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Detailed study of geology of the lower parts of Pliocene in Kurovdagh area by use of 3D seismic survey

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The article is devoted to the study of the geological structure of the lower parts of the Productive Series of the Lower Pliocene of the Kurovdagh field.

It consists of an introduction, problem statement, research questions, research methodology, results, conclusion and list of references. The introduction provides basic information about the field under study, its geographical location, the history of geological and geophysical studies, the lithology of the section, the structure of the Kyurovdag fold and the oil and gas potential of the field.

Oil and gas presence inthefield is related to the Absheron stage of Pleistocene, Akchagyl stage and Productive Series (horizons PS01—PS23) of Neogene. Despite the long-term production from the field, the lower parts of the Productive Series and underlying sediments have not been recovered and sufficiently studied by deep drilling due to the complicated surface and deepseismo-geological environment. It has been recommended to carry out a 3D seismic survey due to a high level of lateral one-fold reflections on seismic records.

The major goals of the 3D seismic survey were studyingthe Kurovdagh field's geologic setting, obtaining characteristics previously unknown to geoscientists, and providing detailed research on velocity section to derive prognostic time-depth dependence.

It was noted that thePetroalliance Services Company Limited geophysical company has performed a field seismic survey on request «The Caspian Energy Group» company. Processing of the acquired data used the FOCUS 5.4 software package manufactured by Paradigm Geophysical.

For repeated interpretation of 3D seismic survey data, the 3D CDP data acquired from the field were used. The kinematic analysis by use of the 3 D cubes revealed the difference by the time shift, frequency spectrum, and amplitude range. The 3 D cubes were brought to a single formby time, phase, and amplitude. The further kinematic interpretation displayed the good quality of the data acquired from Kurovdagh area. The study applied PANGEYA® software for a multi-attribute geological and geophysical data analysis and the standard interpretation.

For volumetric modeling of the productive layers of the Kurovdagh oil field, we used the PETREL.10.2 software package. The study targets included complex, lithologically, and tectonically sealed deposits of Productive Series PS01—PS09 and Akchagyl stage (AKCH). Productive layers are attributed to Neogene's Pliocene stage within the Caspian basin's limits.

It is represented by a thick series of continental, coastal, and marine sediments (sand, clay, coarsely fragmented depositions) of 1600 m thickness and is unconformity laying over the Pontian stage and covered by the Akchagyl layers in a transgressive form. The Akchagyl stage is one of the stages of the Upper Pliocene which is made of clay, limestone, marl, sandstone, sand, and conglomerates.

It became clear that the Kurovdagh field is characterized by a block type structure

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across the geological section. Block sizes are almost unchanged, evidencing conformance of structural stages and heritance of tectonic movements. Mud volcano and diapiric folding and their sizes are the major distinguishing features of the area.

Key words: 3D seismic survey, surface and deep seismic and geological features, processing, reinterpretation, productive series, mud volcano, diapiric folding.

Introduction. The Kurovdagh field is located in the north-western part of the south-eastern Shirvani area of Azerbaijan 120 km south-west of Baku, near the city of Shirvan [Alizade et al., 1966, 2018a,b]. The field is within the limits of Kur-South-Caspian oil and gas province, in Prikurinsk area (Fig. 1).

The field is located on the left bank of the Kur river and is elongated from the north-west to the south-east. A mud volcano ridge

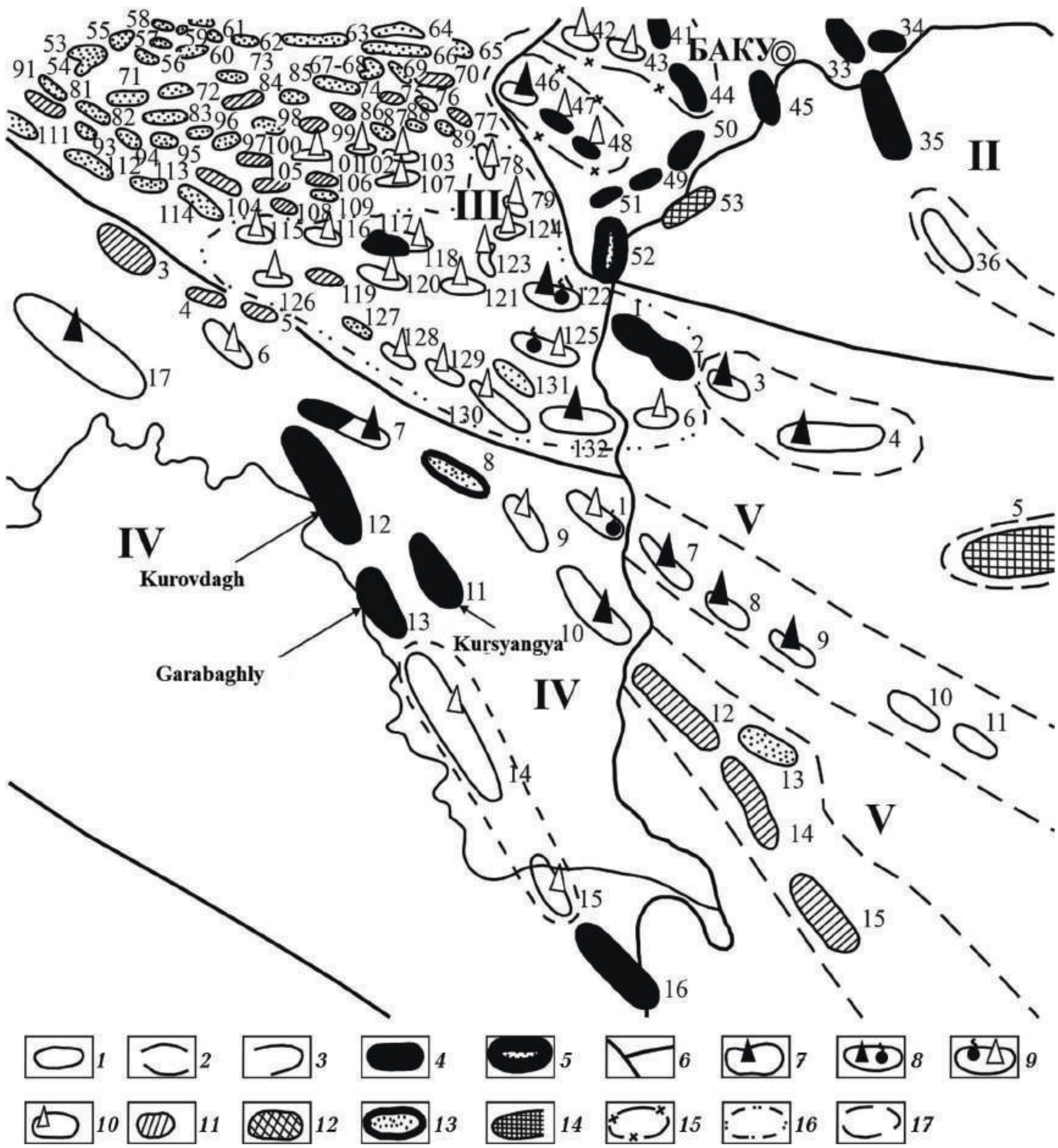

Fig. 1 The map of oil bearing and perspective areas of Azerbaijan (the map fragment) [Akhmedov et al., 2021]: *1* — anticline; *2* — monocline; *3* — structural terraces and structural capes; *4* — oil fields under development; *5* — gas condensate and oil fields currently under development; *6* — boundaries of oil and gas provinces; *7* — structures under exploration drilling; *8* — structures currently under exploration drilling with commercial oil and gas flows;

is located in this area, elongated parallel to the river channel from Hajigabul lake to the south. The ridge is in the form of aplateau complicated by a small ledge of well-cemented limestone-sandy rocks of Absheron and Baku age. The central part of the ledge is complicated by several mud volcanoes evolving gas. The highest point of the Kurovdagh ridgeis the top of Pirgarin mountain (+152 m) in the north and Geok-tepe (+137 m) in the central part of the uplift. The ridge slopes are complicated by eroded zones of various extensions (ravines), generated by rapid rain streams.

Geological and geophysical studies in the area were started before the establishment of the Soviet era. Studies in the area were done in 1929—1935 by V.A. Sulin, M.M. Voronin, etc.

In 1936, a magnetic survey was conducted by M.A. Berezov. It proved the presence of longitudinal faults. Some seismic lines were worked out by reflected waves techniques in 1946—1948. 5 profiles of 30 linear km length wereworked out in 1948. In 1956, a seismic survey by use of reflected waves techniques and refracted waves techniques in amount of 80 linear km allowed to study in more detail the system of longitudinal faults.

More detailed knowledge on the setting of the field was gleaned from the data acquired in 1938 by structural wells drilled down to 200—300 mand in 1941 by drilling of deep exploration wells and further geophysical services.

Seismic survey was donein 1947—1948, while in 1954, the structural drilling was renewed. Deep drilling was started in 1955.

In 1958, seismic survey by reflected and refracted waves techniques were carried outmainly in the north-west pericline of the area. In 1962, the whole area was covered by a gravity survey (1.0 mlG), and in 1976, by a more detailed gravity survey (0.5 mlG). Three lines in the north-eastern subsided part of Kurovdagh area were studied by the CDP (common depth point) technique. In 1984—

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9 — structures, where exploration drilling is completed and commercial oil and gas flows were received; *10* — structures covered by exploration drilling; *11* — structures covered by structural exploration drilling; *12* — structures, covered by the geological survey and mapping drilling from the vessel; *13* — structures, outlined by geophysical survey; *14* — structures and zones with oil and gas presence related to Mesozoic; *15* — structures and zones with oil and gas presence related to Oligocene-Miocene; *16* — structures and zones with oil and gas presence related to Pliocene [Akhmedov et al., 2021]; *17* — structures and zones with oil and gas presence related to Pleistocene.

II — Absheron region: 33 — Garachukhur-Zykh, 34 — Hovsan, 35 — Gumadasyi, 36 — Makarenko bank, 42 — Garaeyhbat (Damlamadja), 43 — Gobi-Shabandagh, 44 — Atashgyah (Shubany), 45 — Bibieyhbat-Ilyich bukhtasi, 46 — Shorbulag, 47 — Sarynja-Gulbakht, 48 — Shongar, 49 — Puta, 50 — Lokbatan, 51 — Kergez-Gyzyltepe, 52 — Garadagh, 53 — Lokbatan-deniz.

III — Shamakhy-Gobustan area: 53 — Leninabad, 54 — Mirzangal, 55 — Teklya, 56 — Jagirli, 57 — Galijan, 58 — Janub Akhudagh, 59 — Janub Shimshadi, 60 — Maraza, 61 — Gurbanchi (Arabshahverdi), 62 — Syghyrkechmeg, 63 — Jengi, 64 — Dostibozy, 65 — Gultamin (Babajan), 66 — JanubJengi, 67, 68 — JanubSungur-Kuturtash, 69 — Alakishlag, 70 — Buransyz-Boyanata, 71 —Khydyrly, 72 — Kazeydagh, 73 — Gaibler-Shaibler, 74 — Baygyshty, 75 — Kalajalyar, 76 —Kirdagh, 77 — Kirkishlak, 78 — Shykhygaya, 79 — Anart, 81 — Chyrakhly, 82 — Ajidere, 83 —Ukakhana, 84 — Shykhzagyrli, 85 — Burgut, 86 — Donguzdyk, 87 — Garghabazar, 88 — Kaftaran, 89 — Aghzykyr, 91 — Matrasa, 93 — Garamanly, 94 — Paladli, 95 — Yavandagh, 96 — Shorsuli, 97 —Gijaki, 98 — Juan, 99 — Sheytanud, 100 — Gijakiakhtarma, 101 — Nardaranakhtarma, 102 — Suleyman, 103 — Cheilakhtarma, 104 — Qarbi Sundi, 105 — Sherqi Sundi, 106 — Kurdamich (Neftik), 107 — Cheildagh, 108 — Ilkhichi, 109 — Zagyrdagh, 111 — Gegler, 112 — Gushchi, 113 — Girda, 114 — Gungermez (uduli), 115 — Qarbi Ajiveli, 116 — Ajiveli, 117 — Umbaky, 118 — Rahim, 119 — Shokikhan, 120 — Azaniklych, 121 — Touraghay, 122 — Kyanizdagh, 123 — Utalghy, 124 — Miajik, 125 — Dyvanny-Kichik Kyanizdagh, 126 — Dashmardan, 127 — Baridash, 128 — Salakhay, 129 — Ayrantekyan, 130 — Kotudagh, 131 — Gyrdagh (Geyerchin), 132 — Dashgyl.

IV — Prikurinsk area: 1 — Pirsaat, 3 — Kalamaddin, 4 — BoyukHarami, 5 — Gyrlykh, 6 — Kichik Harami, 7 — Mishovdagh, 8 — Qalmaz, 9 — Khydyrly, 10 — Byandovan, 11 — Kursyangya, 12 — Kurovdagh, 13 — Garabaghly, 14 — Babazanan-Durovdagh, 15 — Khylly, 16 — Neftchala, 17 — Padar.

V — Baky archipelago: 1 — Sangachal-deniz, 2 — Dyvanniyi, 3 — i. Bulla, 4 — Bulla-deniz, 5 — Andreyeva bank, 6 — Alyat-deniz, 7 — Hamamdagh-deniz, 8 — Svinoy-deniz, 9 — Persianin bank, 10 — Kamen Ignatiya, 11 — Kornilov-Pavlov bank, 12 — Byandovan-deniz, 13 — Kumani bank, 14 — PogorelayaPlita bank, 15 — Golovachev bank, 16 — Karagedova bank [Akhmedov et al., 2021].

1987, in the north-eastern part of the area the seismic lines worked out by the CDP method allowed to outline the elements of conjugation of Kurovdagh and Mishovdagh areas. It became clear that these areas are separated by a relatively small syncline.

Vertical Seismic Profiling (VSP) in this area for the first time was applied in 2002 in four wells (408, 598, 920, and 1022) by the Petro Alliance company. Geological section was studied inclusively down to PS07 horizon of Productive Series.

A 3D CDP seismic survey within the limits of Kurovdagh field was held in 2002—2003. In 2021, the 3D seismic data acquired from the field were used for reinterpretation.

Modern and ancient Caspian sediments are outcropped at the surface, while in the relatively uplifted parts the outcropped sediments include the Absheron stage. Sediments of the Akchagyl stage and Productive Series were recovered by deep wells only. Field structure is made of sediments of the Productive Series, Akchagyl and Absheron stages, and Quaternary age.

Modern and ancient Caspian sediments are represented by continental and marine formations. Continental sediments consist of alluvial, proluvial, deltaic, and eolian sediments. Alluvial sediments are allocated in the valley of the Kur river and are made of sludgy formations covering terraces of the ancient Caspian sea [Abdullayev, 2012].

Mud volcanic breccia is widely developed on the uplifted portions of the area. Pirgarin and Geok-Tepe mountains, the top parts of ravines are madeof mud volcano breccia. It is displayed as grey-brown clay mass with impregnations of ancient Caspian, Absheron, and Baku age fragments. The thickness of these deposits is up to 500—600 m.

Baku-age rocks are outcropped on the surface in the central and south-western part of the Kurovdagh fold. The upper part of the stage is made up of grey-brown clay replaced by the grey clay with thin interlayers of grey clay sands. The Baku stage section as a whole is observed in the north-western pericline of the area. The average thickness of this stage in this area is 119 km.

Absheron-age sediments are displayed on the surface in the central and the south-eastern parts of the fold. In general,the thickness increases from the center to the pericline and from the arc part to the flanks. The thickness in the north-western pericline is 2017 m, in the central portion is 426 m, in the south-eastern pericline is 1850 m. The Absheron stage is divided into the upper, middle and lower substages.

The section of Akchagyl stage is represented by clay varying from dark-grey to black with thin sand interlayers. According to the well logging data, this stage is buried at the depths from –900 m to –3242 m (Well 449). The thickness of the stage is 41—261 m. Due to the upper and middle part of the section, the increase of thickness is observed from the arc to the flanks of the fold.

The Productive Series (thickness of the recovered part is up to 3000 m) is represented by alternating sandy-aleurite and clay rocks. The maximal thickness of the Productive Series recovered by a deep-exploration Well425 is 3354 m ofthe 5190 m total depth of the well. In other wells, the recovered part of Productive Series is significantly lower and constitutes 700—800 m in average [Akhmedov et al., 2021].

The Kurovdagh fold has an asymmetric structure: the steep slope (45—50°) is the south-western flank and gently sloping (20—25°). A system of longitudinal, cross, and radial fractures complicates the structure of the fold and divides the fold into several tectonic blocks in the south-west and north-east flanks (Fig. 2). The largest of them is a longitudinal fracture with a 100—120 m amplitude of displacement and crossing the near-arc portion through the entire extension of the fold. 3D seismic data analysis displayed that longitudinal faults were formed in a shape of a fan starting from the main axial fault and rooted under the Productive Series [Abdullayev et al., 2012]. An exception is faults formed at the boundaries of large structural elements — synclines between large anticlinal zones.

The oil and gas presence in Kurovdagh field was identified by natural oil and gas shows prior to drillingin this area. Mud springs and mud salsas are observed on the top of the Kurovdagh mountain. All of them produce water, oil and gas. Oil and gas shows in the process of structural and mapping drilling were observed in 1913 and 1938 and at exploration drilling in 1941 and 1954—1955. Commercial oil and gas accumulations were identified by deep exploration drilling. In 1955, during the testing of Well 2 located in the south-west of the field,the oil was received from the sandy series of PS01 horizon with an initial average daily oil output of 31 tons. Further drilling in the Kurovdagh area revealed wider boundaries of oil and gas presence in horizon PS01 and identified oil and gas presence in deeper horizons of the Productive Series and the overlying Akchagyl and Absheron horizons. To date, the commercial oil and gas reserves are identified in the middle and low substages of the Absheron stage, in the Akchagyl stage, and the horizons PS01, PS02, PS03, PS04, PS05, PS06, PS07, PS08, PS09, PS10, and PS12 of the Productive Series. Statistics displays that in addition to the above indicated horizons, oil and gas flows were received from the underlying horizons PS13, PS14, PS16, PS17, and PS19 of the Productive Series.

Problem statement. Hydrocarbon accumulations intheKurovdagh field are attributed to the Absheron stage of Pleistocene, Akchagyl stage, and Productive Series (horizons PS01—PS23) of Neogene. Lithology is represented by sandy-clay rocks with various degree of limestone presence [Mammadov, 2008; Kocharli, 2015]. According to the well data, 23 productive horizons were outlined in the Productive Series. The most interesting of them from the point of view of oil and gas presence are the upper twelve. Before, the indexation of horizons was done in the upward direction by use of Roman numbers — I—XXIII or indexes ПТ1—ПТ23. At present, with the involvement of foreign companies, productive horizons have been given the indices PS01—PS23 (PS — Productive Series).

At present, this oil field is under intensive development. The main volume of oil produced so far belongs tothe productive layers of the Lower Pliocene. However, currently the geoscientists of our country are interested in the oil and gas in deeper horizons of PS in Kurovdagh field.

Research questions. It was suggested to conduct a 3D seismic survey related to a higher level of one-fold reflections on seismic records. The main tasks of these 3D seismic surveys [Cordsen et al., 2000; Dean, 2016] include studying the geology of Kurovdagh field, identifying the features previously unknown to geoscientists, and analyzing in more detail the velocity section to design a

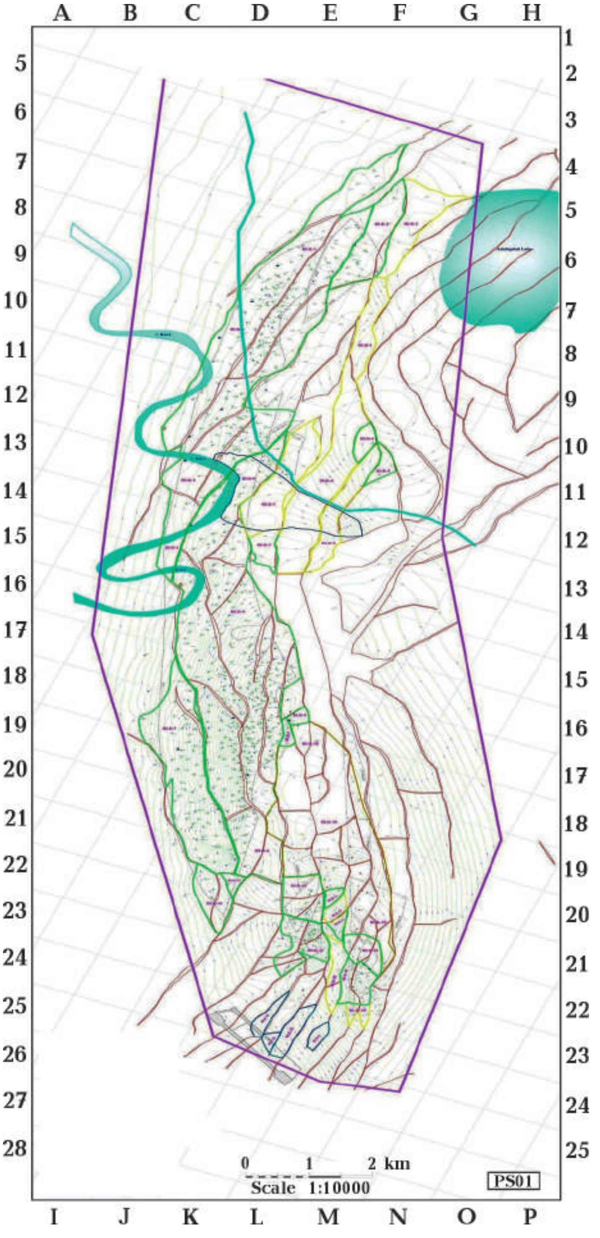

Fig. 2. Block structure of Kurovdagh field.

prognostic time-depth dependence for further use. As a result of these studies, some characteristics of the geological section have been made clear and we consider them in this paper.

The seismic survey was carried out by Petroalliance Services Company Limited for the Caspian Energy Group. The 3D seismic survey covered an area of 265 km^2. In general, the works were done according to the technical task for 3D seismic survey [Cordsen et al., 2000; Dean, 2016]. Thestudy area ismainly within the territory of Shirvan city of the Republic of Azerbaijan (Fig. 3).

Processing 3D seismic data acquired in 2006 in the Kurovdagh area was aimed at the acquisition of time sections to perform structural tasks [Yusubov, Yusubov, 2005]. Processing was done using FOCUS 5.4 software by Paradigm geophysical. The processing graph was constructed considering the geological problems addressed in these studies and tak-

Fig. 3. Position of the seismic survey contour on topographic base.

ing into account the previous experiences and quality of field data.

Methodology. For reinterpretation, 3D CDP data for the Kurovdagh field were obtained. Kinematic analysis done by use of the cubes [Ovcharenko et al., 2002] identified the difference by time shift, frequency spectrum and amplitude range (Fig. 4).

The cubes were brought to the same type by time, phase, and amplitude. Further kinematic interpretation displayed the acquisition of high-quality data for the Kurovdagh field. The studies applied PANGEYA® software for a multi-attribute geological and geophysical data analysis and standard interpretation [Pavlova, 2019]. Wave section is strongly differentiated; frequency spectrum in general is exceptionally high for the section. However, the detailed analysis made it clear that the range of amplitudes and spectrum was overestimated in the upper part of the section, while in the target interval extremely low frequencies and amplitudes were observed (Fig. 5).

The wave field of the area (Fig. 6) is complex in the arc and crest parts of the fold, due tothe peculiarities of the geology of the study area [Yusubov, 2012]. The major complicating feature consists in the presence of fractures of various range, mud volcanoes and diapir, causing lower level of the useful signal, while it is almost impossible to interpret the wave field in some places [Yusubov, Kuliev, 2011]. The regularity of reflections in the flanks of the area is increasing and the quality of acquired data is rising. The presence of faults and fault zones, steep dips of the structures lead to the generation of a large number of interfered, diffracted, many-fold and lateral waves which significantly complicates the interpretation [Akhmedov et al., 2013; Akhmedov, Niyazov, 2021].

It must be noted that the wave field of target reflections was also complicated by applied migration of time section. Application of migration under this geological situation is definitely required, as only the migration procedure allows to establish the true spatial location of reflection boundaries. However, migration regards all seismic reflections in the wave field asone-fold reflection, smooths down, and spreads noise over the entire seismic record, and its precision deteriorates.

The applied ARU procedure with a long window and trace-leveling of amplitudes also causes deterioration of the dynamic range in the target interval. Wave field is characterized by extremely low resolution, low amplitudes, and almost total absence of reflections and strong interference in some places.

Study results. At first, as per common procedure, we didthe stratigraphic breakdown of the target seismic horizons; for this weused breakdowns for most of the wells in the study area and VSP data from four wells: 1022, 408, 920, and 598. As there were practically no data of Sonic Log available for the Kurovdagh field and no possibility to calculate synthetic SL

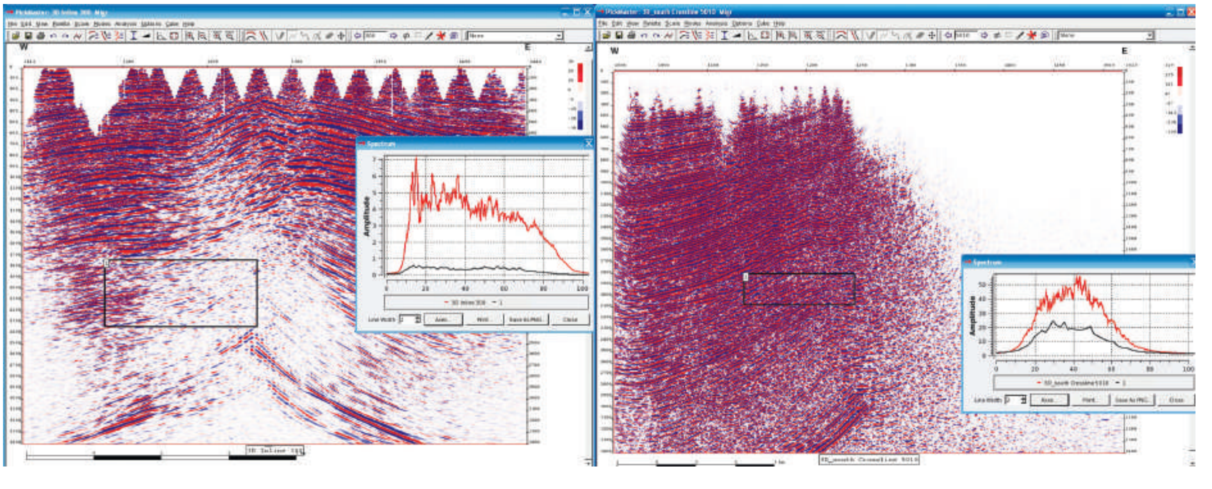

Fig. 4. 3D CDP data tie-up for Kurovdagh field.

curves due to incomplete well logging data, the tying-up was done by use of velocity model designed applying VSP data from Well598 in the study area. According to the report on data interpretation from VSP 598 data, this well (bottom hole at 3190 m) recovered the sedimentary cover down to the VII horizon of Productive Series. The series of high energy

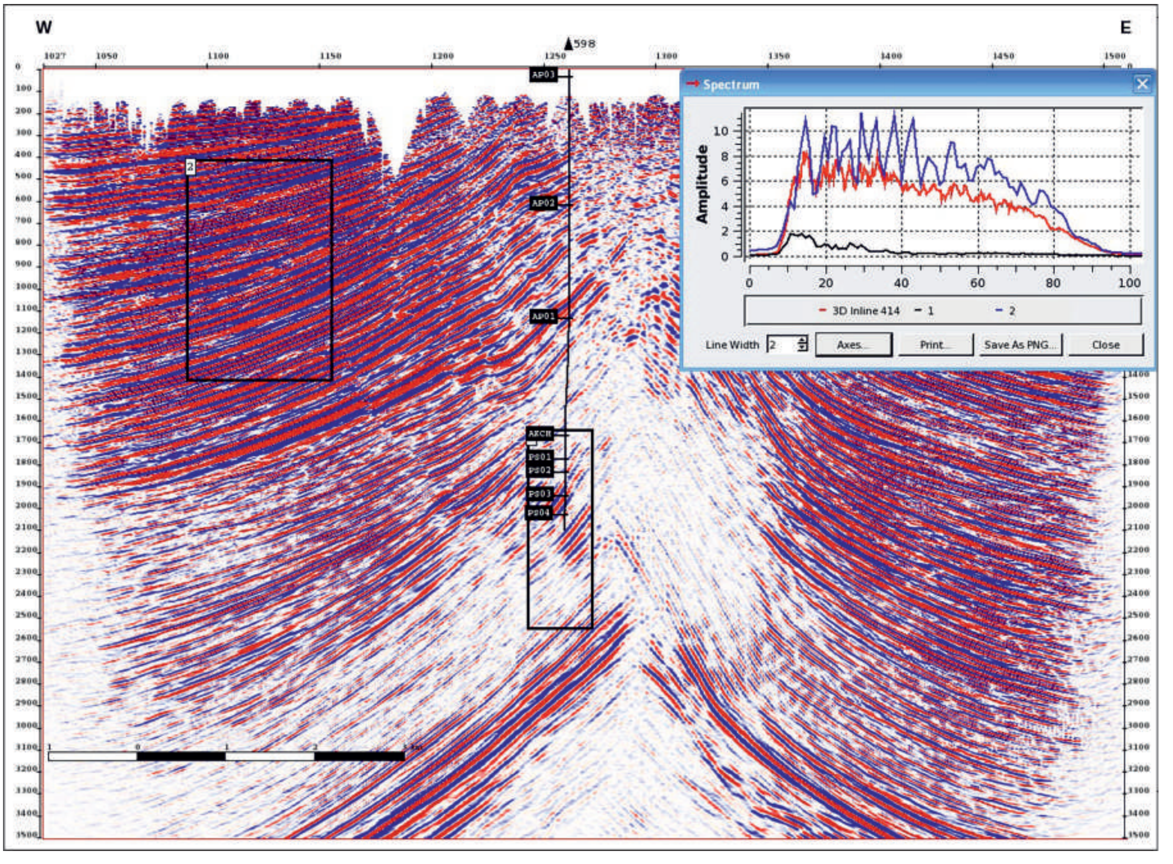

Fig. 5. Amplitude-frequency characteristic of the wave field of 3D cube of Kurovdagh.

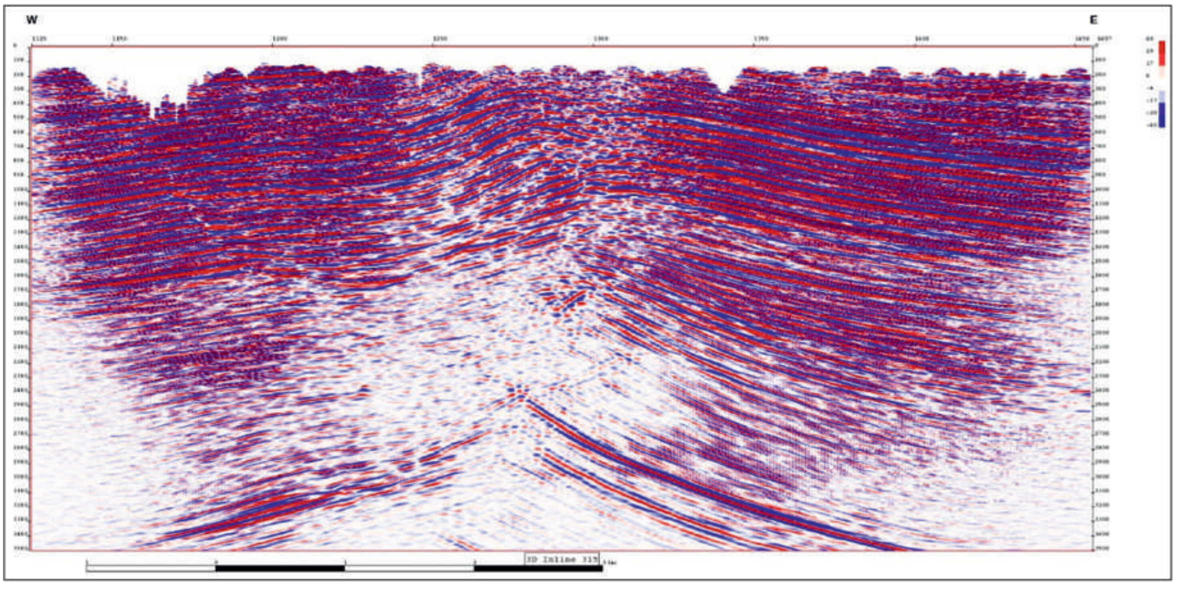

Fig. 6. Wave field nature.

reflections from Middle Absheron, acoustically less differentiated Lower Absheron, clearly observed high amplitude positive reflection from top of Akchagyl (time 1668 ms) are recorded in the wave field. Maximal amplitudes of signals are observed within hori-

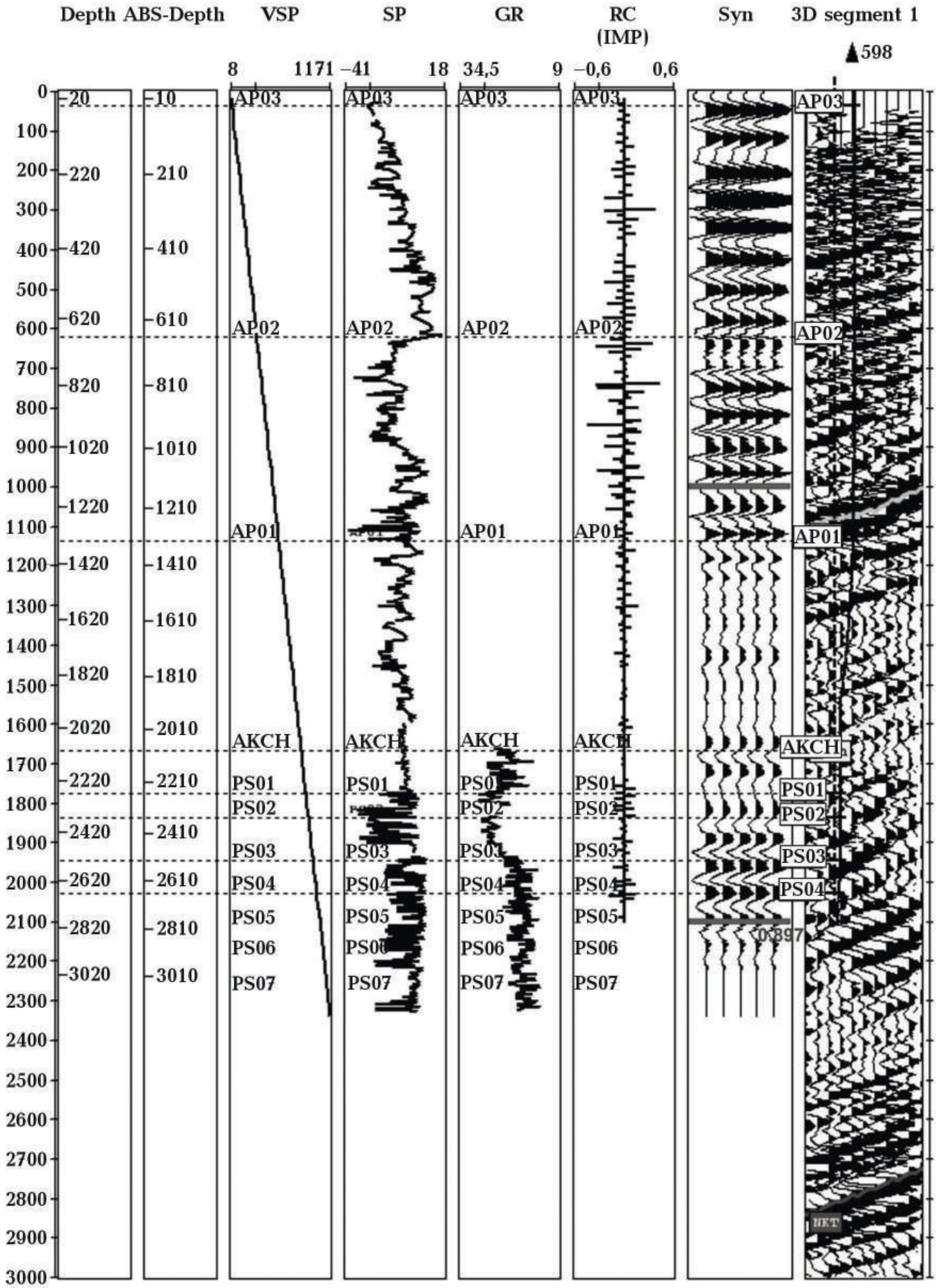

Fig. 7. Seismo-acoustic model for a section of Well598.

zons PS03—PS08. Seismo-acoustic modeling data applied to study the whole wave pattern of target intervals are shown in Fig. 7.

These studies aimed at correlation and analysis of dynamic characteristics of seismic waves attributed to the major oil and gas bearing areas in the region. The following reference horizons PS01, PS05, PS10 of the Productive Series were outlined and correlated throughout the whole study area.

Reflections attributed to the top of horizon PS01 are more consistent both in dynamic characteristics and incorrelation. The wave field in this interval is represented by steeply dipping reflections of visible intensity, complicated by strong interference and worse signal record near to clay diapir. The most complex in correlation of these reflections is the correlation of PS01 reflection. The horizon for tracing on time sections was selected according to the complex negative interferential extremum. This reflection is characterized by significant changes in time of recording, dynamic variance, correlation

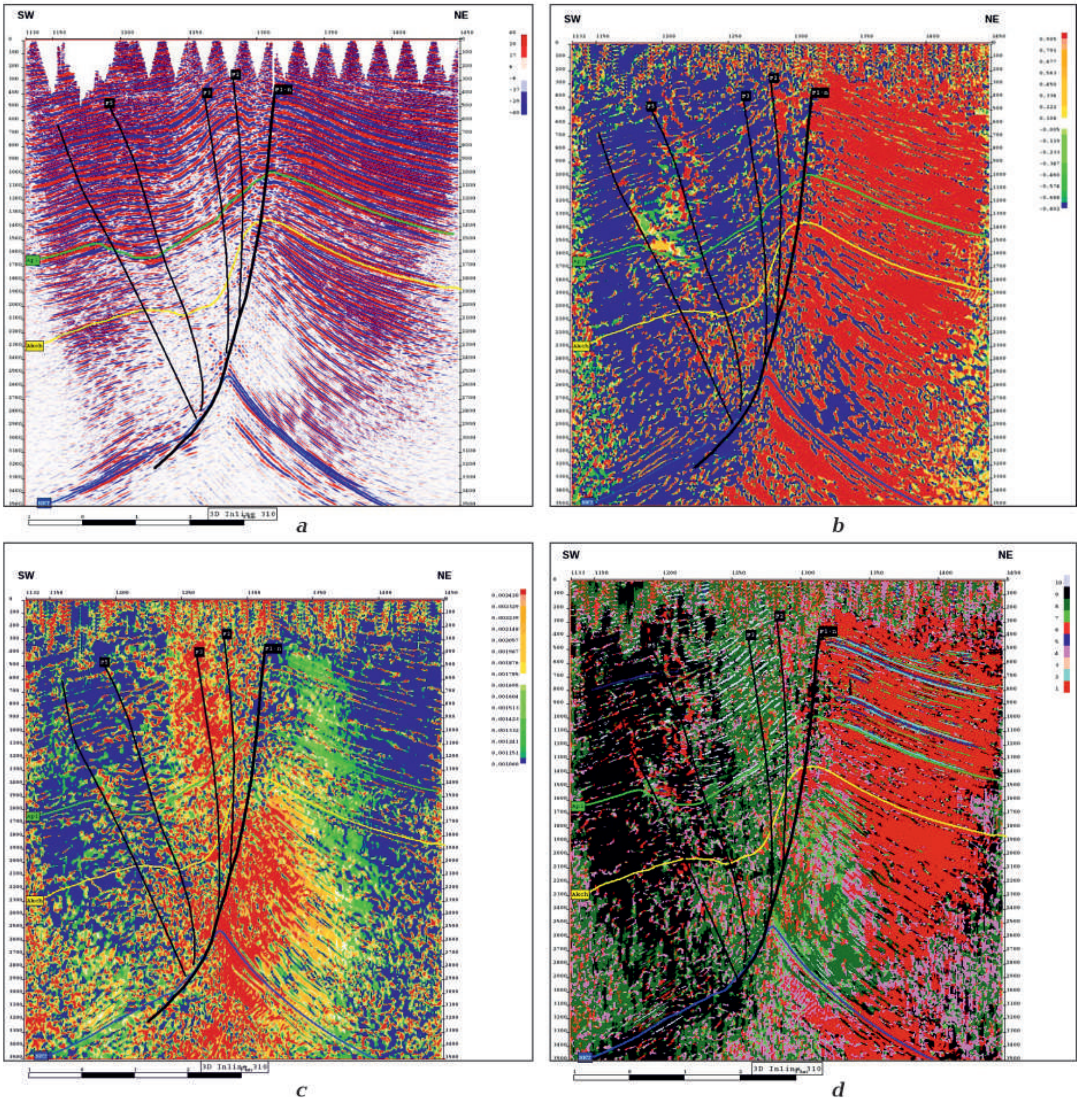

Fig. 8. Correlation of Reference Horizon and faults along Inline 310 by the time section (*a*), by the cube of azimuths (*b*), by the cube of dipping (*c*) and the cube of Taxonomy (*d*).

breaks, the presence of disjunctive dislocations, especially in the arc and near-arc parts of the diapir. The features of geologic setting of the area such asthe large number of faults, growing more numeroustowards the small depths and causing fragmentation of the Neogene-Pliocene sediments, the overpressure, and steeply sloping boundaries being the sources of various interfering wave-noises, extremely deteriorate tracing of horizons in the Productive Series by initial seismic data. Visibly weakened dynamics of this wave field and fragmentary nature of these reflections do not allow to trace all reflections related to the productive layers.

The more deeply buried PS05 series of sediments is represented by a number of steeply dipping reflections, that differ vertically in intensity and frequency of reflected waves. Reflection horizon is traced along very intensive interferential negative wave near the top of the layer. Wave field of this interval is characterized by intensity of the record, strong interference, a large number of disjunctive faults and correlation breaks related to them. The presence of a large number of disjunctive dislocations of various range has already been indicated to be characteristic for the area. On seismic sections, the disjunctive dislocations were selected by displacement of the synphase axes, zones of lack of correlation, and the line of the contact of mixed wave fields of the attributes of the same series (Fig. 8). For this, the analysis involved the cubes of azimuths, dips, coherence and Taxonomy — the sections of typification for selected attributes.

For the volumetric modeling of productive layers of oil field in the south part of Kurovdagh area, we applied PETREL.10.2 software package. The targets of research included complex, lithologically and tectonically sealed deposits of the Productive Series — PS01—PS09 and Akchagyl stage (AKCH). The Productive Series sediments are attributed to the Pliocene of Neogene system of the Caspian basin. These are represented by a thick series of continental and coastal-marine sediments (sand, clay, coarsely-fragmented formations) of 1600 m thickness approximately. The series unconformably overlays Pointian and is transgressively covered by the Akchagyl stage. The Akchagyl stage is one of the substages of the Upper Pliocene, sediments of which are represented by clay, limestone, marl, sandstone, sand, and conglomerates.

Design of structural frame of 3D geological model and uploading of initial data. Structural maps for the top productive layers were acquired by superposition (subtraction) of thickness maps onto the maps of top of the over- (under-)lying layer. As a basis we adopted the structural map for the top of

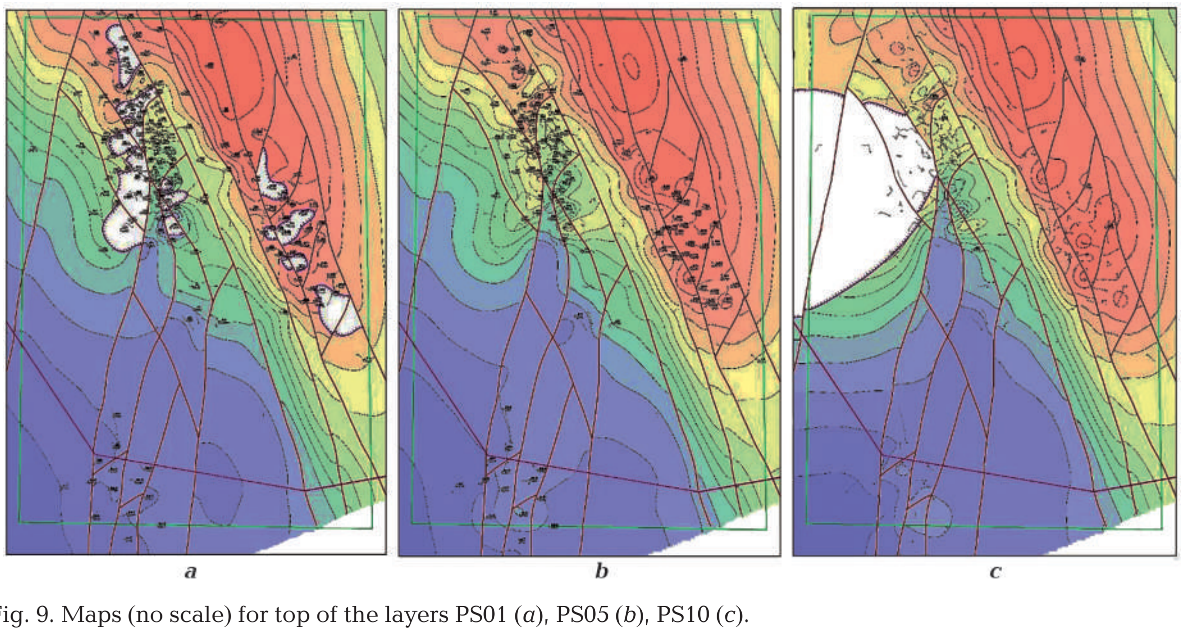

Fig. 9. Maps (no scale) for top of the layers PS01 (*a*), PS05 (*b*), PS10 (*c*).

PS05 layer recovered by all wells drilled in the study area (except for the wells with bottom holes lying higher than this layer). Maps for tops of layers PS04—PS01 were acquired by superposition of thickness maps onto the map of the underlying layer starting from the layer PS05. Structural maps for tops of layers PS06—PS10 were acquired by subtractingthe map of thickness from the map of the top of overlying layer also starting from the layer PS05.

Thus, moving «up» and «down» from PS05, the structural maps for productive horizons PS01—PS10 and for the overlying Akchagyl and Absheron stages were acquired. As an example, Fig. 9 displays structural maps (noscale) for the tops of the layers PS01, PS05, and PS10.

Analysis of all these maps shows that the Kurovdagh area is characterized by a block structure through the studied geological section. The block sizes are almost unvaried, evidencing correspondence of structural levels and inheritance of tectonic movements. By these maps, the most distinguishing features of the area are the presence of mud volcanoes and diapir folding.

The quality of seismic record in fragmented arc and near-arc portions impedes identifying and tracing disjunctive dislocations in detail, therefore the directions of throw-off planes were adopted as sub-vertical. Cubes of subsidences and azimuths were calculated on the basis of the instantaneous phase and instantaneous frequency. This is also the attribute for selection of tectonic fractures. The reliability criteria of mapping of disjunctive dislocations is the sharp variation of the gradient in the cube of subsidence. When constructing and analyzing slices of the above parameters at a given distance from the top of the Productive Series, it is clear that the displacement of zones associated with tectonic disturbances practically does not occur.Moreover, below the horizon PS04 of the Productive Series, the erosion of such zones is observed, evidencing the fading-out of such zones with depth.

Embedding faults into the structural frame was done usingPillar gridding and Making horizons.

Conclusion. The high resolutionability of seismic survey, use of modern processing procedures, and acquisition of typification sections in particular by the technology of PANGEYA allowed to study in more detail the geological setting of the Kurovdagh field in more detail.

The initial digital data applied for construction of geological model of Kurovdagh field were the following:

– 183 wells (depths for top and foot of the layers; dipmeter data: coordinates of well mouths and layer intersections, well paths), of these, 38 well data are supported by interpretation data (well logging curves: specific resistivity, self-potential method, lithology, saturation);

– structural surfaces for top and foot of stratigraphic horizons;

– control of the quality of input data after the upload has been done visually by software packages developed by Pangeya CJSC and PETREL (Schlumberger).

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Детальне вивчення геологічної будови низів нижнього пліоцену площі Кюровдаг сейсморозвідкою 3D

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Стаття присвячена вивченню геологічної будови нижніх відділів продуктивної товщі нижнього пліоцену. Вона складається зі вступу, постановки проблеми, дослідницьких питань, методології досліджень, результатів, висновку та списку використаної літератури. У вступі наведено основні відомості про родовище, його географічне положення, історію геолого-геофізичного вивчення, літологію розрізу, будову Кюровдагської складки та ін.

Нафтогазоносність родовища Кюровдаг пов'язана з апшеронським ярусом плейстоцену, акчагильським ярусом і продуктивною товщею (горизонти PS01-PS23) неогену. Незважаючи на тривалу розробку родовища нижні відділи продуктивної товщі і підстильні відклади ще не розкриті глибоким бурінням, а отже глибина сейсмогеологічної будови порід недостатньо вивчена.

Польові сейсморозвідувальні роботи виконала геофізична компанія «Петроальянссервісіскомпані лімітед» на замовлення компанії «Каспіаненерджі груп». Для обробки матеріалів використано пакет «FOCUS» версії 5.4 компанії Paradigmgeophysical.

Для переінтерпретації даних сейсморозвідки 3D використано матеріали МОГТ-3D за родовищами і кубами та виконано кінематичний аналіз, який виявив різницю за тимчасовим зсувом, спектром частот і діапазоном амплітуд. Куби було зведено до єдиного вигляду за часом, фазою та амплітудами. Подальша кінематична інтерпретація показала, що на площі Кюровдагу отримано досить якісний і кондиційний матеріал. Дослідження проведено на програмному комплексі ПАНГЕЯ® для багатоатрибутного аналізу геолого-геофізичних даних і стандартної інтерпретації.

Для об'ємного моделювання продуктивних пластів нафтового родовища Кюровдаг використано програмний пакет PETREL.10.2. Об'єктами дослідження були складнопобудовані, літологічно і тектонічно екрановані поклади продуктивної товщі PS01—PS09 і акчагильського ярусу (AKCH). Відклади продуктивної товщі належать до підрозділу пліоценового відділу неогенової системи Каспійського басейну. Вона складена потужним комплексом континентальних і прибережно-морських відкладів (піски, глини, грубоуламкові утворення) потужністю до 1600 м. Залягає незгодно з відкладами понтичного ярусу, перекривається трансгресивно акчагильськими шарами. Акчагильський ярус — один із підрозділів верхнього пліоцену, відклади якого представлені глинами, вапняками, мергелями, пісковиками, пісками, конгломератами.

З'ясовано, що площа Кюровдаг характеризується блоковою будовою всього дослідженого розрізу, розміри блоків майже не змінюються, що вказує на відповідність структурних поверхів і успадкованість тектонічних рухів. Розвиток грязьового вулканізму та діапірової складчастості, а також їхні розміри є основною відмінністю побудованих карт.

Ключові слова: сейсморозвідка 3D, поверхневі та глибинні сейсмогеологічні умови, обробка, переінтерпретація, продуктивна товща, грязьовий вулканізм, діапірова складчастість.