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**BIOSTRATIGRAPHY OF THE PALEOGENE SEDIMENTS FROM THE UKRAINE
BY THE PLANKTONIC MICROFOSSILS**

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The interpretation of the large dataset concerning the spatial-temporal distribution of Planctonic Foraminifera, Calcareous nannofossils and Dinocysts in the Paleogene sediments of Ukraine is provided. The characteristics of the stratigraphic distribution of planktonic fossil assemblages in the Paleogene sections, their specifics of the zonal subdivision based on the defined correlation levels are given. As a result of an integrated study the zonal subdivision of Paleogene sediments of Ukraine is substantiated, and an interregional correlation of various facies of the Paleogene sections with the International Stratigraphic Scheme is undertaken. Biozonal scheme based on the planktonic microfossils of the Paleogene of Ukraine is given.

Key words: planktonic foraminifera, calcareous nannofossils, dinocysts, biozonal scheme, correlation, Paleogene, Ukraine.

Introduction. Paleogene deposits in Ukraine are located in the Carpathians, Crimea, Kerch peninsula, Azov and Black Sea basin, East European platform. In the Carpathian-Black Sea region of Tethys the most complete sections of Paleocene deposits are established, which in terrigenous-carbonate, terrigenous-siliceous and carbonate formation. Within northern Ukraine (the territory of the East European platform) the epicontinental basins of Paleoatlantic “boreal” ocean are developed. In the stratigraphic structure of this region, which differs from the southern one by incomplete sections, due to the mainly noncarbonate sedimentation the paleogeographic connections between Tethys and Paleo-Atlantic (boreal) basins are clearly traced. Detailed stratification and substantiation of the spatial-temporal relationships of Paleogene formations of the Tethyan and Boreal-Atlantic segments within Ukraine are based on the study of microfossils, namely, planktonic foraminifera, benthic foraminifera (secreted and agglutinated), calcareous nannofossils, dinoflagellates, diatoms, radiolarians, sponge spicules. Nearly all biostratigraphic charts of the Carpathian, Crimea, Black-Azov Sea regions are generated based on these microfossil groups. The planktonic, benthic foraminifera and calcareous nannofossils are the marker horizon groups that are used for terrigenous-carbonate formations

stratifications, while agglutinated foraminifera, dinoflagellates, sponges spicules, diatoms, radiolarians are more useful for terrigenous-siliceous formations biostratigraphy. The developed biozonations that are based on planktonic or pelagic organisms are of great importance for both regional and global correlations, majorly due to the use of microfossils in determining the boundaries of the main stratigraphic units of the International Stratigraphic Scale (ISC).

Methods and Material. The results of individual author studies of numerous sections, outcrops and drills in Paleogene sections of Carpathian, Southern and Northern regions of Ukraine, processing of large information on the spatial and temporal distribution of planktonic foraminifera, calcareous nannofossils and dinocysts are done. We have examined the presence of microfossils from numerous Paleogene sections from outcrop and borehole material of the Carpathian, Southern (North Black Sea region, Crimea, Kerch peninsula, Azov and Black Sea basins) and Northern (Ukrainian Shield, Dnieper-Donets Depression) regions of Ukraine. Proposed microplanctonic biozonation of Paleogene sediments from Ukraine is based on the integrated studies with bio-, litho-, cyclo- and seismostratigraphic, paleoecological, facies, sedimentological, structural-tectonic methods. The datum levels and the position of the boundaries of diverse stratigraphic units were determined based on the stratigraphical distribution of orthostatigraphic and parataxonomic groups of fauna and flora with consideration of various processes and events. The interpretation of the large dataset concerning the spatial-temporal distribution of foraminifera, calcareous nannofossils and dinocysts in the Paleogene enabled to establish the quality and characteristics of the stratigraphic relations of the planktonic assemblages in the Paleocene-Eocene-Oligocene sections, as well as their cyclicity within the formations. The specifics of the zonal subdivision based on the established correlation levels are provided. Almost all stratigraphic work with detailed stratification of Paleogene sediments were accompanied by microfaunal research and were due to the work of a large group of paleontologists who studied foraminifera in research and production facilities.

Major contributions in the development of biozonal charts of Paleogene deposits based on foraminifera were done by O. K. Kaptarenko-Chernousova (1956–1967), N. N. Subbotina (1939-1960), V. G. Morozova (1939-1967), Ye. K. Shutsкая (1965, 1970, 1974), W. Bolli (1966), W. H. Blow (1979), W. Berggren et al. (1995), V. A. Krashennnikov et al. (1998-2007), V. N. Beniamovski (2001), E. M. Bugrova (2001). We have adopted the biozonal charts for the Carpathian-Crimea-Caucasus region (N. V. Maslun et al., 2015) [3 – 14, 17, 18, 20, 21, 24].

The calcareous nannofossil biozonations were introduced by M. Wade, H. P. Mohler, W. W. Hay, (1967), E. Martini (1971), D. Bukry (1973, 1980). The first calcareous nannofossil biostratigraphy of the Paleogene sediments of the Bakhchisaray section of Crimea was developed by A. S. Andreeva-Grigorovich (1973). A detailed research of the stratigraphic distribution of calcareous nannofossils from the Paleogene sections of the Carpathian region and other southern areas of the former USSR was undertaken in framework for the development of a regional stratigraphic scale of the Paleogene deposits for the southern regions of Ukraine (A. S. Andreeva-Grigorovich, N. G. Muzylöv, I. P. Tabachnikova (1991)) [1, 3, 15, 16, 19, 21 – 23].

The Dinocyst biozonal subdivision of the Paleogene sediments is related to publications by Costa, Downie (1976), Chataneaneuf, Gruas-Cavagnetto (1978), Martini (1970, 1971) were

published. A. S. Andreeva-Grigorovich (1985, 1991, 1994) developed the first Dinocyst biozonal scales for the Paleogene of the Carpathian, Crimean-Caucasus and the Caspian regions of the former Soviet Union. The Dinocyst biozonal scale of the Paleogene sediments of Ukraine has undergone some improvements and refinements (A. S. Andreeva-Grigorovich, T. V. Shevchenko, E. S. Oleinik (2011)) [2].

Zoning by planktonic foraminifera, calcareous nannofossils and dinocysts in the Paleogene sediments from Ukraine.

Paleocene deposits of Ukraine are represented by the upper part of the Rusychanian regional stage and the lower part of the Karpiynian regional stage in the Carpathian region, by the Psolskian and Merlynskian stages of the Sumian regional stage in the Northern Ukraine regions, by the Bilokamian and Kachian regional stages in the Southern Ukraine region.

Danian. In the lowest part of the Danian stage are determined planktonic foraminifera zone **Parvularogoglobigerina eugubina** (in Ukrainian Carpathians, Kerch Peninsula and South-Eastern Crimea), calcareous nannofossil zone **NP1 – Biantholithus sparsus** (in the Ukrainian Carpathians, Crimea and the southern part of the Eastern European Platform), dinocysts zone **DP1 Carpatella cornuta s. str., DP1a Carpatella cornuta s. str.** subzone (in Carpathian Mountains, Northern Ukraine, Mountaneous Crimea). In the Lower Danian stage are defined planktonic foraminifera zone **Eoglobigerina taurica** (in Crimea, Black Sea shelf and in the Northern Black Sea coast), calcareous nannofossil zone **NP2 – Cruciplacolithus tenuis** (in the Carpathian Mountains and Crimea) and Dinocysts subzone **DP1b Cerodinium striatum** (in the Carpathian Mountains).

In the Middle part of Danian stage foraminifera zone **Globoconusa daubjergensis – Parasubbotina pseudobulloides** (in Northern Ukraine, Tarkhankut area of Crimea, Kerch peninsula and the Black Sea shelf), nannoplankton zone **NP3 – Chiasmolithus danicus** (in the Carpathian Mountains, Dnipro-Donets Depression, Mountaneous Crimea) and the middle part of dinocysts subzone **DP1b Cerodinium striatum** were established.

In Upper Danian foraminifera zone **Acarinina inconstans** zone is defined in Crimea, Kerch Peninsula and the Northern Black Sea region.

Nannoplankton zone **NP4 – Ellipsolithus macellus** (Upper Danian – Lower Selandian) was established in Carpathian Mountains. In the North-Western Black Sea shelf the upper subzone *Sphenolithus primus* (NP4b) of the Quillevere et al (2004) zonation has been established.

Selandian. In the lowest part of the Selandian deposits planktonic foraminifera zone **Morozovella angulata** is identified in Crimea, Kerch peninsula, Northern Black Sea coast region and Black Sea shelf. In the Ukrainian Carpathians, the *Morozovella angulata* zone of Lower Selandian correlates to the *Morozovella angulata* and *Morozovella conicotruncata* zones of Southern Ukraine. In the Lower Selandian foraminifera zone **Morozovella conicotruncata** is defined in Crimea, Kerch Peninsula, Northern Black Sea coast region.

In the middle part of Selandian foraminifera zone **Igorina djanensis** (at the foothills area of the Crimea Mountains) and nannoplankton zone **NP5 – Fasciculithus tympaniformis** (in Ukrainian Carpathians; Dnipro-Donets Depression; Black Sea shelf; Crimea) are determined.

The Upper Selandian foraminifera zone **Globanomalina pseudomenardii** is defined in Ukrainian Carpathians. The zone corresponds to the interval of *Igorina djanensis* and *Acarinina subsphaerica* of the South Ukraine region.

Selandian – Thanetian dinocysts zone **DP2 Cerodinium speciosum s. I** is subdivided into three subzones – DP2a, DP2b, DP2c. Selandian subzone **DP2a Cerodinium speciosum** is established in Ukrainian Carpathians, Northern and South Ukrainian regions.

Upper Selandian – Lower Thanetian calcareous nannofossil zone **NP6 – Heliolithus kleinpellii** is defined in Ukrainian Carpathians, Black Sea shelf, Crimea, Western Black Sea coast area.

Thanetian. In the Lower Thanetian deposits foraminifera zone **Acarinina subsphaerica** (in Crimea, Kerch peninsula, Northern Black Sea coast area and Black Sea shelf), nannoplancton zone **NP7 – Discoaster gemmeus** (in Carpathian, Crimea, the Northern Black Sea coast) and dinocysts subzone **DP2b Alisocysta margarita** (in Carpathian region) are defined. Thanetian dinocysts subzone **DP2c Rottnestia borussica** is determined in Ukrainian Carpathians.

In the Upper Thanetian foraminifera zone **Acarinina acarinata** (in Ukrainian Carpathians, Crimea, Kerch Peninsula, Northern Black Sea coast area), Nannoplancton zones **NP8 – Heliolithus riedelii** (in Ukrainian Carpathians; Black Sea shelf, Crimea, Western and Eastern Black Sea coast areas) and **NP9 – Discoaster multiradiatus** (in Ukrainian Carpathians, Northern Black Sea Coast and Mountaneous Crimea), dinocysts zone **DP3 Apectodinium homomorphum** (in Ukrainian Carpathians and South Ukrainian region) are determined.

Eocene deposits in Ukrainian represented by Karpiynian regional stage in Carpathian, Kanivsky, Buchaksky, Kievsky and Obukhivsky Formations in the North Ukraine region, Bakhchisaraysky, Simferopolian, Novopavlian, Kumian, Almian regional stages.

Ypresian. In the Lower Ypresian sediments are determined planctonic foraminifera zone **Morozovella subbotinae** (in the Ukrainian Carpathians, Mountaneous Crimea, Kerch Peninsula, Northern Black Sea coast and the Black Sea shelf), calcareous nannofossil zones **NP10 – Tribrachiatus contortus** (in Trans-Carpathian region) and **NP11 – Discoaster binodosus** (in Carpathians), dinocysts zones **DP4 – Wetzeliella mezkelfeldensis** and **DP5 – Dracodinium simile**, **DP6 – Dracodinium varielongitudum** (in Carpathians and Crimea).

Middle Ypresian calcareous nannofossil zone **NP12 – Tribrachiatus orthostylus** is defined in Ukrainian Carpathians, Mountaneous Crimea, Kerch Peninsula and the Northern Black Sea Coast.

In the Upper Ypresian are determined the planctonic foraminifera zone **Morozovella aragonensis** (in Ukrainian Carpathians, Crimea, Kerch Peninsula, Northern Black Sea coast and the Black Sea shelf), calcareous nannofossil zone **NP13 – Discoaster lodoensis** (Ukrainian Carpathians, Crimea).

Upper Ypresian – Lower Lutetian foraminifera zone **Acarinina bullbrooki** is established in the Ukrainian Carpathians, Crimea, Kerch Peninsula, Northern Black Sea coast and the Black Sea shelf.

Upper Ypresian – Lutetian dinocysts zone **DP7 Charlesdowniea coleothrypta s.l.** (subzones **DP7a Charlesdowniea coleothrypta s. str.** and **DP7b Enneadocysta arcuata**) is determined in Ukrainian Carpathians and Crimea.

Lutetian. In the lower part of Lutetian sediments the foraminifera zone **Acarinina ro-tundimarginata** (in the Ukrainian Carpathians, Crimea, Kerch Peninsula, Northern Black Sea and Black Sea shelf), nannoplancton zone **NP14 – Discoaster subladoensis** (in Carpathian region, Crimea and the Northern Black Sea coast) are determined.

In the middle of Lutetian sediments nannoplancton zone **NP15 – *Nannotetrina fulgens*** is determined in Ukrainian Carpathians, Kryviy Rih iron ore basin, Dnipro region, Crimea and the Kerch Peninsula, Black Sea coastal area.

Upper Lutetian foraminifera zone ***Globigerinatheka subconglobata*** is defined in Southern Ukraine)

Upper Lutetian – Lower Bartonian nannozone **NP16 – *Discoaster tani nodifer*** is defined in Ukrainian Carpathians, Crimea and the Kerch Peninsula. In the North Ukraine region this nannozone is designated as the subzone of the *Discoaster bifax* zone, *Reticulofenestra umbilica* (CP13) zone. It is determined in Kryviy Rih iron ore basin, on the north-eastern side of the Dnipro-Donets Depression, in the Kiev Dnipro region. Upper Lutetian – Lower Bartonian Dinocysts zone **DP8 *Enneadocysta multicornuta*** is defined in the Ukrainian Carpathians and Crimea.

Bartonian foraminifera zone ***Subbotina turcmenica*** is defined in Crimea and Northern Black Sea region. In the Ukrainian Carpathians the *Subbotina turcmenica* zone corresponds to the *Hantkenina alabamensis* zone. Bartonian dinocysts zone **DP9 *Rhombodinium draco*** is defined in the Ukrainian Carpathians and Crimea.

In Upper Bartonian sediments the nannozone **NP17 – *Discoaster saipanensis*** (in the Ukrainian Carpathians, Crimea, Kerch Peninsula and the Northern Black Sea coast, Kiev Dnipro region) and dinocysts zone **DP10 *Rhombodinium porosum*** (in the Ukrainian Carpathians and Crimea) are determined.

Priabonian dinocysts zone **DP11 *Rhombodinium perforatum* / *Charlesdowniea clathrata angulosa*** is identified in the Ukrainian Carpathians and Crimea.

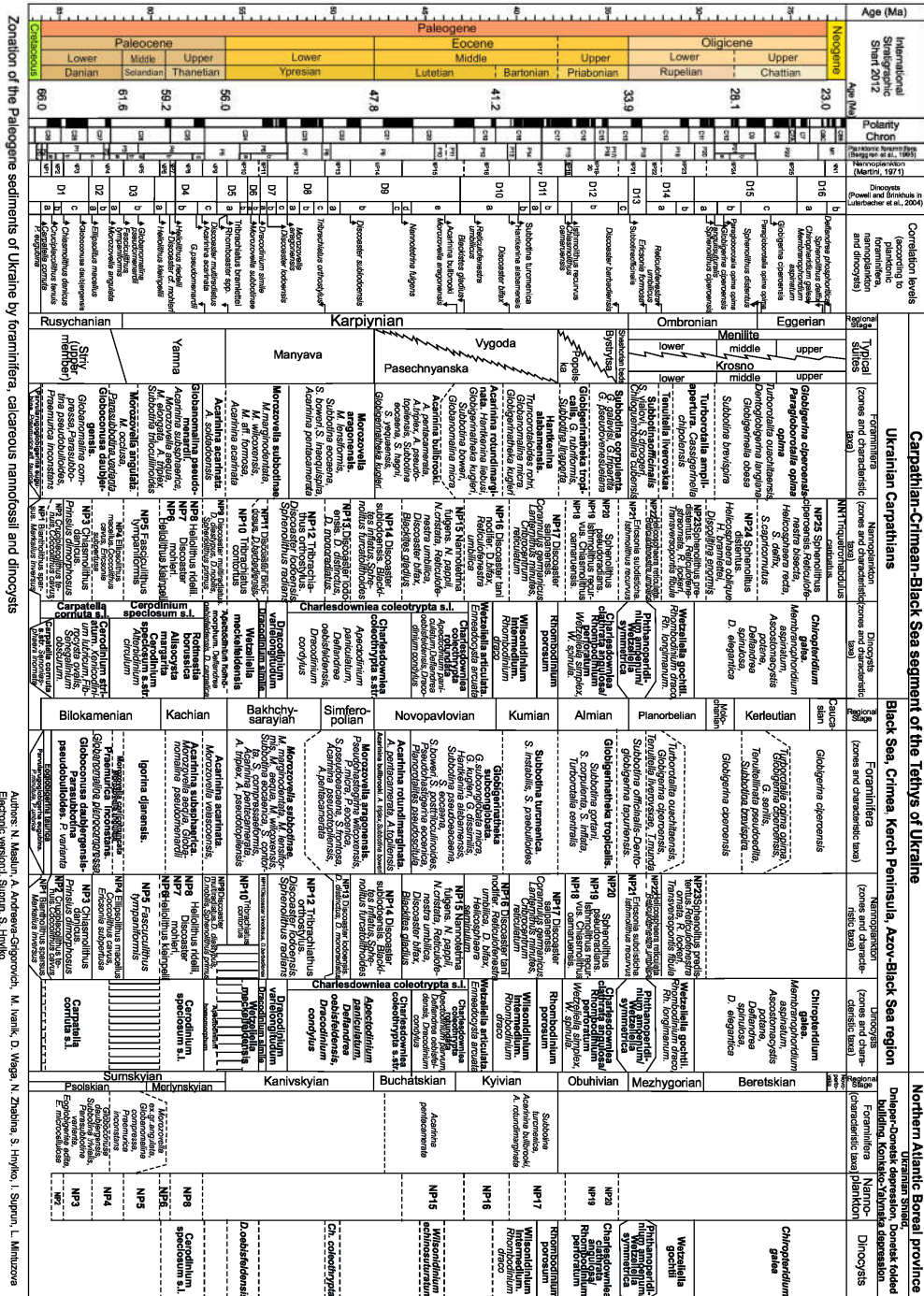
Lower Priabonian foraminifera zone ***Globigerinatea tropicalis*** (in Ukrainian Carpathians and Crimea), nannozone **NP18 – *Chiasmolithus oamaruensis*** (in Ukrainian Carpathians, Crimea, North Black Sea shelf) are determined.

Upper Priabonian foraminifera zone ***Subbotina corpulenta*** is determined in Carpathian region. In the Southern region, the *Globigerinatea tropicalis* and *Subbotina corpulenta* zones of the Carpathian region correspond to the *Globigerinatea tropicalis* s. l. zone. It was derived in Crimea, Kerch Peninsula, Northern Black Sea coast and the Black Sea shelf. In the upper part of Priabonian nannozone **NP19 – *Isthmolithus recurvus*** (in Ukrainian Carpathians, Crimea and on the Black Sea shelf) and **NP20 – *Sphenolithus pseudoradians*** (in Ukrainian Carpathians and Crimea) are defined.

Upper Priabonian – Lower Rupelian nannozone **NP21 – *Ericsonia subdisticha*** is defined in Ukrainian Carpathians and Crimea.

Oligocene deposits are represented by the Ombronian regional stage and the lower part of the Eggerian in the Carpathian region, by Planorbellian, Molochanian, Kerleutian and Caucasian (Lower Caucasian substage) regional stages in the Southern regions of Ukraine.

Rupelian. In the Lower Rupelian deposits planctonic foraminifera zone ***Subbotina officinalis* – *S. vialovi*** is determined in the Ukrainian Carpathians, Crimea and the Northern Black Sea coastal area, and Rupelian foraminifera zone ***Cassigerinella chipolensis*** is defined in the Ukrainian Carpathians. Lower Rupelian calcareous nannofossil zone **NP22 – *Helicosphaera reticulata***, and Rupelian **NP23 – *Sphenolithus predistentus*** zone are identified in the Ukrainian Carpathians, Crimea and the Northern Black Sea. Lower Rupelian dinocysts zones **DP12 *Phthanoperidinium amoenum* / *Wetzeliiella symmetrica*** and **DP13 *Wetzeliiella gochtii*** are determined in the Ukrainian Carpathians, North Ukraine region, Crimea and the Northern Black Sea coast.



Zonation of the Paleogene sediments of Ukraine by foraminifera, calcareous nanofossils and dinocysts

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Upper Rupelian – Chattian Planctonic foraminifera zone **Globigerina ampliapertura** is established in the Ukrainian Carpathians and South Ukraine regions. Upper Rupelian – Lower Chattian nannozone **NP24 – Sphenolithus distentus** is determined in the Ukrainian Carpathians.

Chattian sediments contain the foraminifera zone **Tenuitellinata ciperoensis – T. opima opima** (it is recognized in the Ukrainian Carpathians, Northern Black Sea, Crimea, Azov-Black Sea offshore sections), nannozone **NP25 – Sphenolithus ciperoensis** (in the Ukrainian Carpathians).

Upper Rupelian and Chattian dinocysts zone **DP14 Chiropteridium galea** is determined in Carpathians and the Northern Black Sea region.

Conclusions. Thus, a complete sequence of planktonic foraminifera, calcareous nannofossils, and dinocysts biozonations of the Paleogene deposits from the Carpathian, South and North regions of Ukraine is determined. The most complete sequence of these planktonic microfossils is defined in Carpathians and Crimea. The characteristics of the stratigraphic distribution of planktonic fossil assemblages in the Paleogene sections, their specifics of the zonal subdivision based on the defined correlation levels are given. As a result of an integrated study the zonal subdivision of Paleogene sediments of Ukraine is substantiated, and an interregional correlation of various facies of the Paleogene sections with the International Stratigraphic Scheme is undertaken. Biozonal scheme based on the planktonic microfossils of the Paleogene of Ukraine is given.

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**БІОСТРАТИГРАФІЯ ПАЛЕОГЕНОВИХ ВІДКЛАДІВ УКРАЇНИ ЗА
ПЛАНКТОННИМИ МІКРОФОСИЛІЯМИ**

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Визначено закономірності та особливості стратиграфічної приуроченості планктонних асоціацій викопних решток у палеогенових відкладах України на підставі опрацювання значної інформації щодо просторово-часового розподілу планктонних форамініфер, нанопланктону і диноцист. Унаслідок комплексних досліджень обґрунтовано зональний поділ палеогенових відкладів України, виконано міжрегіональну кореляцію різнофаціальних палеогенових розрізів і кореляцію з Міжнародною стратиграфічною шкалою. Наведено схему зонування за планктонними мікрофосиліями палеогенових відкладів України.

Ключові слова: планктонні форамініфери, нанопланктон, диноцисти, біозональна схема, кореляція, палеоген, Україна.

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