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New fossil flora from Palaeogene sediments near Bersin village (SW Bulgaria)

Нова фосилна флора от палеогенски седименти край с. Берсин (ЮЗ България)

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Abstract. Data for new local palaeoflora near the village of Bersin (SW Bulgaria) are presented. Eight species of fossil plants have been identified. *Eotrigonobalanus furcinervis* is dominant over other species. The flora-bearing layers originate from the lower part of the Nevestino Formation, which is formed by alternating sandstone and mudstone sediments. Based on the established fossil macroflora, it can be assumed that the age of the flora-bearing sediments is late Eocene.

Keywords: Bersin, fossil macroflora, late Eocene, Paleogene sediments, SW Bulgaria.

Geological setting

The present study aims to characterize fossil flora recovered from a small open-pit mine within the Paleogene sedimentary sequences from the north-western part of the Bersin Graben between the villages of Bersin and Granitsa, SE of the town of Kyustendil. Recent geological studies have subdivided the sediments into a formal lithostratigraphic unit – i.e. the Nevestino Formation (Sinnyovsky in: Zhelev et al., 2008). Based on nannofossil assemblages the age of the sedimentary sequence was determined as late Eocene–Oligocene. Within the studied area, the lower part of formation is represented by 30–100 m thick fining upwards conglomerate-sandstone and sandstone-mudstone sediments. The sandstone are coarse- to fine-grained arkose to polymictic with argillaceous-carbonate cement and lenses of poly-lithic fine- to coarse-grained pebble conglomerates and sandy clay in their lower and upper parts, respectively. The sandy-mudstone sediments contain locally beds of fine and medium-grained sandstone (within the lower part) and marly to argillaceous

limestone (within the upper part). The sediments of the upper part of formation have flisch-like character (Vangelov, 2004).

Small pieces (3–5 mm) of fragmented woody and grassy stems were detected along bedding surfaces together with leaf imprints, scattered charred plant detritus and rarely pyrite/marcasite encrustation. These originate from near shore vegetation sedimented within low energy parts of the sedimentary basin.

The sandy-clay sediments west of upper end of the Bersin micro-dam, are used as raw material for ceramic products (bricks) and are mined in an open pit. Fossil flora that we found in this place is now considered briefly and informatively.

Results and discussion

The established fossil macroflora is represented by 18 leaf imprints (Table 1). Eight species from eight families have been identified. Dicotyledonous plants predominate, but there are representatives of ferns (*Rumohra recentior* (Unger) Barthel) and

Table 1. Bersin palaeoflora species, their family, number of leaf imprints, percentage and stratigraphic distribution in Bulgaria after Palamarev et al. (2005)

Species	Family	N	%	Stratigraphic distribution
<i>Bumelia minor</i> (Unger) Unger	Sapotaceae	2	11.2	Lower Eocene–Middle Miocene
<i>Dalbergia rectinervis</i> Ettingshausen	Fabaceae	1	5.6	Lower Oligocene
<i>Daphnogene lanceolata</i> Unger	Lauraceae	1	5.6	Upper Eocene–Lower Pliocene
<i>Engelhardia orsbergensis</i> (Wessel et Weber) Jahnichen, Mai et Walther	Juglandaceae	1	5.6	Lower Eocene–Middle Miocene
<i>Eotrigonobalanus furcinervis</i> (Rossm.) H. Walther et Kvacek	Fagaceae	9	50.0	Lower Eocene–Oligocene
<i>Phoenicites salicifolius</i> (C. Presl) Unger	Arecaceae	1	5.6	Upper Eocene–Lower Oligocene
<i>Rumohra recentior</i> (Unger) Barthel	Dryopteridaceae	1	5.6	Upper Eocene–Lower Oligocene
<i>Ziziphus ziziphoides</i> (Unger) Weyland	Rhamnaceae	2	11.2	Lower Eocene–Upper Oligocene

monocotyledonous plants (*Phoenicites salicifolius* (C. Presl) Unger) (Fig. 1). The dominance of the extinct evergreen Fagaceae species *Eotrigonobalanus furcinervis* (Rossm.) H. Walther et Kvacek is impressive. Its imprints make up 50% of all fossil material. This species probably shaped the woody vegetation. *E. furcinervis* existed from the middle Eocene to the Oligocene–Miocene boundary and was geographically widely distributed, i.e. from central Europe to Russia, as well as to the Mediterranean area (Mai, Walther, 2000; Velitzelos et al., 1999). It is considered as a thermophilous species that grew in evergreen broadleaved forests as well as in mixed mesophytic forests adapted to humid and warm-temperate to subtropical climate (Mai, Walther, 2000). *E. furcinervis* was present in taphocoenoses derived from riparian forests, back swamps, peat bogs and zonal vegetation and therefore this plant tolerated a wide range of water table conditions and soil characteristics. During the Eocene it often predominated in zonal Fagaceae–Lauraceae forests (Mai, Walther, 2000). *Engelhardia orsbergensis* (Wessel et Weber) Jahnichen, Mai et Walther and the palm *Phoenicites salicifolius* (C. Presl) Unger were also common on the floor of tall trees in Bersin palaeovegetation. The *Rumohra recentior* (Unger) Barthel fern was part of the herbaceous vegetation. Probably the grass vegetation was poorly developed along the coast of the sedimentation basin, as evidenced by the relatively coarse flora-bearing sediment. If there was dense grass vegetation, it would retain the coarse particles and the sediments would be finer. Other established species in Bersin palaeoflora formed the floor of shrubs and small trees.

The relative ancient age of the studied paleoflora can be judged by the participation in it of three artificial genera – *Daphnogene*, *Eotrigonobalanus* and *Phoenicites*, which represents 37.5% of its composition. These genera have no close relatives in the

modern flora. The other genera and their species found in the Bersin paleoflora are typical of the Paleogene, although some of them occur, albeit limited to the Miocene–Pliocene boundary (eg *Daphnogene lanceolata* Unger). A stratigraphic distribution is presented (Table 1) for defined here species on the territory of Bulgaria after Palamarev et al. (2005).

The presence of the species such as *Daphnogene lanceolata* Unger, *Phoenicites salicifolius* (C. Presl) Unger and *Rumohra recentior* (Unger) Barthel, which have not been established so far in the lower and middle Eocene in Bulgaria, gives reason to assume that the age of the flora-bearing sediments is most likely late Eocene. The lack of arcto-tertiary representatives in the Bersin macroflora suggests that it developed before the Oligocene, when these elements entered the territory of Bulgaria. Due to the presence of the species *Dalbergia rectinervis* Ettingshausen here, the possibility of a stratigraphic position of the sediments on the upper Eocene–lower Oligocene boundary can also be allowed.

All this can be clarified with additional studies on the Bersin macroflora and upcoming palynological studies of the sediments that include it.

Conclusions

The available geological and stratigraphic data and the subdivision of the Paleogene sediments from the northwestern part of the Bersin Graben from SW Bulgaria are partially considered in the presented brief overview. They need a future systematic review and assessment, taking into account clearly and reasonably the stratigraphic relationships, age data, correlations and development of sedimentary sequences in space and time. The study of local fossil floras in this Graben will be essential in

Fig. 1. Plant material: A, *Bumelia minor*; B, *Dalbergia rectinervis*; C, *Engelhardia orsbergensis*; D, *Rumohra recentior*; E, *Eotrigonobalanus furcinervis*; F, *Daphnogene lanceolata*; G, *Ziziphus ziziphoides*; H, *Phoenicites salicifolius* (scale bar 1 cm)

this direction. The data presented here on the fossil macroflora in sediments of the Nevestino Formation are proof of this. Based on these data, it can be assumed that the age of the flora-bearing sediments is late Eocene. A palynological analysis of these same sediments is forthcoming, which will specify the determination of their age.

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