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Palynology of marine black sands from the Yaroshivka Quarry, Ukraine – a contribution to Middle Eocene palaeogeography of Northern Ukraine

Палінологія морських чорних пісків Ярошівського кар'єру (Україна): до палеогеографічних реконструкцій середнього еоцену Північної України

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Black sands of the Yaroshivka Beds (Middle Eocene, Lutetian) that directly overlie granitoids exploited in the Yaroshivka Quarry (northeastern peripheries of the Ukrainian Shield) have been studied for palynology. This study was conducted with an aim of palaeoenvironment reconstruction that could contribute to the palaeogeography of Ukraine in the Palaeogene. Deposits studied yielded both marine and continental palynomorphs. The former consist mainly of dinoflagellate cysts, Prasinophyceae algae, and acritarchs. Terrestrial palynomorphs are mainly bisaccate pollen grains. Representatives of both palynomorph groups are immature but they show high degree of mechanical damage. Particularly large specimens of chorate dinoflagellate cysts are almost exclusively preserved as torn-off fragments. Small proximate dinoflagellate cysts and tiny acritarchs are usually complete. Palynomorph assemblages described were interpreted as typical for marine, high energetic sedimentary setting located within a proximal zone of terrestrial influences. Subsequent progression of the Eocene transgression led to a complete inundation of the Ukrainian Shield in the area of our study. As a result, different palaeoenvironmental conditions appeared. They caused pronounced changes in palynofacies and palynomorphs assemblages found in the strata transitional to the overlying Kyiv Fm.
Keywords: palynology, dinoflagellate cysts, palynomorphs, palaeoenvironment, palaeogeography, Eocene, Northern Ukraine.

Проведено палінологічний аналіз чорних пісків, розкритих діючим кар'єром біля с. Ярошівка (північно-східна периферія Українського щита (УЩ)), які відносяться до ярошівської товщі середнього еоцену (лютет). Піски, що залягають безпосередньо на кристалічних породах УЩ, містять як морські (цисти динофлагелят, фікоми празінофітових водоростей, акритархи), так і континентальні (загалом, пилкові зерна хвойних рослин) паліноморфи. Збереженість палінологічного матеріалу нижче задовільної – наявний високий ступінь механічного пошкодження як морських, так і наземних викопних груп. Хоратні диноцисти, особливо крупні, представлені майже виключно розірваними фрагментами. Непошкодженими є лише дрібні диноцисти та дрібні акритархи. Описаний палінологічний комплекс інтерпретується як типовий для морського середовища з високою гідродинамічною активністю (прибережна зона). Подальше нарощування еоценової трансгресії призвело до затоплення УЩ в районі нашого дослідження та зміни палеогеографічних умов, які зафіксовані в палінофаціях перехідних до київської світи шарах.
Ключові слова: палінологія, цисти динофлагелят, паліноморфи, умови існування, палеогеографія, еоцен, Північна Україна.

INTRODUCTION

Palaeogene succession of Northern Ukraine contains a few horizons of black clastic deposits, commonly with brown-coal deposits. Terrestrial origin of these deposits is confirmed by occurrence of sporomorphs, higher plant remains, and lack of marine fossils. However, some black clastic strata, traditionally regarded as continental deposits, could accumulate in a marine environment. Such examples are black sands once exposed in the Yaroshivka Quarry where they lie upon crystalline basement of the Ukrainian Shield. They were treated as continental strata (the so-called sub-Kyiv Sands; Ukrainian name: підкиївські піски), that underlie the marine Kyiv Formation (Kiev Fm., sub-Kiev Sands – translit. from Russian) due to, i.a., occurrence of common coalified plant remains. More recently, however, marine fossils have been found there, including shark and bone fish teeth, and marine turtle remains, that witness for marine sedimentary setting. Our preliminary dinoflagellate cyst studies (Gedl, Shevchenko, 2010) also evidence their marine origin. In this paper, we present our further results of palynological studies of these black sands once exposed at Yaroshivka Quarry.

GEOLOGICAL SETTING

Sedimentary succession of Northern Ukraine is highly diversified as it rests on various structures of older substratum. The most prominent part of this substratum is the Ukrainian Shield built of Precambrian crystalline rocks that occupies most of northern part of Ukraine (Fig. 1). The Ukrainian Shield was since its beginning an elevated structure – its sedimentary cover consists of Jurassic and Cretaceous (preserved locally only) and Palaeogene-Neogene successions. To the north-east, the

Ukrainian Shield borders on the Dnieper-Donets Trough that separates it from another Precambrian rigid structure – the Voronezh Crystalline Massif. The trough begun to form as a rift system separating these two crystalline massifs in the Devonian; it is filled with a thick sequence of sedimentary rocks spanning the Devonian through the Neogene…

MATERIALS

The Yaroshivka Beds are dark-brown to black sands and muds, usually quartz with minor admixture of glauconite, that rest directly on Precambrian crystalline basement of the Ukrainian Shield or locally on the Kaniv Fm. Gravel transgressive layers in their base can be observed locally. The Yaroshivka Beds are known from the north-west and central parts of the Ukrainian Shield (Стратиграфическая схема…, 1987, 1993). The best exposures are in granite quarries near Fastiv (at villages of Yaroshivka and Byshev); they are also known from boreholes (Kaniv and Kamianske region).

At the Yaroshivka Quarry, their *locus typicus*, the Yaroshivka Beds reached up to 5 m thickness (Fig. 2). The basal part contains common gravel and coarse-grained sands (Fig. 2, C)...

METHODS

The samples were processed in the micropalaeontological laboratories of the Institute of Geological Sciences, Polish Academy of Sciences, Krakow, and Institute of Geological Sciences of NAS of Ukraine, Kyiv. The palynological procedure applied included 38% hydrochloric-acid (HCl) treatment, 40% hydrofluoric-acid (HF) treatment, heavy-liquid ($ZnCl_2$+HCl; density 2,0 $g \cdot cm^{-3}$) separation, ultrasound for 10-15 s and sieving at 10 µm on a nylon mesh. Nitric-acid (HNO_3) treatment was not applied.

The quantity of rock processed was 250 g for each sample. Palynological slides were made from each sample using glycerine jelly as a mounting medium. The rock samples, palynological residues and slides are stored in the collection of the Institute of Geological Sciences, Polish Academy of Sciences, Krakow.

RESULTS

All samples contain palynological organic matter, although its qualitative content differs throughout the section (Fig. 3). Samples 25–19 from the lower part of the Yaroshivka Beds at the Yaroshivka Quarry yielded high amounts of highly disintegrated, tiny structureless organic particles. A characteristic feature of this interval is frequent occurrence of bisaccate pollen grains, which represent over 90% of all sporomorphs. Spores, although infrequent, are also present (Plate I)…

INTERPRETATION

Results of our palynological study of the Yaroshivka Beds (the Yaroshivka Quarry), which are presented in this paper, are a record of palaeoenvironmental changes that took place during Middle Eocene transgression on the Ukrainian Shield. This transgression covered the Shield – an area, which up to then was emerged. During the Paleocene and Early Eocene the Ukrainian Shield was a land surrounded to the north-east by a basin where marine strata accumulated (the Dnieper-Donets Trough). During the Lutetian, uprising sea level led to flooding of the Ukrainian Shield and resulted in marine sedimentation in this region that for millions years was land…

DISCUSSION

Our interpretations of palaeoenvironmental conditions during deposition of the black sands of the Yaroshivka Beds are consistent with results of previous, partly unpublished studies. Fully marine conditions as based on dinoflagellate cysts are also indicated by occurrence of shark teeth that frequently occur in the basal part of the Yaroshivka Beds at the Yaroshivka Quarry…

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Палинология морских черных песков Ярошовского карьера (Украина): к палеогеографическим реконструкциям среднего эоцена Северной Украины

Проведен палинологический анализ черных песков, вскрытых действующим карьером возле с. Ярошовка (северо-восточная периферия Украинского щита (УЩ)), которые относятся к ярошовской толще среднего эоцена (лютет). Пески залегают непосредственно на кристаллических породах УЩ и содержат как морские (цисты динофлагеллат, фикомы празинофитовых водорослей, акритархи), так и континентальные (в основном пыльцу хвойных) палиноморфы. Сохранность палинологического материала ниже удовлетворительной – органикостенные микрофоссилии как морского, так и наземного происхождения механически повреждены. Особенно это отмечается среди крупных хоратных форм диноцист, они представлены исключительно разорванными формами. Неповрежденными являются только мелкие диноцисты, а также мелкие акритархи. Описанный палинокомплекс интерпретируется как типичный для морской среды с высокой гидродинамической активностью (прибрежная зона). Дальнейшее наращивание эоценовой трансгрессии привело к затоплению УЩ в районе нашего исследования и смене палеогеографических условий, которые зафиксированы в палинофациях переходных к киевской свите слоях.

Морская ярошовская толща является фациальным аналогом морской бучакской свиты – палинологически и литологически она демонстрирует проксимальную часть бучакского морского бассейна. Описанная толща – переходная фация в ряду (с запада на восток): буроугольная формация УЩ (континентальные условия) → ярошовская толща склона УЩ (прибрежно-мелководные (прибрежно-континентальные) условия) → бучакская свита склона УЩ / борта Днепровско-Донецкой впадины (морские условия). Толща прослежена вдоль северо-восточного склона УЩ, прилегающего к Днепровско-Донецкой впадине.

Ключевые слова: палинология, цисты динофлагеллат, палиноморфы, условия существования, палеогеография, эоцен, Северная Украина.