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LATE MIOCENE FLORA FROM KARLOVO BASIN (SOUTHERN BULGARIA). NEW FLORISTIC AND PALAEOECOLOGICAL DATA

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Abstract

This paper presents the results from taxonomical and palaeoecological analysis of the Late Miocene flora from Karlovo basin. The studied flora comes from borehole C-556 located in the eastern part of the basin. The percentage contribution of individual taxa allowed us to differentiate the main vegetation types in the area. The pollen data indicate widest distribution of mixed mesophytic forest communities (*Quercus*, *Fagus*, *Ulmus*, *Carya*, *Pterocarya*, *Carpinus*, *Betula*), existence of hygrophytic (swamp) forests and distribution of the herbaceous palaeocoenoses (high values of Poaceae, Chenopodiaceae, Apiacea, Asteraceae, *Artemisia*, *Thalictrum*, *Polygonum*, Caryophyllaceae, Cichorioideae, Lamiaceae). According to the pollen data, the palaeoflora from Karlovo basin reflects warm-temperate climate during the studied period.

Key words: Bulgaria, Karlovo basin, palaeoecology, pollen, Late Miocene

Introduction. The Neogene sediments from Southern Bulgaria contained important floristic information about the composition and character of the local and regional palaeofloras. The sediments from Karlovo basin are significant for the reconstruction of the palaeogeographical and palaeoecological situation during this period.

The macrofloristical data about the fossil flora from the basin have been absent until now. Object of palynological study were sediments from the western part of the basin from cores C-525, C-551, C-552 and C-567 [1–3]. The sediments from the eastern part have recently been a subject of pollen analysis and palynological subdivision [4]. Sparse vegetation data were presented in some studies based on petrographic and geochemical analysis of the lignites from the basin [5,6]. The diatom flora was also analysed [7,8].

Karlovo basin (Fig. 1) is a graben structure that is a result of fault movements during the Late Miocene – Quaternary development of the area. To the north it is limited by Stara planina Mt. and to the south – by differently-oriented faults from Sredna gora Mt. [9]. The lithostratigraphic units in the basin were described in detail [9,10]: Iganovo Formation with Moskovets member and Kar-

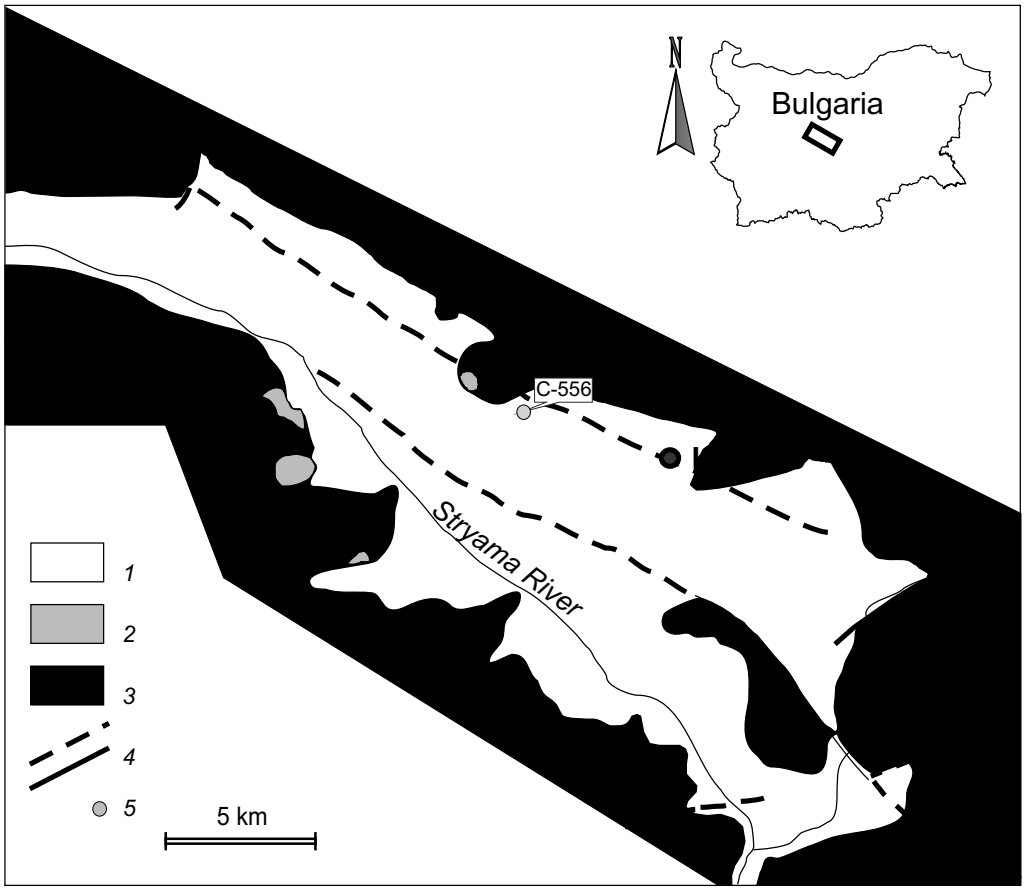

Fig. 1. Geological map of Karlovo basin. Legend: *1.* Pleistocene sediments cover; *2.* Karavelovo Formation; *3.* Pre-Neogene rocks; *4.* Faults; *5.* Investigated core

avelovo Formation (Fig. 2). ANGELOVA et al. [10] assumed absolute age of 6.5 Ma for the basis of Karlovo Graben. The available data assumed Dacian – Early Romanian age for Karavelovo Formation; Late Pontian – Dacian for Moskovets member and Meotian – Pontian – Dacian age for Iganovo Formation.

Materials and methods. A total of 24 samples were studied. The analysed samples come from the core C-556 located in the eastern part of the basin (Fig. 1). Spores and pollen were prepared for analysis in the palynological laboratory of the IBER, BAS, using standard techniques for disintegrating Tertiary sediments [11,12]. The pollen diagram has been created using TILIA 2.0.b.4 and TG View 2.0.2 software [13,14].

Results and discussion. As a result of palynological studies of sediments from C-556, diversified fossil flora represented by 102 pollen and spore types has been established. With highest floristic diversity are Magnoliophyta – 62 pollen types, followed by Pinophyta – 10 pollen types, Polypodiophyta – 9 spore types and Lycopodiophyta – 2 spore types. With wide variety are characterized families Pinaceae (8 pollen types from 5 genera), Juglandaceae (5 pollen types from 5 genera) and Betulaceae (5 pollen types from 4 genera).

The composition of the established palynoflora is dominated by trees and shrub taxa, showing the prevalence of forest vegetation in the area of the basin (Fig. 3). In the spore-pollen assemblages, with highest content, is represented the pollen of *Pinus dyploxylon* type (up to 51.7%), followed by *Alnus* (up to 35.6%), *Carya* (up to 16.3%), *Ulmus* (up to 15.1%), *Quercus* (up to 13.6%) and Taxodiaceae (up to 12.0%). High quantitative participation shows herbaceous vegetation (NAP up to 43.6%) with the major components of Poaceae (up to 25.1%), Chenopodiaceae (up to 10.7%), *Artemisia* (up to 8.4%), *Asteroideae* (up to 2.0%), *Polygonum* (up to 1.2%), Caryophyllaceae (up to 0.9%), Cichorioideae (up to 0.7%) (Fig. 3). Aquatic vegetation is registered in the pollen spectra with representatives from *Sparganium* (up to 6.4%), *Typha* (up to 3.8%), *Alisma* (up to 1.2%), *Potamogeton* (up to 0.9%) and *Nuphar* (up to 0.3%). Palynological data show presence of spores of some ferns, e.g. *Laevigatosporites* (up to 4.0%), *Osmunda* (up to 2.0%), *Polypodium* (up to 0.3%), *Lycopodium* (up to 0.2%) and *Selaginella* (up to 0.2%). From algae were established colonies of *Pediastrum* and *Botryococcus* (Chlorophyta).

The palaeoecological analysis of the fossil flora and percentage participation of individual taxa allow us to differentiate the main vegetation types in the studied area. The most widespread had mixed mesophytic forest communities, as evidenced by their participation in the pollen spectra. They are characterized by rich and diverse floristic composition. Dominant species were representatives of *Quercus*, *Ulmus*, *Carya* and *Fagus* presented with high percentages and accompanied by the species of the genera *Carpinus*, *Betula*, *Zelkova*, *Corylus*, *Castanea*, *Cornus*, *Ilex*, *Buxus* and Ericaceae. The composition of the mesophytic communities involved some thermophillous species like *Eucommia*, *Magnolia*, *Engelhardia*,

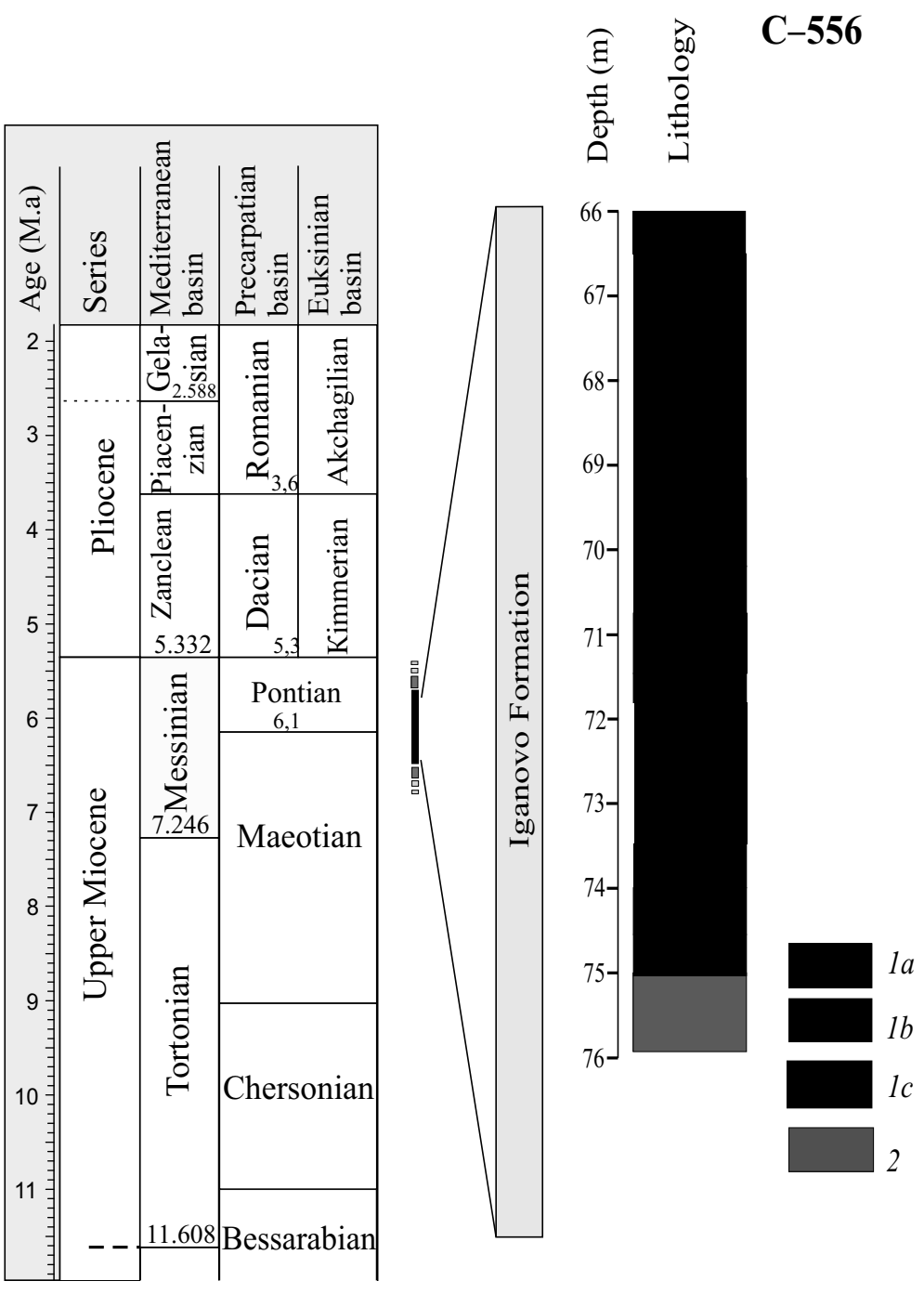

Fig. 2. Lithological column of the core C-556 from Karlovo basin. Legend:
1. Diatomic layers with the following genera: *1a* – Fragilaria;
1b – Aulacosira; *1c* – Actinocyclus; *2.* lignite coal

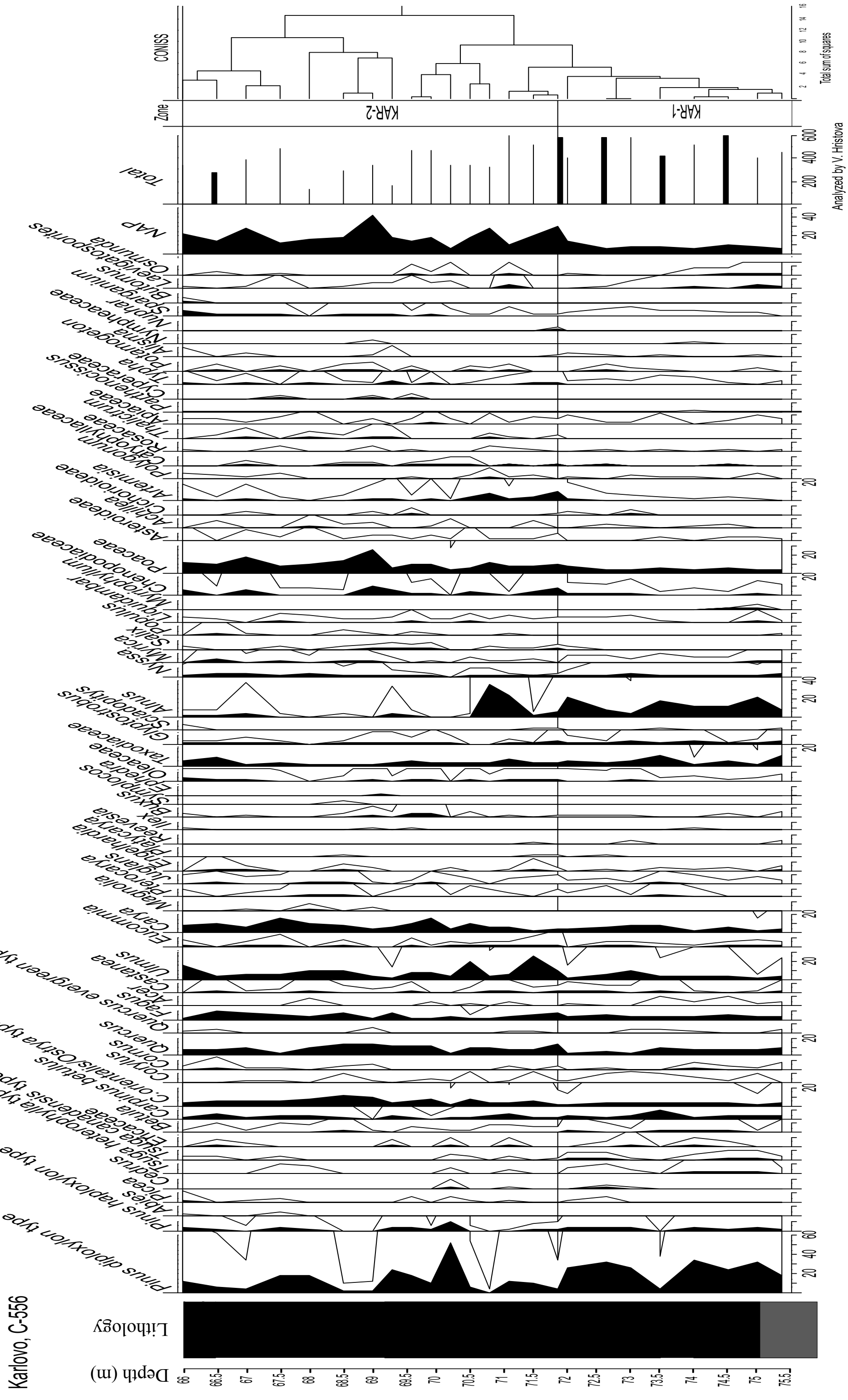

Fig. 3. Simplified percentage spore-pollen diagram of the core C-556, Karlovo basin. Exaggeration factor 10

Platycarya, *Reevesia*, *Symplocos*, recorded in the sediments from LPZ KAR 556-2 (Fig. 3). As a rule they are present in pollen spectra with low values (less than 2%) and could be suggested as relics of Middle Miocene palaeoflora. Liana species from Vitaceae, *Periploca* and *Humulus* also participated in the composition of these communities [2]. Palynological data on the composition of the flora suggest presence of mesophytic forests in the higher areas around the basin, including coniferous representatives of *Pinus*, *Tsuga*, *Abies*, *Picea*, *Cedrus* and *Podocarpus*.

In the peripheral and swampy areas around the basin were distributed hygrophytic (swamp) forests. Their development is directly dependent on the water level of the basin and palaeogeographic changes. The composition of hygrophytic communities was dominated by species from *Alnus* and Taxodiaceae. With them were involved representatives of *Glyptostrobus*, *Nyssa*, *Myrica*, *Liquidambar*, *Osmunda* and *Laevigatosporites*. The increase in the components of these forests in the sediments from the beginning of the investigated period (LPZ KAR 556-1; Fig. 3) indicates that the climate during this period was humid. The conditions in the basin in which sedimentation process flowed were lake-marshy [3]. Palynological data about xerophytic elements in spectra from these pollen zones support this conclusion. The representatives of the genera *Salix*, *Populus*, *Liquidambar* might have been involved in the composition of the river valley palaeocoenoses, developed along the river banks and coastal areas of the basin. In the composition of these palaeocoenoses, liana species of the genus *Parthenocissus* also participated.

The main components of herbaceous palaeocoenoses were Poaceae, Chenopodiaceae, Apiacea, Asteraceae, *Artemisia*, *Thalictrum*, *Polygonum*, Caryophyllaceae, Cichorioideae, Rosaceae, Lamiaceae. Besides them, representatives of *Mentha/Salvia* type, *Scleranthus* type, Dipsaceae and Onagraceae have been involved [2]. The dynamics in the spread of herbaceous vegetation shows that the highest values (NAP to 43.6%) are in the upper part of the profile, which is reflected in LPZ KAR 556-2 (Fig. 3). This is probably related to the appearance of open habitats and less annual rainfall. Judging by the composition of the spectra similar, distribution of herbaceous vegetation was found in the sediments of the western part of Karlovo basin and Stanyantsi basin [1,15].

Aquatic plants had limited distribution, as evidenced by the low percentages in the pollen spectra (Fig. 3). Representatives of this vegetation inhabited peripheral and open areas of the basin. Its floristic composition was poor and included species of *Butomus*, Nymphaeaceae, *Myriophyllum*, *Potamogeton*, *Nuphar*, Cyperaceae, *Sparganium*, *Typha*, *Alisma*.

Conclusions. As a result of current spore-pollen analysis of sediments from Karlovo basin, we recovered a rich and diverse fossil flora including 102 types of pollen and spores from 62 genera in 60 families.

The established composition of the fossil flora and participation of the pollen types provided information about main plant palaeocommunities developed in

the area of the basin during Late Miocene (Pontian). The most widespread ones were mixed mesophytic forest communities. Hygrophytic (swamp) forests were formed and developed under specific environmental conditions with high humidity. The dynamics of distribution of herbaceous vegetation shows increase of participation in sediments with Early and Middle Pontian age. High levels of herbaceous taxa may be related to a change in the palaeogeographic environment as reducing swampy areas, occurrence of open habitats and reducing the annual precipitation. According to the pollen data, the Late Miocene vegetation reflects warm-temperate climate with some cooling during this period.

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