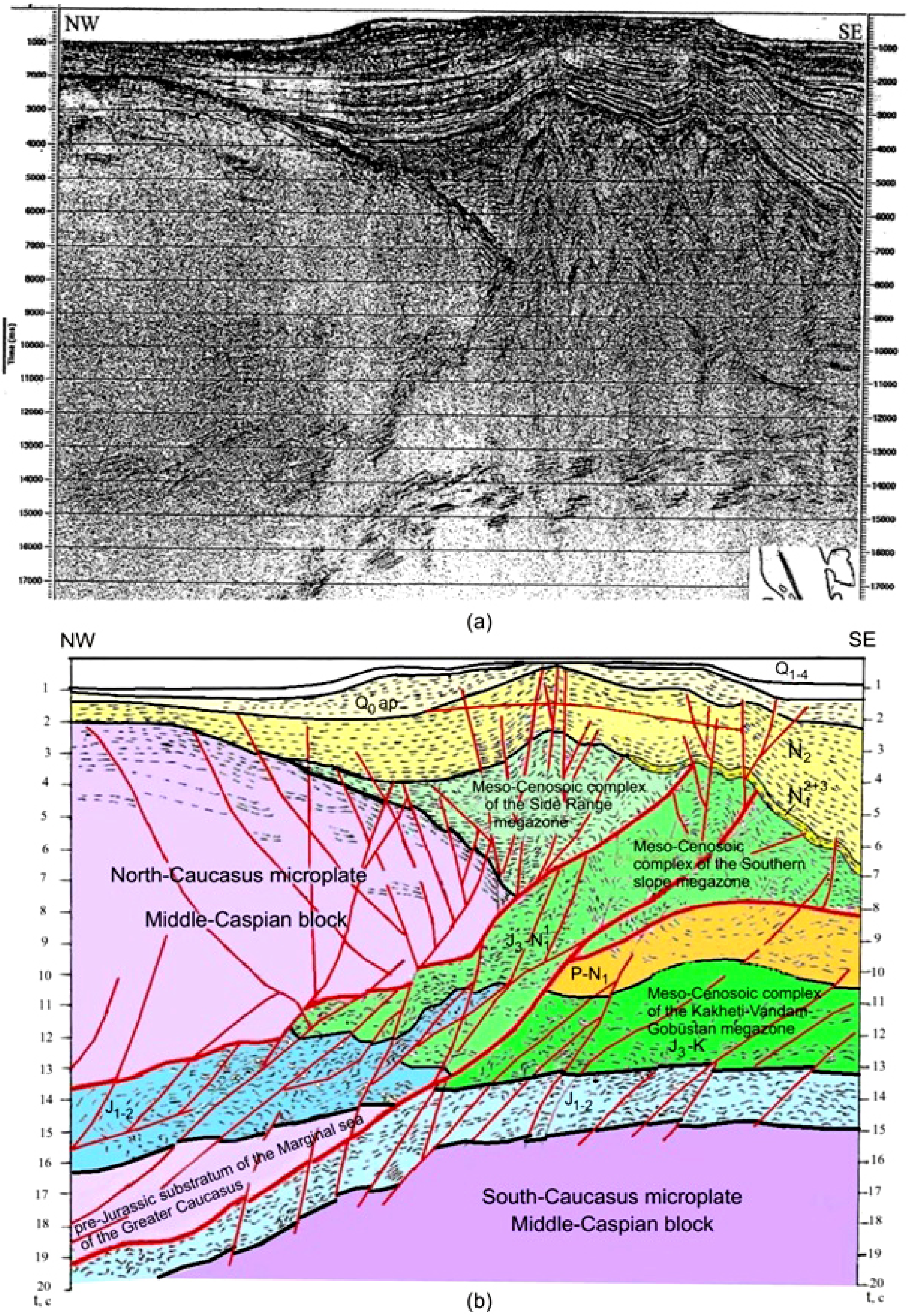

Fig. 9. Submeridional seismic section across the Absheron Threshold (V–V' in Fig. 1) (*a*) and its interpretations by T.N. Kangarli (*b*).

Рис. 9. Субмеридиональный сейсмический разрез через Апшеронский порог (V–V' на рис. 1) (*a*) и его интерпретации (составитель: Т.Н. Кенгерли) (*b*).

the northern flank of Southern Caucasus microplate (Kakheti-Vandam-Gobustan megazone) and the Greater Caucasus accretionary prism. Continued pseudosubduction is indicated by seismicity's uneven by depth distribution (hypocentral depths of 2–6, 8–12, 17–22 and 25–45 km): earthquake focus distribution analysis speaks for a presence of structural-dynamic interrelation between seismic focuses on one side and the sub-

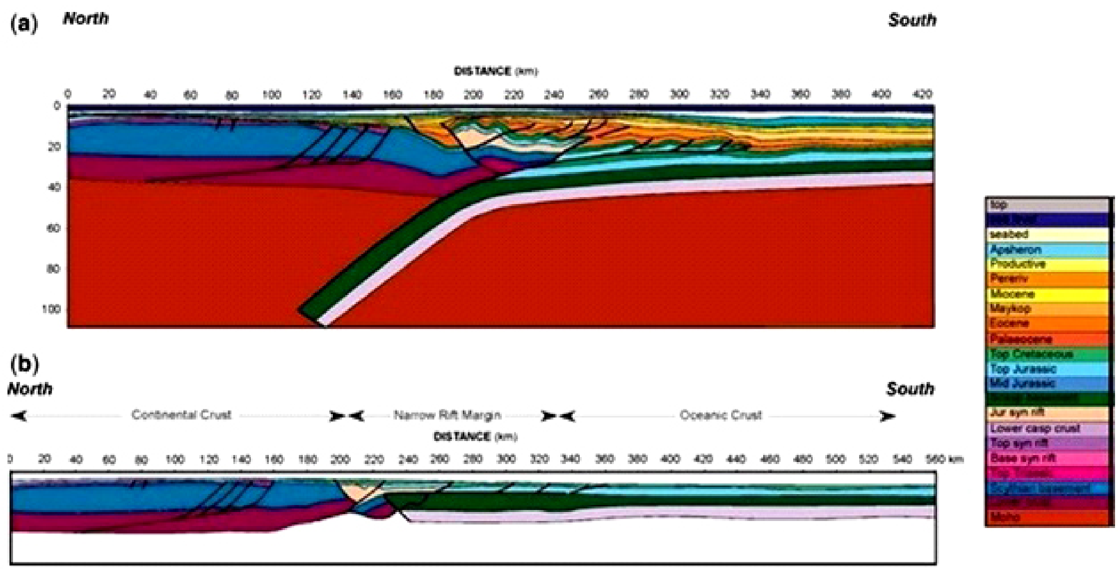

Fig. 10. Tectonic balanced cross-section (see Fig. 9, a) (*a*) and the reconstruction for the Middle and Southern Caspian areas [*Green et al*., 2009] (*b*).

Рис. 10. Тектонический сбалансированный поперечный разрез (см. рис. 9а) (*а*) и реконструкция через районы Среднего и Южного Каспия [*Green et al*., 2009] (*b*).

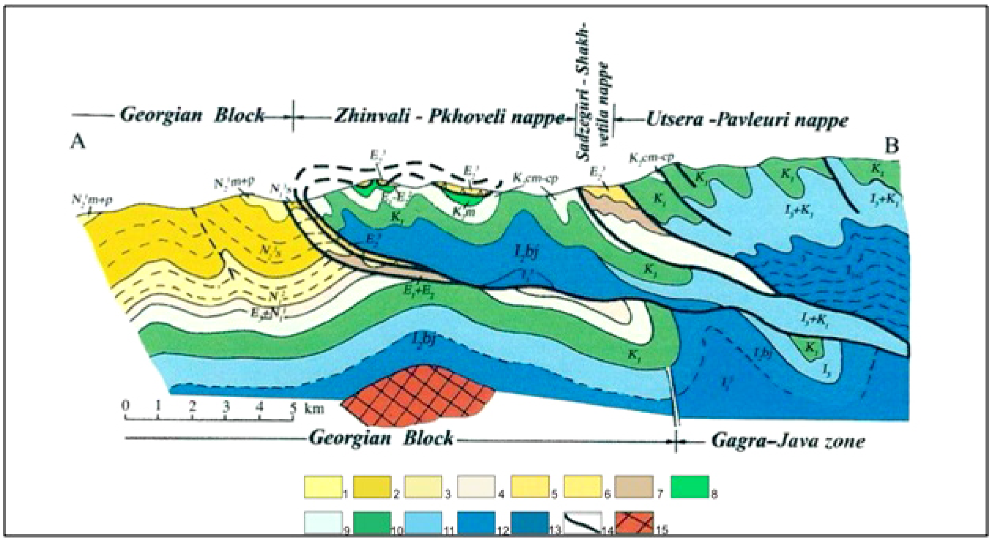

Fig. 11. Geological section along the Patara Liaxvi river in Kakhetia (Eastern Georgia). Compiled by I.P. Gamkrelidze [*P.D. Gamkrelidze, I.P. Gamkrelidze, 1977*].

1 – Meotian and Pontian conglomerates (Dusheti suite); *2* – Sarmatian sandstones and clays; *3* – Middle Miocene sandstones; *4* – Oligocene-Lower Miocene clays and sandstones (Maikopian series); *5* – Upper Eocene (olistostromes); *6* – Upper Eocene (normal-sedimentary suite); *7* – Paleocene- Middle Eocene (sandstone-siltstone flysch); *8* – Maastrichtian (Orbitoid suite); *9* – Cenomanian-Campanian (sandstone-siltstone and limestone flysch and marls); *10* – Lower Cretaceous (sandstone-siltstone flysch); *11* – Upper Jurassic-Lower Cretaceous (flysch); *12* – Middle Jurassic (volcano-sedimentary deposits); *13* – Lower and Middle Jurassic (sandy-argillaceous suite); *14* – thrusts; *15* – pre-Jurassic crystalline basement of the Georgian block.

Рис. 11. Геологический разрез по р. Патара-Лиаксви в Кахетии (Восточная Грузия). Составитель: И.П. Гемкрелидзе [*P.D. Gamkrelidze, I.P. Gamkrelidze, 1977*].

1 – меотский и понтийский конгломераты (душетская свита); *2* – сарматские песчаники и глины; *3* – средне-миоценовые песчаники; *4* – олигоцен–нижне-миоценовые глины и песчаники (майкопская свита); *5* – верхний эоцен (олистостромы); *6* – верхний эоцен (сбросо-осадочная свита); *7* – палеоцен – средний эоцен (песчаник–алевролитовый флиш); *8* – маастрихт (орбитоидская свита); *9* – сеноман–кампан (песчаник-алевролитовые и известняковые флиши и мергели); *10* – нижний мел (песчаник–алевролитовый флиш); *11* – верхняя юра – нижний мел (флиш); *12* – средняя юра (вулкано-осадочные отложения); *13* – нижняя и средняя юра (песчано-глинистая свита); *14* – надвиги; *15* – предюрский кристаллический фундамент Грузинского блока.

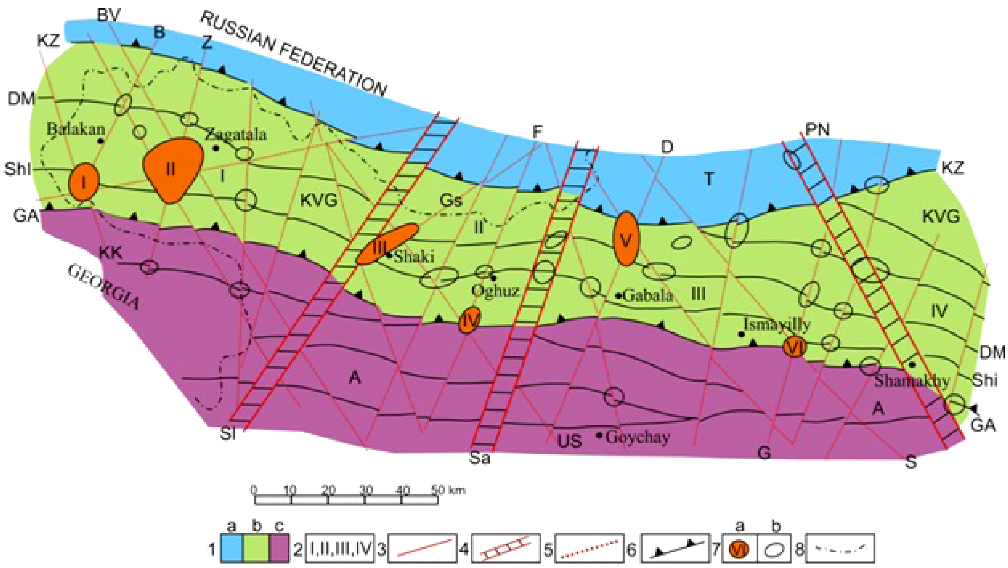

Fig. 12. Schematic map showing the fault tectonics and the pattern of earthquake focal zones at the level of the Pre-Jurassic basement.Compiled by T.N. Kangarli, F.A. Aliyev and A.M. Aliyev [*Kangarli et al., 2017a*].

1 – longitudinal blocks of the first order: a – Tufan (T), b – Kakheti-Vandam-Gobustan (KVG), c – Chatma-Ajinohur (ChA); d – Middle Kur (MK); *2* – transverse blocks of the first order: I – Zagatala, II – Shaki, III – Gabala-Shamakhy, IV – Gobustan; *3* – faults at the boundaries of the longitudinal blocks of the first order: KZ – Kbaad-Zangi, GA – Ganikh-Ayrichay-Alat; NK – Northern Kur; *4* – ruptures limiting the longitudinal blocks of the second order, including: DM – Dashaghil-Mudrisa, ShI – Shambul-Ismayilly; *5* – faults at the boundaries of the transverse blocks of the first order: Sl – Salavat, SA – Samur-Aghdash, PN – Pirsaat-Neftchala; *6* – other ruptures of the "anti-Caucasus" direction, including: KK – Khimrikh-Khalatala, BV – Bulanligchay-Verkhiyan, B – Balakan, Z – Zagatala, GS – Gokhmug-Salyakhan, F – Fiy, US – Ujar-Saribash, D – Damiraparanchay, G – Girdimanchay, S – Sighirly; *7* – focal zones of M≥3 earthquakes recorded in 2012-2016: a – mentioned in this article: I – Balakan, II – Zagatala, III – Shaki, IV – Oghuz, V – Gabala, b – other; *8* – state border.

Рис. 12. Схематическая карта тектонических разломов и распределения зон очагов землетрясений на уровне доюрского фундамента. Составители: Т.Н. Кенгерли, Ф.А. Алиев и А.М. Алиев [*Kangarli et al., 2017a*].

1 – продольные блоки первого порядка: a – Тфанский (T), b – Кахети–Вандам–Гобустанский (KVG), c – Чатма–Аджиноурский (ChA); d – Средне-Куринский (MK); *2* – поперечные блоки первого порядка: I – Загатальский, II – Шекинский, III – Габала–Шамахинский, IV – Гобустанский; *3* – разломы на границах продольных блоков первого порядка: KZ – Кбаад–Зангинский, GA – Ганых–Айричай–Алятский; NK – Северо-Куринский; *4* – разрывы, ограничивающие продольные блоки второго порядка, в том числе: DM – Дашагыл–Мудрисинский, ShI – Шамбул–Исмаиллинский; *5* – разломы на границах поперечных блоков первого уровня: Sl – Салаватский, SA – Самур–Агдашский, PN – Пирсаат–Нефтчалинский; *6* – другие разрывы, простирающиеся в «антикавказском» направлении, в том числе: KK – Химрих–Халатаньский, BV – Буланлигчай–Верхиянский, B – Балаканский, Z – Закаталский, GS – Гохмуг–Салаханский, F – Фийский, US – Уджар–Сарыбашский, D – Дамирапаранчайский, G – Гирдиманчайский, S – Сигирлинский; *7* – зоны очагов землетрясений (M≥3), зарегистрированных в 2012–2016 гг.: a – указанные в статье: I – Балаканское, II – Загатальское, III – Шекинское, IV – Огузское, В – Габалинское, б – прочие; *8* – государственная граница.

vertical and subhorizontal contacts in the earth crust from another [*Kangarli, Veliev, 1988; Kangarli et al., 2016, 2017a; Telesca et al., 2017; Aliyev et al., 2018*]. Horizontal and vertical seismic zonality can be explainned from the viewpoint of block divisibility and tectonic stratification of the earth crust. Within the crust's structure, earthquake focuses are confined mainly to the intersection knots between differently oriented rupture dislocations, or to the planes of deep tectonic failures lateral displacements along the unstable contacts between the material complexes with different competency [*Kangarli, Veliev, 1988; Alizadeh et al., 2013; Kangarli et al., 2016, 2017a, 2017b; Aliyev et al., 2018*].

Based on the space-time focus distribution analysis of all M≥3 earthquakes recorded through a period of instrumental observations (1902–2017), we traced the seismic activity dynamics within the southern slope zone's frontiers (Fig. 12, 13) and came to the following conclusions:

1. Using the outcomes of geophysical data reinterpretation and the region's resultative tectono-magmatic scheme [*Kangarli, Akhundov, 1988; Kangarli, 2012*], following 4 blocks separated by the anti-Caucasus striking fault zones may be distinguished in the west-to-east direction, all with different characteristics of seismic activity: Zagatala, Shaki, Gabala-Shamakhy and Gobustan. First two blocks belong to the eastern, and the other two to the southeastern segments of Greater Caucasus system (see Fig. 12). The boundary between these two segments is determined by Samur-Aghdash left-lateral strike-slip fault. Herewith, the vertical seismic

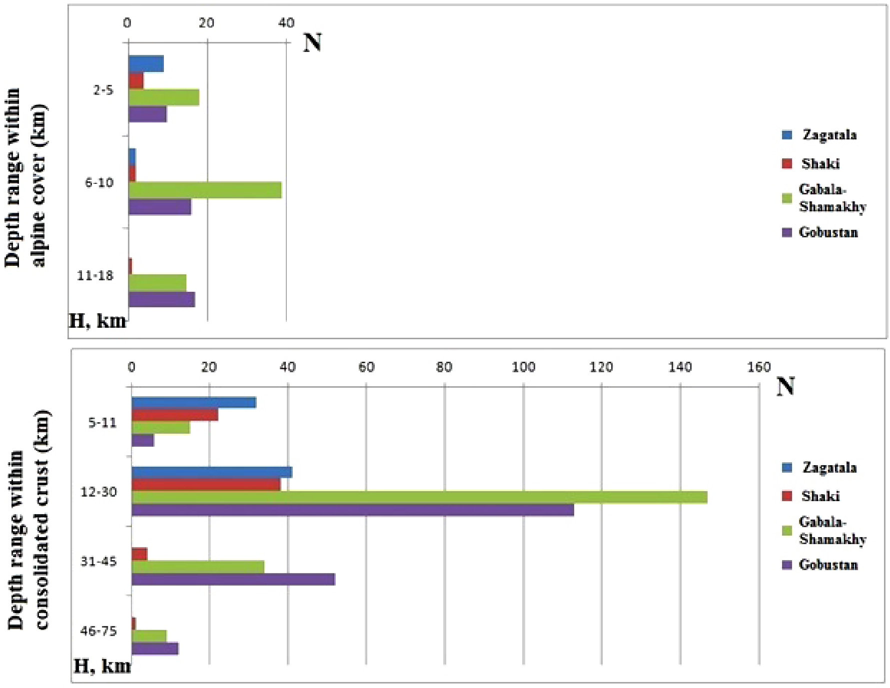

Fig. 13. Histogram of the vertical distribution pattern of earthquake foci (M≥3) in the crustal blocks of the southern slope of the Greater Caucasus within Azerbaijan (1902–2017). Compiled by F.A. Aliyev.

Рис. 13. Гистограмма вертикального распределения очагов землетрясений с M≥3 в блоках земной коры южного склона Большого Кавказа в Азербайджане (1902–2017 гг.). Составитель: Ф.А. Алиев.

focus distribution indicates a regular distribution of most earthquake hypocenters within 12–30 km depths of the pre-Jurassic basement (Fig. 13, 14).

2. First two blocks are distinguished for their lower seismic activity recorded throughout the entire period of observations (see Fig. 13):

- until 1980, 12 seismic events occurred within the Zagatala block's frontiers, confined to the consolidated crust's upper segment. Absolute majority of focuses (11) is located at depths of 12–30 km. Since 1980 until present, 66 events were recorded, with 9 events sourcing from the sedimentary cover, and 57 – from 5–30 km depths of the consolidated crust;

- 14 seismic events have occurred in Shaki block until 1980, 3 of which were confined to 3–5 km deep parts of the alpine cover, and the rest were located in the consolidated crust's upper segment (5–30 km). In 1981–2017, the number of events increased to 65, 3 of which took place in the sedimentary cover, 61 – in the consolidated crust (58 in the upper and 3 in the lower segment), and 1 – below the Moho discontinuity.

3. Gabala-Shamakhy and Gobustan blocks have been more active throughout the entire period of observations, but there were also the leaps of seismic activity recorded in last quarter of XX century:

- until 1980, the total 29 seismic events have been registered within the block's structure, including the Alpine cover (14) and the consolidated crust's upper segment (14 events at depths of 5–30 km, and 1 event below the Moho disgontinuity). In the following period, the block's seismic activity increased to 219 events, 46 of which occurred in the sedimentary cover, 171 – in the consolidated crust (141 – 5–30 km, 30 – 31–45 km), and 8 – below the Moho discontinuity;

- 23 seismic events have occurred in Gobustan block until 1980. 8 events were confined to the Alpine cover, 11 – to the upper (5–30 km), and 4 – to the lower segment (31–45 km) of the consolidated crust. During 1981–2017, the number of events increased to 196, 30 of which occurred in the sedimentary cover, 187 – in the consolidated crust (139 in the upper and 48 in the lower segment), and 9 – below the Moho discontinuity.

4. Even with allowances made to potential errors of earthquake registration technology and methods of the first half of XX century, it has to be stated that the certain rise in the area's seismic activity is generally observed since 1980 (see Fig. 14). Within the zone's eastern segment, active is the upper part of the consolidated crust. In the southeastern segment, seismic activity affects an entire earth crust and even the uppermost part of the mantle. Majority of deep seismic focuses is located in the zone of submeridional Western Caspian fault (north-west oriented right lateral dislocations in Eastern Caspian zone), to the east of which observed is a stepped dipping of the consolidated crust towards the Caspian hollow.

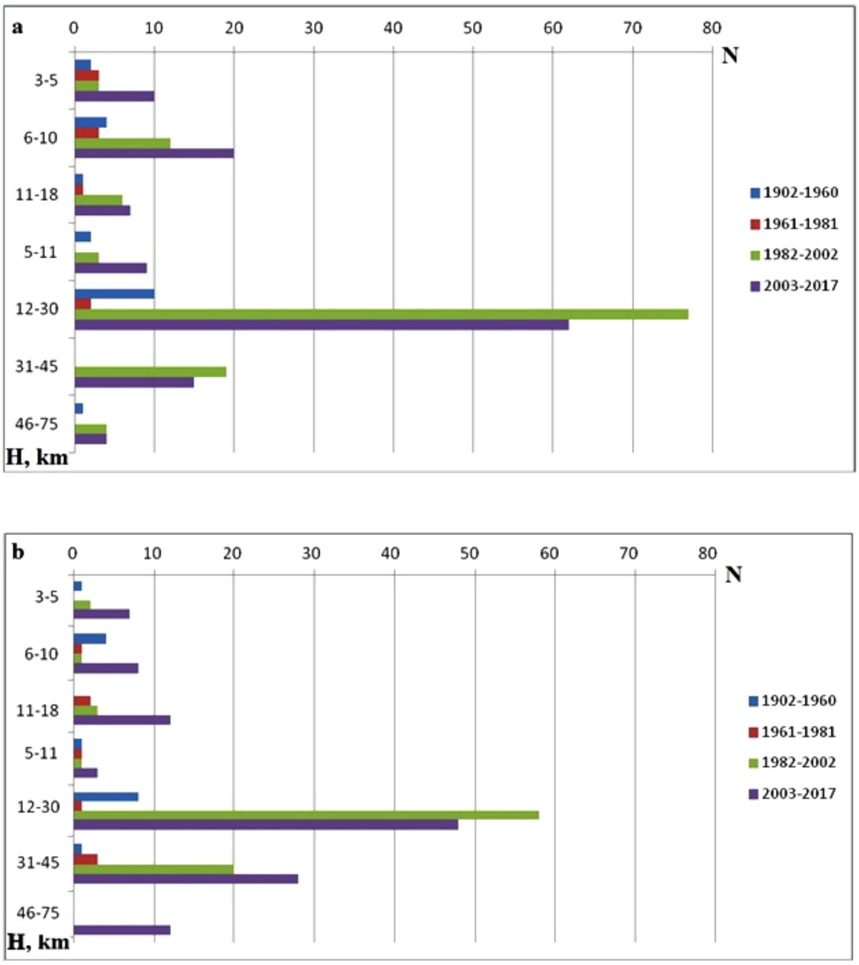

Fig. 14. Histogram showing changes in seismic activity (M≥3 earthquakes) in space (depth) and time in the Azerbaijan part of the southern slope of the Greater Caucasus for the period 1902–2017.Compiled by F.A. Aliyev.

Рис. 14. Гистограмма, показывающая пространственные (по глубине) и временные изменения сейсмической активности (землетрясения с M≥3) в Азербайджанской части южного склона Большого Кавказа за период 1902–2017 гг. Составитель: Ф.А. Алиев.

5. Observed seismic activity is generally consistent with data on lateral movement velocities produced since 1998 by GPS monitoring of the region's modern geodynamics [*Kadirov et al., 2008, 2009, 2015, 2017, 2018; Kadirov, Safarov, 2013; Telesca et al., 2017*]. By 2014, lateral movement velocities of the most monitoring stations have increased by 2–8 mm/year as compared to a baseline of 2004 (Fig. 15). Meanwhile, similar-to-seismic transverse zonality is observed in the velocity distribution: thus, the velocities average at 8–10 mm/year to the west and exceed 13 mm/year (13–29 mm/year) to the east of Samur-Aghdash dislocation.

Simultaneously, a longitudinal zonality is observed in the distribution of horizontal movement velocities, which correlates with the territory's "general-Caucasus" tectonic zonality.

Described process continues also at a contemporary stage of alpine tectogenesis, as demonstrated by real-time GPS surveying of regional geodynamics. Analysis of data on the distribution of vectors of the lateral movement velocities (produced in 1998–2014 by GPS geodesic stations in Azerbaijan and adjacent territories of Iran) indicates considerable (up to 29 mm/year) velocity of the north-northwestward movement of the southwestern and central parts of the Southern Caucasus microplate, including territory of Lesser Caucasus southeastern segment, Kur depression and Mountainous Talish. At the same time, vectors reduce to 6–13 mm/year within the microplate's northeastern flange confined to Kakheti-Vandam-Gobustan megazone of Greater Caucasus, and become as low as 0–6 mm/year (data of 2010–2014) further in the north, on a hanging wall of Kbaad-Zangi deep underthrust, i.e. directly within the accretionary prism's boundaries. In general, the belt's earth crust shortening rate is estimated as 4–10 mm/year.

The aforesaid is confirmed by the earth surface movement directions and velocities registered in Azer-

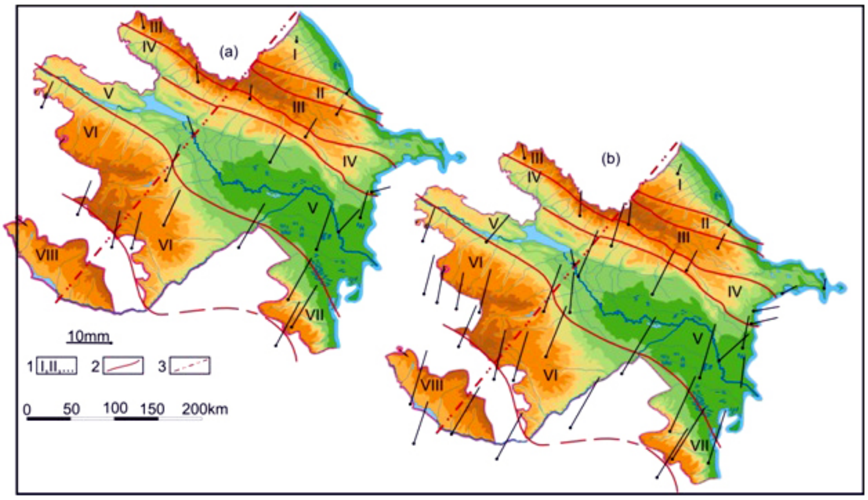

Fig. 15. GPS velocities of horizontal movements in the territory of Azerbaijan and the adjacent areas in 2004 (*a*) and 2014 (*b*). Compiled by F.A. Kadirov and R.T. Safarov.

1 – main structural zones (longitudinal tectonic blocks): I – Gusar-Shabran, II – lateral ridge of the Great Caucasus, III – the southern slope of the Greater Caucasus, IV – Kakheti-Vandam-Gobustan, V – Kura, VI – Atrvin-Garabagh, VII – Talish, VIII – Araz; *2* – deep faults at the boundaries of the structural zones; *3* – Samur fault.

Рис. 15. Скорости горизонтальных движений земной коры по GPS-данным на территории Азербайджана и прилегающих районов в 2004 г. (*a*) и 2014 г. (*b*). Составители: Ф.А. Кадыров и Р.Т. Сафаров.

1 – основные структурные зоны (продольные тектонические блоки): I – Гусар–Шабран, II – боковой хребет Большого Кавказа, III – южный склон Большого Кавказа, IV – Кахети–Вандам–Гобустан, V – Кура, VI – Атрвин–Карабах, VII – Талыш, VIII – Араз; *2* – глубокие разломы на границах структурных зон; *3* – Самурский разлом.

baijan and its' adjacent territories based on the outcomes of GPS observations implemented in 2015 (Fig. 16). Velocity field clearly demonstrates the northeastward motion of the earth surface. One feature of the velocity field is clearly demonstrated by the developed diagrams. It consists in a contrasted decrease

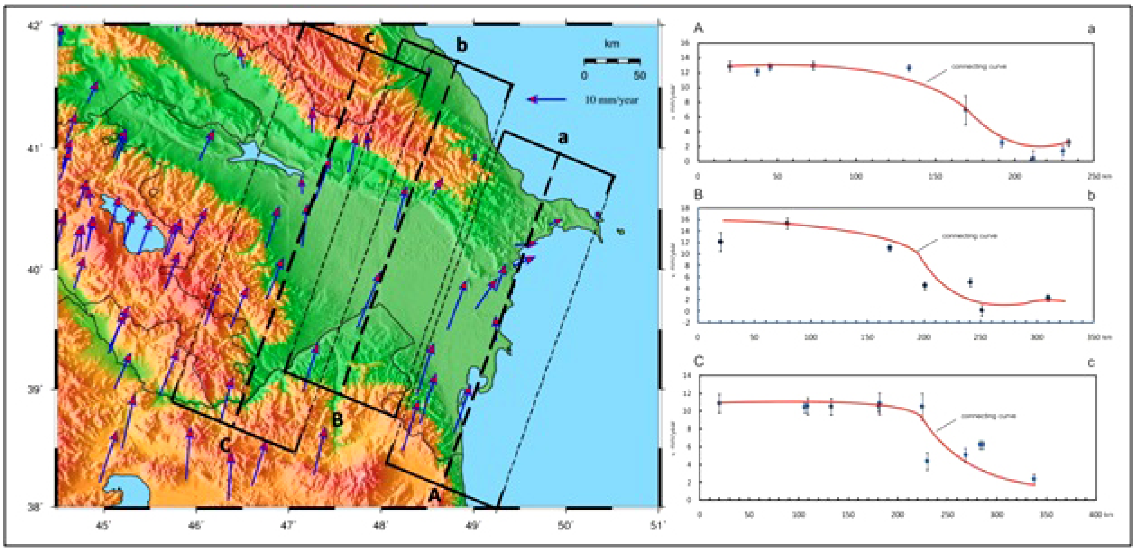

Fig. 16. GPS velocities of horizontal movements in the territory of Azerbaijan and the adjacent areas (2015), and the graphs of parallel components of GPS rates along sections A–a, B–b, and C–c. Compiled by F.A. Kadirov and R.T. Safarov [*Kadirov et al., 2015, 2017*].

Рис. 16. Скорости горизонтальных движений земной коры по GPS-данным на территории Азербайджана и прилегающих районов (2015 г.) и графики параллельных компонентов скоростей по GPS-данным по разрезам A–a, B–b и C–c. Составители: Ф.А. Кадыров и Р.Т. Сафаров [*Kadirov et al., 2015, 2017*].

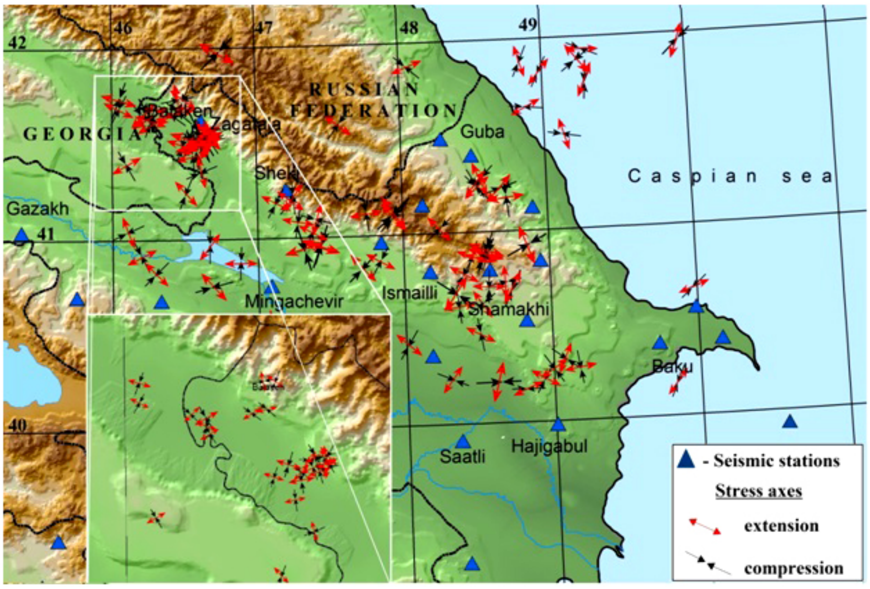

Fig. 17. Tectonic stress distribution pattern according to the mechanisms of M≥3 earthquakes recorded in 2003–2017. Compiled by G.J. Yetirmishli, and S.E. Kazimova.

Рис. 17. Схема распределения тектонических напряжений по данным о механизмах землетрясений с M≥3, зарегистрированных в 2003–2017 гг. Составители: Г.Д. Етирмишли и С.Э. Кязимова.

of velocity observed by the stations from the southern flank of Zangi overthrust, as compared to velocities of Kura and other more southern zones (see Fig. 15, 16).

This phenomenon reflects gradual accumulation of the elastic lateral compression deformations within the zone of pseudosubduction interaction between structures of the northern side of Southern Caucasus microplate (Kakheti-Vandam-Gobustan megazone) from one side and the accretionary prism of Greater Caucasus from another.

Real time effects of the tangential stresses are also indicated by focal mechanisms of M≥3 earthquakes occurred in the region for the period of 2003–2017 (Fig. 17). Distribution analysis of the compression and extension axes speaks for predominance of lateral compression oriented in submeridional and NE-SW directions.

Types of focal mechanisms of the southern slope zone of Greater Caucasus generally correspond to a notion of geodynamics of the microplates' convergent borders [*Rzayev et al., 2013; Alizadeh et al, 2013; Yetirmishli et al, 2014, 2016; Kangarli et al., 2016, 2017a, 2017b; Aliyev et al., 2018*], where the entire range of focal mechanisms, from normal-fault to thrust faulting is observed (Fig. 18).

Space-time distribution analysis of the strong earthquake focuses in the Azerbaijani part of Greater Caucasus region leads to a conclusion that at present stage of tectogenesis most seismically active are structures on the northern flank of Southern Caucasus microplate (both the structures that are buried under the accretionary prism in the north, and the structures that get revealed in a central segment or get covered by a quaternary cover on the southern part of Kakheti-Vandam-Gobustan zone), located in the following two areas:

- zone controlled by a "general-Caucasus" striking Ganikh-Ayrichay-Alat deep overthrust (corresponds to a border of Kakheti-Vandam-Gobustan and Middle Kur tectonic megazones), in the west of the Azerbaijani part of the Greater Caucasus;

- complex tectonic node located in the east of described region within the boundaries of Talish-Samur-Makhachkala submeridional seismotectonic zone: corresponding to an intersection of two faulting zones: 1) northwest striking Western Caspian zone bordered by Pirsaat and Sighirly elementary deep strike slips from the northeast and southwest), and 2) northeast striking Girdimanchay-Shamakhy zone represented by Basgal-Khashi, Aghsu-Khaltan and Jalair-Dibrar dislocations.

Under lateral compression environment, small-scale blocks that constitute the region's earth crust trigger the emergence of transpressive deformations, which combine the shear displacements along framing transverse deformations with the compression structures like "general-Caucasus" ruptures. Such regime leads to an emergence of multiple concentration areas of the elastic deformations confined to the mentioned dislocations and their articulation knots. It is just the exceeded ultimate strength of the rocks that causes an energy discharge and brittle destructions (according to stick-slip mechanism) in such tectonically weakened

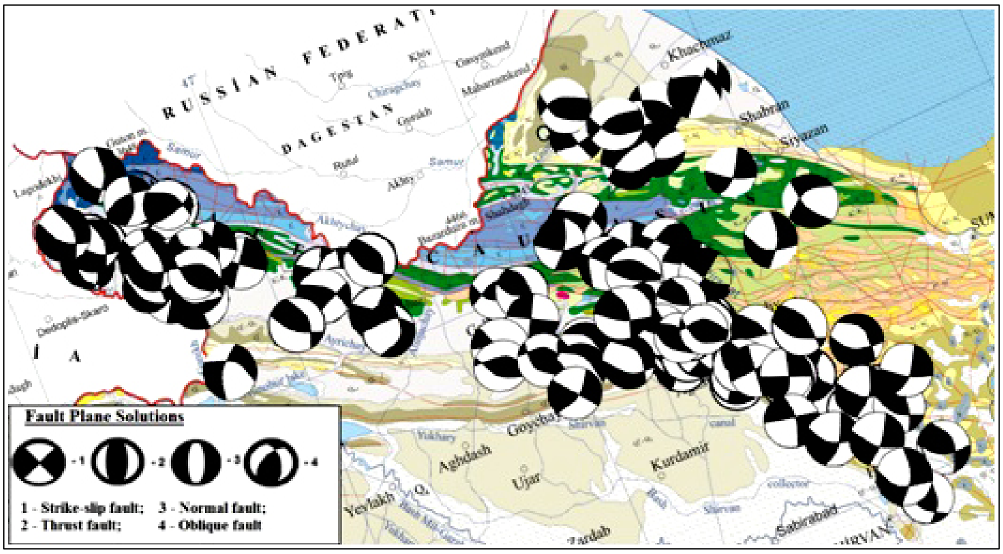

Fig. 18. Fault plane solutions of M≥3 earthquakes for the period of 2003–2017. Compiled by G.J. Yetirmishli, and S.E. Kazimova.

Рис. 18. Механизмы очагов землетрясений с М≥3 за период 2003–2017 гг. Составители: Г.Д. Етирмишли и С.Э. Кязимова.

regions of the southern slope of the Azerbaijani part of Greater Caucasus (see Fig. 12).

The aforesaid is particularly evidenced by the following seismic events that occurred in the Northwestern part of Azerbaijan during 2012–2016 (Fig. 19, 20).

Zagatala focal zone became seismically active in 2012–2014. Major seismic events occurred in May–June 2012, when three shocks were registered with M=5.27–5.69 (07.05.2012), one with M=5.02 (20.06.2012) and numerous aftershocks with M=3.0–4.4. The vast majority of hypocenters are located at the pre-Jurassic basement of the frontal part of Kakheti-Vandam-Gobustan zone within the depths of 5–20 km (Fig. 20, section I-I'). The only exception is the aftershock (M=4.4, H=5 km) occurred in an alpine cover (07.05.2012, 05 h 40.30 sec.) outside of the source zone (on the zone's southeast in Kvemo-Kedi village's (Georgia) vicinity), and confined to a plane of Ganikh-Ayrichay-Alat thrust fault that gently plunges in the northern rhumbs at its' intersection with northeast striking Zagatala transtensional fault. In general, the focal zone represents a complex disjunctive knot inside the pre-Jurassic basement's upper segment, consisting of the elementary intersections of differently striking tectonic deformations to which the earthquake hypocenters are confined (see Fig. 12, 19). Approximate volume of a rock mass to which the hypocenters of all M≥3 events are confined, reaches 3400 km^3. Seismic events were mainly related with Zagatala transverse fault's activation which have caused an intensification of connected "general-Caucasus" and "anti-Caucasus" deformations. Earthquake mechanisms can help indicate fault slip along active fault zones. An example of this would be the May 7, 2012 earthquake that had a large number of aftershocks (Fig. 21, I and II). First shock (M=5.61, H=9 km) was characterized by near-lateral (PL_P=10°) compressive and stretching (PL_T=14°) stresses. The type of movement along both steep (DP_1=87°, DP_2=72°) planes is a dextral shift. *NP1* plane has northeastern (STK_1=125°), and *NP2* plain has southwestern (STK_2=216°) strike. Comparing nodal plane strikes with fault lines demonstrates their compliance with the Shambul-Ismayilly fault (rear scale of Ganikh-Ayrichay-Alat thrust fault) of a "general-Caucasus" strike (*NP1*) and the Zagatala fault with an "anti-Caucasus" strike (*NP1*). Second shock (M=5.7, H=12 km) occurred due to an impact of near-lateral stretching stresses (PL_T=1°). Type of movement along both relatively gentle (DP_1=48°, DP_2=50°) planes is downthrow. *NP1* has southeastern (STK_1=130°), and *NP2* has northwestern (STK_2=340°) strikes. The strike of the nodal planes is correlated with that of the Shambul-Ismayilly "general-Caucasus" (*NP1*) and Bulanigchay-Verkhiyan "anti-Caucasus" (*NP2*) tectonic deformations. Data analysis allows considering the *NP1* plane as the event's major acting component. Mechanisms of the majority of aftershocks points at strike-slip movements within the focal zone's structure with subordinate amount (5 events) of upthrust displacements confined to a plane of Ganikh-Ayrichay-Alat thrust fault and its' rear scales.

Balakan focal zone was active in 2012, 2013 and 2016. Seismic events of October–November, 2012, manifested themselves through a series of earthquakes

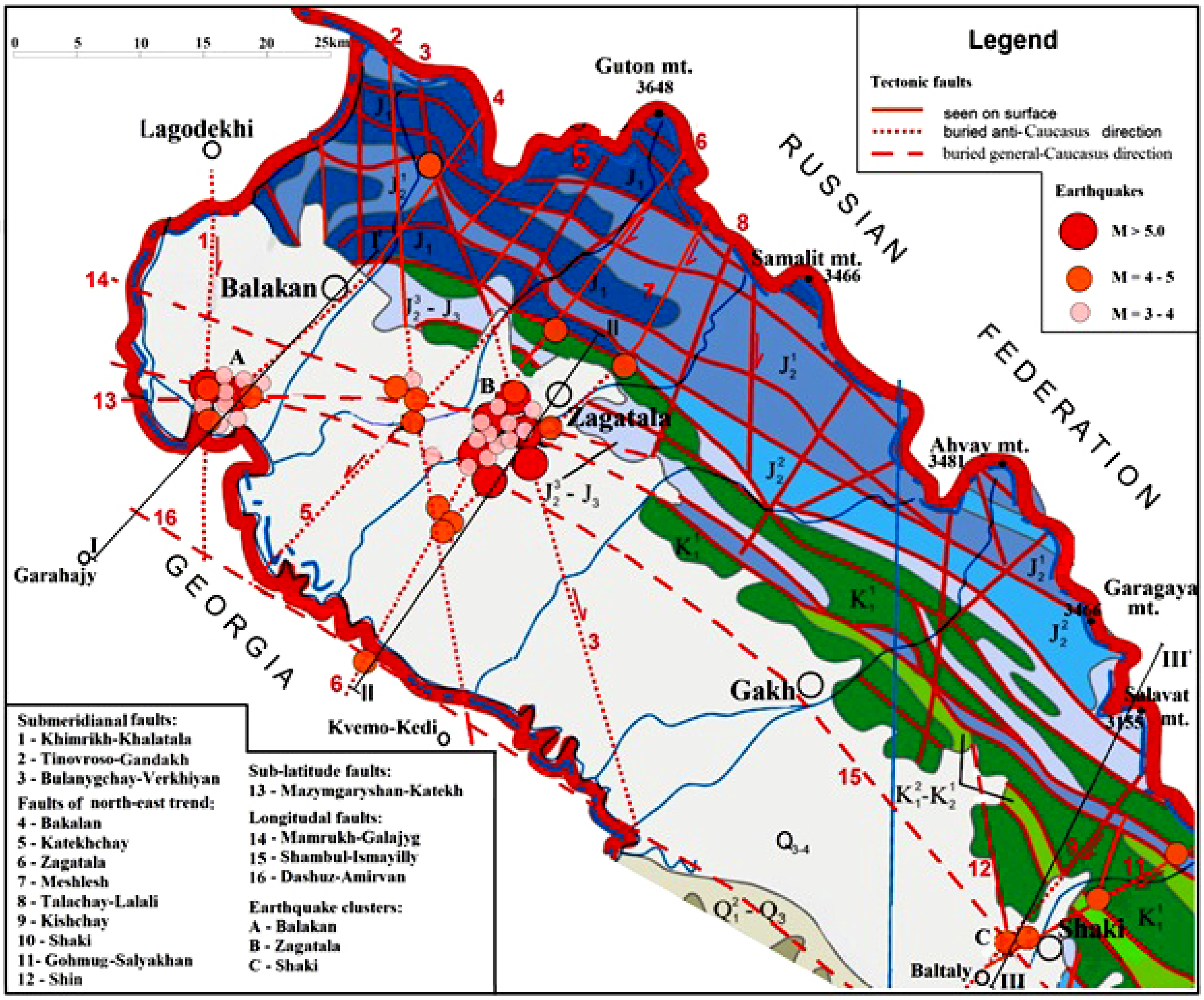

Fig. 19. The ratio of rupture dislocations and M≥3 earthquake epicenters for the period of 2012–2014. Compiled by T.N. Kangarli, F.A. Aliev, and A.M. Aliev [*Kangarli et al., 2017a, 2017b*].

Рис. 19. Соотношение между разрывными дислокациями и эпицентрами землетрясений с M≥3 за период 2012–2014 гг. Составители: Т.Н. Кенгерли, Ф.А. Алиев и А.М. Алиев [*Kangarli et al., 2017a, 2017b*].

with a maximum Mw of 5.60 (14.10.2012). Events of the following years were characterized by relatively low magnitudes of 3.1–4.4. Like in the previous case, the focal zone is confined to a complex intersection of differently striking tectonic deformations with earthquake hypocenters (depth interval of 4–13 km) is located at pre-Jurassic basement, as well confined to surface of the basement and bottom of the Alpine cover of Kakheti-Vandam-Gobustan zone (Fig. 20, section II-II'). Approximate volume of a rock mass to which the hypocenters of all M ≥ 3 events are confined, reaches 500 km^3. Seismic events are mainly related with activation of Khimrikh-Khalatala (2012) and Balakan (2013 and 2016) faults with an “anti-Caucasus” strike. Seismic energy discharge occurred in the most crumble zones which correspond to the intersections of these deformations between each other and with “general-Caucasus” faults. Earthquake mechanisms in the focal zone point at a prevalence of downthrow and fault dislocations with subordinate role of the upthrust type shifts. In particular, October 14, 2012 earthquake (see Fig. 17) with M=5.6 and H=8 km was characterized by the lateral (PL_P=0°) southwest trending stretching and the near-vertical northwest trending compressive (PL_T=48°) stresses (Fig. 21, III). Type of movement along both (DP=57°) planes is a fault. *NP1* plane has a southeastern (STK_1=115°) and *NP2* plane has a northern strike (STK_2=2°). Comparing nodal plane strikes with fault lines speaks for a compliance of *NP1* with Shambul-Ismayilly latitudinal fault, and *NP2* – with Khimrikh-Khalatala diagonal deformation.

Shaki focal zone has relatively little seismic activity (M=3.00–4.07) in 2012–2013. Earthquake hypocenters are located in the upper part of the pre-Jurassic basement of the frontal part of Kakheti-Vandam-Gobustan

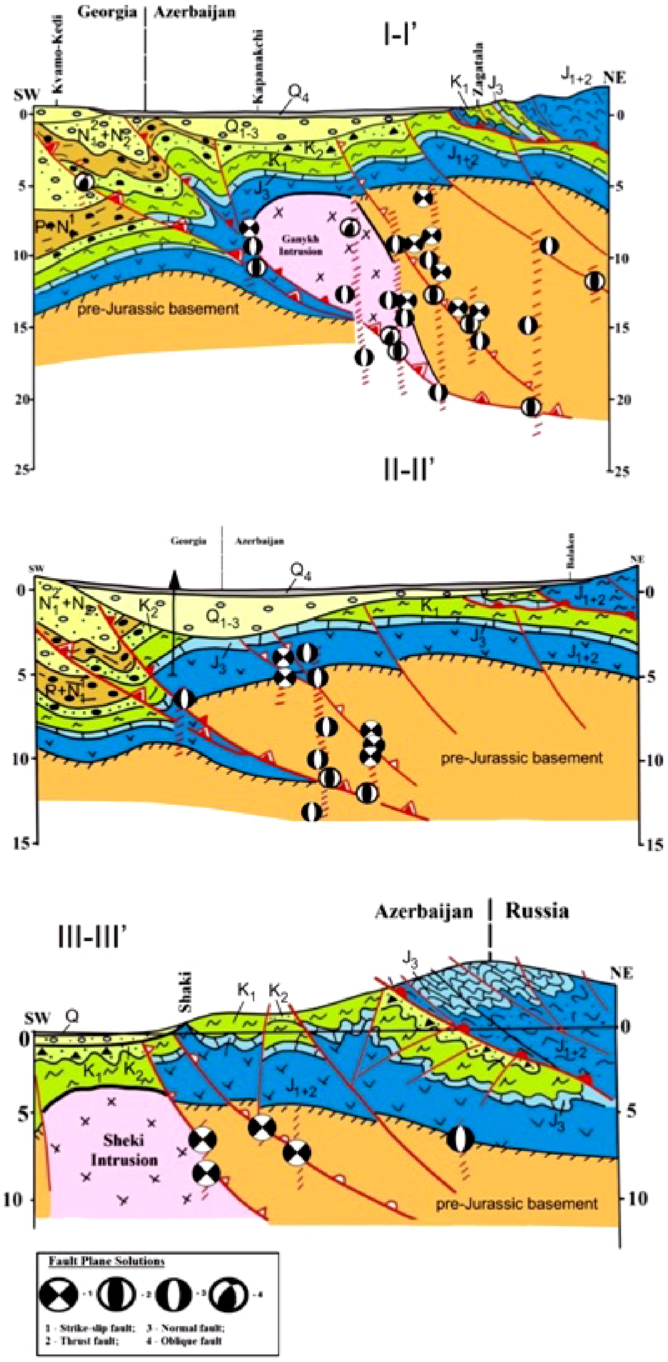

Fig. 20. Geological and geophysical sections across the Zagatala (I–I' in Fig. 19), Balakan (II–II' in Fig. 19) and Shaki (III–III' in Fig. 19) focal zones of earthquakes. Compiled by T.N. Kangarli, F.A. Aliyev and A.M. Aliyev [*Kangarli et al., 2017a*]. Faults: *1* – Ganikh-Ayrichay-Alat; *2* – Zangi; *3* – Shambul-Ismayilly; *4* – Dashaghil-Mudrisa; *5* – other longitudinal fractures; *6* – ruptures of the "anti-Caucasus" direction.

Рис. 20. Геологические и геофизические разрезы через Загатальскую (I–I' на рис. 19), Балаканскую (II–II' на рис. 19) и Шекинскую (III–III' на рис. 19) зоны очагов землетрясений. Составители: Т.Н. Кенгерли, Ф.А. Алиев и А.М. Алиев [*Kangarli et al., 2017a*]. Разломы: *1* – Ганих–Айричай–Алатский; *2* – Зангийский; *3* – Шамбул–Исмаиллийский; *4* – Дашагил–Мудрисинский; *5* – другие продольные разломы; *6* – разрывы, простирающиеся в «анти-каказском» направлении.

zone within the depth interval of 5–9 km (see Fig. 20, section III-III'). The focal zone is confined to Gokhmug-Salyakhan northeast striking transverse deformation. Seismic energy discharge occurred alternately in the latter's intersection northwest striking rupture dislocations. Earthquake mechanisms of the studied period point at a prevalence of faulting dislocations. Example to this would be the May 14, 2012 earthquake (M=4.1, H=6) which was characterized by sublateral stretching (PL_P=7°) stresses with southeastern orientation, as well as compressive (PL_T=14°) stresses with southwestern orientation (Fig. 21, IV). Movement type along both steep (*DP*=85–74°) planes is a fault. *NP1* plane has northwestern (STK_1=342°), and *NP2* has northeastern (STK_2=251°) strike. Comparing nodal plane strikes with fault lines (mapped through geology-geophysical methods) speaks for their compliance with Shin (*NP1*) and Gokhmug-Salyakhan (*NP2*) "anti-Caucasus" rupture dislocations. As indicated by the analysis and comparison of the geology-geophysical material, described seismic event is confined to a complex triple intersection of the "general-Caucasus" Shambul-Ismayilly and the "anti-Caucasus" Shin and Gokhmug-Salyakhan ruptures along the tectonically complicated exocontact of Shaki intrusive massif.

Ismayilly focal zone was active in October–November 2012. The event's main shock magnitude equaled 5.27 (07.10.2012) whereas the following shocks had

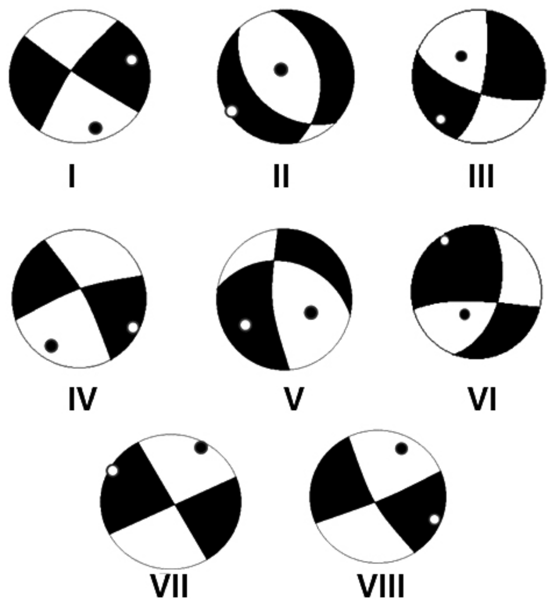

Fig. 21. Focal mechanisms of Zagatala (I, II), Balakan (III), Shaki (IV), Ismayilli (V), Gabala (VI) and Oghuz (VII, VIII) earthquakes. Compiled by S.E. Kazimova.

Рис. 21. Фокальные механизмы Загатальского (I, II), Балаканского (III), Шекинского (IV), Исмаиллинского (V), Габалинского (VI), и Огузского (VII, VIII) землетрясений. Составитель: С.Э. Кязимова.

the magnitudes of 3.0–3.5 (02–12.11.2012). The zone is confined to a complex intersection knot between Sighirly northwest and Girdimanchay northeast striking cross faults from one side and Ganikh-Ayrichay-Alat deformation from another. The zone's earthquake mechanisms confirm strike-slip and slip component of movements along Sighirly fault. They also characterize its' high seismic activity and deep reach. Source mechanism of the Ismayilly earthquake (M=5.27, H=41 km) was characterized by near-lateral stretching stresses (PL_T=21°) with southwestern and near-vertical compressive (PL_P=46°) stresses with southeastern orientation (Fig. 21, V). Movement type along both (*DP*=75–40º) planes is a downthrow with faulting elements. *NP1* has south-southeastern (STK_1=172°), and *NP2* has west-northwestern (STK_2=280°) strike. Comparing nodal plane strike with fault lines speaks for their conformity with Sighirly (*NP1*) and Ganikh-Ayrichay-Alat (*NP2*) deep rupture dislocations.

Gabala focal zone became active in September – beginning of October, 2014. The event consisted of two sensible shocks with M=5.0–5.5 followed by several weak aftershocks. The focus zone is controlled by Damiraparanchay northeast striking dextral slip that complicates a line of an underthrust conjunction between the Kakheti-Vandam-Gobustan zone and the accretionary prism of Greater Caucasus. The focal zone is characterized mainly by shear displacements along the rupture's plane, as exampled by 29.09.2014 earthquake (M=5.5) which occurred at a depth of 13 km within the Kakheti-Vandam-Gobustan zone's pre-Jurassic basement. Mainly near-vertical (PL_P=48°) compressive stresses prevailed in the seismic focus, oriented in sublatitudinal and submeridional directions (Fig. 21, VI). Type of movement along both steep (DP_1=64°, DP_2=53°) planes is a fault. Sublatitudinal (STK_1=265°) *NP1* plain is associated with Dashaghyl-Mudrisa upthrow-thrust fault with the "general-Caucasus" strike. *NP2* plane has the northeastern strike (STK_2=17°) and directly corresponds to the Damiraparanchay deformation.

Oghuz focal zone was active through two moderate earthquakes in September (M=5.9) and October (M=4.0), 2015. It is confined to a complex intersection between Fiy northeast and Ujar-Saribash northwest striking cross faults from one side and Ganikh-Ayrichay-Alat "general-Caucasus" deformation on the southern border of Kakheti-Vandam-Gobustan zone from another. September 4 and 13 earthquakes were impacted by the almost equivalent stretching and compressive stresses occurred at a depth of 16 km in the upper part of pre-Jurassic basement (Fig. 21, VII and VIII). Compressive stresses were near-lateral (PL_P= =0–7°) with northeastern orientation, whereas the horizontal stretching efforts (PL_T=0–2°) had west-northwestern trend. Type of movement along both subvertical displacement planes (DP_1=86–90°, DP_2=83–90°) is a fault with left-hand horizontal component. First nodal plane of *NP1* strikes southeastwards (STK_1=153°) and dips towards the southwest. *NP2* has the northeastern orientation (STK_2=33°) and dips towards the southeast. Comparing nodal plane strikes with the region's rupture tectonics speaks for their conformity with Ujar-Saribash (*NP1*) and Fiy (*NP2*) "anti-Caucasus" rupture dislocations.

Other seismic events of the described period were characterized by weak magnitudes of less than 4.5. Their focuses were mainly grouped in the upper part and surface of pre-Jurassic basement, and subordinately within the Alpine cover's structure.

4. Conclusions

In our study, we correlated the space-time swarm sequence of the different-magnitude seismic events in each seismofocal zone of the Northwestern Azerbaijan. The correlation results bring us to the following conclusions:

- The spatial distribution of the epicenters demonstrates that most seismic events are confined to transverse (northwest, northeast and submeridional striking) disjunctive dislocations. However, the epicentral zones generally have the 'general- Caucasus' strike along and to the north of Ganikh-Ayrichay-Alat deep upthrust. Both transverse and longitudinal dislocations were mapped by the complex of seismic and electrical survey methods as the natural southern extension of the faulting and strike-slip disjunctive zones. The latter outcrop in the mountainous area where complexes of the accretionary zone and its parautochthone bedding come to the ground surface.

- The complication of these complexes by the mentioned anti-Caucasus dislocations speaks for quite a young age of the latter, suggesting that they formed or were activated minimum during the post-Rodanian stage of tectogenesis, which is one of the factors to determine today's activity of these dislocations.

- In separate groups, the focal mechanisms reveal different, mainly subvertical, planes of normal, strike-slip and diagonal-slip movements in the earthquake foci. Only in four cases strictly upthrust and upthrust-thrust movements were established.

- The major hypocenters (M=4.5–5.7) as well as the absolute majority of the aftershocks are confined to the surface or up to 20 km deep parts of the pre-Jurassic basement;

- A considerable part of the swarm sequence's hypocenters is confined to the sloping band that plunges in the northern rhumbs and gets identified with the zone of Ganikh- Ayrichay-Alat deep thrust fault and its rear slices (Shambul-Ismayilly etc.).

- The increased seismic activity in the described period (until 2017) is explained by the accumulation of lateral compression stresses and their further release in the underthrust of the Middle Kura depression and the Vandam tectonic zones along the Ganikh-Ayrichay-Alat thrust fault.

- The lateral compression first contributed to the emergence of transpressional shears along the displacement planes of different-strike transverse faults, and to the energy discharge in the most broken and weakened zones that correspond to the intersection nodes between these dislocations and those between the above-mentioned overthrust and the rear slices of its northern branch.

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