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MACCLINTOCKIA BASINERVIS (ROSSM.) KNOBL. IN CENOZOIC SEDIMENTS IN THE RHODOPES MT. REGION (S BULGARIA)

Vladimir BOZUKOV[1]

Abstract: New data about the stratigraphic and the geographic distribution of the species *Macclintockia basinervis* in Bulgaria are reported. Up to now this species is known from sites close to villages of Satovcha and Hvoina. The species *Cocculus (Macclintockia) canii* is revised as *Macclintockia basinervis*, known from the Hvoina. The site close to the village of Vulche Pole is a new occurrence for this species. All of the sites are in the Rhodopes Mountains (S Bulgaria).

The sediments yielding this flora have the following features: Hvoina is predominantly alluvial; Vulche Pole is proluvial, alluvial and lake-swamp; and Satovcha is lake-swamp. The stratigraphic range of the species in Bulgaria is Upper Eocene - Middle Miocene.

The new find of *M. basinervis* evidences a stable development of the species over the Paleorhodopean massif, which it's the latest and the southernmost refuge in Europe. This refuge demonstrates climatic changes from warm and humid climate, suitable for macrothermic species like *M. basinervis*, to colder and dryer climate conditions typical for Northern Europe.

Keywords: *Macclintockia basinervis*, Bulgaria, Rhodopes, Satovcha, Hvoina, Vulche Pole, Cenozoic

INTRODUCTION

The extinct genus *Macclintockia* is one of the most interesting taxa among the fossil angiosperms due to its undetermined systematic affinity. Described for the first time by Heer (1868) on the basis of leaf impressions from Palaeocene sediments in West Greenland. The specificity of the features of the material he had studied was the reason for referring the genus initially to family *Proteaceae* J. St. Hil. The genera of that family he sought similarity were *Banksia* L., *Dryandra* R. Br., *Grewillea* R. Br. and *Hakea* Schrod.

Later, Heer (1869) revised his opinion and, comparing the species *Macclintockia trinervis* to the recent *Cocculus laurifolius* DC., referred the fossil genus to familly *Menispermaceae* DC.

Saporta & Marion (1878) described the species *Macclintockia heersiensis* from the Paleogene sediments of Gelinden, Belgium and, comparing it to the recent genus *Pilea* Lindley, referred genus *Macclintockia* to fam. *Urticaceae* Jussieu.

Budantsev (1990), observing the historical stages of the genus *Macclintockia* in detail, avoided indicating its affinity to a definite family, and used the group name *Magnoliopsida incertae sedis*.

Fig. 1. Geographical distribution of *Macclintockia basinervis* in Bulgaria. 1 - Hvoina, 2 - Vulche Pole, 3 - Satovcha

The geographic distribution of the genus comprises the present territories of Greenland, Belgium, Czech Republic, Bulgaria, Ukraine, the northern part of Russia, the island of Spitzbergen, the Novosibirsk islands, West Kamchatka, Yakutia, the northwestern parts of North America.

Stratigraphic range in these occurrences spans from the Upper Albian to the Middle Miocene.

LOCATION, GEOLOGY AND STRATIGRAPHY OF THE LOCALITIES WITH *MACCLINTOCKIA* IN BULGARIA

The genus *Macclintockia* is known from Bulgarian Cenozoic sediments with the species *M. basinervis* (Rossm.) Knobl. recorded in three localities occurring in the Rhodopes Mountains. The Rhodopes are situated in the central part of South Bulgaria, along the border with Greece, and they continue to the south in Greece. On the Bulgarian territory, the Rhodopes are situated between the valleys Mesta to the west and Maritsa to the northeast (Fig. 1).

In Rhodopes, strong tectonic and shape-forming processes have developed during the Paleocene. A central place of the complex orographic system of that region has been taken by numerous grabens in which the water of semi salty and freshwater basins have rushed, while the paleorelief has been formed by hills, alternating with plateaus and river valleys (Vaptzarov 1997). To the end of Oligocene, such processes have stopped. The grabens have been filled up with sediments, and these conditions are a reason for the formation of numerous taphocenoses, found in about 50 occurrences (Palamarev 2003).

[1] *Institute of Botany, Bulgarian Academy of Sciences, Acad. G. Bonchev St., bl. 23, 1113 Sofia, Bulgaria, e-mail: bzk@bio.bas.bg*

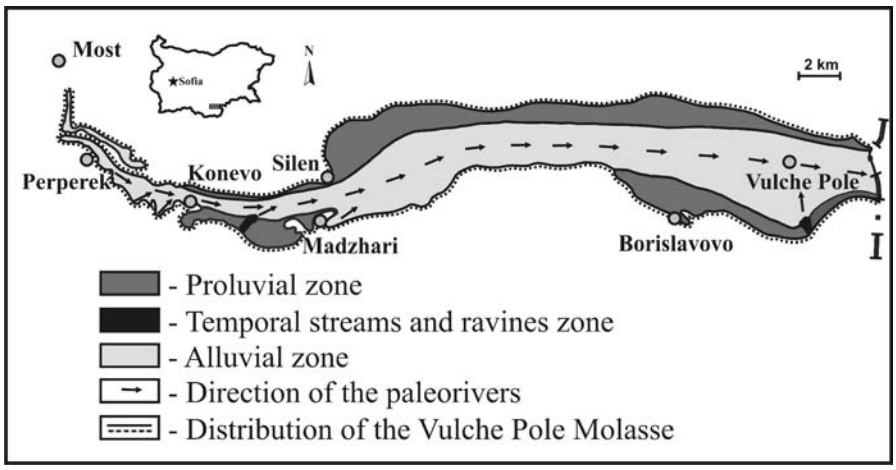

Fig. 2. Sketch map showing the occurrence of the sediments in Vulche Pole Molasse (after Lambeva & Dragomanov 1983).

The records of the genus include the villages Hvoina (Central Rhodopes, Černjavska et al. 1988), and Satovcha (W Rhodopes, Bozukov 1996). The sediments bearing the plant remains are belong to the following geological structures: the Hvoina Basin, and the Satovcha Graben.

The Paleogene deposits of Hvoina Basin are subdivided into four units: the breccia-conglomerate formation, the sandstone-argillite formation, the conglomerate-argillite formation, and the conglomerate formation (Ivanov et al. 1979).

The fossils occur in the terrigenous sediments of the sandstone-argillite formation found in the area of the village Hvoina. Structural and textural features of the deposits indicate a dominant alluvial origin. According to the biostratigraphic interpretation of Černjavska et al. (1988), the paleoflora containing deposits may range between the Latest Eocene and the Early Oligocene.

The Satovcha Graben is divided into two sequences – Satovcha Formation, and Sivik Formation (Vatsev & Pirumova 1983). The Satovcha fossil flora, which is very rich, with over 130 species, originates from the Sivik Formation. The Sivik Formation is composed of limestone, aleurolites, sandy clays and diatomites with coal lens. According to biostratigraphic analysis of the paleofloristic data (Bozukov 2002) the age of the Sivik Formation is Middle Miocene.

Recently, new fossil material belonging to the species *Macclintockia basinervis* has been found in sediments from Vulche Pole Molasse, in eastern Rhodopes (Fig. 2). It is a rhythmical alternation, with conglomerates, sands, sandstones, aleurolites, argillites, and interlayers of tuffs and coal lens. The sediments show proluvial, alluvial and lake-swamp features (Boianov et al. 1992). The age of the deposits is yet unclear, but the paleofloristic data point to a transitional range between Oligocene and Miocene.

MATERIAL AND METHODS

The fossil material was collected from sections close to village Vulche Pole. The studied material consist of 11 rock fragments with plant macroremains (XBn. 98, 103, 106, 114, 177, 180, 193, 210, 226, 231, 232), and the ichnophytological method (Zhilin 1969) was used for it determination. The morphological features of the leaf imprints were determined according to the scheme of Dilcher (1974).

SYSTEMATICS

Magnoliopsida incertae sedis

Macclintockia Heer

Macclintockia basinervis (Rossmässler) Knobloch

(Pl. 1, Figs 1-6)

1840. *Phyllites basinervis* Rossmässler, p. 37, Pl. 9, Figs 41-42.

1865. *Daphnogene excellens* Eichwald, p. 62, Pl. 3, Fig. 9.

1956. *Macclintockia excellens* (Eichw.) Stanislavskiy, p. 1188, Pl. 1, Figs 1-10; Pl. 2, Figs 1-5; Pl. 3, Figs 1-5; Text-figs 1-2.

1962. *M. basinervis* (Rossm.) Knobloch, p. 121, Pl. 6, Fig. 5.

1963. Knobloch, p. 193, Pl. 1, Fig. 9; Pl. 7, Figs 1-5, Pl. 8, Figs 1-3; Pl. 9, Fig. 1; Text-figs 23, 26-29, 32.

1988. *Cocculus* (*Macclintockia*) *kanii* (Heer) Sap. & Mar.; Černjavska et al., p. 30, Pl. 1, Fig. 3.

1996. *Macclintockia basinervis* (Rossm.) Knobl.; Bozukov, p. 71, Pl. 1, Figs 1-5.

Description: Shape – narrow elliptic or narrow oblanceolate; apex acute; leaf margin entire. Venation acrodromous, basal, perfect; midrib straight, becoming considerably thinner towards apex; basal veins thinner then midrib, arising at the angle of 15º from midrib, slightly arch-shaped, originating from little thickening at the transition between petiole and midrib, ending almost in the top of the leaf blade; secondary veins considerably thinner that basal one, 4-5 (6) pairs, arched, more distinct in the upper half of the leaf, arising at the angle of 30-40º from midrib; intercalary veins developed rarely; tertiary veins hardly visible. Size – 6.5-5.5 cm in length, 1.5-0.7 cm in width. The petiole is about 0.1 cm wide.

Comparison: In shape and morphology, the studied material from Vulche Pole is equivalent with that of the other two occurrences (Hvoina and Satovcha) of genus *Macclintockia* in Bulgaria. An essential difference exists only in size of the leaves from the finds Vulche Pole and Satovcha. Most of those of Satovcha (Pl. 1, Figs 9-13) are twice bigger from those from Vulche Pole. While in the fossil flora from Hvoina (Pl. 1, Figs 7-8) sizes of the type are observed in Satovcha, as well as in Vulche Pole.

The determined in Černjavska et al. (1988, p. 30, Pl. 1, Fig. 2, sample CmX-182) leaf imprint as *Cocculus* (*Macclintockia*) *canii* (Heer) Saporta & Marion lacks the apex, misleading the authors in its identification. For the other imprints (sample CmX-124, 184), the apical part is acute or almost attenuate. They lack of other similar features to *Cocculus* (*Macclintockia*) *kanii*, but the well preserved imprint, and the availability of reliable features lead to the assignation to *Macclintockia basinervis*. The material points to the idea that the species *Cocculus* (*Macclintockia*) *kanii* of Černjavska et al. (1988) needs to be reassigned to *Macclintockia basinervis.*

Stanislavskiy (1956) has expressed the opinion that the species *M. kanii* (Heer) Shimp. is one of the types of *M. basinervis*. The insufficient research on the polymorphism of *M. kanii*, due of the lack of enough material, is a reason of lacking a systematic answer for this question.

Comprehensive data for the polymorphism of leafs of *M. basinervis* has been presented by Stanislavskiy (1956). Studying the Eocene flora from Roudnya Baranovskaya (Ukraine), where *M. basinervis* has played a dominant role, the author has determined the variation in shape, size, type of leaf margin, and of venation. The differences between some of the leaves are so significant, that they could be considered as different species, if they were not found at the same place, and if their transitional shapes were not recorded.

According to the shape variation, it is possible to identify the following types of leaf blade: elliptic, very narrow elliptic, oblanceolate, narrow oblanceolate. The leaf apex can be acute or attenuate. According to the type of leaf margin, it is possible to identify entire, as well as dentate forms. The margin itself can be variational in number of the teeth, from one to three pairs, as well as of shape and size of the teeth. According to the type of venation, it is possible to identify the following two types, depending on whether the basal veins reach the upper third of the peture or not: acrodromous basal perfect, and acrodromous basal imperfect. Therefore, there are a different number of pairs of secondary veins – from 1-2 for basal perfect, until 9 for basal imperfect.

It is important to point out that all Bulgarian specimens are similar to those from Roudnya Baranovskaya. This is one more reason pointed to the occurrence of the same species, distributed in Bulgaria, namely *M. basinervis*.

GEOGRAPHICAL DISTRIBUTION AND STRATIGRAPHIC RANGE

Until now, the species *M. basinervis* is known from total 7 occurrences in Europe: 3 in Ukraine (Krasnov 1911; Lepchenko 1929; Stanislavskiy 1956), 2 in the Czech Republic (Knobloch 1962, 1963) and 2 in Bulgaria (Černjavska et al. 1988; Bozukov 1996). Its stratigraphic range spans the Eocene - Middle Miocene (Table 1).

Table 1. Geographical and stratigraphic distribution of *Macclintockia basinervis* in Europe.

COUNTRY	SITE	AUTHORS	EPOCH
Ukraine	Osinovka	Krasnov (1911)	Eocene
	Roudnya Baranovskoy	Lepchenko (1926), Stanislavskiy (1956)	Eocene
	Kremyanka	Pimenova (1937)	Eocene
Czech Republic	Kamenity	Knobloch (1963)	Upper Eocene
	Českí chloumek	Knobloch (1962)	Upper Eocene-Lower Oligocene
Bulgaria	Hvoina	Černjavska et al. (1988)	Upper Eocene- Lower Oligocene
	Vulche Pole	hoc loco	Upper Oligocene- Lower Miocene
	Satovcha	Bozukov (1996)	Middle Miocene

CONCLUSION

The new finding of *M. basinervis* in the eastern Rhodopes has a significant paleofloristic importance, as it is a link between the previous records of the species in the Late Eocene - Early Oligocene flora from Hvoina, and Middle Miocene flora from Satovcha. This new find is an evidence for a stable development of the species over the Paleorhodopean massif. The species appeared in the Rhodopes during Eocene and reached the Middle Miocene, which is its latest and in the same time its southernmost refuge in Europe.

The history of *Macclintockia* may reflect the influence of climatic changes during the range of this extinct genus, pointing to changes from warm and humid climate, suitable for macrothermic species like *M. basinervis*, to colder and dryer climate. The direction of those changes was from north to south.

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PLATE CAPTION

PLATE 1. *Macclintockia basinervis*

1. Vulche Pole, XBn-226 (x2), Upper Oligocene-Lower Miocene;
2. Vulche Pole, XBn-116 (x2), U. Oligocene-L. Miocene;
3. Vulche Pole, XBn-231 (x2), U. Oligocene-L. Miocene;
4. Vulche Pole, XBn-231 (1:1), U. Oligocene-L. Miocene;
5. Vulche Pole, XBn-193 (1:1), U. Oligocene-L. Miocene;
6. Vulche Pole, XBn-180 (1:1), U. Oligocene-L. Miocene;
7. Hvoina, CMX-124 (1:1), U. Eocene-L. Oligocene;
8. Hvoina, CMX-182 (1:1), U. Eocene-L. Oligocene;
9. Satovcha, CAT-2009b basal part (x2), Middle Miocene;
10. Satovcha, CAT-1595 (1:1), M. Miocene;
11. Satovcha, CAT-2125 (1:1), M. Miocene;
12. Satovcha, CAT-2125 apical part (x2), M. Miocene;
13. Satovcha, CAT-1849 (1:1), M. Miocene.

PLATE I