ACTA PALAEONTOLOGICA ROMANIAE V. 4 (2004), P.105-111

THE COMPARATIVE STUDY OF THE COAL FORMING PONTIAN AND DACIAN-ROMANIAN FLORA FROM THE DANUBE-MOTRU SECTOR, SW ROMANIA

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Abstract. This paper presents the floristic epitome of the Pontian flora from Batoti exposure and the Dacian-Romanian flora from Husnicioara open pit, tow outstanding fossil-bearing sites in Mehedinti. In function of the importance of the coal forming taxa, the conclusion is that in the paleoflora at Batoti are frequently taxa indicating a meadow forest, therefore with reduced part in coal-generating. In Husnicioara quarry prevailing specifically taxa in coal-generating swamps, with distinct importance.

Keywords: Flora, Pontian, Dacian-Romanian, Batoți exposure, Husnicioara quarry, Romania

INTRODUCTION

From the comparative analysis of the actual floras from the Dacian Basin, the Pontian, the Dacian and the Romanian, it results the transition character of the Dacian flora and vegetation between the Miocene and Pliocene floras (Țicleanu, 1995).

The study of the coal-forming vegetation yields interesting data for the knowledge of the swamp biotope evolution in the Neogene, although these floras are poor documented as number of species, but rich in accumulations of vegetal fossils.

The paleofloristic material submitted to the comparative analysis regarding its coal forming role and its coal-generating importance was collected from Batoți outcrop and Husnicioara quarry (Mehedinți district). The outcrop with Pontian flora from Batoți is located 25 km south-eastern from Drobeta Turnu Severin, on the left Danube bank (fig.1), where a sequence of clay deposits containing a rich amount of plant remains is cropping out.

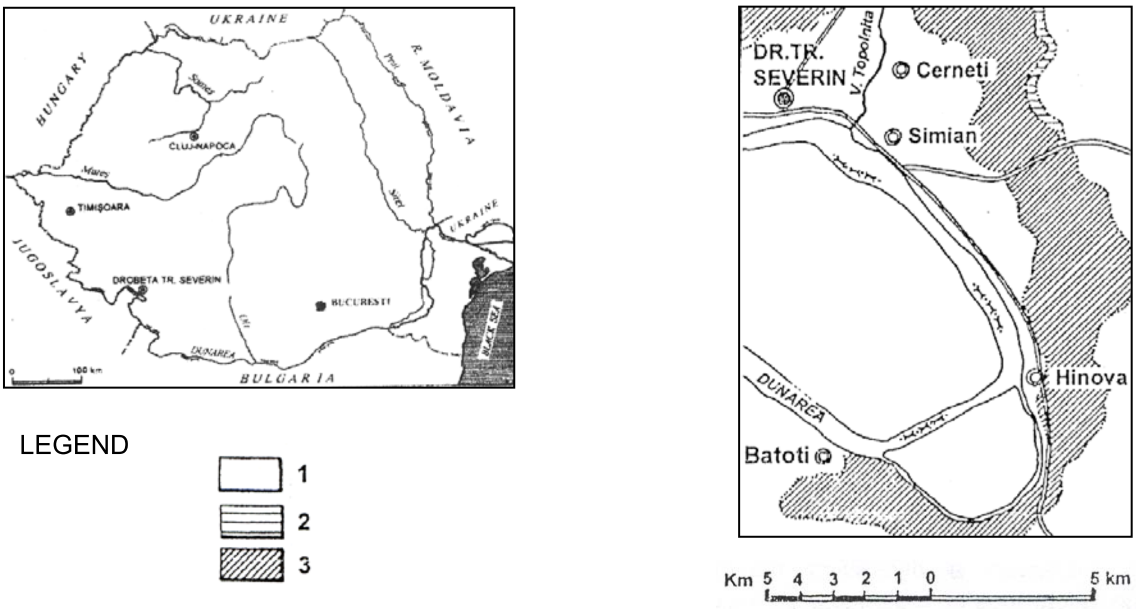

Fig. 1 Location of the Batoti outcrop: 1-Quaternary, 2-Dacian, 3-Pontian (after the geological map of Romania, scale 1:200.000, modified)

Petrescu et al. (2002) did the first research on the palynology of the Pontian deposits mentioning also five macroflora species: *Glyptostrobus europaeus* (BRONGN.) UNGER, *Alnus kefersteini* (GOEPPERT) UNGER, *Salix varians* GOEPPERT, *Fagus pliocaenica* SAPORTA and *Quercus pseudocastanea* GOEPP.

The first research carried strictly on macroflora belongs to Țicleanu et al. (2002). These authors identified the following taxa: *Taxodium dubium* (SERNBERG) HEER, *Glyptostrobus europaeus* (BRONGN.) UNGER, *Platanus platanifolia* (ETT.) KNOBLOCH, *Alnus ducalis* (GAUDIN) KNOBLOCH, *Alnus cecropiaefolia* (ETTINGSH.) BERGER, *Betula insignis* GAUDIN, *Fagus silesiaca* WALTH. & ZAST., *F. pliocaenica* SAPORTA, *Quercus kovatsi* KOVACS, *Q. pontica* KOCH *miocaenica* KUBAT, *Quercus* cf. *macrantheroides* ANDREANSZKI,

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Ulmus pyramidalis GOEPPERT, *Pterocarya paradissiaca* (UNG.) ILJNISKAYA, *Populus populina* (BROGNT.) KNOBLOCH and *Byttneriophyllum tiliaefolium* (AL. BRAUN) KNOBL. ET KVACEK.

Recently, Diaconu (2002 b) added 7 more taxa: ?*Sequoia gigantea* L., *Liquidambar europaea* AL. BRAUN, *Castanea* cf. *crenata* SIEB. ET ZUCC., GIVULESCU, *Carya serraefolia* (GOEPP.) KRAUSEL, *Acer integerrimum* (VIV.) MASSAL, *Vitis teutonica* AL. BRAUN, *Cornus* sp. and confirmed the presence of *Alnus cecropiaefolia* (ETTINGSH.) BERGER. So, the list of the Pontian flora from Batoți includes now 25 taxa.

The Husnicioara quarry is located 15 km eastward from Drobeta Turnu Severin.

The Dacian deposits are clearly visible in the Husnicioara quarry section. Noteworthy are the superjacent deposits to lignite Bed IV.

The accumulation of fossil flora in the gray clay froming the Bed IV's roof, is already mentioned by Diaconu (2000) including: *Byttneriophyllum tilliaefolium* (AL. BR.) KNOBLOCH & KVACEK, *Glyptostrobus europaeus* (BROGNT.) HEER, *Glyptostroboxilon*, *Salix ştefănescui* MAR. & LAUR., *Potamogeton* cf. *nodosus* POIR, *Phragmites oeningensis* AL. BR., *Ceratophyllum submersum* L., *Quercus* sp., *Acer* sp.

Later on, in Husnicioara quarry, but above Bed VI, other taxa were found (Diaconu, 2002 a): *Byttneriophyllum tiliaefolium* (AL. BR.) KNOBLOCH & KVACEK, *Glyptostrobus europaeus* (BROGNT.) HEER, *Glyptostroboxilon*.

Petrescu et al., (1989) studied the microflora of the deposits related to Bed IV from Husnicioara quarry. These data yielded some conclusions on paleoclimatology, as: the arctotertiary elements (*Sciadopitys, Picea, Tsuga, Pinus s/g. diploxylon, Carpinus, Fagus, Ulmus, Compositae* etc.) and intermediarys ones (*Cedrus, Carya, Pterocarya, Zelkova* etc.) are ruling, but the thermophile elements (*Myrica, Reevesia*) are rare.

The Pontian coal-forming vegetation

The paleoecological analysis of the Batoti Pontian flora already presented shows the existence of two distinct paleobiotopes:

-a mesophytic one, corresponding to an allochtonous flora dominated by: *Fagus, Quercus, Castanea, Carya, Pterocarya*, etc.

-a swamp coal-forming one with *Glyptostrobus europaeus*, *Byttneriophyllum tiliaefolium* and *Alnus cecropiaefolia*. The last assemblage may include plants from the seasonal flooded areas (*Alnus cecropiaefolia* and *Byttneriophyllum tiliaefolium* or plants from the almost permanently flooded areas where *Taxodium dubium* and *Glyptostrobus europaeus* were dominant).

Besides the two paleobiotopes, there might be found a high hillocky paleobiotope, or even a rangy one, with *Sequoia gigantea*.

The azonal vegetation with forest swamps comprised *Alnus cecropiaefolia*, *Byttneriophyllum tiliaefolium* and *Liquidambar europaea*, and the forest swamps included *Glyptostrobus europaeus* and *Taxodium dubium*. Another participant of the azonal vegetation, the waterside forests, seems to concern *Platanus platanifolia*, *Salix varians*, *Populus populina*, etc.

The zonal vegetation included at least two vegetation belts. The first belt was located in the plains, or possible in the hills, where *Fagus* forests associated with different species of *Quercus*, *Castanea*, *Pterocarya* developed. The second one occupied higher areas (? high hillocks) where *Sequoia gigantean* was possibly well represented.

As regarding the azonal vegetation, I would like to point out the presence of the association *Glyptostrobus europaeus - Byttneriophyllum tiliaefolium - Alnus cecropiaefolia*, thought by Givulescu (1992) as typical for the Late Miocene, especially for the Pontian. Accordingly this assemblage, one may assume that in the upper deltaic areas belonging of the Pontian Danube delta (Popescu, 2001) it was possibly that peat bogs accumulated, which were later eroded.

The fossil flora from Batoti is the richest Lower Pontian flora in Romania, but also in the next areas (Petrescu, et al., 2002). The floristic inventory reveals vegetation with predominant trees, ranging from high ones (*Sequoia*, *Ulmus*, *Liquidambar*) to small specimens (*Ostrya*, *Cornus*).

The frequence of flora from Batoti is presented the diagram in fig.3.

Not all the plants had an equal participation in the vegetation developed around the areas of sedimentation, so not all the taxa had the same role in forest structure

Based on quantitative examination of the plant fossil it could be noticed that in fact just a small part of them were dominants, while the remaining have only a minor role. From the great number of families, only two are constituents of a real forest: Betulaceae and Fagaceae. The greatest amount of leaves is coming from *Fagus silesiaca* and different species of *Quercus*, and less from *Populus, Ulmus, Carya serraefolia.* Compared to the Chiuzbaia flora, the flora from Batoti has a reduced number of *Zelkova zelkovefolia* specimens.

Starting from the observation of Givulescu (1997) regarding the composition of the forest with trees, bushes and lianas from Chiuzbaia, which he doesn't consider as a whole, we may assume that the Pontian plants from Batoti formed different assemblages, originating from different biotopes, as I mentioned before.

So, there were water plants, plants of a swampy forest, but not in the classical meaning. There were just more or less flooded areas; waterside plants, not necessarily coming from the areas along the water course but mostly the plants coming from areas near the shore; plants of a mesophytic forest, the majority of them being also plants with xerophytic character (*Ostya* sp. aff. *O. virginiana*, *Acer integerrimum*), possibly coming from sunnier areas.

To conclude, the forest from Batoti was a mixed one with *Fagus*, *Quercus*, *Acer*, *Carpinus*, *Carya*, and some conifers, but with a small number of Lauraceae. This forest was layered, with the higher level represented by decidous trees of an arctotertiary origin.

From the viewpoint of the phytogeography, the vegetation represents a mixture, including at least 8 phytogeographic groups: Atlantic Northern American, East-Asian, Caucasian, Central –European, Pacific Northern American, Mediterranean, the South - East of Asia, the Small Asia, and cosmopolite. These are represented through different taxa, but we may underline the groups belonging to Atlantic Northern American element and to the east-Asian element.

This mixture of phytogeographic elements shows at a low scale the general situation of the Late Miocene floras in Romania. In this respect, I can mention that Givulescu (1990:178) also identified a great number of Northern American and East Asian elements. Taking into account the proportions, we may say that the paleoflora from Batoti has a phytogeographic composition close in percentage to the flora from Chiuzbaia (Ţicleanu et al., 2002).

Considering this phytogeographic composition and the frequency of the *Fagus silesiaca* leaves – similar to Chizubaia situation (Givulescu 1990:113) - it seems that the greatest similarities may be established between the flora from Batoti and the recent Northern American forest growing between the Atlantic shore and Alleghany mountains, more precisely a forest of the type “Mixed mesophytic Region” –type, which associated species of *Quercus*, *Pterocarya*, *Ulmus*, etc.

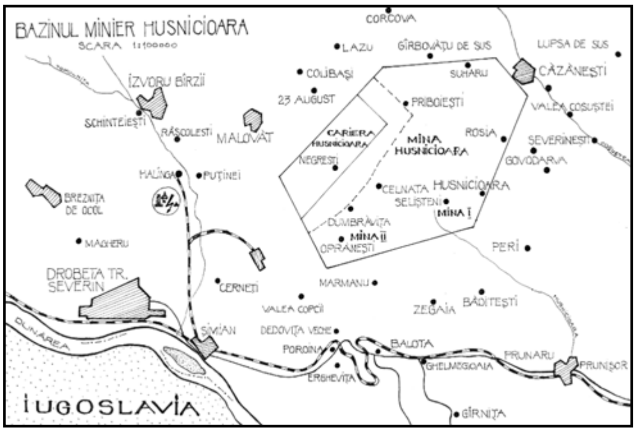
We may wonder: what was the paleoclimate in which this forest vegetated? The climatic conditions during the Early Pontian may be estimated starting from the existence of the termphfile markers (*Glyptostrobus europaeus, Taxodium dubium* and mostly *Byttneriophyllum tiliaefolium*) which indicate an annual average temperature of 14-15 Celsius degrees and an approximate 1200 mm per year rainfall. Moreover, as a result of the palinological research, Petrescu et al. (2002) estimated climatic factors characterized by an annual average temperature (AAT) of 14-15 C degrees, and a rainfall quantity, which exceeded 1200mm per year.

However, the absence of the Lauraceas, but mostly the great frequency of the *Fagus* -type near certain pinofite remains yet undetermined make us assume that AAT didn’t reach 15^0 C. To make a comparison, Chiuzbaia flora was said to have vegetated in a warm temperate climate of Cfa (sensu Koppen) a type in which the annual average temperature possibly ranging between 15,2 – 15,6 ^{0} C and the average annual rainfall quantity varied between 1144 – 1361 mm per year.

The Dacian-Romanian coal-forming vegetation

The studied region is situated in the far West of the Dacian Basin (fig. 2). There were large swamp moors, where *Glyptostrobus europaeus*, *Byttneriophyllum tiliaefolium* and *Salix* div sp., were dominate, forming phytocoenoses with a high significance in the coal-genesis, as they were considered the dominant species of the coal forming paleoflora.

Fig.2 Location of the Husnicioara quarry (scale 1:1 00.000)



The flora frequence from Husnicioara quary is presented in fig. 4.

The paleoecological analysis of the floristic inventory from the Husnicioara quarry shows the existence of a coal-forming swamps biotope with *Glyptostrobus europaeus*, *Byttneriophyllum tiliaefolium* and *Salix* div. sp. Apart from this, it is also possible the existence of a forest with deciduas trees, where *Quercus*, *Carya*, *Carpinus*, *Platanus*, have species with correspondents nowadays in flooded areas

The vegetal scenery seems to include azonal vegetation with swamp forests presented by *Glyptostrobus europaeus* - *Byttneriophyllum tiliaefolium* and components of the mesophytic deciduous forest, respective of the forest with *Quercus*-*Carya*. The floral picture is completed through the data obtained from palinological studies, which bring important information.

The palinological spectrum outlined by Petrescu et al. (1989) issued on the qualitative-quantitative analysis of 6 samples taken from the Bed IV, Husnicioara quarry. It is highly probable that the plant cover around the sedimentation basin evolved during the sedimentation of lignite Bed IV, in a temperate climate, characterized by mean annual temperatures ranging about 13^0 and mean annual rainfall of about 1300 mm. Such a wet, warm-temperate climate (Cfa) could compare favorably with the present climate on the Atlantic coast of North America and in SE China.

Out of the analysis of the main taxa from Husnicioara quarry and from the comparison with the actual correspondents results that for the Dacian-Romanian timespan, there was a type c.f.a.-type climate (Koppen system), mild temperate, wet, with hot summers and winters with minimum temperate below 5^0 C (Ticleanu et al., 1982 a). These conditions bring forward the existence of the swamp biotopes of and developed abundant vegetation, which in favorable circumstances allowed the accumulation of lignite deposits in this basin.

The role of taxa from floristic epitome in coal-genesis

The screening the coal-forming taxa from floristic epitome was make on base of ecological requirement of actual correspondents, their stratigraphic distribution, the habitat and their role in coal-genesis.

The *Pinus* type seemed to have no special role in forming the coal-generating swamp. The presence of *Pinus* vegetal fossil in the small coal basins may be explained through the fact that these fossils were easily transported from the forests lying near the coal-forming swamps.

The annual quantity of phytomass fallen every autumn from *Taxodium distichum* trees is explained through the existence of deciduous stems. This characteristic may be also found at its ancestor, which had an important role in coal-genesis.

The role of *Glyptostrobus europaeus* in forming of coals was grasped since the last century (Schimper, 1872) and accepted by all pealeobotanists interested in the genesis of the coal. Teichmuller (1958) considered it as an important associate in the vegetation formation "*Taxodium* + *Nyssa* Sump fwald". An important role was also given to it by Givulescu (1960, 1967, 1974), Ticleanu (1986) si Diaconu (2000).

The magnoliaceas weren't found in coal deposits in most of the cases, so they didn't play an important role in coal-genesis.

Ceratophyllum species lived in areas permanently covered by water and sometimes they had a pretty big production of phytomass, but they may have contributed to argillaceous coal formation mostly.

Liquidambar europaea vegetated mostly in the waterside forests then in the swamp ones, having a small contribution in coal-genesis.

The contribution of *Platanus platanifolia* in forming the coal-generating phytomass swamp didn't exceed the usual contribution of any waterside forest element.

The role of the species *Ulmus pyramidalis* and *Zelkova zelkovefolia* in forming the coal-generating swamps was much reduced. a *Quercus* species was found in Husnicioara quarry, difficult to be determinate because it's a fragment from a probably transported sample from the proximity oak woods. Anyway, even if it was found in coal deposits, the role of this taxon in coal-genesis was much reduced.

Aluns cecropiaefolia had an important contribution to forming the coal-generating phytomass for the Pontian coal from Visag, Sinersig, Sarmasag etc. This taxon was the component of the assemblage *Glyptostrobus europaeus* - *Byttneriophyllum tiliaefolium - Alnus cecropiaefolia* thought by Givulescu (1992) as typical for the Late Miocene, especially for the Pontian. On the basis of this assemblage it was presumed that in the Pontian Danube delta have been exited peat bogs, which then were eroded. The erosion of the peat bogs might have been possible from various causes:

-the vegetation wasn't abundant enough to from bog with a sufficient thickness. Even if, in Batoti, the three components of the coal-forming typical assemblage were found, except for *Alnus,* which is represented by several samples, the other taxa are rather few, even more; the leaves of *Byttneriophyllum tiliaefolium* are divided. These fossil plant remains proceed from the leaves with great dimensions which were destroyed during transport, a fact noticed by Ticleanu et al. (2002), who presumes that these fragments belonged to trees situated at a certain distance (about several hundred meters away, maybe 1-2 km);

-the eustatic fluctuations of the Pliocene lake were frequent. As the areas where these fragments were found were near the border delta, the peat bog could have been destroyed;

-the tectonic movements, which were the main cause of the coal generation, did not probably fulfill the necessary condition $V_s = V_a$, or the subsidence was reduced in that area.

Among Juglandaceas just *Juglans barbui* seems to have had a greater role in forming the phytomass of the coal-generating swamps, but not greater then any other trees that participated in the formation of the riparian vegetation on the alluvial tops of a bank ridges.

In Oltenia, during Dacian, *Acer tricuspidatum* formed also pure forests, as resulted from the assemblages of fossil collected from the top of the VIII[th] coal layer at the East Rovinari mine (Ticleanu et al., 1982 b). Taking into account the preferences of this taxon (and its recent analog) for humid, swampy soils it may be assumed that it grew in the same conditions as a fossil, especially if it formed monodominant coenoses. So, this taxon had a considerable contribution in forming the coal.

Comparative with the tree species, the Vitaceae contribution at the phytomass constitution of the coal-forming swamps was modest, but it doesn't have to be must neglect.

From Salicaceas family referring to the plant which contributed to forming the Pliocene coal from Oltenia, Preda et al, 1981, assigned an important role to the species named *Salix pliocenica* Barbui. Ticleanu et al (1985) believed that the *Salix* species had a great importance in forming the Rovinari coal in "association with *Myrica* and Cyrillaceae". Then, Ticleanu (1985) shows that especially during the Superior part of the Pliocene different species of Salix formed paleophytocoenoses in the temporary flooded area. This situation might have been the same during Dacian, when the coal from Husnicioara was formed.

Because the *Salix* species were found in most of the coal deposits and on the basis of their present correspondents, which may be found in the eutrophe swamps, it was assumed that they had a great importance in the coal-genesis.

The *Populus* genus, as a component of the waterside forests and of those alluvial tops of a bank ridges, had a reduced importance in the coal-genesis.

The Sterculiaceae family had one of the greatest contributions in the coal-genesis through the taxon *Byttneriophyllum tiliaefolium*, being one of the dominant species of the Dacian-Romanian swamps from the West Oltenia. On the basis of paleogeographic significations we may provide interpretations regarding the contribution of this taxon to forming the phytomass of the coal-forming swamps. The fruit of *Byttneriophyllum tiliaefolium* species were pack saddled with big wings and heavy seeds, which made them difficult to transport. The dissemination couldn't be done on wide areas but only in the vicinity, in swampy areas. This dissemination explains the fact that the species remained a fossil.

Taking into account the size of the tree, the quantity of leaves produced annually and its high spreading beginning with the Sarmatian (the highest spreading being in Pliocene) it results that the *Byttneriophyllum tiliaefolium* species had a great importance in forming the coal-forming swamps.

The big frequency and the good preservation of the fossil vegetal remains of this taxon in Husnicioara quarry (over 100 of collected leaf from the IV Bed's roof, from clayed layer with a 20 cm thickness with 5 m length), in comparing with the few broke sample from Batoti, (fig. 5) shows autochthony and its dominanting role in coal forming swamps in this region. The special role of *Byttneriophyllum tiliaefolium* in coal forming it's emphasized in all of the Ticleanu's works that are talking about these aspects.

The *Potamogeton* species vegetating in the open water areas, constituted the source of phytomass for claying coals and coaling clays from Oltenia Pliocene.

The *Typha latissima* species gave an enough of considerable quantity of phytomass in coal forming swamps from Oltenia.

The coal-forming role of the *Phragmites* species it doesn't have to be appreciated by its frequency in coal deposits. By the fact that the annual stems were drying once with leafs, it can be explained the relative rarity of these taxa in deposits.

CONCLUSIONS

To conclude, the Taxodiaceae (Pinophyta) family, although through barrel species, has represented one of the main providers of phytomass in the coal forming swamps from Western Oltenia, especially due to the rapid growth of deciduous stems characteristic of the taxa *Taxodium dubium* and *Glyptostrobus europaeus*. The plant remains of these taxa accumulated in the anaerobes conditions from the permanently flooded areas, so that the cause loses by destruction were reduced, assuring a considerable phytomass for coal forming.

The Magnoliophyta has the most numerous representatives in the paleofloristic coal forming elements. So, I can mention 11 families from Magnoliopsida and 3 families from Liliopsida.

The Liliataes, due to their biform (weeds), kept themselves as vegetal fossil remains which can be determined, but not compared to the Pinophytas and Magnoliataes. As a result, they appear more rarely in the coal deposits and this thing does not prove their importance in the coal-genesis.

The main coal forming species were *Byttneriophyllum tiliaefolium, Glyptostrobus europaeus, Acer tricuspidatum, Phragmites oeningensis* and *Typha latissima.*

It can be noticed the existence of some taxa (*Glyptostrobus europaeus, Byttneriophyllum tiliaefolium)* since the Oligocene or Burdigalian, but these taxa had an important role in the coal-genesis during the Late Miocene, but especially in the Pliocene.

REFERENCES

Diaconu, 2000, Date preliminare privind studiul paleoflorei din cariera Husnicioara Vest. *Armonii naturale* nr. 4, Arad

Diaconu, 2002a, Observații recente în punctele fosilifere pliocene dintre Dunăre şi Motru. *Drobeta*, vol. XI-XII, p.199-207, Ed. Radical, Drobeta Turnu Severin

Diaconu, 2002b, Date noi privind studiul florei ponțiene de la Batoți (județul Mehedinți). *Oltenia. Studii şi comunicări. Ştiințele naturii,* vol. XVIII, p. 37-44, Craiova.

Givulescu, R. 1960, Paleobotanische Notizen über Buettneriophyllum aequalifolium (Goepp.) Giv. Flora, *All. Bot. Zeit.* , 149, p. 426-434, Jena.

Givulescu, R. 1967, Considerații asupra florelor din Terțiarul R.S. Românei. An. Univ. Buc. Ser. St. Nat. (geol. –geogr.), 16/1, p. 91-97, Bucureşti

Givulescu, R. 1974, Einge fur Rumanien neue fossile pflanzen aus dem fundort Chiuzbaia F (Kreis Maramures). Ed. Acad. R.S.R.,p. 147-151, Bucureşti

Givulescu, R. 1990, Flora fosilă a Miocenului Superior de Chiuzbaia. Ed. Acad. Române, Bucureşti

Givulescu, R. 1992, Les foretes marécageuses du miocène supérieur de Roumanie : un paléobiotope d'exception et sa végétation dans le Miocène supérieur de l'ouest de la Roumanie. Ed. Johanna Kovar-Eder., p. 147-151, Viena.

Givulescu, R. 1997, Istoria pădurilor fosile din Terțiarul Transilvaniei. Ed. Carpatica, p. 113, Cluj-Napoca

Petrescu I., Cernita P., Meilescu C., Codrea V., Pascovici N., Vădan M., Hosu Al., Manda S., Bengulescu L. 1989, Preliminary Approaches to the Polynology of Lower Pliocene (Dacian) Deposits in the Husnicioara Area (Mehedinți Country, S.W. Romania). *Studia Univ. Babeş-Bolyai seria Geol – Geograf.* XXXIV/2, p. 67-74 , Cluj Napoca.

Petrescu I., Bican-Brişan N., Meilescu C., Pătruțoiu I., 2002 – The palynology of the Pontian from Batoti-Mehedinti (South – Western Romania). *Acta Paleontol*. III, Cluj-Napoca.

Popescu, S. M. 2001, Végétation, climat et cyclostratigraphie en Paratethys central au Miocène supérieur et qu Pliocène inférieur, d'après la palynologie. These. Univ. Claude Bernard Lyon 1.

Preda I., Todiriță V., Greblă M., Angel C. 1981, Depozitele pliocene cu ligniți din zona Hîrnea-Bolboceşti-Linia Magheru. *Anal. Univ. Bucureşti, s. geol.*

Schimper W. Ph. 1872, Traité de Paléontologie végétale, II, Paris

Teichmuller M. 1958, Rekonstruktionen verschidener Moor typen Hauptflözes der Niederrheinischen Braunkohlen. *Fortschritte in der Geologie von Rheinland und Westfalen*, 2, p. 599-612.

Țicleanu N., Huică I., Ticleanu M. 1982 a, Contributions a la connaissance de la flore pliocène de la Roumanie. La flore dacienne de Dedovița (District de Mehedinți*). D.S. Inst. Geol. Geograf*. LXVI, 3 p. 127–143 Bucureşti.

Țicleanu N., Roman St., Givulescu R., Bițoianu C. 1982 b, Contributions á la connaissance de la paleoflore et la petrographie de charbons de secteur Rovinari (District Gorj). *Simpozionul de paleobotanică – palinologie. Univ. Babeş Bolyai*, p. 38-91, Cluj Napoca.

Țicleanu N., Roman St., Givulescu R., Bitoianu C. 1985, Considerații paleofloristce şi petrografice privind geneza ligniților din vestul Olteniei. *D.S. Inst. Geol. Geograf.* LXIX p. 71-87, Bucureşti.

Țicleanu, N. 1986 , Remarks on the reconstitution of the Vegetal Associations generating the Neogene coals of Romania. *D.S. Inst. Geol. Geofiz.* 70-71/3, p. 219-233, Bucureşti.

Țicleanu, N. 1995, *Macroflore et végétation daciènnes du Bassin Dacique*, în „*Chronostratigraphie und Neostratotypen, Pl1, Dazien*". Ed. Acad. Rom., p. 473-498, Bucureşti

Țicleanu N., Petrescu I., Diaconu F., Meilescu C., Pătruțoiu I. 2002, Fossil plants from Pontian deposits at Batoți – Mehedinți. *Studia, Univ. Babeş-Bolyai, Geologia, Special ISSUE*, 1, p. 351-364, Cluj-Napoca.

FIGURES

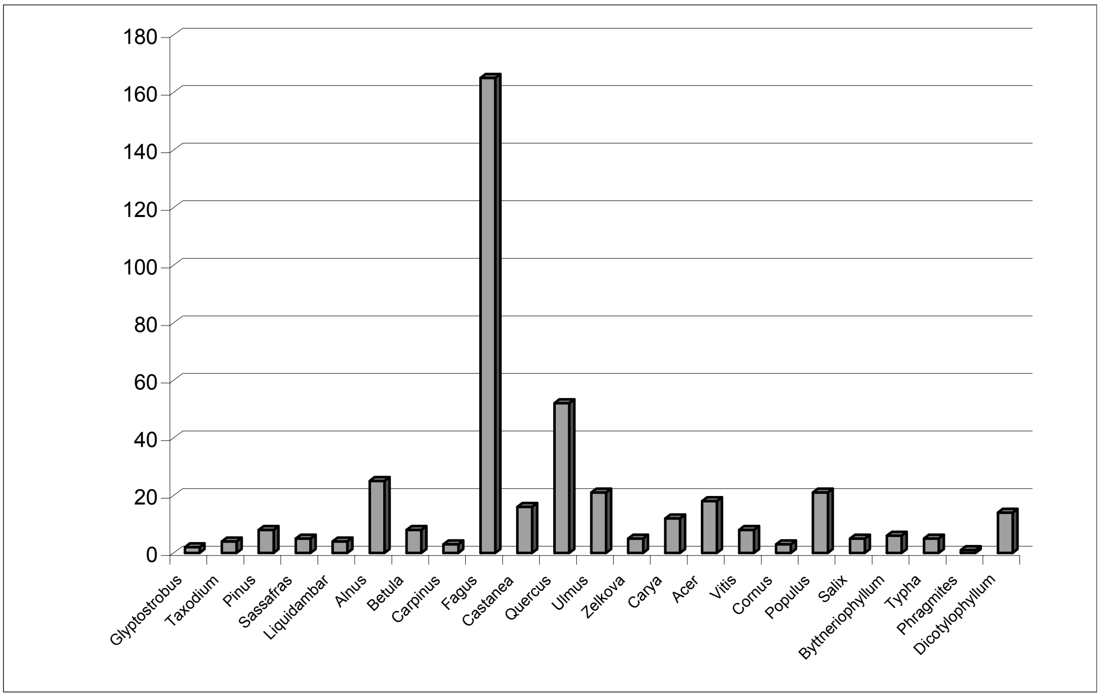
Fig. 1 Location of the Batoti exposure: 1-Quaternary, 2-Dacian, 3-Pontian (after the geological map of Romania, scale 1:200.000, with modifications)

Fig. 2 Location of the Husnicioara quarry (scale 1:1 00.000)

Fig. 3 The taxa frequence from Batoți

Fig. 4 The taxa frequence from Husnicioara quary

Fig. 5 The frequence of the same taxa from Husnicioara and Batoti



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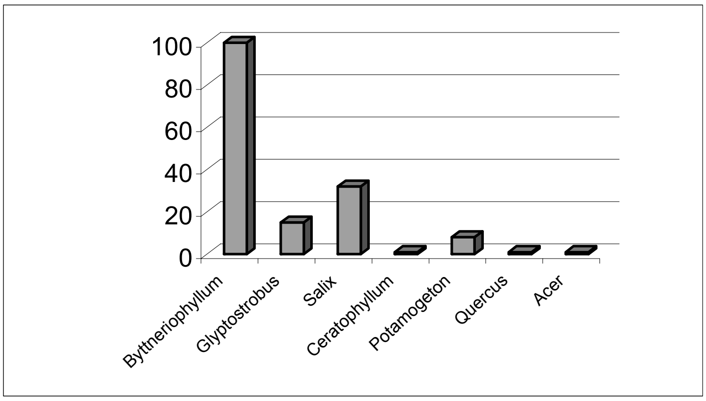

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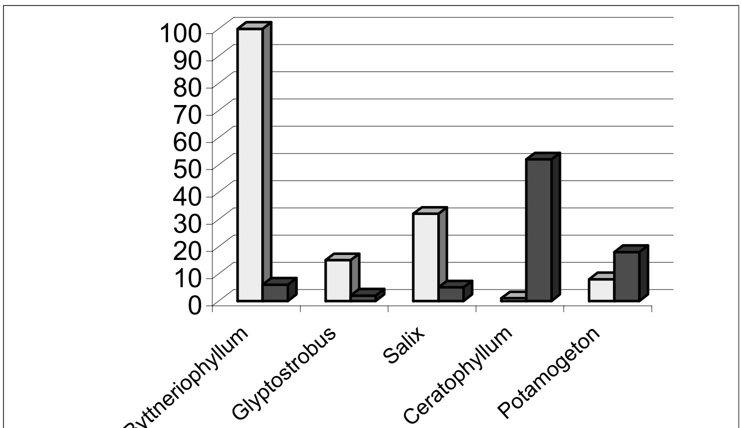

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