количестве моделей геологических структур. Большинство моделей имеют типичные характеристики структур Украинского щита. Несомненно, новый метод нуждается в дальнейшем исследовании и совершенствовании. С развитием технологий один из основных недостатков данного метода, состоящий в том, что на практике сеть наземных измерений является крайне неравномерной, постепенно нивелируется. Появляется всё расширяющаяся возможность использовать новые высокоточные измерения геомагнитного поля, полученные спутниками. Это также позволит получать равномерную сеть наблюдений поля на значительных территориях. На такой сети методика визуализации данных с использованием мнимых векторов и скалярных импедансов может быть достаточно эффективной.

Интегрирование теоретических и программно-алгоритмических разработок позволяет сформировать технологию комплексной интерпретации геолого-геофизических данных, предназначенных для решения задач нефтегазовой геологии. Актуальность и важность полученных результатов обуславливает прогноз новых перспективных участков, а также переоценку запасов известных месторождений.

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JUSTIFICATION OF THE ALBIAN-CENOMANIAN BORDER OF THE KARKINITSKO-NORTH CRIMEAN DEFLECTION BY PALYNOLOGICAL DATA

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Based on the results of the study of microfossils, we carried out stratification of the Albian and Cenomanian sediments of the Karkinitsko-Pivnichnokrymsky deflection on the example of wells 27, 29, 31 drilled on the territory of the Zakhidno-Oktyabrska area. There are two spore-pollen complexes: Albian and Cenomanian. For the first time, the Cretaceous rocks were division according to the systematic composition

of dinocysts, as well as the paleontological characteristics of sediments by other groups of microfossils - spores and pollen of higher plants, remnants of green algae, acritarch and microforaminifera. Zonal taxa of Albian and Cenomanian on dinocysts and spores of higher plants have been established, as a result, the boundary between the Lower and Upper Cretaceous deposits has been drawn in the studied region.

Key words: biostratigraphy; dinocysts; spore-pollen complexes; Albian and Cenomanian sediments; Cretaceous; Karkinitsko-North Crimean deflection.

По результатам изучения микрофосилий проведена стратификация отложений альба и сеномана Каркинитско-Северо-Крымского прогиба на примере скв. № 27, 29, 31, пробуренных на территории Западно-Октябрьской площади. Выделены два спорово-пыльцевых комплекса: альбский и сеноманский. На исследуемой территории впервые проведено расчленение меловых пород по систематическому составу диноцист, а также дополнена палеонтологическая характеристика отложений по другим группам микрофосилий – споры и пыльца высших растений, остатки зеленых водорослей, акритархи и микрофораминиферы. Установлены зональные таксоны альба и сеномана по диноцистам и спорам высших растений, в результате в исследованном регионе проведена граница между отложениями нижнего и верхнего мела.

Ключевые слова: биостратиграфия; диноцисты; спорово-пыльцевые комплексы; отложения альба и сеномана; мел; Каркинитско-Северо-Крымский прогиб.

Introduction. Cretaceous sediments of the Plain Crimea in the last century began to be studied by stratigraphers-paleontologists such as A. T. Bogaets, G. V. Boychuk, R. Y. Leschukh, M. A. Menkis, P. F. Gozhik, L. F. Plotnikova and others [1, 2, 4]. Palynological studies of this region and the data of spore-pollen analysis were conducted by G. A. Orlova-Turchina, M. A. Voronova [8, 16]. Over the last decade, a significant contribution to the elucidation of the geological structure and stratigraphy of the Cretaceous deposits of the Karkinitsky deflection was made by R. Y. Leschukh, N. M. Zhabina, Ya. M. Tuzyak, L. M. Yakushyn, I. I. Ishchenko and others [6, 15]. However, according to paleoalgological analysis, the division of Cretaceous deposits has not been carried out in the study area before. Also, the question of the nature of stratigraphic contact between the series of the Cretaceous system in the Karkinitsky deflection remains debatable. In this regard, our task was to supplement the paleontological characteristics of existing stratigraphic schemes of the region and to stratify in detail the sediments of the Albian and Cenomanian.

Material and methods of research. The objects of our study were microfossils (microphytoplankton, spores and pollen of higher plants and microforaminifera) from Cretaceous deposits of wells 27, 29 and 31 drilled in the Zakhidno-Oktyabrska area of the Karkinitsko-North-Crimean deflection. Earlier, we conducted research in this region on the example of one well 29 [9, 11]. In this work, we compared the results of the studied sediments of the Albian and Cenomanian of three wells in the area of Zakhidno-Oktyabrska area and supplemented the paleontological characteristics of the stratigraphic schemes of the studied region (fig.).

The main methods for determining the relative age of rocks in our studies were biostratigraphic (palynological) and lithostratigraphic.

Analytical work was performed using an Ergaval microscope at the Institute of Geological Sciences of the National Academy of Sciences of Ukraine. Samples of microfossils are stored in the Department of Stratigraphy and Paleontology of Mesozoic Sediments of the Institute of Geological Sciences of the National Academy of Sciences of Ukraine. To identify the dinocyst used classification R. A. Fensome and others [3].

Geological setting. The Karkinitsko-North Crimean deflection occupies the northern part of the Plain Crimea and the adjacent from the west water area of the north-western shelf of the Black Sea. The deflection is a sublatitudinal and asymmetric depression that merges in the east with the Siva depression, with which they form the only deep area of subsidence in the northern part of the plain Crimea. They are located in the area of the joint of the Eastern European platform and the Scythian plate. The beginning of the formation of the Karkinitsky-North Crimean deflection dates

back to the beginning of the Albian period. Within its boundaries, 3 500–3 600 m of sedimentary formations were deposited without a break from the Lower Cretaceous to the Miocene. The pre-Cretaceous foundation of the Karkinitsky-North Crimean deflection is broken by disjunctive disturbances and has a block structure. The Karkinit-North Crimean graben-like deflection is filled with a thick layer (up to 10-11 km) of Mesozoic-Cenozoic sediments.

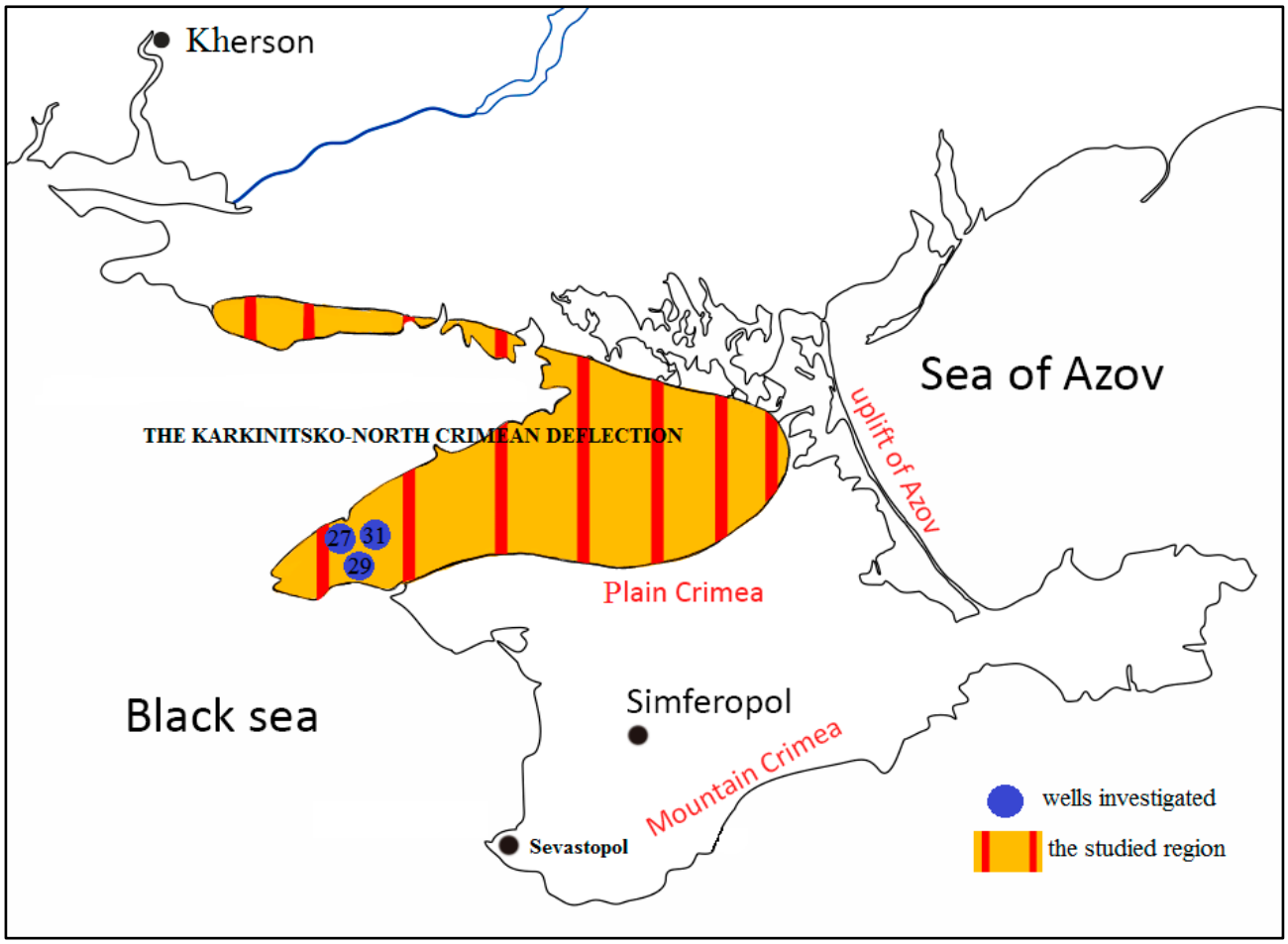

Figure – Map-scheme of the research region

Albian sediments in the Plain Crimea are widespread. Their thickness varies from the first tens of meters in the foothills to more than 2 360 m in the most submerged part of the North Crimean deflection (Serebryanska arae). The sediments are represented by gray, dark gray (to black) siltstone argillites with layers of siltstones [15].

Sediments of the Cenomanian stage are widespread throughout the territory of the Plain Crimea. These deposits are represented by effusive pyroclastic rocks, sandstones, siliceous siltstones, clay marls. Thickness about 300 m [15].

Palynological results. According to paleoalgological analysis of samples of well 29 (2 902–2 682 m) and well 31 (2 975 m) traced the dinocyst complex of the Pterodinium aliferum zone, dating to the Early Albian and corresponding to the eponymous zone (in the same stratigraphic range) of the International Stratigraphic Scale [5]. The complex contains the remains of green algae: *Tasmanites* sp. and acritarchs: *Fromea* sp.

Samples from well 31 (2 798–2 772 m) contain dinocysts *Cribroperidinium* spp. Identified a lot of *Spiniferites ramosus* (Ehrenberg) Mantell., *Achomosphaera ramulifera* (Deflandre) Evitt., *Pterodinium* spp., *Systematophora* sp., *Chlamydophorella nyei* Cookson and Eisenack,

Odontochitina sp. In the complex there are single forms *Oligosphaeridium* sp., *Cleistosphaeridium* sp., *Pervosphaeridium pseudohystrichodinium* (Deflandre) Yun Hyesu., *Prolixosphaeridium* sp., *Callaiosphaeridiu*m sp., *Batiacaspaera* sp., *Sentusidinium* sp. According to the position in the section and the analysis of the systematic composition of the samples, the sediments of the studied range can be dated as Middle-Late (?) Albian.

In samples from well 29 (2 228 m) and well 31 (2 772–2 287 m) the dinocyst complex of the zone Epelidosphaeridia spinosa was traced, dating as the end of the Late Albian–Early Cenomanian [10, 14] and corresponding to the upper part of the zone Cribroperidinium intricatum (Upper Albian) and the lower part of the zone Litosphaeridium siphoniphorum (end of Late Albian–Middle Cenomanian) of the International stratigraphic scales [5]. In samples from well 27 (2 394 m) many dinocysts belonging to the zonal and characteristic Cenomanian. These are *Litosphaeridium siphoniphorum* Cookson and Eisenack and *Callaiosphaeridium asymmetricum* (Deflandre and Courteville) Davey and Williams, *Achomosphaera ramulifera* (Deflandre) Evitt. and other. The complex contains the remains of acritarchs: *Baltisphaeridium longispinosum* (Eisenack) Eisenack.

According to spore-pollen-analysis in the studied samples from the sediments of wells 27, 29 and 31, layers with Albian and Cenomanian spore-pollen complexes have been established. Complexes have clear features of systematic composition, so in this study have a leading role.

The Albian spore-pollen complex consists of single spores of the Gleicheniaceae family (*Gleicheniidites senonicus* Ross., *G. angulatus* (Bolch.) Bolch., *Ornamentifera* sp.). Small forms of *Concavisporites jurienensis* Balme, *C. kainophyticus* (Krutz.) M. Voronova, *Cyathidites* sp. and spores of *Murosporoides* spp. are characteristic of this complex. The noted spores of *Corniculatisporites* sp. are characteristic of the Albian. Spores *Foveosporites* sp., *Ophioglossum* sp. are identified here. Bryophyte and lycophyte spores only make up very limited portions, not exceeding 2 % in relative abundance. The gymnosperms are represented by pollen of the families Pinaceae, Cupressaceae and others. The share of *Classopollis* pollen is up to 3 %. Angiosperm pollen is 8 % and is represented by *Clavatipollenites* sp., *Clavatipollenites hughessi* Coup., *Tricolpopollenites* sp., *Tricolpites* sp., *Tricolporopollenites* sp., *Retitricolpites* sp. The complex contains numerous remains of the structured wood.

The Cenomanian spore-pollen complex differs from the Albian one by a sharp decrease in the percentage of fern spores. There are single spores of *Gleicheniidites* sp., *Plicifera delicata* (Bolch.) Bolch., *Cicatricosisporites* sp., *Cyathidites* sp., *Lygodiumsporites* sp., *Ophioglossum cenomanicum* Chlon. Bean-shaped spores of *Polipodiumsporites* sp. are typical. In the complex there is a variety of pollen of gymnosperms – up to 50 %. A characteristic feature of the complex is the dominance among the gymnosperm pollen of coniferous families Pinaceae (*Pinuspollenites* spp., *Cedripites* spp.), Podocarpaceae and Ginkgoaceae, Cycadaceae. There is a variety of pollen of angiosperms – up to 25 % (*Liliacidites* sp., *Tricolpopollenites* spp., *Clavatipollenites* sp.). The complex contains numerous remains of the structured wood and tracheids.

Microforaminifers of *Subammobaculites* sp. indet., *Subtrochammina* sp. indet., *Subevolutinella* cf. *albensis* Nikit. et Vass., *Subhaplophragmoides* cf. *glomeratoformis* Zaspelova were observed in samples from Albian sediments; *Subvalvulineria* cf. *lenticula plummerae* Loett. from Cenomanian sediments. The findings of microforaminifera (insoles) do not give a clear definition of the age of the host sediments, but only supplement the paleontological characteristics of the studied sediments of Albian and Cenomanian.

Conclusions. The beginning of the Albian is marked by the appearance of the dinocyst *Pterodinium aliferum*. *Epelidosphaeridia spinosa* first appears at the end of the Late Albian, also, the end of the Albian is characterized by the short-lived existence of *Apteodinium maculatum* subsp. *grande* and the last presence of *P. aliferum*. *Odontochitina costata, Apteodinium deflandrei* appear for the first time in the Early Cenomanian, *Litosphaeridium siphoniphorum* first appears on the border of the Early and Middle Cenomanian.

The boundary of the lower and upper parts of the Cretaceous system is determined by the appearance of *Ophioglossum cenomanicum* spores in the Cenomanian sediments and an increase in the content of angiosperm pollen complexes.

The deposits of the territory of the Zakhidno-Oktyabrska area of the Karkinitsko-North-Crimean deflection are dated by an Albian and a Cenomanian according to the age of the fauna [15], according to own data of spore-pollen analysis, the first conducted palaeoalgological researches of this territory, also according to the carried-out correlation of similar age deposits and comparison of Albian and Cenomanian spore-pollen complexes established by previous researchers in adjacent territories – Black Sea basin, Plain and Mountain Crimea [1, 2, 8, 9, 11–13, 16].

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РУБЕЖИ ИЗМЕНЕНИЯ СОСТАВА РАСТИТЕЛЬНОСТИ УКРАИНЫ НА ПРОТЯЖЕНИИ ПОЗДНЕГО МИОЦЕНА И ПЛИОЦЕНА В КОНТЕКСТЕ ОБОСНОВАНИЯ ГРАНИЦ РЕГИОНАЛЬНЫХ СТРАТИГРАФИЧЕСКИХ ПОДРАЗДЕЛЕНИЙ

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Представлены результаты обобщения значительного массива данных по палинологической характеристике сарматских, мэотических, понтических отложений миоцена, киммерийских, куяльницких отложений плиоцена и их континентальных аналогов, а также субаэральных отложений эоплейстоцена Украины. Реконструированы рубежи изменения растительности Украины на протяжении позднего миоцена-плиоцена. На основании палинологических данных внесены предложения по обоснованию границ региональных стратиграфических подразделений неогена и плейстоцена Украины.

Ключевые слова: растительность; миоцен; плиоцен; плейстоцен; палинология; стратиграфия; Украина.

The results of generalization of a considerable array of data on the palynological characteristics of the Sarmatian, Meotian, Pontian deposits of the Miocene, Kimmerian, Kuyalnik deposits of the Pliocene and their continental analogues, as well as subaerial deposits of the Eopleistocene of Ukraine are presented. The frontiers of vegetation change in Ukraine during the Late Miocene-Pliocene are reconstructed. On the basis of palynological data, proposals were made to substantiate the borders of regional stratigraphic subdivisions of the Neogene and Pleistocene of Ukraine.

Keywords: vegetation; Miocene; Pliocene; Pleistocene; palynology; stratigraphy; Ukraine.

Введение. В связи с созданием модифицированных стратиграфических схем кайнозойских отложений Украины нового поколения, а также изменениями в Международной стратиграфической шкале (МСШ) особую актуальность приобретают вопросы палеонтологического обоснования границ средний-верхний миоцен, миоцен-плиоцен, нижний-верхний плиоцен, плиоцен-плейстоцен. Важной составляющей палеонтологических исследований разнофациальных верхнекайнозойских отложений Украины является палинологический метод, позволяющий уточнять возраст стратонов, выполнять внутри- и межрегиональную корреляцию разнофациальных пород, а также прослеживать этапность развития позднекайнозойской растительности.

Основные результаты. Анализ результатов палинологических исследований сарматских отложени Украины [5, 16] свидетельствует о том, что флоры раннего сармата и первой половины среднего сармата близки по составу. Флора первой половины среднего сармата отличается от раннесарматской увеличением роли широколиственных и термофильных пород, также уменьшением количества хвойных. Палинологические данные свидетельствуют также о том, что в конце среднего сармата началась перестройка таксономического состава флоры, наиболее ярко проявившаяся в позднесарматское время. В составе флор уменьшилось уча-