ACTA PALAEONTOLOGICA ROMANIAE V. 7 (2011), P. 123-137

CONTRIBUTIONS TO THE PONTIAN FLORA OF SOUTHWEST OLTENIA (ROMANIA)

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Abstract. The paper deals with the paleoflora collected from a new site in Lower Pontian deposits occurring at Crivina, close to Drobeta Turnu Severin municipality, SW Romania.
The deposits that yield a rich fossil flora from Crivina are mainly represented by layered clays with fossil plant remains, siltic clays and sandy silts, including carbonate sandstone concretions, also containing plant impressions.
The macrofloral assemblage is allochthonous, partly hypautochthonous, and it has a special significance in understanding the evolution of the vegetation and climate of the Late Miocene.
The flora from Crivina is similar to the flora identified in Batoți fossiliferous site. The flora from Batoți represents the only Lower Pontian assemblage described until now in Romania.

Keywords: Lower Pontian, macroflora, Crivina, Oltenia, Romania.

INTRODUCTION

The Pontian deposits crop out along the Romanian Danube bank, which was investigated on several occasions (Diaconu, 2002a); mollusk faunas at Erghevița, Bistrița, Mojiei Valley, Cârjei Valley, Ostrovul Corbului, Obârşia de Câmp and Lower Pontian paleoflora at Batoți were thus identified.

In 2008, Crăciunescu Gabriel, archeologist at the Iron Gates Region Museum in Drobeta Turnu Severin, discovered a new fossil plants site at Crivina. This site occurs 40 km south of Drobeta Turnu Severin (Mehedinți County), on the left bank of the Danube (Fig. 1), in an area that is part of the Danube Green Corridor Natural Park. The succession is dominated by clayey deposits and it includes a rich fossil vegetal association (Pl. I, fig. 1).

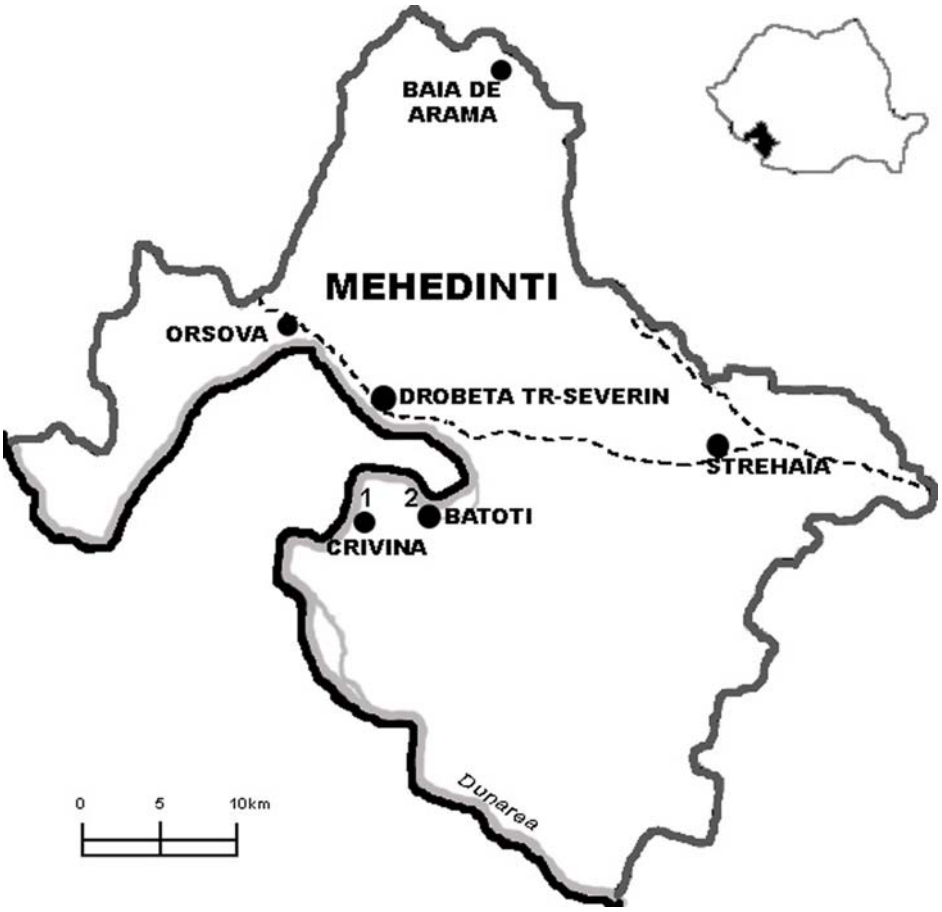

Fig. 1 - Location of Crivina and Batoți sites on the geological map of Turnu Severin sector (based on the geological map 1:200,000 L-34-XXX, Turnu Severin, 1967).

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PREVIOUS RESEARCH

The occurrence of fossil plants in the Pontian deposits near Drobeta Turnu Severin has been mentioned for the first time by Barbu (1954), at Negoieşti. Macrofloral studies on the Pontian deposits with fossil plants from Batoți were performed by Țicleanu et al. (2002) and Diaconu (2002b, 2003, 2004a, 2004b, 2008). Corroborating the results of the previous researches, Diaconu et al. (2004) pointed out the importance of Batoți micro- and macroflora in the frame of the paleofloristic heritage of Romania. The flora from Batoți represents the only Lower Pontian assemblage described until now from Romania. The 50 identified taxa are arguments for a paleofloral assemblage of a very special scientific importance. From a palynological point of view, no other similar microflora - as far as richness and diversity are concerned - is known from Romania and its neighbouring areas (Petrescu et al., 2002).

TAPHONOMIC CONSIDERATIONS

The Lower Pontian succession cropping out in the fossiliferous site is about 20 m thick (Pl. I, Fig. 2); however only a few meters contain fossil vegetal remains, located in well- layered clay, sometimes showing local variegated features. Most of these layered remains occur as coarse vegetal detritus, frequently preserving leaf remains that are very rarely complete.

The high density of vegetal detritus and its location along a few millimetres-thick sequence in the lower part of some very thin (2-3 cm) clay layers points to an allochthonous origin, the fossil plant remains being probably transported from long distances (km?) into the basin (delta?) during the autumn floods. Another argument for the allochtonous nature of the fossil accumulations is the degree of fragmentation of the leaf material. The occurrence of foliar imprints of coriaceous and subcoriaceous (*Fagus, Quercus,* etc.) leaves is another argument for an allochthonous origin.

At certain levels, large carbonate concretions occur (Pl. I, fig. 3) resulted by $CaCO_3$ cementation of clayey silts. They have a relatively high hardness but they can be exfoliated along planes which often contain very well-preserved plant imprints.

The fossil plant sequence is included in clayey soils, sometimes interlayered with fine sands; the succession was attributed to the Odessian (Lower Pontian) by Marinescu (1978) on the basis of the fossil content including *Valenciennius annulatus* Rousseau 1842 and *Paradacna abichi* Hoern.

Another argument for the Lower Pontian age is represented by the levels of fossil mollusks (Pl. II, Fig.1) in the sequence from Crivina. The mollusk fauna identified contains *Paradacna okrugici* (Brusina) (Pl. II, fig. 2 a,b), *Pseudocatillus* sp., (Pl. II, fig. 2 c), *Dreissenomya aperta* (Deshayes) (Pl. II, fig. 2 d).

MATERIAL AND METHODS

The macrofloristic material consists of leaf impressions, the compressions being destroyed by oxidation.

The material was selected by using a stereomicroscope. Sometimes, because of the obvious contrast between the colour of the foliar impressions and the colour of the host rock, pictures were used for comparisons with materials preserved without anatomical details. The material is currently curated in the collections of the Iron Gates Region Museum.

SYSTEMATICS

Phyllum **MAGNOLIAPHYTA**
Class **MAGNOLIATAE**
Family **LAURACEAE**
Laurophyllum GOEPPERT 1857
Laurophyllum sp.
Plate VII, fig. 1 A

Description: The material has obovate leaves with entire margins, long petioles, and straight and conspicuous midvein; secondary veins are not clearly visible. The general morphological features indicate laurel-like leaves.

Remarks: Our samples are similar to those described by Paraschiv (2004, p. 319, Pl. I, fig. 4)

Family **BETULACEAE**
Genus ***Alnus*** GEARTNER 1791
Alnus cecropiaefolia (ETTINGSHAUSEN) BERGER, 1955
Plate III, figs. 1, 2; Plate IV, fig. 3

1851-*Artocarpidium cecropiaefolia* ETTINGSHAUSEN 15, T. 2, f. 3-4

1955- *Alnus cecropiaefolia* (ETT.) BERGER 87, fig. text 30

1972-*Alnus cecropiaefolia* (ETTINGSHAUSEN) BERGER, Zastawniak , Pl.I, fig.5; Pl.XIV, fig.1

1999-*Alnus cecropiaefolia* (ETTINGSHAUSEN) BERGER, Givulescu, p. 33, Pl.11, fig.1

2002-*Alnus cecropiaefolia* (ETTINGSHAUSEN) BERGER, Țicleanu et al., p. 354, Pl. II, fig. 1

Description: Large elliptical leaves, with a rounded base and double dentate margins, and falcate teeth. Pinnate-craspedodromous venation with a strong main vein, thick at the base and narrowing to the apex; the secondary veins diverge at angles of 80^0 in the basal side and 30^0 in the upper side. The tertiary veins form a net of parallel rectangles.

Remarks: This species is characteristic for the Pontian coal deposits of Romania. Our samples are similar in morphology to those described by Zastawniak (1972, Pl. I, fig.5; Pl.XIV, fig.1), Givulescu (1999, p.33, Pl.11, fig.1) and Țicleanu et al. (2002, p. 354, Pl. II, fig. 1).

Occurence in Romania: Micu et. al (1985) point out that this species appears for the first time in the Sarmatian swamps of the Comăneşti Basin, and that it is characteristic to the Pontian coal deposits of the Pannonian Basin in localities such as Sărmăşag, Derna and Lugoj (Givulescu, 1978).

The recent correspondent: No indubitable recent correspondent has been identified yet.

Genus ***Betula*** LINNE 1753
Betula insignis GAUDIN, 1862
Plate III, fig. 3

1998-*Betula insignis* GAUDIN, Knobloch, p.38-39, pl.18, fig.3; pl.24, fig.4

2002-*Betula insignis* GAUDIN, Țicleanu et al., p. 354, Pl. II, fig. 2

Description: Imprint of a leaf with sufficient elements for determination. The leaf is obovate, with truncate base, double serrate margin and pinnate-craspedodromous venation. Strong main vein and

secondary veins opposed at the beginning and subopposed afterwards. From the internal face of the secondary veins tertiary veins diverge, that go into teeth from the margin.

Remarks: This exemplary can be compared to the one drawn by Knobloch (1998, p.38-39, pl.18, fig.3 and pl.24, fig.4) and Țicleanu et al. (2002, p. 354, Pl. II, fig. 2).

Occurrence in Romania: It is also described as *Betula pseudoluminifera* from Chiuzbaia, with which it is considered synonymous (Knobloch, 1998). Țicleanu et al. (2002) pointed out this species in the Pontian deposits from Batoți.

The recent correspondent: *Betula luminifera* WINKLER.

Genus ***Carpinus*** LINNE 1753
Carpinus grandis UNGER, 1850
Plate III, fig. 4; Plate IV, fig. 4B)
1850- *Carpinus grandis* UNGER 400
1852- *Carpinus grandis* UNG. Unger 39, T.20, f. 4,5
1969-*Carpinus grandis* UNGER, Givulescu & Ghiurcă, p.26, T.6, fig.9; T.7, fig.4; T.8, fig.3
1990-*Carpinus grandis* UNGER, Givulescu, p.66, Pl. 28, fig. 7, 8; Pl. 36, fig.2
2004a-*Carpinus grandis* UNGER, Diaconu, p. 76, Pl. I, fig.7

Description: Elliptical leaves with an acute apex, missing base and a composed toothed edge. The venation is pinnate, simply craspedodromous; a slightly sinuous vein thinning from the base to the apex, alternating secondary veins, parallel tertiary veins form a rectangular mesh network.

Remarks: This species is very frequent in the paleoflora from Chiuzbaia (Maramureş), (Givulescu, 1990, p. 66, Pl. 28, fig. 7, 8, Pl. 36, fig.2).

Occurrence in Romania and in Europe: Carpinus grandis makes its appearance in the Arctic Tertiary, becoming rather widespread before the end of the Oligocene; it is recorded from Europe. *Carpinus grandis* was one of the most frequent fossil taxon from Europe during the Late Oligocene - Late Pliocene. In Romania it can be found in Pontian deposits from Chiuzbaia (Givulescu, 1990) and Batoți (Diaconu, 2004a).

The recent correspondent: *Carpinus betulus* LINNÉ.

Family **FAGACEAE**
Genus ***Fagus*** LINNÉ 1753
Fagus silesiaca WALTHER & ZASTAWNIAK, 1991
Plate IV, fig. 4 A; Plate V, figs. 1a, 1b, 2)
1979-*Fagus attenuata* GOEPP., Givulescu, p. 21(85), T.12, f.1-10; T.22, fig.6; T.42, figs.12-18; T.43, figs.6-11
1990-*Fagus attenuata* GOEPP., Givulescu, p. 77, Pl.17, figs.6,7; Pl.22, figs.5,13; Pl.30, fig.1; Pl.38, fig.4; Pl.42, fig.1; Pl.43, figs. 5,6

Description: The imprints are lanceolate - ovate, with acute or acuminate apex, dentate margins with a small triangular tooth at the end of the secondary veins. The venation is pinnate-craspedodromous, with a strong main vein, straight in the lower part and slightly curved? in the upper half.

Remarks: By means of the general shape and dentate margin, our samples are similar to those described by Givulescu (1990, p. 77) as *Fagus attenuata*, which is a synonym of the *F. silesiaca* species.

Occurrence: *Fagus silesiaca* is widespread in Miocene deposits of Central Europe, including Romania, in the Sarmatian–Lower Dacian interval.

The recent correspondent: *Fagus grandifolia* HEER (syn. *F. americana* SWEET, *F. ferruginea* AIT.).

Genus ***Castanea*** MILLER 1759
Castanea cf. *crenata* SIEBOLD & ZUCCARINI, 1846
Plate IV, fig. 1
1990-*Castanea* cf. *crenata* SIEBOLD & ZUCCARINI, Givulescu, p. 82, Pl. 13, fig. 4
2002b-*Castanea* cf. *crenata* SIEBOLD & ZUCCARINI, Diaconu, p. 39, Pl. II, fig.2

Description: Only one fragment was collected, represented by a leaf imprint without apex**.** The margin is toothed with sharp diagonal upward teeth, concave apical side and straight basal side. Between two teeth, the sinus is rounded and slightly marked. The pinnate venation is craspedodromous with a straight main vein, to which the secondary veins ending with the margin teeth are connected. The tertiary vein is not visible.

Remarks: The teeth have affinities to those illustrated in Givulescu (1990, p. 82, Pl. 13, fig. 4) and Diaconu (2002b, p. 39, Pl. II, fig.2).

Occurrence: This taxon was reported for the first time in the Romanian Neogene flora of Romania by Givulescu (1979).

The recent correspondent: *Castanea crenata* SIEBOLD & ZUCCARINI 1846.

Castanea cf. *sativa* MILLER, 1754
Plate IV, fig. 2

Description: The material is represented by the imprint of an oblong-lanceolate leaf fragment with toothed margins, the teeth obliquely pointing outwards. The pinnate venation is simple craspedodromous, with sinuous main veins thinning to the apex; the secondary veins are slightly curved and each ends in the marginal teeth.

Remarks: This taxon can be compared to the extant species *Castanea sativa*, based on identical morphology.

Occurrence: This species is widespread in Mio-Pliocene sediments of Europe and in Romania.

The recent correspondent: *Castanea sativa* Miller 1754.

Genus ***Quercus*** LINNÉ 1753
Quercus kovátsi E. KOVÁCS, 1962
Plate VI, fig. 2
1962- *Quercus kovátsi* E. KOVÁCS 291, fig. 4
1979-*Quercus kovátsi* E. KOV., Givulescu, p. 24(88), T.14, figs.4-6; T.22, fig.3
1990-*Quercus kovátsi* E. KOVÁCS, Givulescu, p. 39, Pl. 6, fig. 4; Pl. 33, fig. 5
2002- *Quercus kovátsi* E. KOVÁCS, Țicleanu et al., p. 355, Pl. I, fig. 5

Description: The material is represented by a single imprint of a lanceolate leaf, without apex and base, probably slightly rounded. The margin is lobed, with triangular lobes and rounded sinuses. The venation is pinnate-craspedodromous, with an obvious main vein thinning to the apex, and 7 pairs of secondary veins alternately diverged under angles of 70 ^{0} in the lower side to 30^{0} in the upper side.

Remarks: This fragment can be compared to that illustrated in Givulescu (1990, p.39, Pl.6, Fig. 4; Pl. 33, fig. 5) and Țicleanu et al. (2002, p. 355, Pl. I, fig. 5).

Occurrence: *Quercus kovatsi* was identified in

Sarmatian deposits of Hungary; it is frequently found in Pontian deposits at Chiuzbaia and recorded at Batoți, too.

The recent correspondent: *Quercus petraea* (MATT.) LIEBL.

Quercus pontica C. KOCH var. *miocaenica* KUBÁT, 1955
Plate V, fig. 3
1849- *Quercus pontica* C. KOCH 312
1955 - *Quercus pontica*, *moicenica* KUBÁT in Andrenszky et Kovacs-Sonkodi 175, T.10, f.9. T. 11, f.4, T. 12, f.5
1969- *Quercus pontica moicenica* KUBÁT, Givulescu and Ghiurcă 37, T.11, f.1
1986-*Quercus pontica* C. KOCH *miocaenica* KUBÁT Knobloch, Pl.20, fig.3
1988-*Quercus pontica* C. KOCH *miocaenica* KUBÁT, Knobloch, Pl.3, fig.9;Pl. 12, fig. 1,2
1990-*Quercus pontica* C. KOCH *miocaenica* KUBÁT, Givulescu, p. 87, Pl. 13, fig.1

Description: The material is represented by imprints of obovate leaf fragments, with asymmetrical obtuse base and lobed side, the apex being not present. The venation is pinnate-craspedodromous, with a strong main vein to the base. The main vein is straight or very weakly curved.

Remarks: By means of size and shape, our samples are similar to *Quercus pontica miocaenica* illustrated in Givulescu (1990, p. 87, Pl. 13, fig.1), and also to those described by Knobloch (1986, Pl.20, fig. 3) and Knobloch (1988, Pl.3, fig.9; Pl. 12, figs. 1, 2).

Occurrence: This taxon was recorded for the first time in the Neogene deposits of Romania at Chiuzbaia by Givulescu (1990) and later at Batoți (Ticleanu et al., 2002).

The recent correspondent: *Quercus pontica* K.KOCH.

Quercus drymeja UNGER, 1847
Plate VI, fig. 1a, 1b
1847- *Quercus drymeja* UNGER 113, T. 32, f. 1-4
1969-*Quercus drymeja* UNG., Givulescu & Ghiurcă, p.39, T.9, fig.11
1990-*Quercus drymeja* UNG., Givulescu, p. 83, Pl. 2, fig. 7; Pl. 6, fig. 3

Description: The material is represented by an imprint of a lanceolate leaf, without apex and base, with dentate margins, small teeth obliquely directed outwards, almost equally spaced. The venation is pinnate-craspedodromous, with obvious sinuous main vein thinning to the apex. The secondary veins are slightly visible.

Occurrence: This species was recorded from several occurrences, both in westwards and eastwards localities: Ron Valley, Podgumer, Kurilo (Givulescu, 1990). In Romania, it occurs in Lower Sarmatian to Upper Pliocene deposits, being cited at Daia and Săcădat, Cornițel, Valea de Criş, Gheghie, Delureni, Bodoş - Biborțeni.

The recent correspondent: According to Grangeon (1958), the recent correspondent might be *Quercus serrata* THBG.

Family **ULMACEAE**
Genus ***Ulmus*** LINNÉ **1753**
Ulmus pyramidalis GOEPPERT, 1855
Plate VII, fig. 1B, figs. 2a, 2b)
1855- *Ulmus longifolia* GOEPPERT 28, T.13, f. 1-3
1855- *Ulmus pyramidalis* GOEPPERT28, T.13, f. 1-3
1971 - *Ulmus pyramidalis* GOEPPERT, Buzek, Pl. XX, XXI
1999 - *Ulmus pyramidalis* GOEPPERT, Givulescu, Pl.27, fig.2

Description: The material is represented by imprints of leaves with visible asymmetric base, serrated margin and pinnate venation, typically craspedodromous. The secondary veins are reverse or slightly reverse, and one of them is typically bifurcated from the mid-point.

Observations: The fragments show enough diagnostic features, thus they can be assigned to *Ulmus pyramidalis,* described and illustrated by Buzek (1971, Pl. XX, XXI) and Givulescu (1999, Pl. 27, fig. 2).

Occurrence: This species was frequently recorded in European Neogene deposits, including those from Romania.

The recent correspondent: Many researchers associate the fossil species with *Ulmus americana* WILD.

Family **JUGLANDACEAE**
Genus ***Carya*** NUTTAL 1818
Carya serraefolia (GOEPPERT) KRÄUSEL, 1920
Plate VI, fig. 3
1855- *Quercus serraefolia* Goeppert 17, T.5, f.14
1920- *Carya serraefolia* (Goepp.) Kräusel 389, T.5, f. 2
1990-*Carya serraefolia* (Goepp.) Kräusel, Givulescu, p.104, Pl.29, fig.6
2001-*Carya serraefolia* (Goepp.) Kräusel, Țicleanu et al., p. 28, Pl.I, fig.1

Description: The material is represented by the imprint of an elliptic, slightly asymmetric and scythe shaped leaf, without apex but with an acute cuneate base, and a harsh serrated margin. The characteristic venation is pinnate-craspedodromous, with a curved main vein, thin to the apex, and the secondary veins are curved and branched to the margins.

Remarks: Based on the secondary venation, our fragment is similar to the one described by Givulescu (1990, p.104, Pl.29, fig.6) and by Țicleanu et al. (2001, p.28, Pl. I, fig. 1).

Occurrence: This species is relatively rare in some of the European Mio-Pliocene floras, but nevertheless frequent in occurrences from Romania (Givulescu & Ghiurcă, 1969).

The recent correspondent: *Carya serraefolia* has affinities with two actual species from North America: *C. amara* and *C. tomentosa*.

Genus ***Pterocarya***
Pterocarya paradissiaca (UNGER) ILJNISKAYA, 1962
Plate VIII, fig. 2
1970-*Pterocarya denticulata* (O. WEB.) HEER, Țicleanu (Pauliuc et al., p.132, fig.14)
2002-*Pterocarya paradissiaca* (UNGER) ILJNISKAYA, Ticleanu et al., p. 357, Pl. I, fig. 9

Description: The material is represented by an imprint of a well-preserved slightly elongated lanceolate leaf. The venation is pinnate, camptodromous-craspedodromous, with a typical, slightly curved main vein, from which the secondary veins separate, curving towards the margin, and combining into a comptodromous style in their proximity.

Observations: The exemplary can be compared with the one described by Țicleanu et al. (2002, p. 357, Pl. I, fig. 9).

Occurrence: It is a rare species in European Neogene deposits; it has been recorded in Romania by Pauliuc et al. (1970) and Ticleanu et al. (2002).

The recent correspondent: *Pterocarya caucasiaca* C.A. MEY.

Family **CORNACEAE**
Genus ***Cornus*** LINNÉ 1753
Cornus sp.
Plate VIII, fig. 3

Description: The material is represented by badly preserved elliptical imprints without base and an entire slightly sinuous margin. The venation is pinnate-craspedodromous, with a strong main vein at the base, thinning to the apex, the secondary veins are thin, curved, and the first pair is parallel to the leaf margin. The tertiary venation has not been preserved.

Observations: Based on morphology, our fragment is similar with that of Givulescu (1990, p. 142, Pl. 4, fig.12) and Diaconu (2002 b, p. 40, Pl. III, fig. 2).

Occurence: *Cornus* sp. is relatively often recorded in Neogene floras from Romania.

Recent Correspondent: *Cornus mas* LINNE.

Family **SALICACEAE**
Genus ***Populus*** LINNE 1753
Populus populina (BRONGNIART) KNOBLOCH, 1964
1822-*Phyllites populina* BRONGNIART 237, T. 14, f.4
1064- *Populus populina* (BRNGT.) KNOBLOCH 601
1988-*Populus populina* (BRNGT.) KNOBLOCH, Knobloch, p. 16, pl.9, figs.2, 6 and pl.13, fig.3

Description: The material is represented by imprints of several ovate leaves with acute apex, rounded base, and crenate margin. The venation is actinodromous, perfectly marginally. The main vein is slightly sinuous, with lateral veins detaching right to the margin of the lamina under 25°-30°. From the lower side of the lateral veins, five secondary, simple or bifurcate, slightly upwards curved veins are detaching, penetrating the marginal teeth.

Observations: Our fragments can be compared to those described by Knobloch (1988).

Occurrence: A widespread Mio-Pliocene species in Europe and Romania.

Recent Correspondent: *Populus canadensis* MOENCH.

Clasa **LILIATAE**
Family POSCEAE
Dicotylophyllum sp.

Description: Lanceolate leaves with asymmetric decurent, obtuse base, with irregularly dentate, crenate margin. The venation is pinnate, probably camptodromous or semicraspedodromous, with a slightly sinuous main vein; the secondary veins are thin, irregularly distributed, and they curve and combine with each other.

Observations: These fragments are similar with the ones described and illustrated in Givulescu (1990, p. 166, Pl. 10, fig. 7).

PALEOPHYTOGEOGRAPHICAL PHYTOCOENOTICAL CONSIDERATIONS

Up to now, the flora from Crivina includes only 16 taxa. Considering the frequency and the preservation degree of the material, some assumptions can be made on the phytogeography and vegetation during Lower Pontian times in southwest Oltenia.

The distribution of the recent correspondents for the taxa from Batoți (table 1) is the following: 3 in Central Europe, 3 in North America, 3 in China, 2 in Minor Asia,1 in Caucaz, 1 in Japan, 1 doubtful correspondent, while for the other 2 no present correspondent has been established.

Table 1 – Recent correspondents of the taxa from Batoți area.

Nr. crt.	TAXON	RECENT CORRESPONDENTS	SPREADING AREA
1.	*Alnus cecropiaefolia* (ETTINGSHAUSEN) BERGER	uncertain	-
2.	*Laurophyllum sp.*	-	-
3.	*Betula insignis* GAUDIN	*B. luminifera* WINKLER	China
4.	*Carpinus grandis* UNGER	*C. betulus* LINNÉ	Western Europe, Central and South (without P. Iberian), in Crimea and Caucasus
5.	*Fagus silesiaca* WALTH. & ZAST.	*F. grandifolia* HER.	USA and East of Canada
6.	*Castanea* cf. *sativa* MILLER	*C. sativa* MILLER	Around the Mediterranean, Asia Minor and the Caucasus
7.	*Castanea* cf. *crenata* SIEBOLD & ZUCCARINI	*C. crenata* SIEBOLD & ZUCCARINI	Japan
8.	*Quercus drymeja* UNGER	*Q. serrata* THBG.	China and Japan
9.	*Quercus pontica* C. KOCH *miocaenica* KUBAT	*Q. pontica* K.KOCH.	Asia Minor
10.	*Quercus kovatsi* E. KOVACS	*Q. petraea* (MATT.) LIEBL.	Central and South Europe, in Caucasus
11.	*Ulmus pyramidalis* GOEPPERT	*U. canadensi* WILD.	USA
12.	*Carya serraefolia* (GOEPP.) KRAUSEL	*C. amara, C. tementosa*	North America
13.	*Pterocarya paradissiaca* (UNGER) ILJNISKAYA	*P. caucasiaca* C. A. MEY.	Iran, Armenia and Caucasus
14.	*Cornus* sp.	*C. mas* LINNÉ	South Europe and South-West Asia
15.	*Populus populina* (BRONGNIART) KNOBLOCH	*P. canadensis* MOENCH	North America
16.	*Dicotylophyllum* sp.	-	-

Paleoecological studies based on the actualism principle consider that fossil plants have had approximately the same cenotic behaviour and ecological requirements as their actual correspondents.

So, the paleoecological study of the flora from Crivina indicated the presence of two distinctive paleobiotopes: a mesophytic association characterized by the occurrence of an allochthonous flora dominated by *Fagus*, *Quercus*, *Castanea*, *Carya* and *Pterocarya* etc. and a marsh-type, coal-generating association with *Alnus cecropiaefolium*.

Taking into account this phytocoenosis and the frequency of leaves of *Fagus silesiaca*, similar to that in the association of Batoți (Țicleanu et al., 2002:358), we assume the existence in the local vegetation of a "Mixed mesophytic forest region" type, associated with species of *Quercus*, *Pterocarya*, *Ulmus*, etc.

Besides this similar phytocoenotical composition, we observe that from the 50 taxa of Batoți, 15 taxa are found in the flora of Crivina too, representing a quarter of the taxa identified until now. Moreover, the dominant elements in the Batoți assemblages, i.e. *Fagus silesiaca* and various species of *Quercus* with lobate leaves are also prevailing in the flora from Crivina, thus providing a very interesting comparative study.

Concerning climate parameters, the study of Petrescu et al. (2001) estimated an annual average temperature between 14-15º C, and precipitations exceeding 1200 mm/year.

CONCLUSIONS

The previously-investigated Batoți association revealed the presence of 50 macrofloral taxa. Until now, by means of its stratigraphical position, this flora was the only Lower Pontian flora known in Romania. At the same time, from palynological point of view, Batoți assemblage groups the richest and most varied microflora in Romania. However, Batoți site is now covered by the building works carried out by Hidroconstructia S.A. Porțile de Fier.

In this situation, Crivina site with a paleoflora similar to Batoți is the only outcrop allowing future research to be carried on. The 16 currently identified taxa point to a paleofloral association of a very special scientific importance. All these arguments plead for preserving the Lower Pontian deposits rich in fossil plants from Crivina as site of special scientific interest (SSSI).

Acknowledgments

Acknowledgements are due to Conf. Univ. Dr. Mihai Popa for reviewing the English translation of this paper and for suggestions that have improved its final content.

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PLATES

PLATE I

Fig. 1 - Outcrops with fossil plants on the left side of the Danube, Crivina site
Fig. 2 - Lithological synthetic column of Crivina site
Fig. 3 - Concretions of calcareous sandstone in the sequence of clay deposits from Crivina

PLATE II

Fig. 1 - Level of fossil mollusks in the sequence from Crivina
Fig. 2 – Details from the fossil level:
a, b - *Paradacna okrugici* (BRUSINA)
c - *Pseudocatillus* sp.
d - *Dreissenomya aperta* (DESHAYES)

PLATE III

Fig. 1, 2 - *Alnus cecropiaefolia* (ETTINGSHAUSEN) BERGER
Fig. 3 - *Betula insignis* GAUDIN
Fig. 4 - *Carpinus grandis* UNGER

PLATE IV

Fig. 1 - *Castanea* cf. *crenata* SIEBOLD & ZUCCARINI
Fig. 2 - *Castanea* cf. *sativa* MILLER
Fig. 3 - *Alnus cecropiaefolia* (ETTINGSHAUSEN) BERGER
Fig. 4, A - *Fagus silesiaca* WALTHER & ZASTAWNIAK; B - *Carpinus grandis* UNGER

PLATE V

Fig. 1 a, 1b, 2 - *Fagus silesiaca* WALTHER & ZASTAWNIAK
Fig. 3 - *Quercus pontica* C. KOCH *miocaenica* KUBÁT

PLATE VI

Fig. 1a, 1b - *Quercus drymeja* UNGER
Fig. 2 - *Quercus kovatsi* E. KOVACS
Fig. 3 - *Carya serraefolia* (GOEPPERT) KRÄUSEL

PLATE VII

Fig. 1 - A - *Laurophyllum* sp.; B - *Ulmus pyramidalis* GOEPPERT
Fig. 2 a, 2b - *Ulmus pyramidalis* GOEPPERT

PLATE VIII

Fig. 1a, 1b - *Ulmus pyramidalis* GOEPPERT
Fig. 2 - *Pterocarya paradissiaca* (UNGER) ILJNISKAYA
Fig. 3 - *Cornus* sp.
Fig. 4 - *Dicotylophyllum* sp.

PLATE I

Fig. 1

Fig. 2

Fig. 3

PLATE II

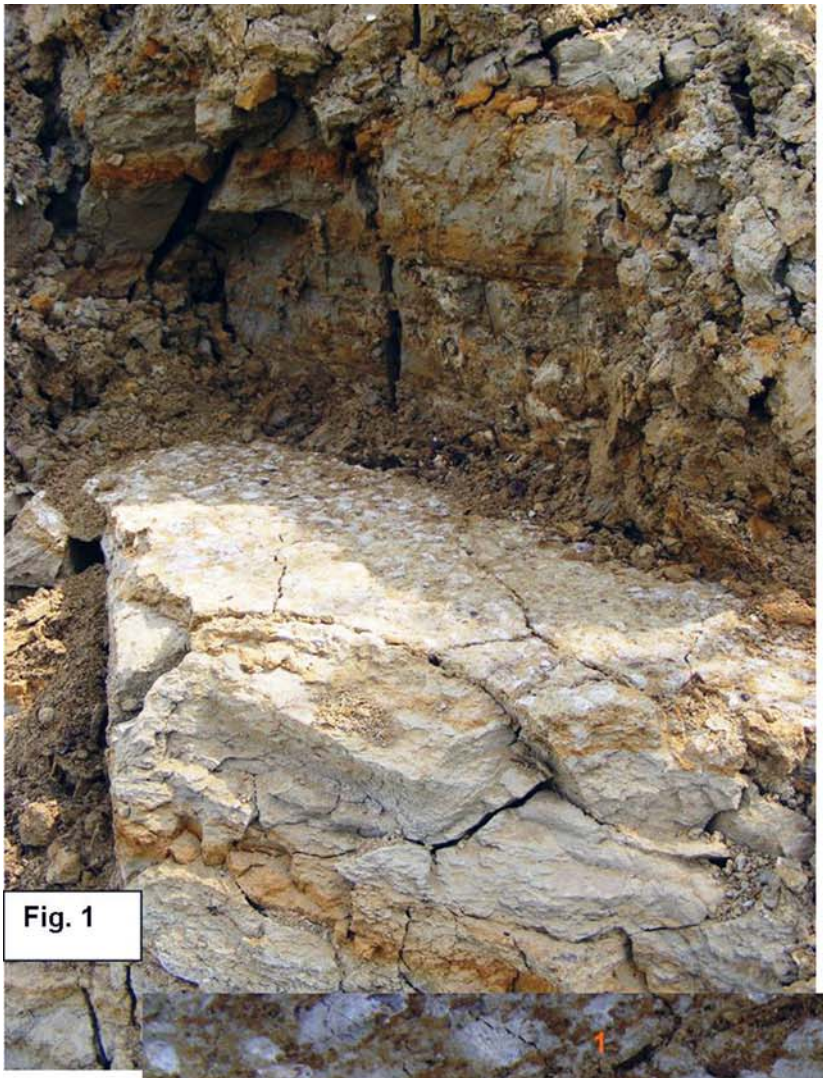


Fig. 1

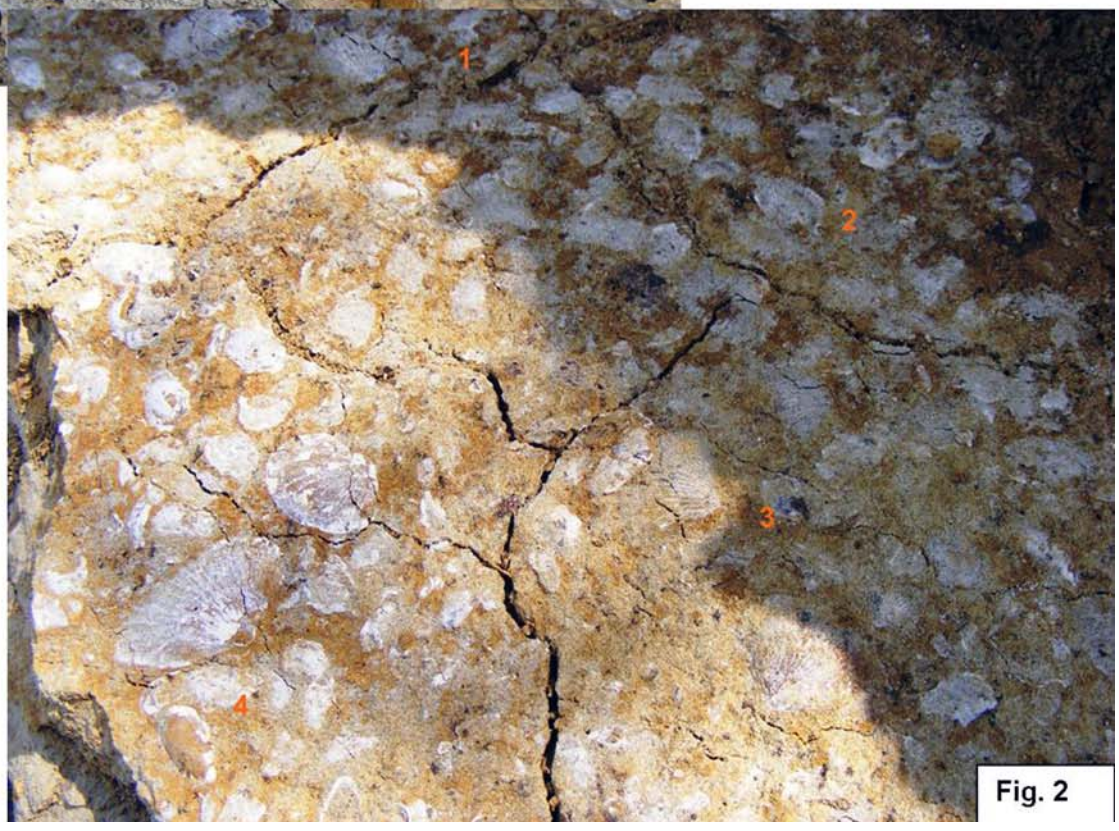
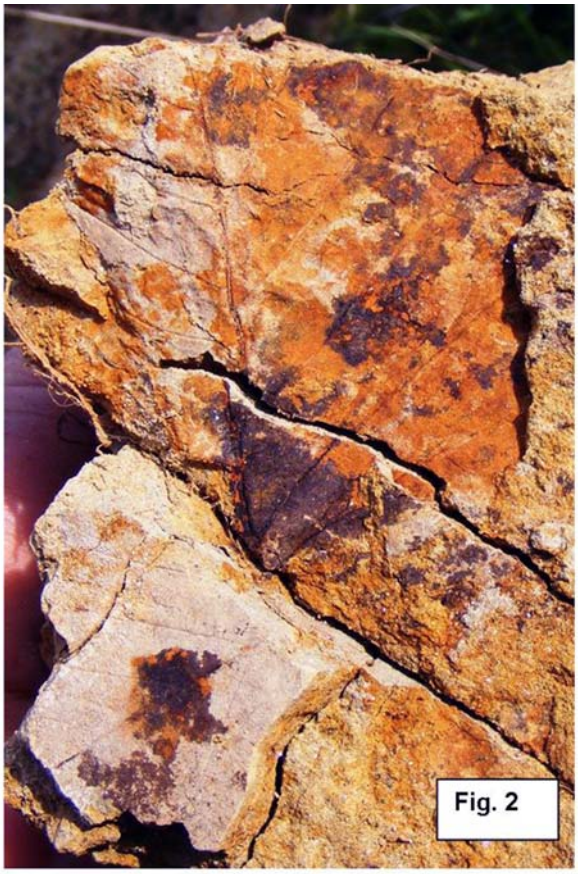


Fig. 2

PLATE III

Fig. 1



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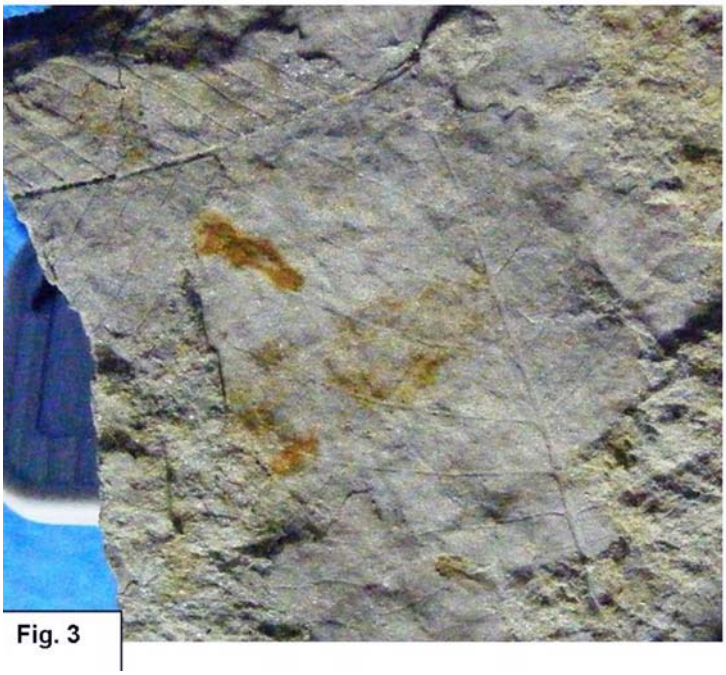


Fig. 3

Fig. 4

PLATE IV


Fig. 1

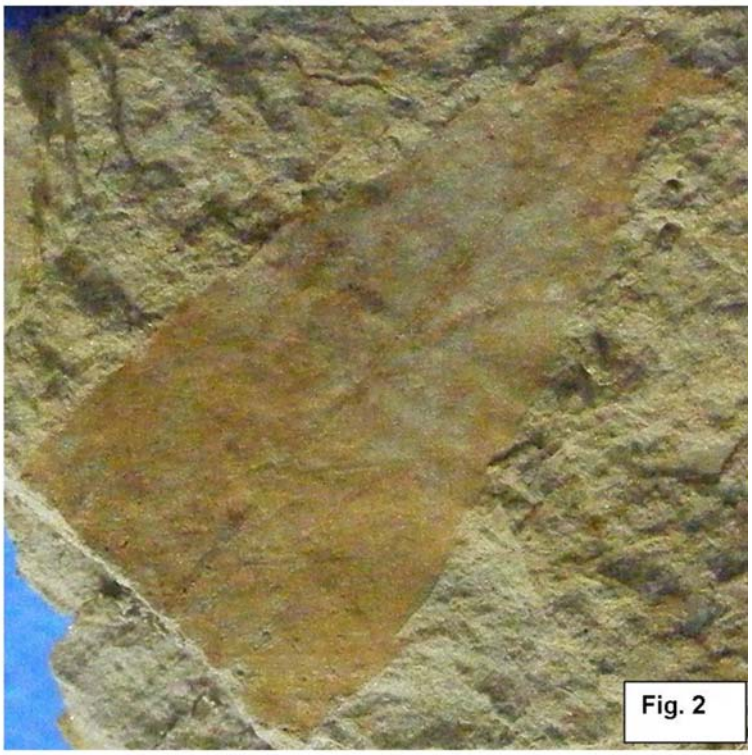


Fig. 2


Fig. 3

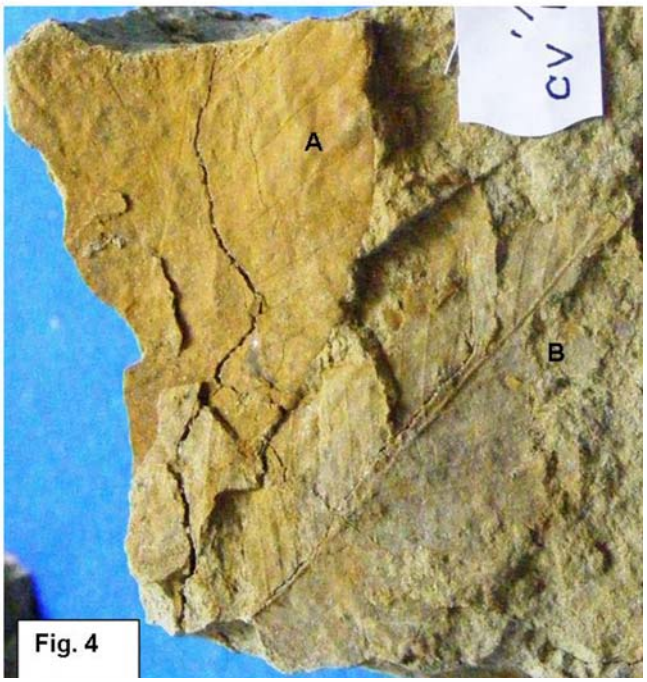
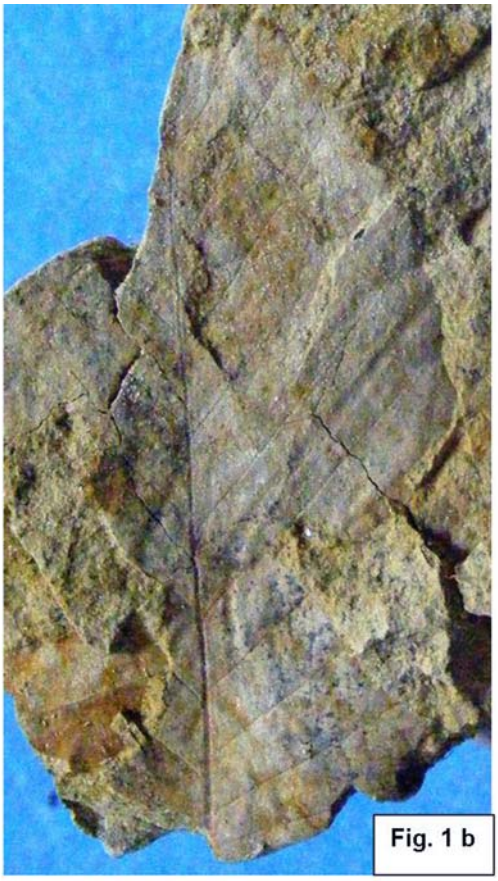


Fig. 4

PLATE V


Fig. 1 a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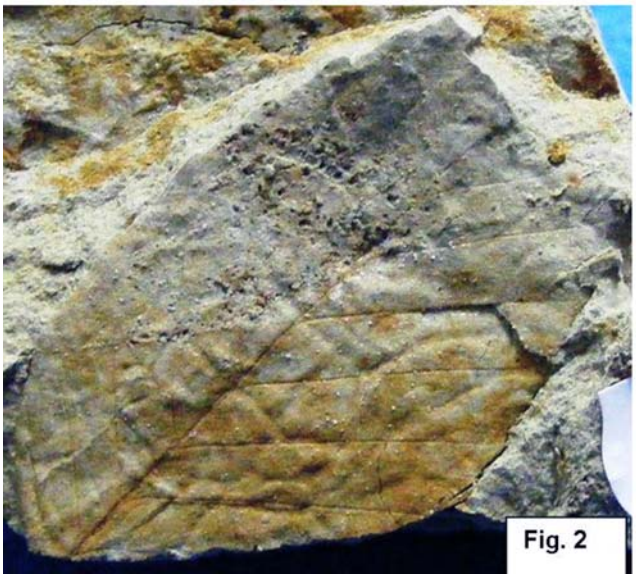
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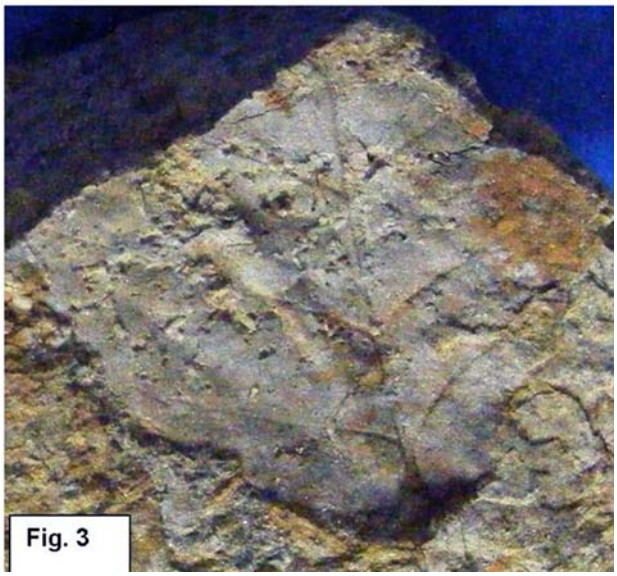


Fig. 3

PLATE VI

Fig. 1 a

Fig. 1 b

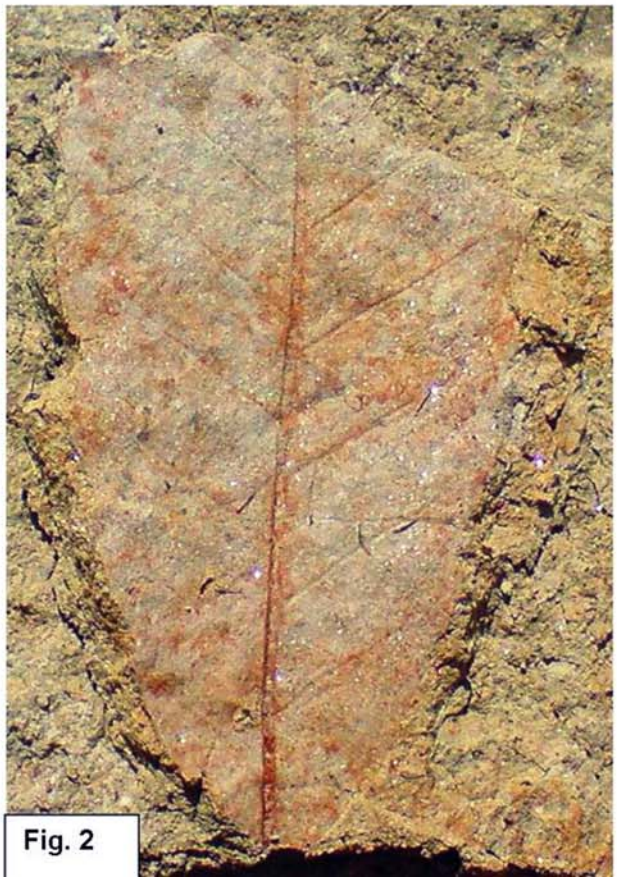


Fig. 2

Fig. 3

PLATE VII

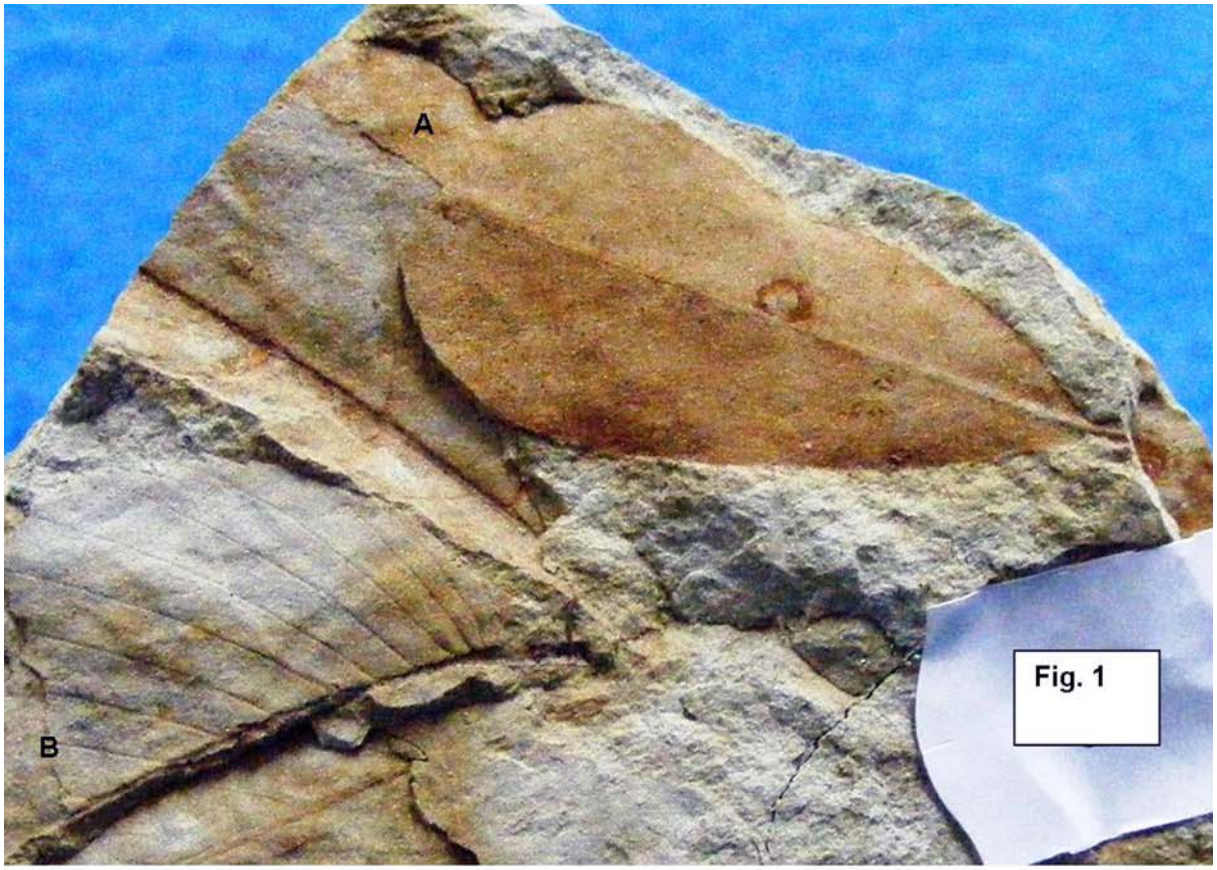
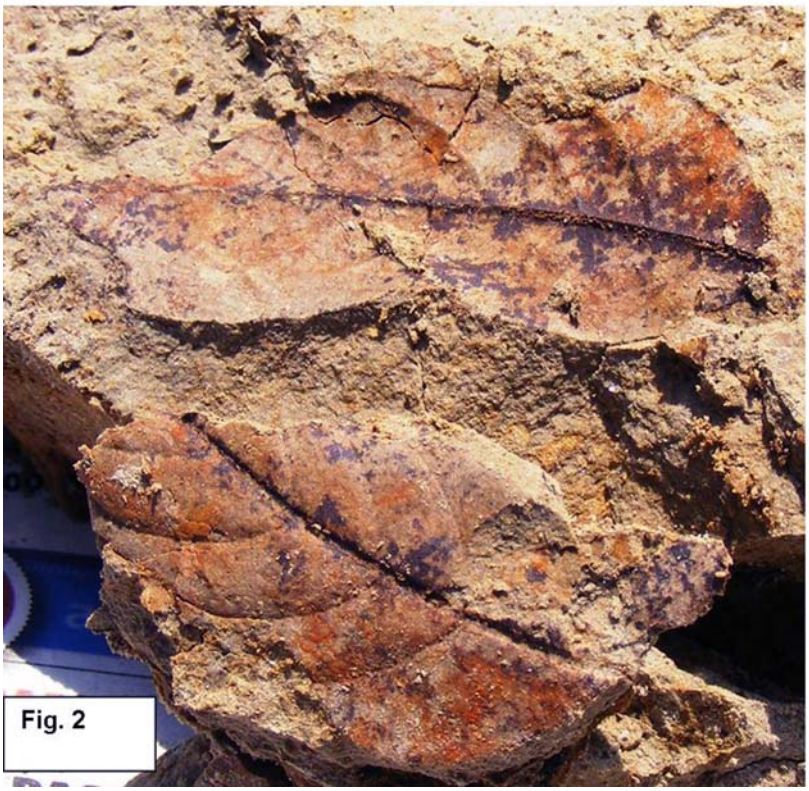


PLATE VIII


Fig. 1 a


Fig. 1 b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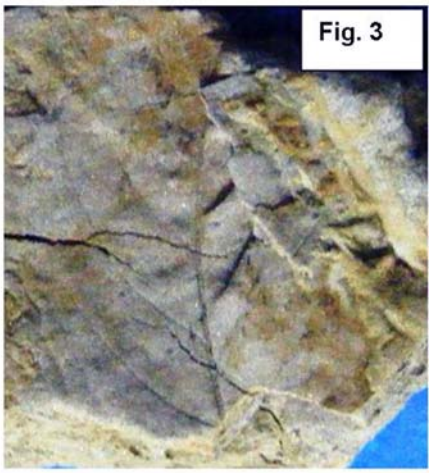
Fig. 3


Fig. 4