FIRST RECORD OF THE UPPER EOCENE AMBER FROM CENTRAL EASTERN CARPATHIANS (IAPA VALLEY, NEAMT COUNTY, ROMANIA)

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Abstract. The occurrence of amber in the Upper Eocene deposits of the outer Moldavide Nappes is herein presented. The geological significance and various properties of the amber from the Duraș Site (Neamț County) are, for the first time, discussed. The primary amber occurrence is located in the glauconite-rich siliceous arenites, of the Lucăcești Formation, latest Eocene, *i.e.*, Priabonian, in age. The chemical properties and IR spectra of the amber from the Duraș are similar to those of the Almaschite amber variety, from the same region, but different from other amber varieties, such as Rumanite (Buzău region, South - Eastern Carpathians), Muntenite from the Southern Carpathians, and Schraufite (North - Eastern Carpathians, Bucovina).

Key words: amber, Lucăcești Formation, Upper Eocene, Vrancea Nappe, NE Romania.

1. INTRODUCTION

Amber was first mentioned, in Romania, in a document dating back to 1578; the Prince Mihnea and his wife, Doamna Neaga, visiting the Aluniș Church (Buzău County), endowed this settlement with land, where „amber shards of rare beauty" may be found (Ghiurcă, 1999). The Romanian amber was mentioned in many foreign works (fide Raicevich, 1789; Demidov, 1837; Vaillant, 1844; Herbich, 1854 cited in Murgoci, 1903), while Grigore Ștefănescu (1890) was the first Romanian geologist that spoke about the Buzău Amber. Helm (1891) described the amber from the Romanian Kingdom as „Rumänite" and distinguished it based on the physical and chemical properties from the Baltic amber (= the Succinite). A variety of the Romanite was described as Almaschite (Murgoci, 1924) and recognized as a new mineral by Spencer (1931).

The sedimentary deposits containing amber are widespread in the Romania, being identified in 360 outcrops (Protescu, 1937; Brana, 1967) that are mostly located in Paleogene sediments of the outer Carpathian bend. Pioneer investigations of Murgoci (1903, 1924) and Protescu (1937) mentioned the contribution of Romanian and foreign scientists, up to the middle part of the last century, in identifying the amber occurrence over the Romanian territory. Other papers focused on the exploitation of the amber from the S Eastern Carpathians, i.e., Colți and Sibiciu localities from the Buzău County (Rabichon, 1928, 1929, 1933, 1938; Grigorescu, 1930, 1930a, 1931, 1932), the amber origin (Rabichon, 1934) and its occurrence (Rabichon, 1937), as well as the presence of the amber in Cretaceous sediments (Murgeanu, 1934).

The first exploration of amber in Romania by rudimentary ditches, shafts and galleries started in the southern part of the outer Eastern Carpathians (Colți village), in 1828. Major productions registered between the years 1924 and 1935, from 67 to 130 kg per year. In the 19th Century, the amber was representative for Romania, so it was the symbol of the country to the World's Fair in Paris (Exposition Universelle, Paris, 1867).

In the last decades of the 20th Century, geological prospection of the amber restarted in the aforementioned region (Tiugan & Tiugan, 1976; and Vasilescu & Vasilescu, 1977), in Oligocene deposits. At the end of the last century, the amber was studied from geological (Ghiurcă & Drăgănescu, 1986), gemological (Ghiurcă, 1989, 1999), chemical (Ghiurcă & Vávra, 1990) and palaeobotanical points of view (Petrescu *et al*., 1989; Iamandei *et al*., 2012). Investigations of the amber from the southern part of the Eastern Carpathians, i.e. Colţi region, were devoted to its genesis (Neacşu, 2003, Neacşu, 2006), and other various aspects, such as differences between the Rumanite and Succinite (Neacşu & Dumitraş, 2008; Neacşu, 2010), as well as chemical and mineralogical properties (Neacşu *et al*., 2013; Neacşu *et al*., 2014).

A significant advancement in the study of the amber from Romania was made between the years 2007-2010, by the results obtained from the Project ROMANIT (http://www.romanit.ro/ro/harta-sit.html), led by the History Museum of Romania (Bucharest). An important aim was establishing the criteria that differentiated the Romanian amber from the Baltic one; this issue may lead to the certification of amber artifacts found in archaeological sites, based on the modern analytical methods (Teodor *et al*., 2009; Truică *et al*., 2012; Teodor *et al*., 2016).

Most of the amber investigations were carried out on the southern part of the Eastern Carpathians, but the amber was mentioned also in the central part of the outer Eastern Carpathians, i.e. the Neamţ County, around the Cozla and Pietricica localities (Poni, 1900; Murgoci, 1903) and Almaş Valley (Murgoci, 1923). The amber presence on the Iapa Valley, region on which this study is focused, together with those from the upper Cracău Valley was mentioned by Murgoci (1924) and Rabichon (1938). Recently, an amber fragment was discovered in Rupelian (Lower Oligocene) sediments of the 'Bituminous Marl' Formation at Văleni, S from the Piatra Neamţ town (Crina Miclăuş, personal communication).

This paper is focused on the amber occurrence from the central part of the Eastern Carpathians (Duraş site, Iapa Valley). Most of the data have been obtained by geological investigation carried out in 1982. Besides, genetical considerations are presented, along with physical and chemical data, based on recent analysis of the amber from the above mentioned region.

2. GEOLOGICAL SETTING

The studied site from the Iapa Valley is located in the Bistriţa Halfwindow, where the Vrancea Nappe, part of the Outer Moldavides structures, is exposed (**Fig. 1a**). Lithostratigraphic and tectonic investigations of this area were included in several papers (Băncilă, 1958; Mutihac & Ionesi, 1974; Mutihac, 1990; Săndulescu, 1984).

The data presented herein focused on the lithostratigraphic and tectonic aspects of the amber occurrence in the Duraş site (Iapa Valley). In the region comprises between the Calu Valley, towards N and the Tazlău Valley at the S, the Upper Cretaceous-Lower Miocene formed vertical or reversed anticlines ands synclines, N-S orientated, with faulted flanks, the faults being verticals and/or reversed (Tazlău Sheet, scale 1: 50 000 made by Micu, 1983).

After Micu (1983) and Săndulescu & Micu (1986), in the spring region of the Calu and Iapa valleys (**Fig. 1b**), the Tarcău Nappe is composed of two units: the Tarcău Sandstone Digitation, made by the Lower Tarcău Formation (Paleocene-Lower Eocene, i.e. Ypresian, in age) and the Strigoiu Scale, made by the Putna Formations ((Paleocene-Lower Eocene in age, i.e. Ypresian,), the Straja Formation (Lower Eocene-Middle Eocene in age, Ypresian *pro parte*-Lutetian) and the Ciunget Formation (showing a similar age as the above-mentioned unit.). The Strigoiu digitation marked the frontal part of the Tarcău Nappe that thrusted towards E the Vrancea Nappe, along the Vaduri Digitation (**Fig. 1c**).

In the Duraş region, the Vaduri Digitation (Săndulescu & Micu, 1986), is characterized by the following lithostratigraphic units: Jghiabu Mare Formation (Lower Eocene, i.e. Ypresian), the Doamna Limestone unit and the Variegated Clay unit (Middle Eocene, Lutetian), and the Bisericani Formation, followed by the Globigerina Marl unit and the Lucăceşti Formation (all Upper Eocene in age, i.e. Priabonian). These are followed by Oligocene mainly bituminous rocks and by the Lower Miocene ones (**Fig. 1d**). In the Iapa Valley section, the frontal part of the Vaduri Digitation is marked by a reversed anticline with a faulted eastern flank; in its axis, the Jgheabu Mare unit crops out, followed towards W by a similar succession as afore mentioned, such as the Doamna Limestone, the Variegated Clays, the Bisericani, the Globigerina Marls and the Lucăceşti Formation. The Oligocene sediments that constitute the Rantău-Poiana Măniş and Barchiz synclines (Popescu, 2005; Grasu *et al*., 2007) enclosed the Lower Menilite and Lower Dysodile units, followed by the Lower Kliwa Formation, mainly made by massive siliceous sandstones and sandy turbidites.

The Lucăceşti Formation (= the Lucăceşti Sandstone), which is placed at the top of the Eocene (Melinte & Constantin, 1990; Melinte, 1995) in the Bistriţa Halfwindow, shows a variable thickness, between 3 and 30 m (Humă, 1971; Moroşanu, 1986; Grasu *et al*., 2007). This unit is composed of 1-2 m in thickness quartz arenites, frequently containing glauconite; sometimes, conglomerates containing green schist elements and Jurassic limestones with *Globochaete alpina* Lombard (in Calu Valley, Matei *et al*., 1982) are present.

3. PREVIOUS DATA

Based on local people information (Matei *et al*., 1982), firstly the amber from the Duraş Site was identified by villager Cociorvă Vasile in 1922, when the forest road was built on the Iapa Valley. Afterwards, the jewelers Flor Andronic şi Lulu Donciu from Bucharest started the amber exploitation on this

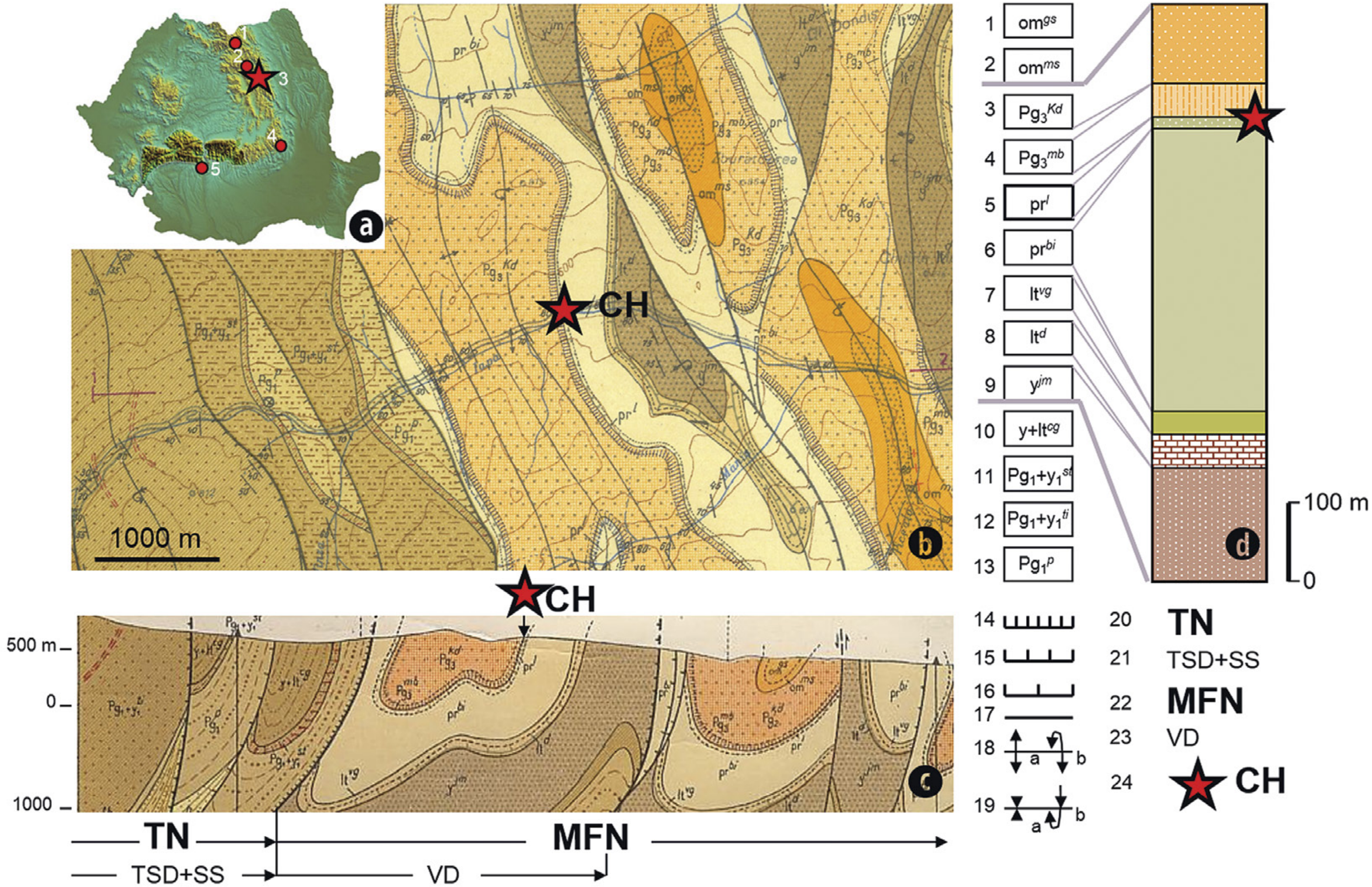

Fig. 1. a. Location of the amber occurrence in the Duraș Site (3), and other sites with amber from Romania (1, 2, 4 and 5 explained in Table 1); **b, c.** Geological map and cross-section with the location of the amber in the Duraș Site (after Micu, 1983); **d.** Lithological units (the newest first). Lower Miocene: 1. Gura Șoimului Formation; 2. Upper Menilites and Upper Dysodiles Formations; Oligocene: 3. Kliwa Formation; 4. Lower Dysodiles and Lower Menilites Formations; Upper Eocene (Priabonian and Bartonian): 5. Globigerina Marls and Lucăcești Sandstone; 6. Bisericani Formation: Middle Eocene (Lutetian): 7. Variegated (red and green) clays and marls; 8. Doamna Limestone; Lower Eocene (Ypresian): 9. Jghiabu Mare Formation; Ypresian-Lutetian: 10. Ciunget Formation; Lower Ypresian-Lutetian: 11. Straja Formation; Paleocene-Lower Eocene (Ypresian): 12. Lower Tarcău Formation; Paleocene: 13. Putna Formation; 14. Nappe; 15. Digitation; 16. Reversed Fault; 17. Normal Fault; 18. Anticline axis: vertical (a), reversed (b); 19. Syncline axis: vertical (a), reversed (b); 20. Tarcău Nappe (TN); 21. Tarcău Sandstone Digitation and Strigoiu Scale (TSD+SS); 22. Vrancea Nappe/Marginal Folds Nappe (MFN); 23. Vaduri Digitation (VD); 24. The amber occurrence.

site in 1936 and built two narrow railways for releasing the carved rocks.

The exploitation have started at one level and continued with a second and third one. Around 150 kg bright red, burgundy and black amber pieces have been obtained. In some amber pieces insects have been observed.

Later, the single cartographic mention on the Iapa Valley amber belongs to Humă (1970). The stratigraphic position and primary amber deposits of the Amber in the Duraș Site (Iapa Valley) were designated by Brustur *et al*. (2007, p.149), without any detail.

In 1981, as a result of a demand made by a villager from the Negulești locality, geological prospection started in the region, including cartography, mapping and small excavations for making artifical outcrops. These investigations confirmed the presence of the amber in the Lucăcești Formation (Matei *et al*., 1982). Some preliminary data on the amber occurrence were presented by Brustur *et al*. (1986) and Brustur *et al*. (1988).

4. MATERIAL AND METHODS

For identifying the occurrence of the amber from Iapa Valley information from local people that knew an old amber exploitation, abandoned before the Second World War, have been used. Hence, in an outcrop located in the sandstones of the Lucăcești Formation, situated in the right bank of the Iapa Valley, at ca. 550 m upstream the confluence with Frasin Brook, in the Duraș Site, six artificial outcrops (D1-D6) have been performed. These have been realized on a total length of 220 m, directional in the rock beds (W dip direction 75-80^{o}), the azimuth being 332^{o} (**Fig. 2a**).

In the Duraș Site, the Lucăcești Formation, with a stratigraphical thickness of around 20 m, conformably overlies the Bisericani Formation and followed the bituminous Oligocene sediments (**Fig. 2b**). The amber is situated in the lower half of the Lucăcești Formation, under a level of green-gray clays that contain planktonic foraminiferal assemblages with: *Globigerina pseudoeocaena* var. *pseudoeocaena* Subbotina, *G. eocaena* Gümbel, *G. inflata* d'Orbigny, *G. corpulenta* Subbotina, *G. eocaenica* var. *eocaenica* Terquem, *G. frontosa* Subbotina and *Globigerinoides conglobatus* Brady. The aforementioned taxa indicate a Late Eocene age (Priabonian)*.

The occurrence type of the amber has been very well observed in the artificial outcrop D1, in which a tabbed amber crust have been observed, with a total length of 6.5-7 m and a thickness between 1.5-8 cm (**Fig**. **2c**). The imbricate southern margin of this crust has thinned up to the disappearance, on a direction following two thin crusts (maximum 1.5 cm), of 1.5-2 m length each and small-sized spherical nodules (maximum diameter 3-4 cm).

The amber is situated at the level of siliceous sandstones **(Fig. 2c1**) that occur between a rich-glauconite whitish-gray sandstone, with ripple-marks at the base (**Fig. 2c2**) and a breccia (**Fig. 2c3**) followed by green-gray clays and marls with globigerinids (**Fig. 2c, b1**), in the top. In places, nearby the amber crust (**Fig. 2d1**) coal fragments (**Fig. 2d2**) have been observed, at around 0.50 m above the sandstones showing ripple-mark structures (**Fig. 2d3**).

In the D2-D5 artificial outcrops, the amber has been discovered only as nodules, while in D6 no amber has been identified. The tabbed shape of the amber crust in the Duraș Site has been rarely reported so far; they are some with the ones described by Polish geologists as 'streamlets' (Zalewska, 1964).

Hence, analyses have been made, in 1983, on two amber samples discovered in the D1 artificial outcrop, in the Research Centre of Chemical Fibers Săvinești (CCFCS).The chemical composition of the amber has been studied with the analyzer CARLO-ERBA 1104. Fluorescence analyses have been performed withy a Wood lamp.

Infrared (IR) Spectral analysis has been done in the Research Centre of Chemical Fibers Săvinești (CCFCS), with an IR4 spectrofotometer, on three amber samples, two from the artifical outcrop D1 in the Duraș Site and one from the Almaschite amber variety (Neamț County, close to the Duraș Site). Pictures of the amber have been taken with an Olympus binocular microscope SZ 61, including a photo camera Cannon.

5. RESULTS

5.1. Chemical and physical features of the amber in the Duraș Site

The analysis of the two amber samples from the Duraș Site indicate for Carbon values of 82.29% and 75.45%, while for the Hydrogen the values are 10.61% and, respectively 9.48%. The average values of Carbon, 78.87% C and Hydrogen 10.04% are close to the values obtained for other amber types identified in the Eastern Carpathians, such as Almaschite and Rumanite. By contrast, the amber type from the Southern Carpathians, i.e. the Muntenite has bigger values both for C and H, while the Schraufite from the N extremity of the Eastern Carpathians (Bucovina region) shows lower values of C and H (**Table 1**).

The fluorescence analyses of the Duraș amber indicate blue to violet colors. These are close to the colors identified for the Rumanite (nearby Colți area, Buzău County, southern part of the Eastern Carpathians) and Almaschite (Neamț County, central Eastern Carpathians, close to the Duraș Site) (**Table 2**).

* Microfaunas analyzed by Constanța Corobea (*fide* Matei *et al*., 1982).

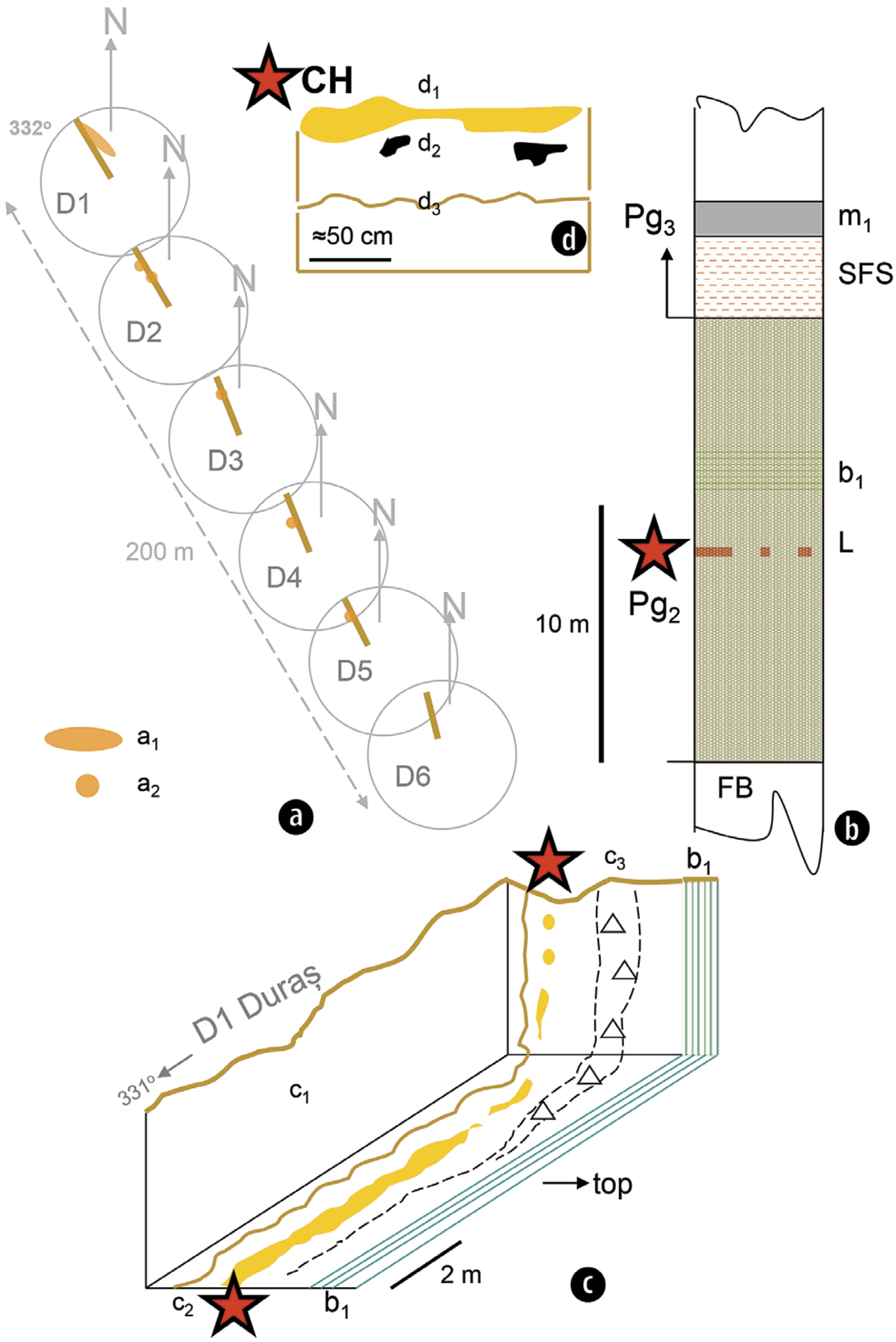

Fig. 2. a. Location of the D1-D6 artificial outcrops and the amber occurrence as imbricate crusts (a_1) and nodules (a_2); **b.** Stratigraphical position of the amber in the Lucăcești Formation (L) below the green-gray clays (b_1), situated between the Bisericani Formation (FB), Late Eocene in age (Pg_2) and the Oligocene (Pg_3), such as the Slaty Bituminous Shales and the Fierăstrău Sandstone (SFS) and Lower Menilites (m_1); **c.** sketch of the artificial outcrop D1 Duraș, showing the glauconitic sandstone beds (c_1) that contains imbricate crusts and nodules of amber, between the ripple-mark surface bed (c_2), the sedimentary breccia (c_3) and/or the level with green-gray clays (b_1); **d**. imbricate amber crust (d_1) associated with coal fragments (d_2), placed above the bed showing ripple-marks (d_3).

Table 1. Chemical composition of amber occurring in the Romanian Carpathians. Location of the amber sites (1, 2, 3, 4 and 5) in Fig. 1a.

Amber type	No. analysis	Chemical composition					References
		Carbon	Hydrogen	Oxygen	Sulphur	Ash	
Schraufite (Bucovina) [1]	1	73.81	8.82	17.37	-	0.015	Schröckinger, 1875
Almaschite (Neamţ) [2]	2	80.80	10.59	2.78	0.82	4.50	Murgoci, 1924; Spencer, 1931
Amber of the Duraş Site [3]	2	78.87	10.04	-	-	-	Matei *et al.*, 1982
Rumanite (Buzău) [4]	6	81.25	10.26	6.78	-	0.55	Trofimov, 1974
Muntenite (Olăneşti) [5]	1	85.45	11.46	2.55	0.54	-	Murgoci, 1924; Trofimov, 1974

Table 2. Fluorescence of the amber from several localities from Romania, including from the Duraş Site

No.	Provenance	Fluorescence
1	Leordeanu (Colţi area, Buzău County)*	Light violet
2	Dragomir (Colţi area, Buzău County)*	Azure
3	Almaschite (Neamţ County)**	Light blue-violet
4	Duraş Amber (Neamţ County)***	Violet-blue (azure)

* Vasilescu Gheorghe Collection; ** Vodă Alexandru Collection; *** Brustur Titus Collection.

The amber from the Duraş Site is insoluble in alcohol, turpentine oil, carbon sulphide, ether and chloroform. The specific weight is 1.003 g/cm^3. The amber is characterized by a brown-blackish color, with reddish up to yellowish spots (**Fig. 3a**); it is often fissured. Rarely, green-bluish granules are also present. The examination at the binocular microscope, under reflected light of a nodule (from Fig. 3a) shows a sharp contact between the amber and the sandstone with glauconite (**Fig. 3b, c**). Besides, traces of the viscous resin flow (**Fig. 3d**), mm enclaves of red to brown amber surrounded by the black amber (**Fig. 3e**), submilimetric bubble traces of heavily compressed air, with round and elliptic shapes (**Fig. 3f**), along with fragmented multicolored amber (**Fig. 3g**) are also present.

5.2. Infrared Spectral analysis

From the shape of the spectral curves (**Fig. 4**), similitudes of the **I**1 and **I**2 curves characterizing the amber of the Duraş Site may be observed; these curves show resemblances with the one characterizing the Almaschite, but differs from the curves of the Rumanite and Baltic amber.

Even we gathered only few data of the Duraş amber properties (i.e., IR spectrum and chemical and physical), we may advance the idea that these data support the hypothesis of Murgoci (1924) about the existence of 'The Piatra Amber'. Under this name the author described the Almaschite variety of amber found also in the Neamţ County, the same region where the Duraş Site is located, in the central part of the Eastern Carpathians. Moreover, taking into consideration the description from the Romanian geological literature regarding the amber occurrence from Târgu-Ocna and Bogata** (Bacău County), Duraş Site (Iapa Valley), Pietricica, Almaş (the later ones from the Neamţ County) and Vama (Suceava County), all of them situated in the central part of the Eastern Carpathians, we suggest the existence of an *Amber Moldavian Province* in the outer structures of the Eastern Carpathians, i.e. the Outer Moldavide nappes.

To note that the occurrence from Pietricica, aforementioned, is situa-ted in the Neamţ County and not close by the Bacău town (Pietricica Hill), as erroneously was mentioned Boroffka (2002, Fig. 1; 2006, Fig. 1). Possibly, the toponomy has led to this confusion, as the amber has described at Pietricica, nearby the Piatra Neamţ town, by Poni (1900) and later by Murgoci (1903).

** 5 km W from Târgu-Ocna, in the Oligocene Lower Kliwa Formation, Tarcău Nappe (Constantin Gaiţă – personal communication 1975).

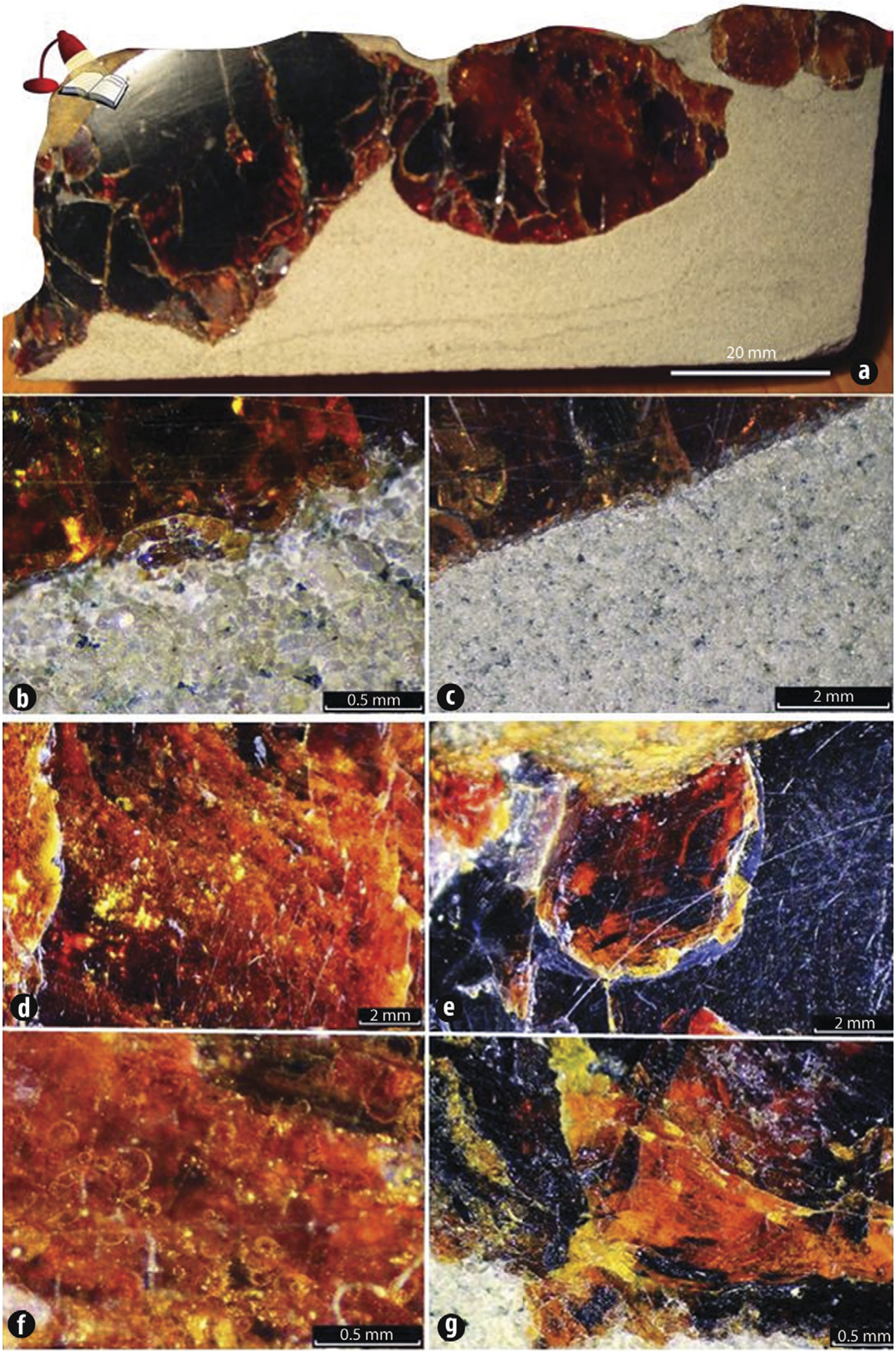

Fig. 3. Features of the Duraș amber from the collection Titus Brustur. **a.** Nodules of brown-blackish amber in the siliceous sandstone with glauconite of the Lucăcești Formation (artificial outcrop D1, 4.5 m); b-g. Microphotographs taken at the microscope with reflected light; **b**-**c**. The boundary between the siliceous sandstone with glauconite and the amber nodule; **d.** Red-orange amber showing traces of flow; **e.** Red-brownish amber enclave red-brownish in the black amber; **f.** Red-yellowish amber with circular and elliptical traces of the air bubbles in the viscous resin; **g.** Multicolored fragmented amber and the contact with the siliceous sandstone with glauconite.

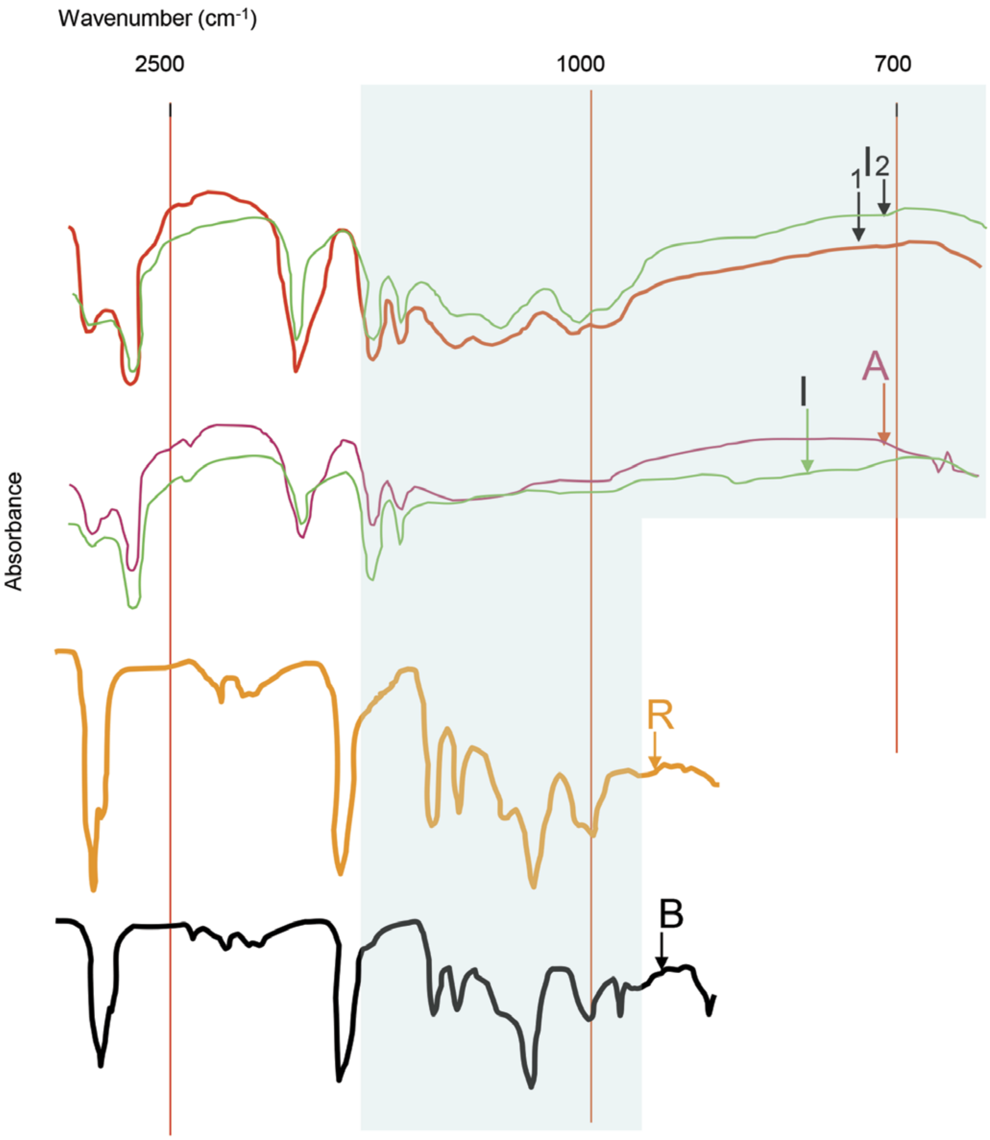

Fig. 4. IR spectrum of the amber in the Duraş Site (**I** – **1** and **2** from the artificial outcrop D1, at a distance of around 2.5 m), in comparison with the IR spectra of the Almaschite (**A**), Romanite (**R**) and Baltic amber (R and B after Neacşu & Dumitraş, 2008).

6. DISCUSSION AND CONCLUSIONS

The presence of the amber in the central part of the Eastern Carpathians (Duraş site, Neamţ County) is to be added to the other amber occurrences from the Romanian Carpathian regions, such as the Paleogene ones from the Southern Carpathians (Richard, 1897; Murgoci, 1903; Protescu, 1937, among others) and the Paleogene-Lower Miocene of the Eastern Carpathians (Murgoci, 1923, 1924), including their N part, in Bucovina (Schröckinger, 1875). In the whole Romanian Carpathian bend, the Romanian amber (= Romanite), including its variety Almaschite (described by Murgoci, 1924 and recognized as a new mineral, Spencer (1931), occurs in the Oligocene-Lower Miocene bituminous facies. The amber described herein from the central part of the Eastern Carpathians is Late Eocene in age.

All the aforementioned amber varieties are exclusively placed in the Oligocene-Lower Miocene bituminous deposits (= Kliwa Sandstone facies). Their age distinguished from the Duraş amber site that is located in the Lucăceşti Formation, just below a thin greenish clay succession that contain a planktonic foraminiferal assemblages with *Globigerina* div. sp. and *Globigerinoides conglobatus*, indicative taxa of Late Eocene interval, i.e. Priabonian.

Similar features were observed in the Ardeluţa and Lupoaia lithostratigraphic units that occur in the western part of the Vrancea Nappe, in the Tarcău Nappe (Ionesi, 1982), which are therefore inner equivalents formations of the Lucăceşti Formation. In the Vrancea Nappe from Humor Halfwindow, the later unit contains the same planktonic foraminiferal assemblages as above described (Ionesi, 1971, 1980), along with nummulites such as *Nummulites fabianii* (Prever) and *N. chavannesi* de la Harpe, bivalves and gastropods (Ionesi & Ionesi, 1966). Based on calcareous nannoplankton investigation, the Lucăcești Formation extends in the upper Priabonian biozone NP20 (Ionesi, 1982) and partly in the uppermost biozone NP21 (Săndulescu *et al*., 1987). Recent nannofossil studies (Melinte & Constantin, 1990; Melinte, 1995) identified the presence of significant biostratigraphical taxa such as: *Isthmolithus recurvus* Deflandre *in* Deflandre and Fert, 1954, *Reticulofenestra umbilicus* (Levin, 1965) Martini & Ritzkowski, 1968, *R. hillae* Bukry & Percival, 1971, *R. reticulata* (Gartner & Smith, 1967) Roth & Thierstein, 1972, *Discoaster barbadiensis* Tan, 1927 and *D. saipanensis* Bramlette & Riedel, 1954 assigned to the NP19-NP21 biozones, which cover the Late Priabonian interval (between 36.97 and 34.44 Ma, Gradstein et al., 2012).

Since now, the Lucăcești Formation, mainly made by massive sandstones interbedded with sandy turbidites was studied mainly from paleontological (Ionesi & Ionesi, 1966; Ionesi, 1971, 1982 and others) and petrographical point of view (Grasu *et al*., 1988), but less from its genetic significance. Some authors (Botez *et al*., 1960) believe that this unit accumulated in a shallow marine paleoenvironment, argued by the variably thickness of this unit up to its disappearance in some sections, along with the presence of ruditic beds, indicative for a local exondation (Popescu-Voitești, 1936; Humă, 1971; Grasu, 1996). In our opinion, this paleosetting has favored the appearance of the primary amber occurrence in the Duraș Site. The regional tectonics has determined the emergence of incipient anticlines, and also the resedimentation by slumping of soft deposits, such as the Oligocene bituminous marls. These features are mainly present in the northern areal occurrence of the Vrancea Nappe, in the Bistrița and Humor half-windows (Ionesi & Grasu, 1993).

The studied area was placed in a foreland basin (Grasu *et al*.1999), belonging to the Outer Moldavide Basin. Miclăuș *et al*. (2009) placed the Upper Eocene units (Bisericani, Globigerina Marl and Lucăcești) in a forebulge depozone sub-basin, while the Oligocene rocks accumulated in the subsiding sub-basin of the forebulge depozone.

Probably, during the Eocene, on the land developed the woody vegetation extending in the vicinity of to the littoral zone, with shallow and well-oxygenated waters, where siliceous arenites, rich in glauconite accumulated; these were the host rocks of the resin accumulation that in time transformed in amber. This scenario is agreement with some previous studies (Masicka, 1972), which considered the amber presence as a good indicator of the shoreline.

The palynologic assemblage of the Lucăcești Formation contain the pantropical palynomorph Normapolles along with Arctotertiary ones, gymnosperms and phytoplankton (Olaru, 1978; Tăutu *in* Micu *et al*., 1984). These correspond to an important threshold bionomic, showing a reduction up to the extinction of Normapolles, a diminishing of Postnormapolles and sharp increase of the arctotertiary elements; this later bioevent is coincident with a minimum in plant development linked to the pronounced cooling of Oligocene times.

The observed changes in palynologic assemblages observed in the Eastern Carpathians, where the Moldavide basin was placed, fit very well with the global ones at those times, leading to the extinction of several animal and plant taxa. The vegetation of Europe essentially changed; hence, the Middle Eocene tropical forests were replaced, during the Late Eocene, by subtropical taxa and swamps with Taxodiaceae taxa and reed (Prothero, 1994). The global reconstruction of the vegetation and terrestrial temperatures evolution of the Eocene-Oligocene boundary interval, i.e., 33.9-33.3 Ma (Pound & Salzmann, 2017), indicated a heterogeneity linked to the regional and tectonic setting, global cooling and sea-level fall, accompanied by the significant decrease of the atmospheric CO_2 concentration. After Hren *et al*. (2013), the later event determined the Eocene greenhouse end and the development of Oligocene icehouse, leading to the instauration of permanent ice caps in the Northern Hemisphere.

The amber is a fossil resin which the origin is still under debated. Yet, no consensus has been made on the paleobotanic taxa implied in the succinosis process that generated the well-known amber of the N Europe, i.e. the Baltic region. The amber has been attributed since longtime to the families Araucariaceae and Pinaceae, at which the Family Sciadopityaceae was added (Wolfe *et al*., 2009).

Recently, the kerogene evolution, based on the C, H and O atomic ratios was used by Ivanova *et al*. (2012) for comparing the fossil resin of different ages, and for identifying the genesis and the postdiagenetic effects on it. On the published diagram by the aforementioned authors, the Paleozoic fossil resins and the Mesozoic and Tertiary ones occupied distinct fields. This finding suggests a higher diagenesis of the resin included in the Paleozoic sediments than those of the Mesozoic and Tertiary ones, and also a diversification of the resin types produced by the Tertiary vegetation.

In general, high intensity succinosis intervals and widespread amber occurrences are probably linked to global events, i.e. climate fluctuation, that affected the forestry generating the resin. For instance, in Romania three succinosis intervals were identified, leading to the amber occurrences (Rabichon, 1934) such is: Lowermost Cretaceous, Eocene and Oligocene; the author considered as 'an amber period' the Lower Oligocene interval. After Rabichon (1934), the amber may be rarely found in a primary deposit, most of the known exploitations in the world are extracting amber from secondary deposits, i.e. reworked. This is the case of the well-known Baltic amber, i.e. the Succinite, redeposited in Eocene glauconitic marls (Wolfe *et al*., 2009). At Bitterfeld, the Upper Eocene amber is reworked in Lower Miocene deposits (Barthel & Hetzer, 1982), but this amber variety yielded differences from the Baltic one (Wolfe *et al*., 2016).

The human being paid attention to the amber since ancient times, being us as source for various finery, cult objects, etc, in the Paleolithic, Neolithic, Bronze Age, Iron Age, Antiquity and up to nowadays (Gridan, 2003). Various aspects related to the amber have been studied by historians and archaeologists, in order to establish the amber source and transport ways, especially in Europe and Asia.

In Romania, several investigations on amber were done since the beginning of the last century (ex. Murgoci, 1903; Protescu, 1937; Rabichon, 1938; Ghiurcă 1996; Ghiurcă & Drăgănescu, 1986; Neacşu, 2003). The amber sources, along with various aspects concerning prehistorical amber objects were discussed by Wolmann (1996), Boroffka (2002, 2006), Niculică (2013) and Gogâltan (2016); the later included in his work a rich documentary material on the prehistoric amber from Transylvania and E Hungary.

The existence of a primary amber deposit at Duraș supports the existence of the '*Moldavian Amber Province*' in the Eastern Carpathians of Romania. This finding may constitute a support for further geological studies, but also archaeological ones, focused on the pre-historical and historical sites. This work reveals that in Romania not only the amber variety Rumanit from Colți region (Buzău County) may be interesting for the topic presented herein.

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