

FOSSIL PLANTS FROM ROMANIAN DEPOSITS OF BÂCLEȘ, DOLJ DISTRICT, ROMANIA

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ABSTRACT. From the Middle Romanian lacustrine deposits of the Oltenia province, the authors describe the youngest fossil flora known until now in Oltenia. The inventory of the fossil flora includes the following taxa: *Taxodium dubium*, *?Platanus platanifolia*, *Ulmus laevis*, *Quercus roburoides*, *Q. cf. muehlenbergii*, *Carya serraefolia*, *Acer cf. tricuspdatum* and *Salix* sp. In the Bâcleș fossil flora, *Glyptostrobus europaeus*, which is a thermophilous and shows a high frequency in all Oltenia area till the XV-th coal seam, is absent. Consequently, having in view the high frequency of *Taxodium dubium*, which indicate temperate climate conditions, the other consider that the fossil flora from Bâcleș is much more younger and marks an important cooling. From palaeofloristic point of view, the study of Bâcleș fossil flora is indicative for river meadow forest and, probably, flat plain forest environments.

KEYWORDS: Pliocene, Middle Romanian, macroflora, Oltenia.

INTRODUCTION

The important frequency of telmatic, lacustrine and riparian facies in the Pliocene deposits of Oltenia province (southwestern Romania), provides a rich palaeofloristic material, for now insufficiently known. The research made until now referred specially at the Dacian (Lower Pliocene) macroflora, the Romanian one (Upper Pliocene) being much less known. In this context, the presentation of some fossil plants from the upper part of the Middle Romanian deposits, discovered by one of the authors (Enciu) in the neighborhood of Bâcleș locality, brings new information and completes the conspectus of Pliocene flora and vegetation of the southwestern part of Romania.

The first information regarding the Pliocene flora from Oltenia province came from a historical work of Marion and Laurent (1898), which determined two fossil taxa on some samples sent to Paris by G. Ștefanescu. Later, Barbu (1933, 1954) added to the Pliocene palaeofloristic inventory other 16 taxa. Further, at the knowledge of Pliocene fossil macroflora from Oltenia have also contributed: Barbu and Givulescu (1964), Givulescu (1966, 1990), Țicleanu (1982, 1985, 1989, 1992) and Țicleanu et al (1985). A complete reviewing of their results was made by Țicleanu (1995).

For the reconstruction of Pliocene fossil flora and vegetation from Oltenia, an important meaning have had also the palynological research made by Roman

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(in Țicleanu et al, 1982, 1985), Nanii (1982), Petrescu et al (1987, 1989 a, b), Drivaliari (1993), Drivaliari et al (1999).

GEOLOGICAL SETTING

On the main banks of Argetoaia River and its tributaries, the rare outcrops (Fig. 1) reveal the upper part of the Jiu-Motru Formation, the Căndești Formation and the "overlying formation".

Under the local level of erosion, the continuously mechanic drilling for coal prospecting (No 37 and 40, Fig. 1) and for groundwater exploration (No 30 and 32, Fig. 1), crossed the lower part of the Jiu-Motru Formation and then the Berbești Formation.

The Berbești Formation (Andreescu et al, 1985) consists of about 100 m thick sandy deposits (with 1-2 m beds of coal). Based on a lot of cardiids (Enciu, 1998), this prevailing fine-medium siliciclastic pile of rocks was reported to the Early Dacian (N2dc1). Over the previous formation, the boreholes revealed a 70-120 m thick clayey-coaly lithostratigraphic unit, defined as the Jiu-Motru Formation (Andreescu et al, 1985).

As the geological sections reveal (Fig. 1) in the lowermost part of this formation (sample 4614), in the neighborhood of the Rocșoreni village, in the hydrogeological borehole No 30, Dacian brackish mollusks were identified: *Horiodacna rumana*, *Dreissena berbestiensis*, *Euxinocardium* sp. and others.

In the proximity of the Giura village (sample No 4785) and at the base of main Argetoaia valley (sample No 4787), this formation includes varied smooth and sculptured species of the Romanian psilonioninae. In the last site, between 270-275 m a.s.l., Enciu (1998) pointed out an interesting level having fossil plants remains.

Using as proofs the Berbești and Jiu-Motru Formations conformity relationship and the above-mentioned list of the brackish and fresh-water mollusks, the last one was assigned to the Upper Dacian - Middle Romanian (N2dc2-ro2).

According to the present stage of our research over the Jiu-Motru Formation, in the surroundings of the Băcleș locality, it develops the peripheral, south-easternmost edge of the Căndești Formation, Upper Romanian - Lower Pleistocene in age (Mrazec & Teisseyre, 1901; Andreescu, 1971; Alexeeva et al, 1983). This formation was born as a result of the impressive uplift of the Carpathians during the Walachian orogenetic event (Hyppolyte and Săndulescu, 1994; Enciu, 1998, 2000).

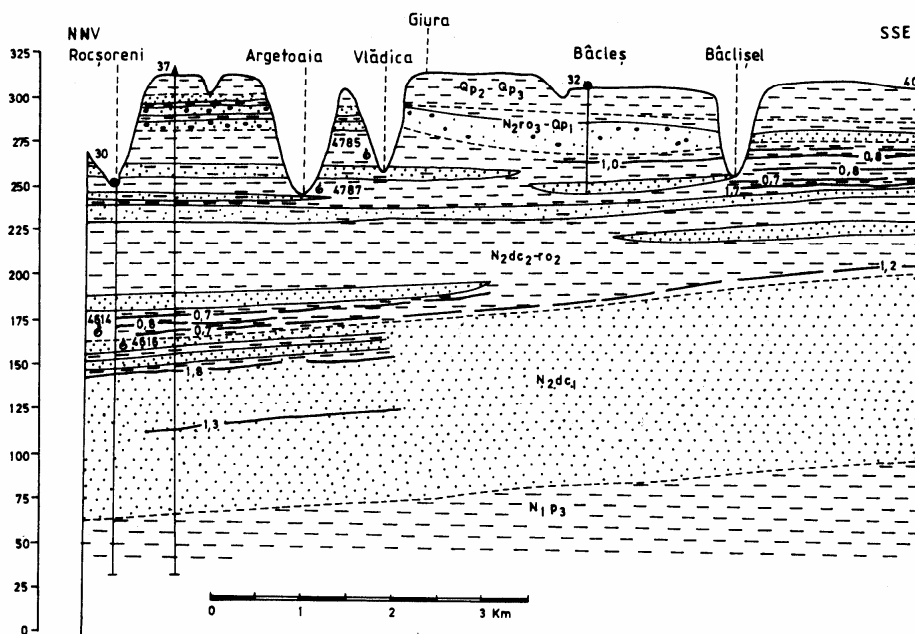
Over the Căndești Formation, the boreholes for land reclamation projects identified 10-15 m thickness of non-stratified clayey-silty rocks, Middle-Upper Pleistocene in age (named "the overlying formation").

PALAEOBOTANICAL AND TAPHONOMICAL OBSERVATIONS

The vegetal fossil remains (VFR) from Băcleș fossiliferous point are found in clays and silty clays with frequent oxidation traces and a weak tendency of stratification. Although the sedimentation of VFR was made in decantation conditions, a small part of the original vegetal material suffered a short transport (hypautochtony), which made the material to be more or less damaged. In the present paper we determined the following species:

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GEOLOGICAL SECTION ALONG OF THE STREHAIA - BACLES UPLIFT



I. STRATIGRAPHIC ELEMENTS

- Op_2-Op_3 The Overlying Formation (Middle - Upper Pleistocene)
- $N_2ro_3-Op_1$ The Candesti Formation (Upper Romanian - Lower Pleistocene)
- $N_2dc_2-ro_2$ The Jiu-Motru Formation (Upper Dacian - Middle Romanian)
- N_2dc_1 The Berbesti Formation (Lower Dacian)
- N_1p_3 The Ilovat Formation (Upper Pontian)

II. LITHOLOGIC ELEMENTS

- Gravels and sands
- Sandy rocks
- Clayey rocks
- Coal (0,8 thickness, m)

III. OTHER SIGNS

- Geological (a) and hydrogeological boreholes (b)
- Number of the paleontological sample
- Geological boundary
- Lithological boundary

Taxodium dubium (Sternb.) Heer
?Platanus platanifolia (Ett.) Knobloch
Ulmus laevis L.
Quercus roburoides Gaudin
Quercus cf. muehlenbergii Engelman
Carya serraefolia (Goepp.) Kräusel
Acer cf. tricuspdatum Bronn.
Salix sp.

METHODS

The palaeofloristic material consists of leaf impressions, the compression being destroyed by oxidation and replaced mostly by limonite. In these conditions, the work method consisted in the drawing on transparent nylon pellicle at the stereomicroscope of all visible details of the morphology of fossil leaves and in macroscopical photography of samples with a good preservation.

SYSTEMATICS

Phyllum **PINOPHYTA**

Clasa **PINATAE**

Family **TAXODIACEAE**

***Taxodium dubium* (Sternb.) Heer (Pl. II, Fig. 2)**

Material: 10 samples with the number of inventory: BC-1, BC-4, BC-7, BC-8, BC-21, BC-22, BC-25, BC-26, BC-27 and BC-31.

Description: compressions of the deciduous stems which are branched and covered by scaleous leaves with 0.8-1.5 cm length and maximum 1 mm width.

Observations: the VFR of *T. dubium* are the most frequent remains from the Bâcleș fossiliferous point, probably this tree vegetated in the near vicinity of the sedimentation area.

Occurrence in the fossil floras of Romania: it is a rare taxon, being found in Chattian deposits of Petroșani Basin, in Almașului Basin (Țicleanu, unpubl.), in the Pontian flora of Băița (Ruffle & Givulescu, 1974), and in the Middle Romanian deposits from Oltenia (Țicleanu, unpubl.).

The actual correspondent: *Taxodium distichum* (L.) Rich., a 1-st size tree which can reach 50 m height and live 6000 years; it is a hygrophytic species, well adapted to swamps with almost permanently flooded conditions (11 months/year). The species prefers wet and warm climate, with subtropical or oceanic influences. Today it is spread in the southeastern part of USA, in the swamps of inferior course of Mississippi and in Florida. In Romania, *T. distichum* is cultivated and now is adapted to the temperate climate.

Phyllum **MAGNOLIOPHYTA**

Clasa **MAGNOLIATAE**

Family **PLATANACEAE**

?*Platanus platanifolia* (Ett.) Knobloch (Pl. II, Fig. 1)

Material: the samples with the number of inventory: BC-16 and BC-17.

Description: the basal part of a leaf with palmate shape (?5 lobes). Palmate nervation. From the primary strong vein of the greatest lobe diverge, close to the base, two lateral veins at the angle of 45°, and from these diverge other two secondary veins, running into the lobes. In the largest lobe, from the primary vein diverge two secondary opposite veins.

Observations: even the original position of the divergence place of the secondary veins is not preserved, a reason to put the genus in discussion. We think that the other characters and the general aspect still represent the taxon *P. orientalis*.

Occurrence in the fossil floras of Romania: the taxon is frequent in the Miocene deposits from Romania.

The actual correspondent: is considered to be *P. orientalis*, which is a tree with over 30 m high, and lives in Greece, Asia, Caucasus, Caspian Sea – where in the south forms mixed forests with *Zelkova zelkovaefolia* and *Pterocarya fraxinifolia*. It prefers riparian zones with very humid soils.

Family **ULMACEAE**

***Ulmus laevis* L. (Pl. I, Fig. 5)**

Material: one sample: BC-34.

Description: the inferior part of a foliar impression with ovate shape, strongly asymmetric, pinnate-craspedodromous nervation. The base of the leaf is asymmetric and oblique. The margins and the apex weren't kept. From the primary strong vein diverge 11 pairs of secondary opposite veins. Probably the total number of secondary veins was higher. Some of the secondary veins have a specific bifurcation, which is visible only at *Ulmus*.

Observations: the general aspect, the asymmetry and the presence of bifurcate secondary veins are characteristics of the genus *Ulmus*. In the actual flora of Romania, the species *U. laevis* and *U. foliacea* have similar leaf shapes with the fossil. The difference consists in the number of secondary veins: *U. laevis* have 12 to 19 pairs of secondary veins, and *U. foliacea* have maximum 12 pairs of secondary veins.

Occurrence in the fossil floras of Romania: *U. laevis* is for the first time cited in the fossil flora of Romania.

The actual correspondent: is considered to be *Ulmus laevis* L., a tree which is up to 35 m high, and prefers meadow river forests. It is spread in Europe, from France to Ural Mountains, excepting British Islands and Scandinavian Peninsula.

Family **FAGACEAE**

***Quercus roburoides* Gaudin. (Pl. II, Fig. 4)**

Material: one sample: BC-33.

Description: the shape of the leaf is obovate and the dimensions are 11 cm of length and 5 cm width; it has no apex, with lobate rounded margins and each lobe separated by sinuses incised in laminae up to 1.5 cm. The base is of an auriculate shape. From the strong primary vein diverge? 10 pairs of secondary veins and the

angle of divergence of the secondary veins decrease from base to apex. The tertiary nervation is orthogonal, reticulated and very obvious.

Observations: taking into account the shape and the rounded aspect of the lobes and the low angle of sinuses, we attribute the specimen to *Q. roburoides*.

Occurrence in the fossil floras of Romania: it is frequent in Pontian and Dacian deposits.

The actual correspondent: is considered to be *Q. robur* L., a 1-st size tree which is spread in the whole Europe, from the Atlantic Ocean to the Urals and to the Caspian Sea, excepting septentrional zones of the Scandinavian Peninsula and the south of the Iberian Peninsula. *Q. robur* is a tree which resists to xerophytic conditions and forms river plain forests.

***Quercus cf. muehlenbergii* Engelman (Pl. II, Fig. 3)**

Material: one sample: BC-29.

Description: the impression of the superior part of a pinnate-lobate leaf, elongate, asymmetric, with the lobes having the basal side convex and apical side straight, and inter-lobal rounded sinuses. The nervation is pinnate with the primary vein obvious, and alternately secondary veins. The tertiary veins are reticulated.

Observations: the impression keeps enough characters of *Quercus* type. The specific association was made on the base of the description given by Givulescu (1990).

Occurrence in the fossil floras of Romania: *Q. muehlenbergii* was cited in the Pontian flora from Chiuzbaia.

The actual correspondent: is considered to be *Q. muehlenbergii*, which is a tree up to 25 m high, which lives in the eastern part of USA from the Great Lakes to the Gulf of Mexico, excepting the Florida Peninsula.

Family JUGLANDACEAE

***Carya serraefolia* (Goepf.) Kräusel (Pl. I, Fig. 1)**

Material: samples BC-28 and BC-29.

Description: the impression and the incomplete compression of a leaf with short elliptic shape (8 cm long and 4 cm wide) and cuneate base. The nervation is of pinnate-craspedrodome simple type. The primary vein is prominent, slightly curved in the inferior part of the leaf. From the primary vein diverge 10 pairs of secondary veins, which diverge in tertiary veins and therefore on the margin they create a characteristic picture having the shape of "V" letter, and with the teeth obvious inserted into the serrate margin.

Observations: our exemplar resembles to those described by Givulescu (1969) from Chiuzbaia.

Occurrence in the fossil floras of Romania: very frequent in the Miocene and Pliocene deposits of Romania (after Givulescu and Ghiurcă, 1969).

The actual correspondent: unknown, probably one of the species *Carya amara* or *Carya tomentosa*, which are trees up to 25 m high and live in the river meadow forest and flooded zones from USA.

Family ACERACEAE

***Acer cf. tricuspdatum* Bronn. (Pl. I, Fig. 2, 3)**

Material: samples BC-14, BC-19 and BC-20.

Description: the impression of a trilobated leaf where the margins of lobes are double serrated with the teeth with variable dimension. From the primary vein diverge pairs of secondary veins, which are terminated in the biggest teeth of the margin.

Observations: the asymmetric disposal of the lobes, the margin type and the general aspect of the leaf and the nervation represent enough characters for a specific attribution, but the absence of an entire leaf determine us to be uncertain. Our impression resembles to the specimen figured by Buzek (1971).

Occurrence in the fossil floras of Romania: very frequent in the Pliocene deposits of Romania.

The actual correspondent: is considered to be *Acer rubrum* L., which is a 1-st size hygrophyte tree, widely spread in the eastern part of USA, between Labrador Peninsula and the Great Lakes zone, at north, and the Mississippi Delta and Florida Peninsula, at south. *Acer rubrum* is a euritherm species, preferring wet soils, especially the swamp zones periodically flooded.

Family SALICACEAE

***Salix* sp. (Pl. I, Fig. 4)**

Material: samples BC-23 and BC-35.

Description: two incomplete foliar impressions, without apex and base, nervation characteristic to the *Salix* genus with a prominent primary vein, from which diverge secondary veins arched and united towards the margins. Sometimes between those appear intersecondary veins. The network of tertiary veins forms a special arrangement with the veins, which run perpendicularly to the primary vein. The margin of the described leaf seems to be finely and irregularly serrate.

Observations: because of the absence of the entire leaf impression, a specific determination is impossible. The actual ecological affinities of the *Salix* are for wet soils, living in meadow river zones and in swamp zones periodically flooded.

PALEOPHYTOCOENOTIC AND BIOSTRATIGRAPHIC CONSIDERATIONS

Obviously, the limited number of species doesn't allow too many phytocoenotic considerations, but after the correlation with data from nearby areas, we can say that the discovery of the Băcleș fossil flora arise some questions regarding the evolution of the flora and vegetation from upper part of the Pliocene.

First of all, we have to mention that is very surprising the high relative number of impressions of *Taxodium dubium*. Until the present work, *Taxodium dubium* was known in Oltenia (Țicleanu, unpubl.) only from the deposits covering the VII-th coal seam from Steic microquarry (west of Lupoiaia quarry) and the deposits above the XI-th coal seam from Jiț Sud quarry, both coal seams situated in the Lower and Middle Romanian deposits. Both in Steic and in Jiț Sud, *Taxodium dubium* was found associated with *Glyptostrobus europaeus*, also a taxodiacean, with a large frequency at the Pliocene level (Țicleanu & Dinulescu, 1999). Relying on the large spreading of *Glyptostrobus europaeus* and on its absence in the Băcleș

fossil flora, we consider that this absence is not accidental, but it has special climatic significance. From the information given by Collani (1926) is known that *Glyptostrobus pensilis*, the present day correspondent of *Glyptostrobus europaeus*, doesn't develop and doesn't fructify in the Botanical Garden from Paris, at 11.5°C - MAT (mean annual temperature). We suppose that it's absence from Bâcleș flora can accord to the decrease of MAT under the limit where this tree can survive. In exchange, *Taxodium dubium* is more tolerant regarding the temperature.

The last known appearance of *Glyptostrobus europaeus* accompanied by *Byttneriophyllum tiliaefolium*, a thermophilous sterculiacean, was found at the level of the XV-th coal seam, in the deposits of Middle Romanian. From here, the conclusion that the cooling of climate under the ecologic limits of *Glyptostrobus europaeus*, had taken place further of the sedimentation of the XV-th coal seam, most probably in the upper part of Romanian, and the studied flora can be situated in the final part of the Middle Romanian.

Comparing the fossil vegetal association with the present day correspondents, which are usually river meadow trees, we can assume that towards the end of Romanian, at Bâcleș existed a meadow forest with: *Taxodium dubium*, *Quercus muehlenbergii*, *Carya serraefolia*, *Ulmus laevis*, *Platanus orientalis* and species of *Salix*. The presence of *Quercus roburoides* is another argument for the existence of a flat plain forest.

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PLATES

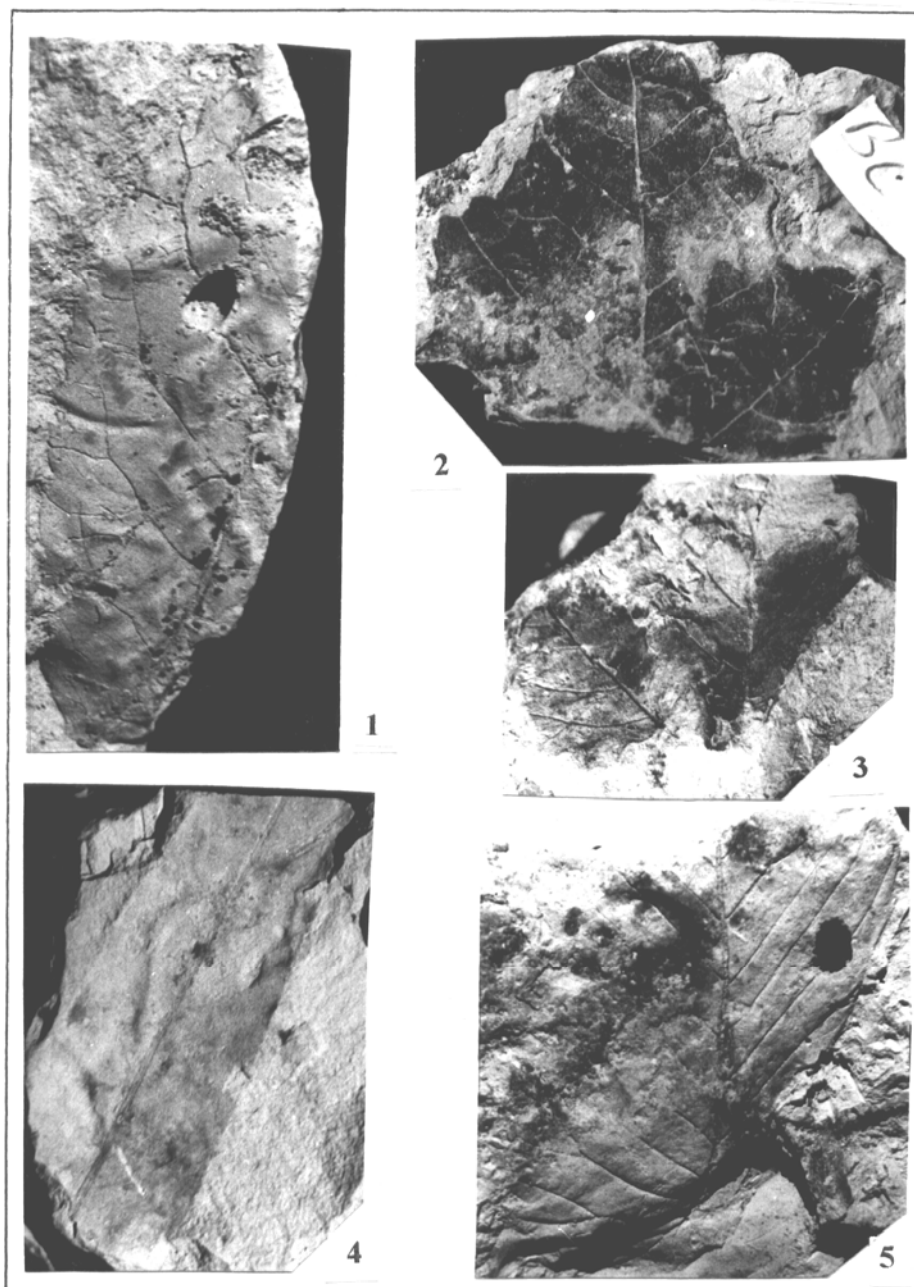
Plate I

- Fig. 1 - *Carya serraefolia* (Goepp.) Kr. (x 1.2)
Fig. 2, 3 - *Acer cf. tricuspdatum* Bronn (x 1.5, x 1)
Fig. 4 - *Salix* sp. (x 2)
Fig. 5 - *Ulmus laevis* L. (x 1.5)

Plate II

- Fig. 1 - ?*Platanus platanifolia* (Ett.) Knobl. (x 1.2)
Fig. 2 - *Taxodium dubium* (Sternb.) Heer (x 1.5)
Fig. 3 - *Quercus cf. muehlenbergii* Engelman (x 1.2)
Fig. 4 - *Quercus roburoides* Gaudin (x 1)

Planșa I



Planșa II

