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SEDIMENTOGENESIS OF EARLY MAYKOP (LOWER OLIGOCENE) DEPOSITS IN THE AZOV-BLACK SEA REGION

Purpose. Research of lithological features of the sedimentary complex of Early Oligocene within Azov-Black Sea Region and reconstruction of its sedimentary conditions. **Method**. The method includes lithologo-facial, mineralo-petrographic, lithmological, electrofacial and sedimento-paleooceanographycal analyses. **Results**. It is established, lithological structure of section and lithologo-facial zonality of the Lower Oligocene (Lower Maykop) of Karkinite-North Crimean and Indolo-Kubanian depressions. Four type of series was distinguished, what differing of containing in their structure of clastogene (sandstone, siltstone) lithotypes, spatial distribution which is characterized by a certain lateral zonality, that represent built lithologo-facial models. In detail the petrographic features of the main rock types are studied. Lithmological sections were built, which allowed establish the layered structure of the section thickneses, what resulting in the development of two regional and local clastogene bands, separated pelitomorphic formations. Sedimento-paleooceanographic situation of basal clastogene band were reconstructed and proper models were built. Two sedimentation basins with different dynamics and depositional environments are distinguished: internal Odessa-Kerch (close, estuary, northern) and exernal Black Sea (open, southern) which separated by the Kilian-Kalamitian-Crimean-Caucasian range of submarine-surface elevations. In the exernal, in the open for the oceanic water Black Sea sedimentation basin, the near shore-marine conditions were predominant, with accumulation of clayey, aleuritic-clayey and aleuritic muds of facial zones: “shelf plain”, “along shore bar” and “fan”. In the internal, in the close Odessa sedimentation basin, the near shore-marine and alluvial-deltaic sedimentary environment prevailed. Throwing down of the detritic material provided for the four river systems, which drainaged present areas of West (Moldovian paleoland) and Northern Black Sea, forming psammitic-aleuritic node bodies of facial zones: “river bed”, “river mouth bar”, “fan”, and which were separated, , formed to the axian zones of the consedimentation uplift, by the bodies of facial zone “along shore bar”. **Scientific novelty.** First, the result of complexes litogenetic researches, was reconstructed situation of sedimentation of basal clastogene band of the Lower Oligocene within the Azov-Black Sea Region. **Practical significance**. Study of features of lithological strata structure, creation of the sedimentation models will be instrumental to clarify of certain question of stratum character, finding out spatial distribution of sedimentary bodies of different composition and genesis. Which will be geological basis for more grounded prognosis of prospective oil and gas objects spatial distribution.

Key words: Azov-Black Sea region, Oligocene, paleooceanography, alluvial-deltaic system, fan, shelf.

Introduction

Lower Oligocene of Maykop deposits within the Azov-Black Sea region have significant areal distribution and no local stations on the territory of East-European platform, mega-anticlinorium of the Mountainous Crimea and axial zones of the Kilian-Zmiyinyi uplift, Central Crimean and the Middel-Azov uplifts (Plahotnui et al., 1971; Samarskyi,; Poluhtovych et al., 1998; Deneha et al., 1998, Gozhyk et al,. 2010, Gozhyk et al,. 2011, Mykhailov et al., 2014). At the same time, the fullness of the specified depth section and its thickness are characterized by significant areal variations. The most complete Maykop section at maximum depth has been discovered on the territory of the Kerch Peninsula and the water area of the Black Sea Kerch littoral shelf, where its depth reaches 1,500 and more meters. Not less thickness (1.000 or more meters) and complete Lower Maykop section discovered also within the South-Eastern Plain Crimea and North-Western shelf of the Black Sea (Odessa shelf). Instead, within the North-Eastern Plain Crimea territory, Syvash littoral and central areas of the Sea of Azov non-thickness sections of Lower Maykop, thickness ranging from 200–300 metres (Syvash littoral) 400–500 metres (North-Eastern part of the Plain Crimea). Moreover, power reduction in these areas is as a result of regular depth reduction of individual horizons, and due to their cosedimentation upwelling (transgressive character of thickness formation) or later erosion.

In the structure of section thickness, according to paleontological data (Hozhyk et al., 2006; Pechionkina, 1964; Okulovskyi, 1987), two region-layers can be distinguished: planorbel and ostracode (Molochansk). Moreover, according to lithology, planorbel region-layer can be divided into two undersuit: lower and higher planorbel.

Geological backround

As it has been shown by exploration activities (Gerasimov et al., 2008) for the period of Oligocene the examined area was continually influenced by tectonic movements which started still in Cretaceous-Eocene, but these days they have gained greater

intensity (dynamic) and it was related to the processes of further formation of major depression structures first-order series – Karkinite-Northern Crimea (West), Northern Azov (North-East), Indolo-Kubanian (Central-East) and Sorokin (South-East) depressions (Fig. 1).

According to the results of the analysis of the characteristics of areal distribution of thicknesses of Lower Maykop layers in the Azov-Black Sea, all the above mentioned structures of Early Oligocene, in their morphological aspect, are elongated in terms of sub-latitudinal extent, asymmetric in profile with gently sloping northern and steep southern margins of the form. The distinctive fact is the presence within the axial zone of a number of depressions in zones of depression of higher order, widespread local con-sedimentary uplifts and also the development of non-root diapir folds formed exclusively within the Kubanian and Southern Kerch troughs.

The depressions vary in thickness and fullness of Maykop profile, in the degree of geological analysis. Thus, thickneses of Lower Maykop depth demonstrate a distinctive increase in the direction from north to south: from 10–100 m in the Northern Black Sea and Sea of Azov to 500–1500 m within the Kerch Peninsula, Odessa and Kerch littoral Black Sea shelves (Fig. 2). Lithofacies features and mineralogical and petrographic features of Lower Maykop deposits are the most studied in detail within Karkinit-Northern Crimea and Indolo-Kubanian depressions, that is due to the presence of sufficiently numerous factual material as a result of exploration events.

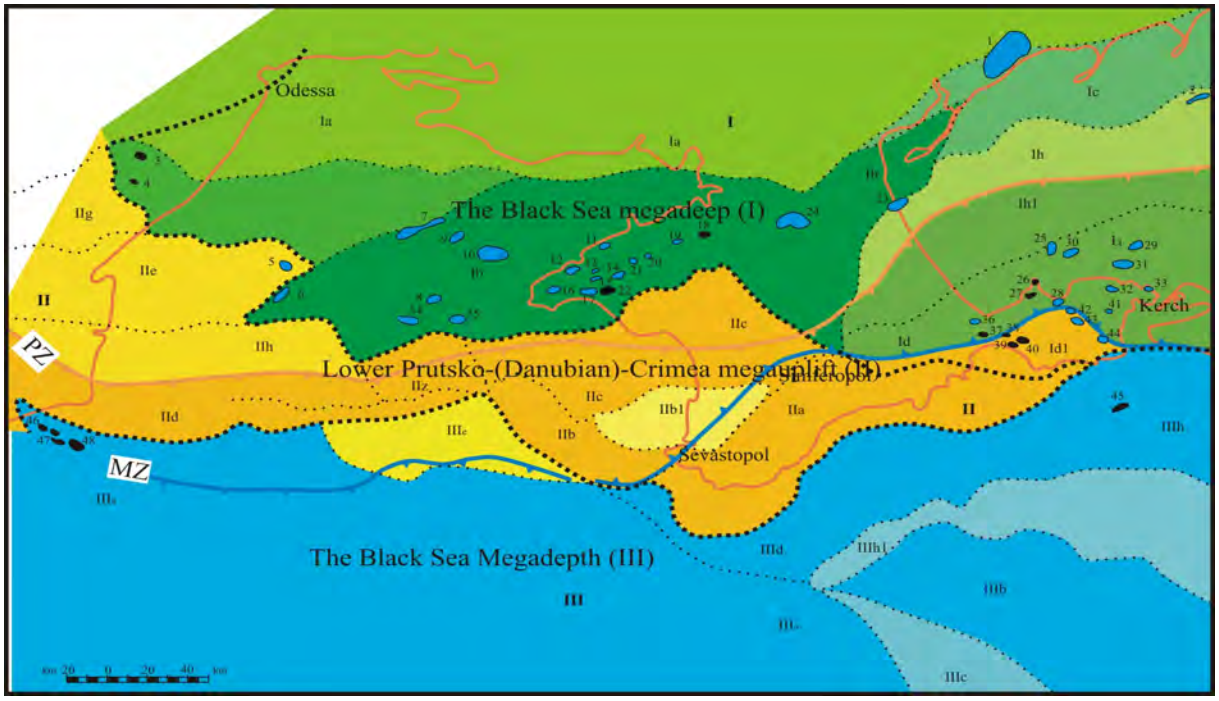

Fig. 1. Tectonic map of Cretaceous structural layer of platform cover Black Sea littoral-Crimea oil and gas fields (Gerasimov et al., 2008)

PZ – Late Paleozoic sutura (Danube-Tersk), MZ – Mesozoic suturas (Pecheniaha-Kamena and Crimean-Caucasian). I – the Black Sea littoral mega-deeps: I-a – South Black Sea monocline; Ib – Northern Crimea rift-trough; I-c – Northern Azov trough; I-h – Middle Azov uplift; I-h1 – Azov shaft; I-d – Indolo-Kubanian rift-trought; I-d1 – Prymorsk monocline. II – Lower Prutsko (Danubian) – Crimean mega- uplift: II-a – Mountainous Crimea infolded overlap structure (by V.V. Yudin); II-b – Kachynsk block of Early Mesozoic Lavrasia passive border with infolded Almin trough; II-b1 – Almin depression; II-c – Central Crimea uplift; II-h – Illichevsk uplift; II-d – Gubkin upliftl; II-e – Regional level (North border zone of Western Black Sea rift-trough); II-g – Danubian uplift; II-z – Bolhrad-Lyman block. III – The Black Sea mega-depth: III-a – Western Black Sea rift-trough; III-b – Eastern Black Sea rift-trough; III-c – Central Black Sea rift- uplift; III-h – residual Shatskyi rift-uplift; III-h-1 – Tietiayev uplift; III-d – Crimea littoral-Caucasus infolded zone; III-e – Pre-Mysian Upper Jurassic-Lower Cretaceous border trough. Research area is in the square. The list of fields: 1 – Pryazovske, 2 – Morske, 3 – Skhidno-Saratske, 4 – Zhovtoyarske, 5 – Bezimenne, 6 – Odeske, 7 – Golitsynske, 8 – Arkhanhelske, 9 – Pivdenno-Golitsynske, 10 – Shmidtivske, 11 – Yarylgatske, 12 – Chornomorske, 13 – Karlavske, 14 – Hlibivske, 15 – Krasnopolyanske, 16 – Olenivske, 17 – Zakhidno-Oktiabrske, 18 – Tetianivske, 19 – Serebrianske, 20 – Zadornenske, 21 – Kirovske, 22 – Oktiabrske, 23 – Strilkove, 24 – Dzhankoyske, 25 – Pivnichno-Kazantypske, 26 – Aktaske, 27 – Semenivske, 28 – Povorotne, 29 – Pivnichno-Kerchenske, 30 – Skhidno-Kazantypske, 31 – Pivnichno-Bulghanakske, 32 – Voykivske, 33 – Borzovske, 34 – Shtormove, 35 – Krymske, 36 – Pivdenno-Syvashske, 37 – Vladyslavivske, 38 – Balochne 39 – Moshkarivske 40 – Kuybyshivske, 41 – Prydorozhne, 42 – Oleksiyivskee 43 – Fontanivske 44 – Pryozerne, 45 – Subbotina, 46 – Sinoye, 47 – Zakhidna Lebada, 48 – Skhidna Lebada.

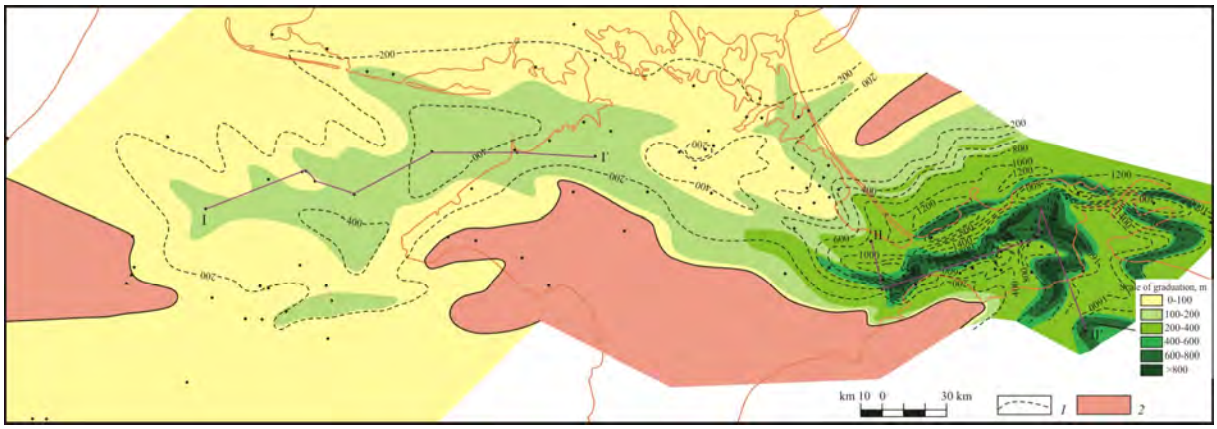

Fig. 2. Lithofacies scheme (aleuro-psammitic) of Lower Maykop layers in the Azov-Black Sea region. 1 – isolites, m., 2 – non-existence of deposits. Profiles: I-I' and II- II'

Purpose

Research of lithological features of the sedimentary complex and determination of genetic environment of sand-aleuritic accumulative bodies of Early Oligocene within Azov-Black Sea Region and reconstruction of its sedimentary conditions.

Methods

Litholofacies constructions were realized on rhe basis of lithological typification of deposits on the profile of wells, in accordance with method (Kiselov A. E. and et al.., 1983). Lithmological structure of deposits was determined on the basis of isolation of lithmits – formation of the superrock level, which inaccordance with (Karogodin YU. N., 1980), represented associations of rock bodies (layers), lithmits were isolated on the basis of methodical approach (Grygorchuk K. et al., 2009)

Results

Lithology of the Early Maykop

Lithological structure Lower Maykop thicknesses section in Azov-Black Sea region is rather connatural three-component and features distinct dominance of terrigenous varieties (90 % section), which differ in content aleuro-psammitic component (Fig. 3). The layers of aleuritic and psammitic rock are most common for lower and upper horizons of the thickness profile, and their role is growing in the process of approaching the sources of debris material drift or within some local morphological forms.

There has been estimated a natural trend of change in lithological structure of explored section in the region from south to north: from full and powerful sections of Lower Maykop thickness in Indolo-Kubanian and Karkinit-Northern Crimea depressions featuring a development of aleuro-psammitic deposits in the lower part and the almost complete non-existence in the upper one up to the reduced (non-existing lower horizons of thickness) with the development of coarse-grained lithotypes at the upper part of the section within the Ukrainian monocline.

The analysis of areal-secular division of thickness-forming components (sandstones + aleurolites and mudstones) of Lower Maykop thickness section in the Azov-Black Sea region revealed a number of natural features (Fig. 2).

Areal distribution of total thicknesses of the aleurolite-sandstone horizons in terms of explored thickness is distinctively correlated with the nature of thickness variations, demonstrating maximum values on the territory of Kerch Peninsula and water areas of Odessa and Kerch littoral shelves in the Black Sea. Alongside, several fields of maximum development are localized.

A significant areal distribution, elongated in terms of sub-latitudinal extent field features isolite values of 600 m, localized within the Kerch Peninsula (Fig. 2). It extends from the district of Vladyslavivsk area in the west to Prydorozne area in the east and further towards Dubrovka area in the south. The field is bordered by the line of lower values (300 m) of parameter. Besides, within the area, there is an estimated development of a number of small areal vastly elongated in terms of sub-latitudinal extent isolite fields with values over 500 meters. These fields are mainly areally gravitating to the northern and southern slopes of cosedimentation uplifts.

Within the northern territories of the region (East of the Plain Crimea and Syvash littoral) local geographical range isolite maximum values, forms an elongated in terms of sub-meridional extent field in the district of Strilkove area with lengthening towards Genichesk (North), Ust-Salgir (South) and Dzhankoy (West) structures. The maximum value of the parameter within its borders does not exceed 120–150 m but totals 40 % of the profile thickness. This field in terms of structural point areally tends to axial depression zone.

Probably relatively areally vast, the geographical range of the psammitic-aleuritic types (total capacity of more than 500 m) of Lower Maykop thickness is localized in the southern districts of explored area (Subbotina area, Prukerchian shelf of Black Sea).

According to percentage in Lower Maykop sections eastern areas of the region aleurolite-sandstone horizons extended field of values over 50 % has been recorded, which extends from South to North in towards the next areas: Subbotina-Fontanivske-Strilkove. The lingulas towards Vladyslavivske, Ust-Salgir and Dzhankoy areas can be observed.

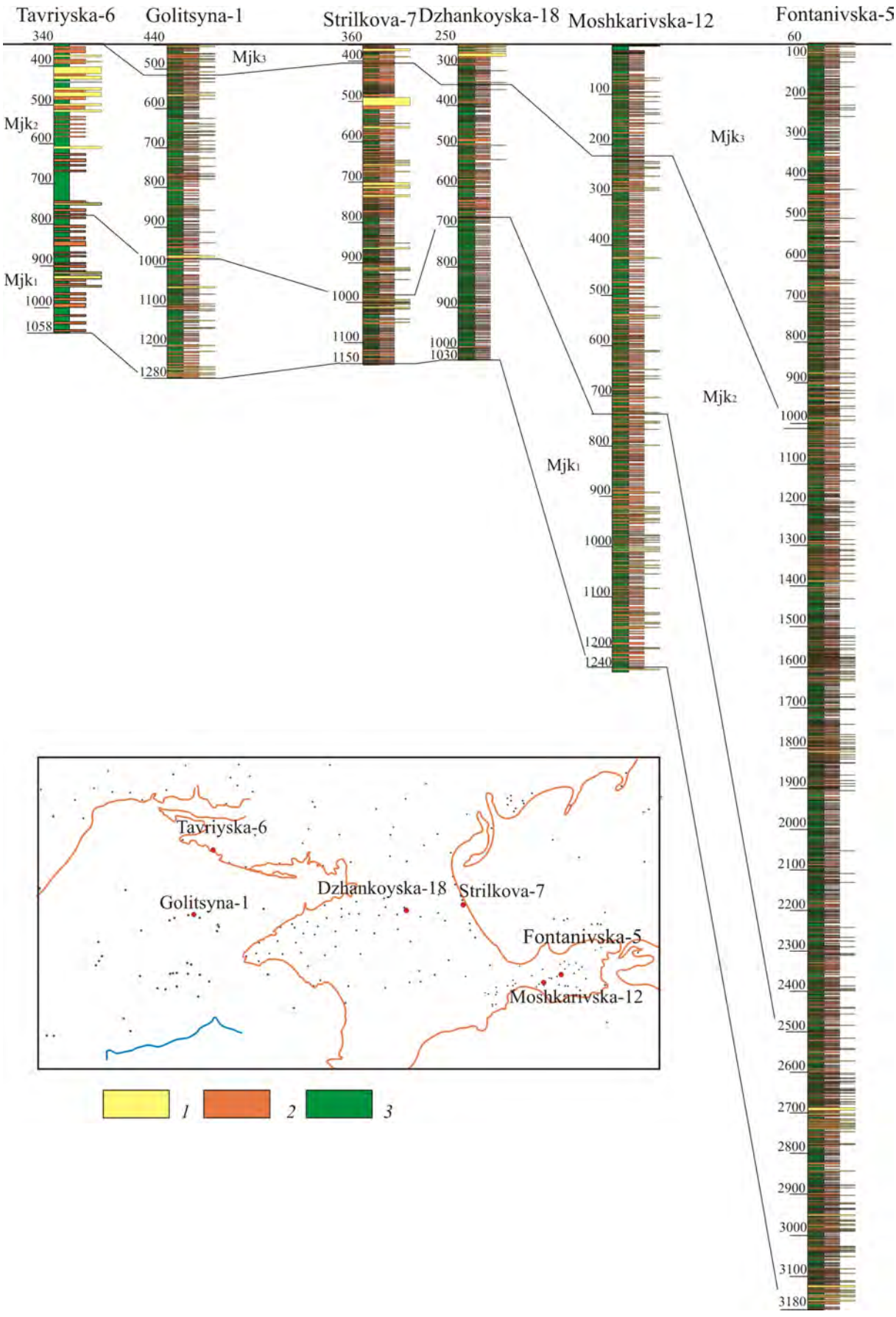

Fig. 3. Lithological structure of Lower Oligocene thickness section (Lower Maykop) in Azov-Black Sea region. 1 – sandstone, 2 – aleurolites (siltstones), 3 – mudstones

Within the north-western Black Sea shelf there were localized five areally small extremely elongated in terms of geographical range sandstones with a maximum total thickness from 5 to 35 m (with dominant values up to 10 m), which is 20 % of the profile (Fig. 2). Unlike psammite, the nature of the areal distribution of aleurolite seams is explored in terms of depth section demonstrates here relatively different features. Primarily, this is due to more widespread extent of these varieties, and it results in values of their total thickness from 7 to 144 meters (15–50 % of profile). Secondly, the deposit data form practically one large geographical range of distribution, which covers the axial zone of sedimentation basin.

Mineralogical and Petrographic characteristics

Lower Maykop deposits in the Azov-Black Sea region, as noted above, are featured rather in connatural clay layers with diverse content of aleuritic-psammite and carbonate (sideritic) component, quantity and range of faunal species residues (Fig. 4). The seams of aleuro-psammitic varieties tend to lower or upper layers of depth. Within Indolo-Kubanian depression the last ones form distinctive basal Dyurmen suite, with 20–650 m of total thickness.

Below is mentioned the generalizing mineralogical and petrographic description of distinctive lithotypes of Lower Maykop thickness in the Azov-Black Sea region.

Argillites. Dark gray mudstone, gray with greenish tinge, with powder and lenses of aleuro-psammitic material of gray and greenish-gray colour, brittle, layered, sometimes subtly-parallel layered, clastic, containing slickenside. Their content of calcium carbonate is low and gradually increases to 10–22 % in the southern areas of the region. Kern is often fractured. Cracks are vertical and horizontal, full of light gray carbonaceous material, leucoxene and easy bitumen.

Under the microscope, the bed-rock is thinly scaly with distinct orientation of hydro-micaceous composition mixed with pelitomorphic carbonate.

Clastic material 1–3 to 15–40 % 0,02–0,6 mm in size unevenly distributed in the form of intermittent seams with the thickness of several millimeters, lenses and nests. Some smooth transitions of aleurolite into clay and vice versa can be often observed. It is presented in angular grains of quartz, rare feldspar, muscovite scales, and secluded fragments of effusive and crystalline rocks. There exist quite a lot (1–3 %) of pale green evenly distributed glauconite concretions in the rock. Throughout the rock some impregnation of dusty pyrite can be marked, sometimes leucoxene, fine (0,01–0,02 mm) grains of siderite (seams up to 20 % of rock), ferric hydroxide, and fine pieces of carbonaceous plant detritus. Faunistic remains, that are mainly fragments and chips of thin shells of ostracods, globigerine, fish scales, spicules of siliceous and carbonate composition (carbonate spicules prevail in the seams from the lower part of the thickness section) are distributed evenly throughout the rock, and their content reaches 8–10 %. The samples from the northern territories of the region (Kherson area) have marks of deposit feeder burrows (worms) filled with powdery pyrite. Accessory minerals are oval zircon and common garnet, phosphate mineral.

Aleurolites and sandstones in the researched sections are observed mainly in the form of seams ranging from 0,3–1 m to 20 m thickness of clay layers. The stone of grey and light-grey colour with greenish or brownish tint is slightly micaceous and often hard clayish, slightly calcareous, with glauconite. The structure of aleuro-pelitic texture is massive, rarely lamellar (lenticular-layered) due to the dark seams of concentrated clayish material. The content of calcium carbonate seams reaches 5–8 %.

Detrital material (70–75 % up to 90 %) up to 0.2 mm of irregular angular semi-rolled form is distributed unevenly. It is presented in grains of quartz (up to 80–90 %), feldspar (plagioclase, rarely microcline up to 10–15 %), and fragments of siliceous rocks (up to 8–10 %). Many (up to 15–20 %) concretions of glauconite, its flaky isometric grains are of bright green color and 0,06–0,08 mm in size. Ore minerals are dusty pyrite, leucoxene rarely hydroxides of iron. Accessory minerals are garnet, epidote, zircon. Faunistic remains (up to 20 %) are presented in fragments and chips of shells of ostracods, nummulites, many siliceous spicules of sponges and carbonate composition.

Cement (25–30 %) is hydromicaceous, hydromicaceous-chlorite, hydromicaceous-halloysite, and rarely of siliceous-chlorite-carbonate contact-pore structure, in areas of the basal type.

Lithmologycal structure of the Early Oligocene

Lithmology structure of Lower Maykop thickness in the Azov-Black Sea region is characterized by a significant areal-secular variations and the presence of reference (regional) horizons. Overall it is formed from 19 to 84 litmites of regional, zonal and local plans of 20–80 m thickness. They are represented by six lithological complexes of four classification fields (Fig. 5), and clayish litotypes have the most common areal distribution among them (fields VI and VII, 50–65 %).

Extensive and practically pervious development, psammitic-aleuritic litmites can be observed in the south-western part of Indolo-Kubanian basin (Pivnichnyi Vladyslavivsk, Ust-Salgir and other areas). Here at the capacity of Lower Maykop thickness of more than 1000 m in its section extensive development (over 30 % of section) obtained litmites of mixed (III) and aleuritic (IV) classification fields.

Also, extensive development of clastogens (up to 55 %) is marked as well in sections of Kerch Peninsula central territories (Krasnohirsk, Kuibyshiv, Fontanivske and other areas) and the water areas of Kerch littoral in the Black Sea (Subbotina area) where they are featured by litmites of two classification fields: mixed (III, up to 45 %) and aleuritic (IV, up to 54 %). Lithological structure of section of the last is formed by aleurolite layers (from 0,1–1 to 8 m thickness) with single seams of sandstone (up to 0,2–1,5 m) and argillite (mudstone) (from 0,1–1,5 to 15 m).

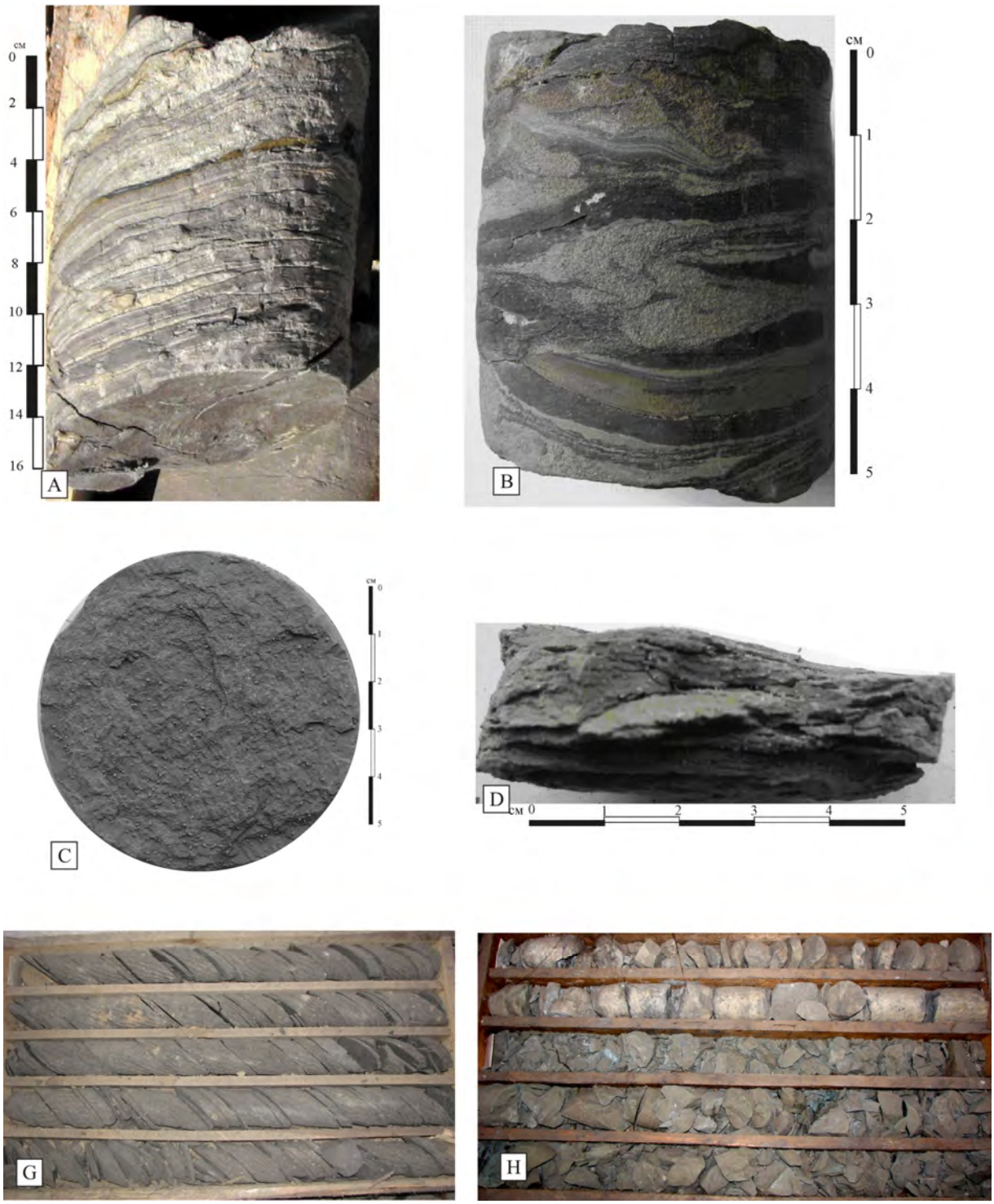

Fig. 4. Typical textures and distinctness of Maykop layers in Azov-Black Sea region
A – well Marfivska-1, gap 3134 – 3146 m (middle). Early Oligocene. Indolo-Kubanian depression; **B** – well Subotina-2, gap 2003,5 – 2009,5 m. Early Oligocene. Sorokin depression; **C** – well Selskogo-40, gap 1056 – 1060 m. Late Oligocene. (middle maykop) Karkinite-North Crimean depression; **D** – well Krumska-3, gap 801 – 911 m. Late Oligocene (middle maykop) Karkinite-North Crimean depression; **G** – well Povorotna-6, gap 3949 – 3959 m. Cross bending, laminar partial of the lower maykop deposit. Indolo-Kubanian depression; **H** – well Slusarivska-6. gap 3924 – 3941 m. Early Oligocene. Indolo-Kubanian depression

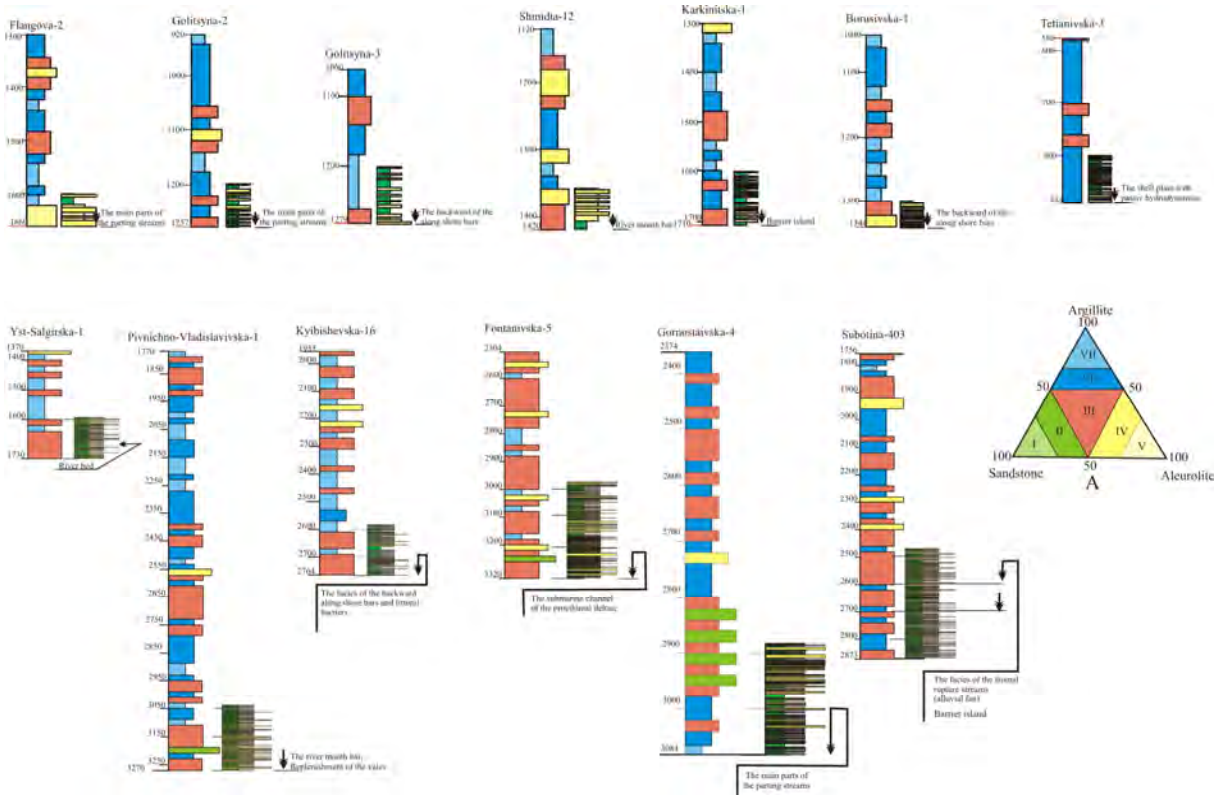

Fig. 5. Lithmology structure of Lower Maykop thickness in the Azov-Black Sea region and lithologic structure of its basal layers with sedimento-paleo-oceanography elements. **A** – Classification triangle

Within the north-western Black Sea shelf wide, extensive and practically pervious development, psammitic-aleuritic litmites can be observed in its south-western part (Desantna, Olimpyiska area). Here at the thickness of Lower Maykop thickness of about 500 m in its sections prevail (70 % of section) litmites of mixed (III, up to 53 %) and aleuritic (IV, up to 17 %) classification fields.

Also, extensive development of clastogens (55 %) is marked as well in sections of northern part of the Black Sea (Tavriya, Kherson area) where they are featured by litmites of two classification fields: mixed (III, up to 30 %) and aleuritic (IV, up to 23 %) fields.

In the rest of the territory the fraction of psammitic-aleuritic litmites in the sections of Lower Maykop thickness does not exceed 25 %.

Quite distinctively, in the lithmology structure section of Lower Maykop thickness of the region, the basal clastogenic member of subregional plan (Fig. 5) is distinguished.

The last can be observed in the western and central regions of Indolo-Kubanian basin in the southern margin of Sorokina depression, north-western regions Karkinit-Northern Crimea trough and, locally, on the western slopes of the Ukrainian monocline. It is presented mainly by the formations of two fields: aleuritic (IV) and mixed (III) which replace each other faciesly. In the axial zones of cosedimentation depressions these deposits are split by seams of clayish varieties (fields VI and VII). According to lithological member section is formed by layers of aleurolite seams (thickness of certain seams is from 0,5–1 to 6 meters 25–50 % of section), sandstone (0,5–1,5 m 22–30 %) and argillite (from 0,5–15 to 7 m, 23–63 %) (Fig. 5).

The above detailed sedimentologic reconstructions, which were based on the research of areal-secular features distribution of psammite and aleurolite lithotypes, mineralogical and petrographic specialization of depth-forming components supported by the results of lithogenetical interpretation of data of geophysical researches of boreholes (GRB) (Muromtsem, 1983; Porebski, 1999). The data allowed diagnosing in basal member section of Lower Maykop thickness of the Azov-Black Sea several basic types of sedimentation environments (Fig. 5): accumulative deposits of alluvial origin, different types of littoral bars: river (estuary/mouth) or sea (barrier islands alongshore bars) origin.

That said, as well as using facies balance principle (Selley, 1989), in particular the principle of areal stability of alluvial-delta system structure: a riverbed – an river mouth bar – a barrier island – an alluvial cone/fan, there has been created the Azov-Black Sea region geological and paleo-oceanographic model at the beginning of Early Maykop cycle (Fig. 6).

Paleogeographyc conditions of sedimentation of the Early Maykop

In terms of Early Oligocene sediment accumulation reconstruction regional paleogeographic features of this time should be taken into consideration, mainly determined by two events: firstly, this is Pre-Oligocene regressive episode; secondly, this is Early

Oligocene transgression. The first led to the formation of complex erosion and tectonic topography, the second is the diachronous nature of Maykop sediments basal layers. Still, taking into consideration the paleo-oceanographic situation of Oligocene in the Tethys (Zonenshine at al., 1987; Kazmin at al., 1998, 2000, 2006) (Fig. 7), it can be stated that transgression spread northward from the West Black Sea trough through the Kalamitska Strait and from East Black Sea trough over South Kerch trough, and sediment accumulation began in the Black Sea offshore line, along with the continuing penetration into the water area of the north-western shelf of the Black sea and the Kerch Peninsula, the Plain Crimea and then in the northern Black Sea littoral region.

The beginning of the Oligocene transgression affects the formation of clastogenic deposits of "basal" band, and its further development led to the accumulation of lutite (pelitic silt) and aleuro-pelitic silts within almost entire sedimentation basin.

The episode of sea level lowering in the middle of Early Maykop caused the formation of sand and silt accumulative bodies of depth section medium parts, but the regress tendencies at the end of Early Maikop became obvious due to the clastogens accumulation only in the peripheral areas of sedimentation basin.

Moreover, the areas of practically pervious development of barrier genesis nodal bodies along with the inclusion of single seams of alluvial fans facies zones (Olympyiska area, Desantna area, Golitsyn area – Western districts of the region; Uvarivskyi district, Slyusarivska, Dubrovska areas, Subbotina area – Eastern and Southern ones). The deposits of alluvial-delta system were traced in the northern parts of the region (Tauryiska area, Strilkove area, Ust-Salgir area): riverbed, mouth bar, barrier islands and alluvial fans deposits. The pelagic silt sedimentation prevailed in sedimentary basins deposit centers (Myhailivsk, Karkinit, Tamansk, Sorokine etc.).

Due to the cyclical nature of sediment accumulation the construction general geological paleo-oceanographic model of Early Oligocene is inexpedient, as in the process the principal features of sedimentation are averaged and "blurred". The latter is primarily caused by the existence of elongated transgressive episodes alongside with the regional lutite (pelitic silt) pelagic sedimentation. However, as it is well known (Zhyzhchenko, 1974), the level of accuracy of paleo-oceanographic reconstructions provides a choice of narrow "quasi-synchronous" age interval.

Considering this there has been built a geological and paleo-oceanographic map of the beginning of the Early Oligocene cycle – the time of basal miles Lower Maykop formation (Fig. 6).

When considering the issue of paleodynamics of terrigenous fault at the beginning of Early Oligocene in the Azov-Black Sea basin taking into account of the complicated sea-bed morphometry is extremely obligatory. The analysis of the nature of deposit thickness distribution, variations of aleuro-psammitic components of litmites and considering data (Zonenshine at al., 1987; Kazmin at al., 2000, 2006) it can be stated, that in the Azov-Black Sea paleo-basin existed a ridge of sub-latitudinal extent local paleo-uplifts: (Dobrudzk)-Kiliya-(Kalamita-Crimean-Caucasian), which significantly affected the dynamics of transmission and distribution of terrigenous material.

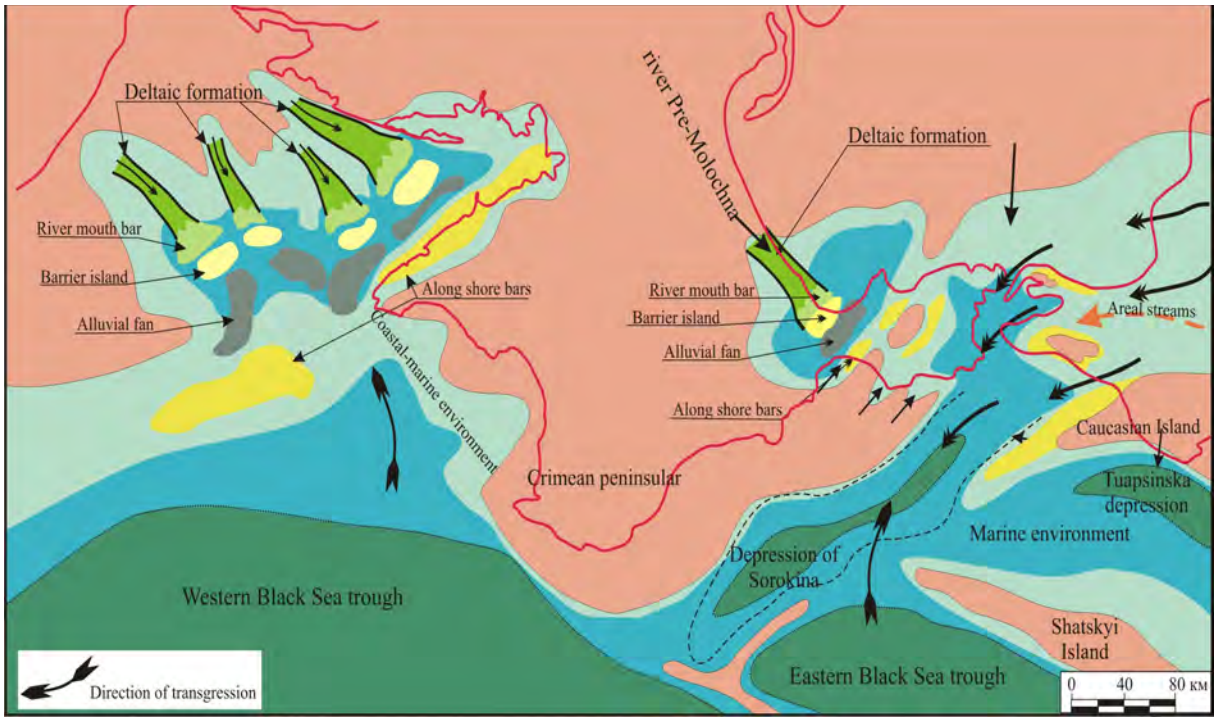

Fig. 6. The sedimentological-paleooceanographic map of the Azov-Black Sea segment of the Tethys. The beginning of the Early Oligocene

Regarding the sources of the latter in the margins of Eastern regions the Azov-Black Sea paleo-basin, it is necessary to take into consideration (Zonenshine at al., 1987; Kazmin at al., 2000, 2006) the evidences of the essential role of large northern rivers (paleo Don-Kuban), which during the Paleocene, Eocene and Oligocene supplied a substantial amount of clastic material into the Eastern part o the Black Sea basin, covering the Eastern part of the Kerch Peninsula and its Southern shelf.

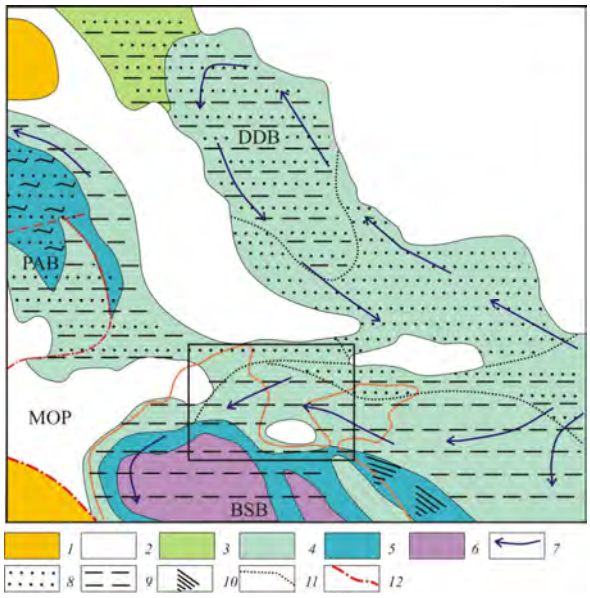

Fig. 7. A fragment of paleo-geographic map at palinspastic reconstruction. Paleogene: Oligocene (35.4–23.4 million years) (Kazmin at al., 1998)

Basins: BSB – Black Sea, DDB – Dnipro-Donetsk, PAB – Pannonian. Micro-continents: MOP – Moesia (Miziya) plate. 1 – medium and low mountains; 2 – low plain; 3 – lagoons, littorals (coastal plains periodically flooded by the sea); 4 – shelf, shelf seas/shallow seas; 5 – continental slope, deep sea; 6 – ocean bottom, abyssal plain; 7 – direction of sea streams /ocean current; 8 – sands; 9 – aleurolites, clays; 10 – turbidites, flysch; 11 – the borderi of sediment accumulation zones; 12 – faults. The area of the research is in the square

Analyzing the terrigenous-mineralogical indicators of Dyurmen deposits the existence of multiple sources of supply can be concluded. It is indicated by the peculiarities of accessory minerals associations, the presence in distinct members of the suite of Upper Eocene chalky clay debris, Upper Cretaceous limestone, quartz bearing sandstones; pyroxene grains – the indicators of basic series igneous rocks; this may indicate the destruction of the "southern" paleo-land (the Crimean Peninsula). The latter is reflected in the established nature of the areal distribution of aleurolites and sand-bearing lithofacies (isolite, clastic factor).

The interaction of opposingly directed alluvial streams (Paleo-Don and Paleo-Molochna, and seasonal watercourses of Crimean land) resulted in a complex nature of aleuro-psammitic materials distribution in this part of the researched area.

In Nothern (Odessa-Kerch) estuarial sedimentary basin within of which prevailed the coastal-marine and alluvial delta conditions of sediment accumulation, the nature of areal-secular distribution of clastogens was determined by four river systems sub-latitudinal extent which drained the nowadays territories of the Black Sea western littoral and two – Nothern Black Sea area (Kokhan at al., 2014). The latter featured sources of minor amounts supply of clastic material into the sediment accumulation basin, that we believe caused land peneplanation (base-leveling), and formed small in area and thickness of the psammite-aleurolitic nodal materials of facies zones "riverbed" and at the marine continuation – "river mouth bar", "alluvial fan".

Besides the alluvial streams, the clastic lithotypes distribution features within the region were largely determined by global and oceanographic factors: firstly, by the influence of wave-cut, tidal and regional streams. Due to ocean level rise there also significantly increased the influence of wave-cut and tidal streams, causing destruction of accumulative constructs inherent in deltaic environment. In addition, according to (Kazmin at al., 2000, 2006), in the Early Oligocene within the Western Caucasian basin there existed the sub-latitudinal powerful flow, directed from the East to the West which contributed to the formation of alongshore barriers and spits (tongues of land). It is obviously that according to the level of sea basin progradation, the flow also extended to the territories of the Azov-Kerch and Odessa basins.

All this led to a proper redistribution of clastic sediments along paleo-island ridge and to the formation of sub-latitudinal bands of accumulative materials, mainly of alongshore bars and spits (tongues of land) type.

Scientific novelty and Practical significance

First, the result of complexes researches features of litholo-lithmological structure of Early Maykop deposits of the Azov-Black Sea region was determined, paleooceanographic situation of sedimentation of basal layers was reconstructed and proper models were built. The resulting will be finding out spatial distribution of clastogene bodies of different genesis, which will be geological basis for more grounded selection of prospective oil and gas objects within the Azov-Black Sea region.

Conclusions

Properties of spacial distribution of Early Oligocene deposits of the Azov-Black Sea region are characterized. Some areas of maximum development of clastogene lithotypes (with summary of value of parameter over 600 m) were distinguished within the Karkinite-North Crimean, Indolo-Kubanian and South Kerch depressions.

The lithmological structure of section has been established, which formed from 19 to 84 lithmites of regional, zonal and lical distribution with thickness of 20-80 m. They are represented by six lithological complexes of the four classified fields, at the most of spatial distribution are clay lithmites. Basal subregional band has been distinguished and lithological structure their profile has been established.

Based on the complexes investigations paleooceanographic situation of basal bands of Early Oligocene deposits were reconstructed: two sedimentation basins with different dynamics and conditions of sedimentation: internal (Odessa-Kerch) estuary and external open for the oceanic water (Black Sea), which separated by the Kilian-Kalamitian-Crimean-Caucasian range of submarine-surface elevations.

In the external, it is open for the oceanic water of Black Sea sedimentation basin, the near shore-marine conditions were predominant, with accumulation of clayey, aleuritic-clayey and aleuritic muds of facial zones “shelf plain”, “along shore bar”, “fan”. In the internal, in the close sedimentation basin, the near shore marine and alluvial-deltaic sedimentary conditions were predominant. Detritic material was derived by six of river stream flow, which drainaged present areas of west (Moldovian paleoland) and Northern Black Sea, forming psammitic-aleuritic node bodies of facial zones: “river bed”, “river mouth bar”, “fan” and which were separated, formed in the axial zones of consedimentation uplift, by the bodies of facial zone “long shore bar”.

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СЕДИМЕНТОГЕНЕЗ НИЖНЬОМАЙКОПСЬКИХ (НИЖНЬООЛІГОЦЕНОВИХ) ВІДКЛАДІВ АЗОВО-ЧОРНОМОРСЬКОГО РЕГІОНУ

Мета. Дослідження літологічних особливостей осадового комплексу ранньоолігоценового віку в межах Азово-Чорноморського регіону та реконструкція умов його осадонагромадження. **Методика**. Методика містить літолого-фаціальний, мінерало-петрографічний, літмологічний, електрофаціальний та седиментолого-палеоокеанографічний аналізи. **Результати**. Встановлено, літологічну структуру розрізу та літолого-фаціальну зональність нижньоолігоценової (нижньомайкопської) товщі Каркінітсько-Північнокримського та Індоло-Кубанського прогинів. Виділено чотири типи розрізу товщі, що різняться за вмістом у їхній структурі кластогенних (пісковик, алевроліт) літотипів, просторово-вікове поширення яких характеризується певною латеральною зональністю, що відображають побудовані літолого-фаціальні моделі. Детально вивчені петрографічні особливості основних типів порід. Побудовано літмологічні перетини, які дали змогу встановити ярусну структуру розрізу товщі, що проявилась у розвитку двох регіональних та локальної кластогенних пачок, розмежованих пелітоморфними утвореннями. Реконструйовано седиментолого-палеоокеанографічні обстановки осадонагромадження базальної кластогенної пачки нижнього майкопу та побудована відповідна модель. Виокремлено два седиментаційні басейни з різною гідродинамікою та умовами седиментації: внутрішній Одесько-Керченський (закритий, естуарієвий, північний) та зовнішній Чорноморський (відкритий, південний), що розмежовані Кілійсько-Каламітсько-Кримсько-Кавказькою грядою підводно-надводних височин. У зовнішньому відкритому до океанічних вод Чорноморському седиментаційному басейні домінували прибережно-морські умови з накопиченням глинистих, алевро-глинистих і алевритових мулів фаціальних зон типу “шельфова рівнина”, “вздовжбереговий бар” та “конус виносу”. У внутрішньому закритому Одеському седиментаційному басейні домінували прибережно-морські та алювіально-дельтові умови осадонагромадження. Скид уламкового матеріалу забезпечували чотири річкові системи, які дренували сучасні терени західного Причорномор’я (Молдавська палеосуша), формуючи незначні за площею та потужністю псамо-алевритові вузлові тіла фаціальних зон: “русло”, “гирловий бар”, “конус виносу” та розмежовуючих їх, сформованих в осьових зонах конседиментаційних піднять тіл фаціальної зони “вздовжбереговий бар”. **Наукова новизна**. Вперше, за результатами комплексних літогенетичних досліджень, реконструйовані обстановки осадонагромадження базальної кластогенної пачки нижньо-олігоценової товщі в межах Азово-Чорноморського регіону. **Практична значущість**. Вивчення особливостей літологічної будови товщі та створення седиментаційних моделей сприятиме уточненню певних питань стратиграфічного характеру, з’ясуванню просторово-вікового поширення осадових тіл різного складу та генезису, що слугуватиме геологічною основою для більш обґрунтованого прогнозу просторово-вікового поширення нафтогазоперспективних об’єктів.

Ключові слова: Азово-Чорноморський регіон, олігоцен, палеоокеанографія, алювіально-дельтова система, конус виносу, шельф.

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СЕДИМЕНТОГЕНЕЗ НИЖНЬОМАЙКОПСЬКИХ (НИЖНЬООЛИГОЦЕНОВЫХ) ОТЛОЖЕНИЙ АЗОВО-ЧЕРНОМОРСЬКОГО РЕГИОНА

Цель. Исследование литологических особенностей осадочного комплекса ранньоолигоценового возраста в пределах Азово-Черноморского региона и реконструкция условий его осадонакопления. **Методика.** Методика включает литолого-фациальный, минерально-петрографический, литмологический, електрофациальний и седиментолого-палеоокеанографический анализы. **Результаты**. Установлено, литологическую структуру разреза и литолого-фациальною зональность нижньоолигоценовои (нижньомайкопськои) толщи Каркинитско-Северокрымского и Индоло-Кубанского прогибов. Выделены четыре типа разреза толщи, различные по содержанию в их структуре кластогенных (песчаник, алевролит) литотипов, пространственно-возрастное распространение которых характеризуется определенной латеральной зональностью, что отображають построеные литолого-фациальные модели. Подробно изучены петрографические особенности основных типов пород. Построено литмологические сечения, которые позволили установить ярусную структуру разреза толщи, проявилась в развитии двух региональных и локальной кластогенных пачек, разделенных пелитоморфными образованиями.

Реконструировано седиментолого-палеоокеанографические обстановки осадонакопления базальной кластогенной пачки нижнего майкопа и построена соответствующая модель. Выделены два седиментационные бассейны с разной гидродинамикой условий седиментации: внутренний Одесско-Керченский (закрытый, эстуариевий, северный) и внешний Черноморский (открытый, южный), что разграничены Килийского-Каламитского-Крымско-Кавказской грядой подводно-надводных возвышенностей. Во внешнем открытом в океанических водах Черноморском седиментационном бассейне доминировали прибрежно-морские условия с накоплением глинистых, алевро-глинистых и алевритовых илов фациальных зон типа «шельфовая равнина», «вздовжбереговой бар» и «конус выноса». Во внутреннем закрытом Одесском седиментационном бассейне доминировали прибрежно-морские и аллювиально-дельтовые условия осадонакопления. Сброс обломочного материала обеспечивали четыре речные системы, дренировавшие современные территории западного Причерноморья (Молдавская палеосуша), формируя незначительные по площади и мощности псамо-алевритовые узловые тела фациальных зон "русло", "устьевой бар", "конус выноса" и разделяемые их, сложившиеся в осевых зонах конседиментацийние поднятия тел фациальной зоны "вздовжбереговий бар". **Научная новизна**. Впервые, по результатам комплексных литогенетических исследований, реконструированы обстановки осадонакопления базальной кластогенной пачки нижньоолигоценовои толщи в пределах Азово-Черноморского региона**. Практическая значимость**. Изучение особенностей литологического строения толщи и создание седиментационных моделей будет способствовать уточнению определенных вопросов стратиграфического характера, установлению пространственно-возрастного распространения осадочных тел различного состава и генезиса, служить геологической основой для более обоснованного прогноза пространственно-возрастного распространения нефтегазоперспективных объектов.

Ключевые слова: Азово-Черноморский регион, олигоцен, палеоокеанография, аллювиально-дельтовая система, конус выноса, шельф.

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