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Studii şi cercetări, Geologie – Geografie 9, 2004, Bistriţa, p. 7-9

IN RECOGNITION OF PROF. DAN RĂDULESCU PhD ON 75TH ANNIVERSARY

Ioan MÂRZA*

I will begin in the homage that my fellow geologists from the "Babeş-Bolyai" University in Cluj and I wish to bring Prof. Dan Rădulescu on his 75th birthday, with a few rhymed words.

To the beat of wavers,
The sand grain builds
Atop on the bank
Akin to the thought.

To the beat of winds,
The sand grain builds
To the desert law
To build a new tilt.

To the beat of life
In the book of time
Young and old years build
To weave a wreath.

Dear Professor, Academician Dan Rădulescu,

We wish to honor you and the wreath of 75 lilies which you are celebrating today March 25th 2004 (Acad. Dan Rădulescu was born in Bucharest town, on the 20-th Hanuary 1928). Please receive our heartfelt congratulation, we wish you to continue wearing it in health, happiness and with the same young spirit which you have always shared with us.

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The more and more rich in years wreath, the passage towards senior age, these symbolize the spiritual trength which constitutes the sipport for physical fitness and for a clear sighted thinking shown by our distinguished honoree constantly active in both his academic and social life.

Prof. Dan Rădulescu stands out in his scientificresearch which spans over half a century as a distinguished petrographer & petrologist, vulcanologist and tectonician. He proved himself as a visionary petrologist, who explored study of roks further than simply describing their composition and genetic nature, by first considering the geotectonic context where they had been formed, as the major geologic phenomenology as a whole is connected to the tectonic seating. He is a visionarz petrographer as the work he performed for a lifetime was structured within this framework, this concept mentioned above which eas only recently adopted in the world of petrographs. Prof. Dan Rădulescu developed first and foremost a conceptual petrography, analytically subordinated, which contrasted with the practice of the time, when he started and pursued most of his scientific activity. He contributed to the development of a research direction which strongly influenced young petrographers, such as vulcanology and vulcanites together with all of their components and manifestation. Many young geologists, PhD students, and passionate collaborators of the volcanic phenomenology studied under his guidance.

Although he remained thoughout his life and indebted prisoners to vulcanology and vulcanites, to petrology in general and partially to geotectonics which in a larger sense also means petrogenesis (asserts Prof. Mihai Ducea PhD)- he left us an amazing dowry in his books. They are characterized by broad geoscientific diversity and such they become important guides for students and specialists alike.

In as far as his style, or the instrument he used to build his rich scientific work, books and papers alike, I would to underline his concise and suggestive style, wherein the logic of ideas, opf phenomena which he describes flow clearly and naturally from one to another like the clear water of a spring. The words in his sentences are like the sturdy bricks in an enduring construction, where if were to try ti replace them the edifice would collapse. His thoughtful, analytic and profound style mirrors the personality of the great man of science.

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Prof. Dan Rădulescu is a man who distinguished himself throughout his career though his actions and not just bare words. His actions and by this I mean his achievements have been numerous and remarkable, while his words were few, calm and wise.

I have been fortunate enough to work for several years together with Prof. Dan Rădulescu in the Supervisory Board of the Ministry of Education, where he has the President of the Board. This allowed me to witness his objectivity and his great sense of responsibility with which he tackled each case and issue, imposing on the entire Supervisory Board, by his example, the spirit of exigency, of duty and accountability in each and all the decisions we took.

These traits of character promoted him over the years in high public functions as the Director of the Geologic Institute of Romania, the Ministry of Geology, the Romanian Ambassador in Grece, the Vice-President of the Romanian Academy.

The circumstances I describe above created a strong bond between me and Prof. Rădulescu, in essence a big hearted man of kind nature.

In conclusion I would like to congratulate Professor and Academician Dan Rădulescu on his 75th anniversary on behalf of the geologists at the "Babeş-Bolyai" University in Cluj-Napoca wishing him many happy and healthy years in the advancement of Romanian geology.

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Paleontologie. Biostratigrafie

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Studii şi cercetări, Geologie – Geografie 9, 2004, Bistriţa, p. 13-46

EVOLUTION OF KNOWLEDGE ON PALEOGENE LAND FORMATIONS FROM THE NW BORDER OF THE TRANSYLVANIAN BASIN

Cristina FĂRCAŞ*, Vlad CODREA*

Abstract. The Paleogene formations and their related fossils engaged a series of research beginning with the early XVII century. This paper presents the historical evolution on the knowledge of terrestrial Paleogene formations, pointing out the main contributions useful for a correct interpretation of stratigraphy, bioevents, paleoclimatic and paleogeographic turnovers.
Key-words: Transylvanian Basin, terrestrial formations, history of research, Paleogene flora and fauna, bioevents.

INTRODUCTION

Located in the inner Romanian Carpatian area, the Paleogene Transylvanian Basin is superposed on two main categories of tectonic structures (Săndulescu, 1984): i. distorted elements belonging to the Dacides and Transylvanids and ii. their Upper Cretaceous-Upper Miocene post-tectogenetic cover. Its actual outline is a heritage issued from the last sedimentary basin that evolved in the area, which function started in the Middle Miocene (Badenian).

The Paleogene formations are exposed is several outcrops regnant in specific areas as: the N and NW basin borders, where the deposits thickness are the greatest known (between 500 and 1800 m at Jibou-Preluca); at SE, in Perşani Mts; at S at Turnu Roşu (=Porceşti) and Dobârca; at SW, in Alba-Iulia neighboorhood.

As a general rule, especially in NW (Gilău-Meseş-Preluca areas), one

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can follow continental-lacustrine formations and marine-brakish onesinterbedded. Large lithofacies changements can be observed, generated by the Laramie and post-Laramie tectogenesis (Ciupagea et al., 1970).

The sudies carried on these formations are numerous, beginning in the early XVII-th century. The majority of students focused their attention on the marine formations, mainly dur to the richness of the mollusk fauna. Much less studies were consecrate to the continental formations, where fossils are extremely scarce and the lithology sometimes, too uniform. In this manner, after three centuries of reserarch, huge disproportion exists between the knowledge of the Paleogene marine formations vs. continental ones.

1700-1900 EPOCH

A series of interesting informations occurred in several ancient publications from the early XVIIth century. Unfortunately, a lot of them are bibliophile rarities, difficult if not impossible to be found in the Romanian libraries: *e.g.* Köleseri (1717), Fridwalzky (1767), Ignatz von Born (1774) (*fide* Hauer & Stache, 1863). In these circumstances, one can consider that the first modern and wrought mentions concering the Paleogene from Transylvania belong to Fichtel (1780). In his monographic work concering „The Mineralogy of Transylvania", a generous section is dedicated to some formations and fossils encountered in NW side of the Transylvanian Depression, as Jibou, Huedin, Baciu or Cluj. Some specific mollusks are illustrated, with an especial attention on the *Gryphaea* genus from Jibou area. Beside the Paleogene fossils, Fichtel's book refers other geological aspects related to Transylvania too, as the Lower Miocene mollusk faunas from Coruş, or the Badenian salt mining in the salinas from this region.

After Fichtel, the following mentions concerning the Paleogene formations belong to Beudant (1822). This French scientist accomplished a fieldtrip in Hungary and Transylvania in 1818, an excellent opportunity for him to redact a large and detailed report, "*Voyage minéralogique et géologique en Hongrie*". In his work, a lot of geological data can be found. However, the deposits are presented generally only, without a separation on different formations. It is obvious that the geology represents only a subsidiary chapter of this work, completing an overview focused mainly on other aspects (social, etnography, policy etc).

Due to Beudant's contribution one dispose now of several informations concerning the geology of some areas from Trasylvania, as:

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Braşov neighboorhoods, the region once known as „Walachia borders" represented by the South Carpatians, the central part of the Depression or Banat region.

In the central part, the salt and anhydrite formations are pointed out, in a similar way as Fichtel did. Beudant compared several „bituminous woods" recovered from the salt to the similar ones discovered at Wieliczka. However, such discoveries are extremely rare in the Transylvanian salt and it is possibly that Beudant did confusion, the fossil woods originating in reality from the Middle Miocene gypsum.

Some paragraphs are concerned to the Cluj neighboorhood areas, where several sites with fossil trunks, coal deposits or limestone used as raw material had been mentioned. In the same area, Beudant's attention focused on some localities where sand deposits occur. The sand formations contain a large amount of fossil mollusks. The French geologist compared some of them already figured by Fichtel, mostly belonging to clams or oysters, to similar forms known from the Paris Basin or the South of France.

Even devoid of too many details, its geologic map representing the NW region of the Transylvanian Depression it is an interesting one. In the proximity of Cluj, at Baciu, Leghia and Căpuşu Mic are symbolized "calcaire grossier parisien"-type deposits, and at Zimbor, "molass or sandstone with lignite". The areas from Jibou are assigned to the Mesozoic.

Near from Jibou, cropping out in the Someş banks, the white or slight coloured gypsum deposits used for different ornamental products has a geological appartenance that Beudant was unable to define clearness (the explanations related to the genesis are extremely indeterminate: the evaporites are assigned to the coal sandstone, Zechstein or even to the lowermost part of Jurassic!). Same confusion persists when he dealed with the fossil mollusks, that "*sembleraient indiquer les parties inférieures du Jura*" (pag. 318).

Due to the presence in the Meseş area of fossils resembling to the ones from Jibou area (grypheids reworked fragmented shells), Beudant supposed a similitude between the evolutions of these two areas, the Meseş one interpreted as an extension of the deposits exposed in the Jibou sector. In this context, it is reiterate the less inspired interpretation for the *Gryphea* shells that would argue either the Early Jurassic or the Thuringian Zechstein.

Beudant's work contains also other various geologic data extremely valuable as primordial, as: the presence of Mesozoic limestone in Apuseni

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Mts, the Ice Age mammal bone-bearing caves as the one from Fânațe, the Feleac concretions etc.

Other mentions on the Paleogene from the Transylvanian Basin as a consequence of journeys in this region belong to Boué (1831) and Lilienbach (1833).

However, all these mentions refer only to details and give not a general geologic view on the Transylvanian Basin.

In these circumstances, one can consider that the first monographic work related to the topic is the one of Hauer & Stache (1863). It was done at Bielz suggestion, who was member of the Natural Science Society from Sibiu (Hermannstadt). It square up to in a much more structured systematic manner the summum of informations already accumulated.

As the time allocate for this monograph was short if related to the complexity of such a region, the two authors divided between them the research targets. Stache studied the sectors from the N and the western border of the depression and Hauer, focused its attention on the S, pending to the South Carpatians crest. Several data issued from some other contributors, as Richthoffen, Partsch and Stur, concering the Preluca, Lăpuş, Țibleş, East Harghita, Mureş culoir, Zărand, Drocea etc.

There are presented structural, genetic and petrographic essential informations, many of them remaining still alive. The book value increase due to the existence of a geologic guide into its second section, where one can find a localities index and 25 small areas treated from geologic, geographic and even economic viewpoints.

The various rocks located in the field were integrated in different geologic ages, presented downward, from the newest toward the oldest, each period being divided in units (epochs).

Obviously, our interest is focused on the Paleogene, treated by the two authors. According their opinion, it included the Eocene only, divided in three units, a very different perspective if compared to the actual situation. One can observe the absence of the outlining of the Paleocene deposits, as well as the assignement of the Oligocene formations to some upper horizons of the Eocene.

The petrographic and paleontologic interpretations related to the Paleogene lead to some conclusions: the freshwater limestone from Rona-Jibou and the marl with *Nummulites perforatus* MONTFORT are assigned to the Early Eocene. Some formations are simply included into the Eocene,

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without any other detail: the bryozooan marl (Cluj and Baciu), the Hoia limestone which extension is followed until the Meseş area, the first mentioned Curtuiuş Formation, the Porceşti limestone abondant in shells, echinoderms and fish teeth. Ileanda Formation or "Cetăţuia beds" (the actual Gruia Sandstone Formation) with "*Corbula*" (*Lentidium*) appeared also.

Hauer & Stache's work found an intensive use by the subsecvent generations of geologists (Maxim, 1964, 1968) and is still valuable

Complementary data on the Paleogene from the Transylvanian Depression belong to Pávay Elek, charged in 1869 by the Hungarian Ministry of Industry and Research to study the geology of Cluj and Remetea areas. The data related to the geological investigations served to the construction of the railway linking Cluj from Oradea. The results of the geological study, the annexed maps and numerous sketches, a lot of them outlining new details, formed the base for two papers, published in 1871 and 1872.

Attracted by the richness of the fossil fauna, Pávay did a detailed description of the region geology, where he concentrate the bulk of the petrographic and paleontologic observations issued from that he called "*Kolozsvári medencz*" ("Cluj basin"). The presence of marine deposits, documented by the rich invertebrate assemblages suggested to the author the existence in Eocene of a submerged sedimentary basin. As a consequence he named this basin „*Eocene sea*".

Interpreting the geologic data, Pávay tried to sketch a stratigraphic division of the deposits (sometimes, erroneously), corresponding to three epochs of the Eocene (lower, middle and upper) also known from the Paris Basin.

Essential is the fact that he provided a lot of paleontological data, with a special interest on mammals. In this manner, he enriched the list of taxa known from Transylvania. Such an example refers to the large mammal mentioned from the site of Rădaia, assigned to *Palaeotherium* genus (later described as a new species by Böckh, 1876, as *Brachydiastematherium transsylvanicum* BÖCKH & MATYASOVSKY, 1876). On this evidence, the red sandstone deposits from Cluj vicinity were assigned to the Early Eocene.

In the Middle Eocene, he remarked in the field two horizons with nummulites (lower and upper) interbedded with oyster bearing, as well as the „*intermedia* beds" and „bryozooan beds" in the Late Eocene.

It is extremely clear that he succeed to discern the deposition succession – sometimes, extremely difficult recognizable in the field – from

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"Cluj basin", beginning with the oldest sediments till the newest ones. However, sometimes he failed in doing a correct determination of fossils and as a consequence, in establishing correctly the assignement of some deposits to one or another Paleogene epoch.

Later contributions for the Paleogene formations from Transylvania belong to well-known geologists as Koch and Hofmann. Their field data published in long series of papers (between 1876-1900), offer valuable geologic informations, subsecvently reiterated as refferable elements by different students.

Because the topics investigated by these two scientists were often in common, we considered appropriate to present in parallel the evolution of their results.

In a juvenilia, redacted with the collegial help of some curators, Koch (1876) succeed to draw up a large and laborious repertory of fossils collected previously to the beginning of his career, curate in different museums, adding also several personal informations concering Transylvania. He accorded a special attention to the Eocene mammals (from Rădaia, from the outcrops located at Mănăştur or Cluj, at Jebuc or Rodna at Valea Vinului), arguing on this basis the existence of the Paleogene into the area. The list contains the name of 89 sites where the fossil vertebrates originated from, specifying the remains (bones or teeth), the names of students involved in the studies and the collections where the fossils were curate (mainly in the museums located in the most importantant Transylvanian cities: Braşov, Sebeş, Târgu-Mureş, Cluj etc).

After this study, Koch continued to investigate circumstantially the Paleogene formations from Transylvaina, in a complex way: mineralogy, extension, thickness, pitch, fossils, mapping. Koch interpreted the value of each fossil, trying to deduce the sedimentary environments for the different formations.

Koch has also several tentatives to correlate the Paleogene formations exposed in different depression areas, and even more, to establish similitudes with other European basins, as Paris, Belgium, London etc.

The Paleogene formations from Transylvania were presented in two wide monographs issued in 1894 and 1900. The data contained in is based also on the previous publications belonging to Hofmann (1879, 1881, 1883, 1887, 1888), Pávay (1871, 1872), Böckh (1876). In the section concerned to

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the Paleogene formations, Koch sketched a series of correlations (based mainly on lithology) with Paris Basin.

The oldest Paleogene sediments were considered the *„lower variegated clay beds"*, compared with the Soisson deposits and assigned as belonging to the Early Eocene (Londian). The most representative area where these deposits are cropping out, with maximum thickness, is around the small town of Jibou. Koch considered that the top of this succession corresponds to *„the freshwater limestone from Jibou and Rona"*, although the existence of a pile of variegated red clays existing on the freshwater limestone.

The following continental formation mentioned by Koch is „the upper variegated clay" from Rădaia, than the so-called *„middle freshwater horizon"* with a top represented by gypsum deposits (at Jebuc and Stana). However, later, he reconsidered these units as belonging to the base of *„upper calcaire grossier"*.

In discerning the stratigraphic units, Koch used some data belonging to Hofmann, an outstanding geologist who worked mainly in Sălaj district. Hofmann mentioned for the first time the Jibou Formation (1879) as "*Gruppen der bunten Thone, Süsswasserkalke und Mergel von Zsibó*" (Early Eocene). At its top, at Jibou (Rona), he mentioned a *„freswater limestone and marl subhorizon"* with fossils, interbedded between two variegated clay subhorizons.

At the level of *„Nummulites perforata* beds" (1879), as a consequence of his mapping works carried on in the Meseş area, he supposed the presence of a fault located in the area comprised betwen Benefalău and Cuceu. *„The Racoţi Sandstone"* (1879) was mentioned as a subhorizon of the *„lower calcaire grossier horizon"*, the *„Turbuţa Beds"* (1879) distinguished in Meseş area, with small snails. Later, he mentioned also in this last formation the existence of thin intercalations of *„freshwater limestone"* (South from Meseş Mts).

As opposed to their forrunners, these two geologists distinguished the existence in the Transylvanian Depression of the Oligocene deposits. At their epoch, the Oligocene included the Aquitanian too. The Oligocene deposits outlined in the field were divided into a series of *„formations"*, based on petrography, paleontology and exposure areas.

In the *„Early and Middle Oligocene"*, Koch (1878) established the stratigraphic location of *„Hoia Beds"*, with a type-section on Hoia Hill, at Cluj.

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Later (1894), into the Hoia limestones he mentioned fossil forams, alga, fish and mammals (*Halitherium* sp.). Hofmann (1879) proved the stratigraphic correspondent of these strata on the eastern Meseş Mts slope, as *„lower marine sediments with many mollusk shells*".

The *„Curtuiuş Beds*" described by Hofmann (1879) as *„lower brackish beds*", had been reinterpreted by the same as *„brackish and freshwater Curtuiuş beds*". After Koch (1880), the „beds" were named *„Formations with brown coal from Curtuiuş*".

Koch (1874) mentioned the *„Mera Beds*" as *„the shell fish sandstone*" and later (1875) the „epoch of the *Scutella* marl and shell fish sandstone". As a result of his mapping experience carried out in the eastern side of the Sălaj district, Hofmann (1879) named these strata as *„upper marine beds rich in mollusks*", and in 1883 he introduced the *„Ciocmani Beds*" name (equivalent of Mera Beds in Jibou area), after the village Ciocmani, where the richness of fossils is remarkable. Finally, the appellation of *„Mera Beds*" come from Koch (1880), after the Mera village.

In Aquitanian (*"aquitanischen Schichten*" or *„upper brackish beds*"; Hofmann, 1881), Hofmann included all the deposits comprised between the Ileanda Mare Beds and Coruş Beds. On his turn, Koch (1894) included in the Aquitanian series several strata outlined in Cluj area, represented by: Tic Beds - including the coal deposits mentioned in 1883, with a maximum thickness at Ticu-Tămaşa in Almaşului Valley -, Cetate Beds or Corbula Beds (1894), Zimbor Beds (1883) and Sân Mihai-Deşert Beds (1883).

Consequence of observations made by Fuchs (1894), in the second half of his monograph concerning the Tertiary deposits from Transylvania, Koch (1900) placed the Tic and Cetate beds into Oligocene (Chattian) and Zimbor (assigned by Haug, in 1920 to the Oligocene) and Sân Mihai-Deşert Beds to the Miocene (Aquitanian).

After more than a century from their research, the data aquired was used thenceforth by a larger number of geologists involved in the investigation of the Transylvanian Basin. Even now, Koch's two monographs still represent a basic reference for the geology of Transylvania.

1900-2004 EPOCH

In the first half of the XXth century, the Paleogene from Trasylvania was less studied if compared with the previous decades. The majority of geologists involved in this topic dealt with details only, or they tried to

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improve the stratigraphic schema drawn by Hoffman and Koch. Such an example is the revision published by Haug (1920). He separed into the Eocene, the Eonummulitic (Paleocene) and Mesonummulitic (Eocene *s. str.*), the last one including the Lutetian, Priabonian and Auversian *sensu* J. Boussac (1911).

Some data concerning the petrography in the NW part of the Trasylvanian Basin belong to Szádeczky (1930), but the approach on the Paleogene from *„the Cluj Cretaceous-Eocene syncline*" is just subsidiary or his study.

Another study on the Paleogene was carried on by Szádecky-Kardoss (1930). He define the so-called *„Transylvanian basin*", resulted in his oppinion trough the plunge of the *„Transylvanian land*" during the Mediterranean. The exposures of the Paleogene formations is indicated in two areas (basins), different from the facies viewpoint. The first one is located in NW and SW (Ţicău, Jibou, Cluj-Napoca and Alba Iulia), and the second one in S and SE (Porceşti, Lueta). A „large and durably threshold" represented by *„a land*" separed these two areas.

Mateescu studied the NW part of the Transylvanian Basin, focusing mainly his interest on the geology and physiography of the Huedin Depression (1925, 1926) or the facies variations of the Paleogene deposits reported to the Moigrad fault (1938). In his oppinion, the alternance of marine *vs.* land sediments, as well as the lateral variations are due to the Moigrad fault. The age of the lower variegated red clay should be ante-Lutetian (Danian-Paleocen).

Another outstanding student involved in the study of the Trasylvanian Paleogene was Popescu-Voiteşti (1926), who drawn the first paleogeographic synthesis of the Eocene from Romania. He considered that the median Carpatian axis functioned as a *„border*" between two biologic provinces: one corresponding to the Transylvanian Depression, and the second one in the Getic Depression and Dobroudja. Later, Bombiță (1963) disagreed with this pattern.

Other data concerning the Paleogene are related to some field mission repports: Ferenczi (1950), Májzon (1950), Mihaltz (1950), Reich (1950), Pătruț (1952), Joja (1956), Răileanu & Saulea (1954, 1956), Dumitrescu (1957), Barbu (1956, 1962), Bombiță (1957, 1963 a, b, 1984 a, b), Mészáros (1957, 1959, 1961), Niță Pion (1966), Petrescu (1968, 1970, 1971, 1972, 1987), Popescu (1976, 1978), Rusu (1967, 1970, 1977, 1989,

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1995), Tătărâm (1963, 1984). Some thesis had been done too in these areas, as the ones of Petrescu (1969), Şuraru (1970), Moisescu (1975), Rusu (1977), Codrea (1995), Baciu (1999) etc.

THE PALEOGENE LAND DEPOSITS FROM NW BORDER OF THE TRANSYLVANIAN BASIN

The Paleogene deposits from the area are corresponding to the filling of a foreland basin that evolved post-Laramie tectogenesis, in the convergence area between the Preapulian and Getic cratons (Hosu, 1999). In Eocene, the stratigraphic succession indicates a rhythmic sedimentation, evidence by land ("lower variegated series" and "upper variegated series") and marine ("lower marine series" and "upper marine series") formations, interbedded (Răileanu & Saulea, 1956). The alternance of these two deposit types and the more advanced investigations in marine deposits, allowed to establish the geological ages f or the land formations too.

Three sedimentation realms are distinguished: Gilău, Meseş and Preluca (Rusu, 1970; Popescu, 1978).

The Jibou Formation (Hofmann, 1879; Late Maastrichtian-Lutetian; abr. JBF)

In all the three sedimentary realms, the Paleogene succession starts with the land JBF (Popescu, 1976), exceeding 1500 m in thickness in Meseş area.

The JBF deposits lye in unconformity on the metamorphic or Mesosoic basement. Its sedimentation begun before the K/T boundary, because in the basal sections some dinosaur fossils had been recorded by Nopcsa (1905) and recently by us (unpublished data). Same fossils are known in similar deposits at Alba Iulia-Sebeş-Vinţu de Jos from Alba district (Codrea et al., 2001 a, b). The top of JBF is Early Eocene (Ypresian), evidence by some turtle remains mentioned in Sălaj district, at Giurtelecul Şimleului (Codrea & Fărcaş, 2002).

The lithology is typical for a river system, with microconlomerate and sandstone channelfills and floodplain deposits represented by red siltic clay and fine sand (Codrea et al., 2003 b).

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Different geologists used different names for the JBF: "Gruppen der bunten Thone, Süsswasserkalke und Mergel von Zsibó" (Hofmann, 1879); "Untere bunte Thonschichten; Unterer Horizont des Süsswasserkalkes" (Koch, 1894); „lower variegated clay series" (Răileanu & Saulea, 1954, 1956); „lower variegated series" (Mészáros, 1957); „lower variegated clay" (Bombiță, 1963 a); „red land clay" (Bombiță, 1963 b), „lower irised clay horizon" (Dragoş, 1966); „lower variegated complex" (Răileanu & Mészáros, 1966); „lower red and variegated clay series" (Moisescu, 1975); „Jibou Formation" (Popescu, 1978; Rusu, 1987); "lower variegated clay horizon" (Tătărâm, 1984); "Jibou Beds - lower variegated clay complex" (Ghergari et al., 1987).

Into the JBF, some lacustrine intercalations are known. They are interpreted as members of the JBF: the Horlacea limestone (Rusu, 1995) or the most important, the Rona Member (Codrea & Săsăran, 2002).

The classical type-section of the Rona Member was mentioned at Rona, by Hauer & Stache (1863), than by Hofmann (1879). Codrea & Săsăran (2002) added a complementary section located at Jibou, at the Botanical garden area.

The flora and fauna assemblages from Rona-Jibou, mostly unique for our country and even for the Eastern Europe, prove successive stages in the lake developpment.

The paleontology refers mainly to:

I. c*harophytes*, extremely usefull for paleobathymetry. The assemblage includes *Dughiella bacilaris* (index species) and *Nitellopsis (C.) paracolensis*, two species marker for the Thanetian, in association with *Harrisichara* aff. *saportae*, *Harrisichara denticulata*, *Harrisichara* cf. *leptocera*, *Peckichara* aff. *atlasensis*, *Dughiella bacillaris*, *Microchara* cf. *pachytelis* (Baciu, 1999; Baciu, 2003).

II. *microflora*, including more than hundred new taxa for our country (Petrescu, 2003, Codrea et al., 2003 b). The Phytoplankton is represented by *Ovoidites, Botryococcus* and *Pediastrum.* Ferns are dominating the spores: *Leiotriletes microadriensis, Triplanosporites microsinuosus, Laevigatisporites haardti, Polypodiaceaesporites marxheimensis, Leiotriletes wolffi, L. maxoides palaeogenicus, Triplanosporites sinuosus, Concavisporites (Obtusisporis) minimus, Laevigatisporites*

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bisulcatoides, Polypodiidites secundus, Microfoveolatosporis pseudodentatus. Rare: *Toroiosporis (Duplotoroiosporis) solutionis, Triplanosporites sinomaxoides, Extrapunctatosporis* sp., *Verrucatosporites favus, Camarazonosporites (C.) heskemensis, Polypodiaceoisporites* cf. *rectolatus, Verrucingulatisporites* sp., but there are also Sphagnaceae with *Stereisporites (St.) stereoides, St. (St.) eovalidus.* Gymnosperms are rare, represented by *Ephedripites* or Coniferals, as *Pityosporites microalatus* and *Pityosporites labdacus.* The greatest part of this assemblage belongs to Angiosperms: *Sparganiaceaepollenites, Monocolpopollenites, Arecipites, Monocolpopollenites magnus, Nudopollis endangulatus, Magnolipollis ovalis, Anacolsidites pseudoefelatus, Platycaryapollenites levis, Caryapollenites praesimplex, Subtriporopollenites magnoporatus* etc. Very frequent forms: *Interpollis supplingensis, Plicapollis pseudoexcelsus, Triatripollenites coryphaeus, Subtriporopollenites anulatus, Compositoipollenites rizophorus, Tricolporopollenites cingulum* etc.

III. *mollusks* (*Galba arrenulata, Australorbis elegans ;* Mészáros,1997).

IV. Vertebrates, including : fish (Amiidae : *Cyclurus*), amphibians (Anoura indet.), turtles (Pleurodira: *Ronella botanica*), crocodilians (cf. *Doratodon* sp., Crocodylidae *s. l.* indet.), squamata (cf. Lacertidae, Serpentes), mammals (Multituberculata: *Hainina* sp. –two forms-, Protheutheria – *Aboletylestes* sp., Condylarthra - cf. *Paschatherium* sp. Chiroptera or Lipotyphla, ? Rodentia, ? Eutheria (Gheerbrant et al., 1999; Codrea et al., 2000).

The flora and fauna assemblages suggest a Thanetian age for the Rona Member, and a lacustrine paleoenvironment that evolved in a subtropical climate. The biota affinities belong to the Western Europe bioprovince.

Some data concerning the land environment originate however, from marine deposits too. Such an example is a mammal fossil collected in the Mortănuşa Formation (Bombiță & Moisescu, 1968), more exactly to the top of the Ciuleni Member (Rusu, 1972; Early Priabonian). It belongs to a carnivore assigned to ?*Cynodictis* (Codrea & Vremir, 2003 c). The area the

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animal immigrated to Transylvania from remains unknown (Western Europe or Asia), but the genus is well-known from the Middle Paleogene from Europe. It proves the existence in the Early Priabonian of dense forested areas, in a "paratropical" climate, with an average of 20° C and 1200 mm/year rainfall (Petrescu & Givulescu, 1987; Givulescu, 1997).

The Valea Nadăşului Formation (Popescu, 1978; Priabonian, NP18-NP19; abr VNF).

It represents the second main land formation, cropping out both in Gilău and Preluca areas.

The lithology involves two types of deposits (Popescu, 1978): sand dominating towards the base and red silty clay with green-clay, sand or microconglomerate lens-like intercalations. This lithology share a lot of feathures in common with the JBF, a reason for Koch (1894) to appellate it "upper variegated clay". Later, it is known under various names, as "the upper variegated clay series" (Răileanu & Saulea, 1954, 1956); „upper variegated series" (Mészáros, 1957), „land sand and clay" (Bombiţă, 1963 b), „upper irised clay horizon" (Dragoş, 1966), „upper red and variegated clay horizon" (Moisescu, 1975), „Valea Nadăşului Formation" (Popescu, 1978), „upper variegated clay horizon (Tătărâm, 1984), „Valea Nadăşului Beds" (Ghergari et al., 1987) etc.

The importance of VNF is due mainly to the first discovery of large Paleogene land mammals from our country. Pávay (1871), the first to discover such fossils at Rădaia assigned them to *Paleotherium*. Later, Böckh (1876) reconsidered this assignement and described a new species, de *Brachydiastematherium transsylvanicum*. Another mammal discovered by Koch (1879) in the same locality, is *Prohyracodon orientale,* a primitive rhino.

Besides Rădaia, another relevant site for the same stratigraphic level is at Morlaca, located just on the western rim of the Transylvanian Depression, at the contact with the Vlădeasa Mt. magmatites. Mészáros et al. (2001) mentioned there a rib fragment belonging to a large mammal (*Brachydiastematherium*-like).

From a paleogeographic viewpoint, the fossils from Valea Nadăşului Formation suggest easterly immigration waves, from Asia toward Europe that

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reached Transylvania before the "Grande Coupure" event (Codrea & Fărcaş, 2002).

The discoveries from VNF do not cease to vertebrates. Several contributors, as Pop & Petrescu (1971), Petrescu (2003) or Petrescu & Givulescu (1987) pointed out interesting data concerning the Eocene flora too. The main site is located on Valea Răoasă, at Morlaca, not very far from Huedin town. It consists on 0.2 m thick dark coal clay, illustrating a short brackish-lacustrine episode. A Charophyte assemblage with *Sphaerochara* cf. *labellata* and different forms of *Chara* (Baciu, 2003) evidence the freshwater environment. The age of the level is proved by microflora (Petrescu, 2003), with the following taxa:

SPORITES

- the majority belongs to tropical/subtropical-type ferns as: Gleicheniaceae, Schizeaceae (*Lygodium*), Polypodiaceae: *Undulatisporites pseudobrasiliensis, Leiotriletes adriennis, Verucatosporites afavus*, etc.

POLLENITES

- Conifers: Taxodiaceae (*Inaperturopollenites hiatus*) and Pinaceae (*Pityosporites microalatus, P. labdacus*);
- Monocotyledonous angiosperms, with Palmae monocolpate pollen (*Monocolpopollenites grandis, M. microalatus, Nypa*);
- Dicotyledonous angiosperms, including an assemblage with several families: Juglandaceae (*Plicatopollis plicatus, Engelhardtia*), Fagaceae (*Castanopsis, Tricolpopollenites cingulum, T. porasper,* etc), Myricaceae (*Triatriopollenites bituitus, T. rurensis*), Aquifoliaceae (*Tricolporopollenites illiacus*), Sterculiaceae (*Granotricolporites semiglobosus*), Sapotaceae (*Tetracolporopollenites ellipsus, T. obscurus*).

All these taxa suggest a tropical/subtropical-type climate in the Priabonian from Morlaca (Petrescu, 2003).

The Turbuţa Formation (Hofmann, 1879; Early Priabonian; abr. TF)

TF is a lateral correspondent of VNF. These two formations share the same sedimentary environment (flood plain), but TF is more flooded compared with VNF.

TF is exposed mainly on the Meseş area, with a lesser extension in Preluca. TF is sandwiched between two marine formations, well documented by nannoplankton and mollusk assemblages (Mészáros, 1991): bellow, the

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Racoţi and Viştea formations belong to NP 18 zone, and Jebucu Formation, located above, to NP 19. As a consequence, TF is Priabonian.

The base of TF includes dark bituminous shale clay and freshwater mollusk limestone, followed by a level of blue-greenisch clay and dolomicrite, with red clay and gypsum lenses, interbedded. The last level includes gypsum and dolomicrites (Popescu, 1984).

An illustrating outcrop is located on the left bank of Şanţului Valley. It proves the existence of a short episode of swampy tendency, with caracteristic snails.

The flora and fauna include:

- charophyte: *Harrisichara vasiformis*, *Chara* sp., *Sphaerochara* sp. (Baciu & Hartenberger, 2001);
- SPORITES
- Schizeaceae - *Leiotriletes adriennis* (*Lygodium*), *Cicatricosisporites dorogensis* (*Anomia*), *C. pseudodorogensis* (*Schizea*); Polypodiaceae – *Laevigatisporites discordatus*, *Verucatosporites tennelis*, *Undulozonosporites magnus* etc.
- POLLENITES
- Taxodiaceae - (*Inaperturopollenites hiatus*)
- Monocotiledonous angiosperms - Palmae: *Monocolpopollenites minor*, *Arecipites granulatus*, *Spinizonocolpites baculatus* (*Nypa*); Burmaniaceae – *Diporites iszkaszentgyörgyi*
    - Dicotyledonous angiosperms - Myricaceae (*Triatriopollenites bituitus*, *T. rurensis*), Fagaceae (*Tricolpopollenites cingulum*, *T. liblarensis*), Juglandaceae (*Plicatopollis plicatus*, *Pterocaryapollenites stellatus*), Symplocaceae (*Porocolpopollenites fsp. D. Kds.*), Sapotaceae (*Tetracolporopollenites sapotoides*), Sterculiaceae (*Granotricolporites semiglobosus*), Myrtaceae, Elaeagnaceae, Nyssaceae, Araliaceae, Aquifoliaceae (*Tricolporopollenites illiacus*), Icacinaceae, Acanhaceae etc.

The flora suggest a subtropical/tropical climate for the Priabonian, with an average of 20ş C and 1200 mm/year (Petrescu & Givulescu, 1987).

- VERTEBRATA
- Fish: *Lepisosteyde* indet, some jaw fragments with teeth;
- Reptiles: *Lacertilia* indet.; Turtles: *Testudinidae* indet.; Crocodilians - *Alligatoroidea* indet. (teeth with similar features to the ones found in Rona Member (JF); Mammals - Ord. *Marsupialia*, *Peratherium* sp.

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(first such mention in Eastern Europe); - Ord. Rodentia-*Atavocricetodon* cf. *atavus*, *Pseudocricetodon* sp.

This vertebrate assemblage from Treznea offers a series of essential informations concerning the immigration tendencies and their associated pathways, related to the eustatic variations.

The marsupials seem to have an exclusive European derivaton. On the other hand, the hamsters document immigrations from Asia. Probably, the immigration waves were successive, and the pathways enough numerous, but one of them reached Europe from SE. In our contry, the first newcomers arrived somehow earlier to the well-known event "Grande Coupure" as it is known in Western Europe (Stehlin, 1909).

The second marine series into the Paleogene succession fall on the **Turea Group** (Rusu, 1995), also known as the "upper marine series" (Răileanu & Saulea, 1956). Like in the previous marine series, in spite of the marine sedimentary environments, some land vertebrates are also known from these deposits, originating from the emerged areas bordering the Paleogene Sea.

The Jebuc Formation (Bombiță, 1984; Priabonian; abr. JcF)

The transition from the continental formation toward the marine series concerns an evaporite facies represnted by JcF. The main exposure falls into the Gilău area, but it can be followed also in Meseş area too; in Preluca, JcF is missing.

One of the most illustrating outcrops is located at Bociu (near Huedin). There, a 5 cm thin level, is very rich in charophytes (Baciu & Hartenberger, 2001), proving the *Harrisichara vasiformis-tuberculata* (Middle/Late Priabonian) biozone, including an assemblage with *Tolypella caudate*, *Harrisichara vasiformis-tuberculata*, *Stephanochara aff. compta*, *Chara* sp. Besides, some teeth prove the existence of a hamster – *Atavocricetodon* cf. *nanoides* Freudenthal (Baciu & Hartenberger, 2001).

According Baciu & Hartenberger (2001), this hamster species proves the same scenario as in Treznea.

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The Mera Formation (Koch, 1880; Early Rupelian or Merian; abr. MF)

The MF type-section is located in Gilău area. It corresponds to the interval comprised between the Hoia Limestone and Moigrad Formation.

On Popeştilor Valley, not very far from Cluj-Napoca, some cranial bones and teeth had been found. The fossil is assigned to a promitive rhino, "*Ronzotherium*" *kochi.* This genus can be included also among the first large mammal newcomers, arriving in Transylvania from Asia (Codrea, 2000).

In the same formation, also in Gilău area, but at Fildu de Jos (Sălaj district), the oldest indricothere ever found in our country had been found (Codrea, 2000). It could belongs to ?*Urtinotherium* genus (smaller-sized if compared with the *Indricotherium*). It shares the same origin with the previous rhino already mentioned from MF.

The Moigrad Formation (Rusu, 1970; Rupelian; abr. MF).

It is exposed mainly in Meseş area, sandwiched between two marine formations: Curtuiuş Formation beneath and Creaca Formation above. In Gilău area, it is partially substitute by MF, and in Preluca area by the Ciocmani Formation.

Rusu (1970) pointed out the main lithology feathures: a dominance of red silty clay, interrupted by sandstone and microconglomerate, with maximum 150 m thickness at Moigrad. The sedimentary environment correspond also to a flood plain.

Once, MF was described as "the upper brackish beds" (Hofmann, 1879), or a part of "Ticu Beds" ("Schichten von Forgácskút"), first mentioned by Koch (1883). *Sensu* Koch, the "Ticu Beds" included also coal deposits, at the succession top. Later, several other names are also known: "Valea Agrişului Beds" (Joja, 1956), "Lower Tic Beds" (Răileanu et al., 1960), "Ticu Beds" (Moisescu, 1963), Lower Ticu Beds" (Moisescu & Popescu, 1967), "Dâmbu Trifului Beds" (Moisescu, 1972), "Moigrad Beds" (Rusu, 1970) etc.

The type-section is located on Ursoaiei Valley, E from Moigrad (Rusu, 1970).

Unfortunately, until now, very few fossils had been collected from these deposits. The only such data concern the charophyte and ostracode assemblages (Baciu, 2003). However, some indricothere remains were unearthed at Dâmbu Trifului (unpublished data).

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The Dâncu Formation (Rusu, 1972; Rupelian; MP 23 or MP 24; abr. DF)

It represents the top of the "Ticu Beds" *sensu* Koch. This succession yielded some vertebrate remains, originating from different sites: Cluj-Napoca, Suceag, Mera, Aghireş (Codrea & Fărcaş, 2002).

The flora assemblage investigations yielded a large sample of fossil plants. The site is located on Cetăţii Valley, tributary to Almaşului Valley, not very far from Almaşu locality. The list of plants, with 25 taxa, including: *Rumohra recentior*, *Osmunda lignitum*, *Sequoia abietina*, *Pinus* sp. *Alnus gaudini*, *Quercus lemoignei*, *Berchemia dacica*, *Sideroxylon salicites*, *Poacites* sp. etc. The paleotropical/arctotertiary ratio suggest a temperate humid warm climate for the Rupelian (Givulescu, 1997).

A vertebrate assemblage indicates the MP 23 or MP 24 units, including:

- fish: *Enoplophthalmus* sp. *Hemitrichas* sp., *Dapalis transylvanicus*, *Dapalis* sp. (Reichenbacher & Codrea, 1999);
- reptiles: Squamata – *Anguidae* indet., *Serpentes* indet.; Turtles: *Chinemys strandi*; *Trionyx* sp. Crocodilians – *Diplocynodon* sp., Birds: *Rhalicrex koloszvarenis*, Anserinae indet.; Mammals - Insectivora indet., Rodenţia - ? *Paracricetodon* sp.; Condylarthrs – *Kochictis centennii*; Entelodonts – *Entelodontidae* indet., *Entelodon* aff. *deguilhemi*; Anthracothers – *Elomeryx crispus*, *Anthracotherium* sp.

The Gruia Formation (Rusu, 1989; Rupelian, possibly MP 24; abr. GF)

The only vertebrate fossils are mentioned from Turea-Corneşti (Cluj district). Two teeth document a small indricothere, assigned to a new species *Benaratherium gabuniai* (Rădulescu & Samson, 1989), interpreted as an ancestor of *B. callistrati*.

"The Zimbor Beds" (Koch, 1883)

Synonymies: "Upper brackish beds" (Hofmann, 1879); "The Valea Agrişului Beds are corresponding to Ticu, Cetate, Jimbor beds (Oligocene), Sîn Mihai (Aquitanian) and Coruş (Early Burdigalian)" (Joja, 1956). Accordingly to Răileanu & Saulea (1956), the last Oligocene sedimentary cycle ends with "Valea Almaşului Beds" that includes in Cluj area the "Zimbor Beds" and "Sîn Mihai Beds", both described by Koch (1883). Inside them, it

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had been mentioned the "Var Sandstone" (between Zimbor and Surduc) or the "Kliwa Sandstone" (Pătruț, 1952), interpreted as an equivalent of the "Zimbor horizon and maybe, of the Cetate".

The lithology of the "Zimbor Beds" includes two basic types of deposits: red clay in the lower section and coal sandstone in the upper one. That explains why the "Zimbor Beds" had been divided into two distinct formations: Cuzăplac and Cubleşu (Moisescu, 1972).

The Cuzăplac Formation (Moisescu, 1972; Late Oligocene; Late Kiscellian-Early Egerian; abr. CzF).

Synonymies: "Zimbor Beds" or "the lower horizon" (Moisescu, 1963), "Zimbor beds" (Moisescu & Popescu, 1967), "the red clay-marl with pebbles horizon" (Şuraru, 1971), "Cuzăplac beds" (Moisescu, 1972), "The red clay horizon" (Rusu, 1977) etc.

CzF is exposed mainly in Gilău area, sandwiched between the Var Sandstone Formation at the base and Cubleşu Formation above. In Meseş and Preluca it is laterally substitutes by Valea Almaşului Formation. In Preluca area, its correspondents are Buzaş and Vima formations.

The dominance belongs to floodplain clay and channel fills (mainly coarse elements as gravels). The thickness reaches 270 m in the borehole from Tihău, 350 m at Brusturi or 170 m at Tihău (Rusu, 1977).

Fossils are rare, but however, at Sutoru (Sălaj district), an Indricothere jaw had been mentioned by Codrea (1989, 2000), assigned to *Paraceratherium prohorovi*, a well-known species in the Late Oligocene from Asia. It is the youngest Indricothere known from our country.

The Cubleşu Formation (Moisescu, 1972; Late Oligocene; abr. CbF)

Synonymies: „the coal-sandstone horizon" (Şuraru, 1971), „Upper Zimbor Beds" or „Cubleşu Beds" (Moisescu, 1972), "sandstone-coal horizon" (Rusu, 1977) etc.

CbF is exposed mainly in Gilău area, sandwiched by two red clay formations: CzF and Sîncraiu. Laterally, it is replaced by Valea Almaşului (in Meseş and Preluca areas) and Buzaş and Vima (in Preluca area) formations.

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The lithology refers to sandstone, sand with gray clay interbedded, shaly coal and coal. Like in CbF the thicknes is variable: 70 m in the boreholes from Hida and Zimbor and 170 m at Tihău (Rusu, 1977).

The investigations carried on in the brick factory quarry from Surduc (Sălaj district) yielded a large sample of fossil plants assigned by Petrescu to "Zimbor Beds". The plants belong to the Early Chattian, with 52 taxa, including: *Magnolia mariae*, *Persea princeps*, *Persea oligocenica*, *Sassafras* cf. *randaiense*, *Ulmus pyramidalis*, *Dryophyllum palaeocastanea*, *Quercus* (*Cyclobalanopsis*) *transilvanica*, *Fagus* sp., *Alnus* sp., *Carya denticulate*, *Platanus neptuni* etc. Some new taxa had been described too: *Magnolia maria, Berchemia dacica, Persea oligocenica, Quercus* (*Cyclobalanopsis*) *transilvanica.* Interpreting the paleotropical/arctotertiary ratio (58,05:41,93), one can point out a greater balance of the arctotertiary ones (Petrescu, 1969). As a conclusion, this ratio suggests a tropical-type climate, with dry episodes, or a wet or very wet temperate one (Givulescu, 1997).

The Sâncraiu Formation (Moisescu, 1972; Late Chattian ; abr. SF)

According to (Moisescu, 1972), SF includes „the red clay complex, with the largest extension in between Sîncraiului and Cubleşu valleys". Among SF synonymies one can mention: „Schichten von Puszta-Stz-Mihály" (Koch, 1883); „Sânmihai horizon" (Răileanu & Saulea, 1956); „red clay horizon" (Şuraru, 1971; Rusu, 1977) etc.

The fossils from SF are originating from Cristolțel (Sălaj district). They include a series of mammal teeh: Anthracothers – *Anthracotherium* sp., a middle-sized form (Rădulescu & Samson, 1989), *Anthracotherium magnum* (Martonfi, 1890; Răileanu et al., 1960), ? *Paraentelodon* (C.V. personal observation, unpublished data).

CONCLUSIONS

The terrestrial Paleogene formations from the N-W side of the Transylvania Basin host several representative localities with Paleocene, Eocene and Oligocene vertebrate assemblages.

This overview concerned the terrestrial formations of: Jibou, Valea Nadăşului, Turbuța, Moigrad, Dâncu, Gruia, Cuzăplac, Cubleş and Sâncraiu, but pointed out also the data concerning the land mammals known from marine deposits (Mortănuşa, Jebuc, Mera formations).

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The Paleogene flora and fauna include a large list of taxa, allowing to establish with accuracy the geological ages, as well as the main bio-events.

The actual stage of knowledge of the terrestrial Paleogene formations from Transylvania allows a series of paleobiogeographic interpretations for the 65 - - 23 M.y. timespan. If in Paleocene and the Early Eocene the land mammal faunas have exclusively European affinities, beginning with the Late Eocene, Transylvania represented a landbridge on the passageway connecting Asia and Western Europe. This reality is obvious, evidence by the large number of taxa with Asian affinities. Several waves of immigrants arrived in Transylvania. Not all these representatives were successful in reaching the Western Europe (*e.g.* Indricothers). Compared with the Western Europe, the first intruders arrived earlier to the "Grande Coupure" event (Stehlin, 1909).

This kind of research is still at the beginning, because for several decades, the vertebrate faunas were neglected in Transylvania. However, this area has the advantage of representative sections, and a lot of promising sites are still wainting for a research.

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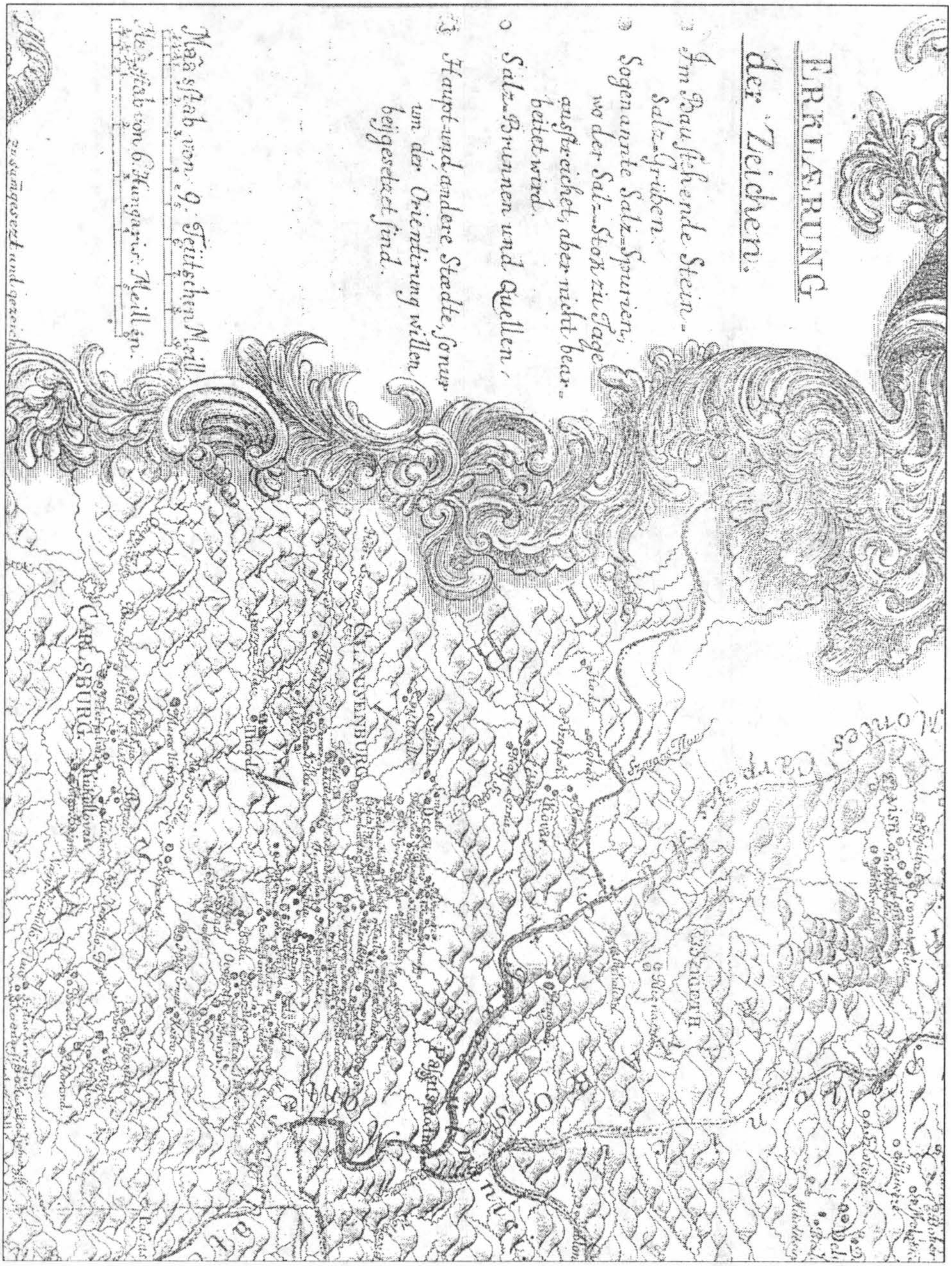

PL. I – Detail of Fichtel's map representing the NW side of the Transylvanian Basin.

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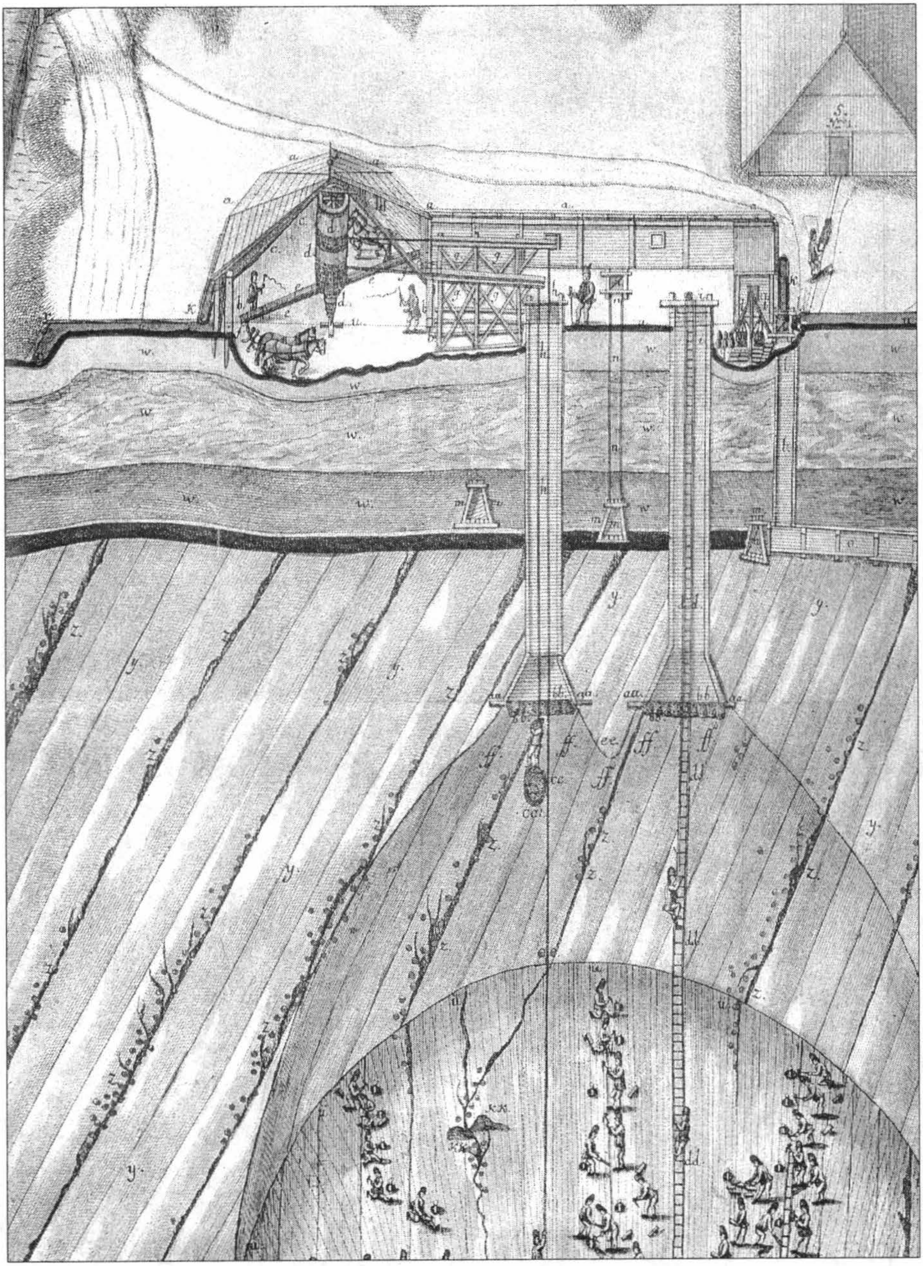

Pl. II – Detail of Fichtel's illustration representing an ancient salt-mine from Transylvania

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VOYAGE
MINÉRALOGIQUE ET GÉOLOGIQUE,
EN HONGRIE,
PENDANT L'ANNÉE 1818;

PAR F.-S. BEUDANT,

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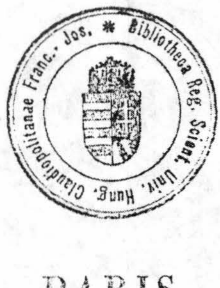
ATLAS.

TOME QUATRIÈME.



PARIS,

CHEZ VERDIÈRE, LIBRAIRE, QUAI DES AUGUSTINS, N° 25.

1822.

Pl. III – Beudant's Atlas (1822) front page

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Au Roi.

Sire,

La protection spéciale que Votre Majesté accorde aux sciences m'a fourni l'occasion de me livrer exclusivement à une des parties les moins avancées de l'Histoire naturelle, dans le riche établiſsement qu'elle a fondé pour en hâter les progrès.

La munificence de Votre Majesté m'a procuré les moyens de visiter la Hongrie, ce royaume jusqu'à présent si peu connu, et cependant si digne de l'être, tant par la

Pl. IV – Beudant's foreword (facsimile)

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nature de ses richesses minérales que par son analogie avec plusieurs contrées célèbres du nouveau continent.

Votre Majesté m'a encore accordé une nouvelle faveur en m'aidant à publier les résultats de mon voyage avec tous les développemens nécessaires.

Si mon ouvrage a quelque utilité, elle sera donc, Sire, le fruit de votre bienveillance; et c'est à ce titre que j'ose vous supplier d'agréer l'hommage de mes travaux, quelque éloignés qu'ils soient, sans doute, de remplir dignement les intentions éclairées de Votre Majesté pour l'avancement des connaissances humaines.

Je suis avec un profond respect,

Sire,

De Votre Majesté,

Le très-humble, très-obéissant et très-fidèle sujet,

F. S. Beudant.

Pl. V – Beudant's foreword (facsimile; continuation)

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Pl. VI – Detail of Beudant's map representing the NW side of the Transylvanian Basin.

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Studii şi cercetări, Geologie – Geografie 9, 2004, Bistriţa, p. 47-59

LES CONCRÉTIONS GRESEUSES FOSSILIFÈRES EN SARMATIEN DE IZVOARELE (DOBROGEA DE SUD-OUEST)

Ioan CHINTĂUAN *

Résumé. En Roumanie, dans les grés sableux et les sables greseux, d'âges miocéne et pliocéne, existent des concrétion (greseuses) avec des formes et des dimensions trés variables. Telles. structures ont été identifiées aussi dans d'autres pays d'Europe, d'Asie, d'Amerique du Nord, mais seulement celles de l'extremité ouestique de Dobrogea du Sud (à Izvoarele ; Constanța) continnent une macrofaune de molusques fossiles. À Izvoarele donc, nous avons identifiés, en primiére pour la Roumanie, des concretions greseuses fosilifères uniques dans le pays et, à nos connaissances, au monde. Vingt-six espéces de molusques, avec vingt espèces de bivalves et six taxons de gastèropodes, ont étè identifiés.
Cet article présent en première notre découverte.
Mots clés: concrétions greseuses fosilifères, Sarmatien, Izvoarele (Dobrogea du Sud-Quest, Roumanie), première mention.

Rezumat. În gresiile nisipoase şi în nisipurile compacte, miocene şi pliocene din România există concrețiuni grezoase de forme şi dimensiuni foarte diferite.

Aceste tipuri de roci au fost identificate şi în alte ţări din Europa, Asia, America de Nord, dar numai în extremitatea vestică a Dobrogei de sud, la Izvoarele (CT), ele conțin o macrofaună de moluşte fosile. Aici, în Sarmațianul din malul drept al Dunării, am identificat pentru prima dată concrețiuni grezoase fosilifere, aflorimentul de aici fiind singurul cu un astfel de conținut.

În concrețiunile grezoase, calcaroase, de la Izvoarele, am recunoscut 26 specii de moluşte, dintre care 20 specii de bivalve şi 6 taxoni de gastropode.
Lucrarea constituie prima semnalare a unor concreţuni grezoase fosilifere.
Cuvinte cheie: concrețiuni grezoase fosilifere, Sarmaţian, Izvoarele (Dobrogea de sud-vest, România), prima semnalare.

La localité Izvoarele (Pârjoaia) se trouve à l'extrémité d'Ouest de Dobrogea de Sud, à 15Km en aval d'Ostrov, le centre de la même commune. Situé dans un bassinet de dépression de petites dimensions (1500 /1000 m), formé par le ruisseau Izvoarele, sur la troisième terrasse du Danube dont il est l'affluent droit, le village a des maisons parsemées sur les deux rives du ruisseau jusqu' à 50 m distance de fleuve.

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* Complexul Muzeal Bistrița-Năsăud, Bistrița

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A approximativement 200m en amont de la confluence du ruisseau Izvoarele avec le Danube il y a des ouvertures naturelles - des ruptures de la deuxième terrasse du Danube – où on trouve des formations sarmatiennes fossillifères, représentées par des calcaires en grès, par des marnes calcarifères et par des grès sablonneux fins.

Dans les marnes calcarifères il y a des concrétions calcarifères – **septarii** et dans les grès sablonneux des concrétions en grès.

A la base des ruptures de grosses couches sarmatiennes qui forment la rive droite, élevée, du Danube il y a des nombreux fragments de roches et de concrétions qui constituent, à des eaux basses, la plage du fleuve.

La rive haute du Danube, en amont d'Izvoarele, sur une longueur d'approximativement 4km, est escarpée, tout en laissant une plage large de 30-50km, où des fragments de roches qui constituent la rive haute d'environ 4m se sont répandus. On y trouve, sur cette plage longue et libérée par des eaux seulement dans les périodes de forte sécheresse, dans quelques points, situés dans la moitié d'amont (Ostrov), à jour, des grosses couches (40-100cm) de marnes et de grès calcarifères ayant de nombreux débris fossilifères sarmatiens (bivalves, gastéropodes) – un **lumachel** formé particulièrement par des espèces des genres ***Cerastoderma, Ervilia, Gibbula, Hydrobia, Mohresternia*** – sur lesquelles se superposent des grès fins sablonneux. Dans ces grès il y a des concrétions calcarifères et en grès, de différentes formes, plusieurs d'entre elles fossilifères.

C'est ici qu'on a identifié pour la première fois des concrétions en grès et des concrétions (septarii) calcarifères fossilifères. La richesse fossilifère (en mollusques) des marnes calcarifères et des grès sablonneux du secteur Izvoarele-Ostrov a marqué seulement la richesse fossilifère des concrétions et non pas leur formation.

La formation des concrétions n'est pas dû aux mollusques de la rive calcaire et du sable transformé dans des marnes calcarifères et dans des grès, mais aux débris végétaux de ces sédiments. Les hydroxides de fer, chargés positivement, ont précipité autour d'eux tout en résultant une croûte en limonite qui a constitué le noyau – le centre de concrétion.

La matière organique végétale et de type sapropélique contenue dans la vase et dans le sable calcarifère, a déterminé la précipitation du fer trouvé sous fome de gel d'hydroxide chargé positivement. Le résultat à été la formation d'une croûte compacte en limonite autour de la vase transformée plus tard en marne.

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Le carbonate de calcium, à la différence d'oxi-hydroxides de fer et de manganèse, ne se dépose pas compactement. Sa précipitation a lieu parmi les granules de sable qui entourent le noyau et ne peuvent pas être écarter, la pression lithostatique étant supérieure à la pression de sédimentation.

La croûte en limonite, qui est formée au début et qui a encadré la vase avec la matière organique végétale conduisant à l'achevement du noyau-centre de concrétion pendant le développement du processus, a été prise dans la solution. Elle n'a que 1-3mm à cause de la quantité réduite de fer de la solution interstitielle par comparaison à la grande quantité de carbonate de calcium présente dans la même solution.

On explique la quantité différente de deux substances présentes dans la solution et puis précipitées, par la richesse en calcium des sediments où les concrétions se sont formées et celle des roches qui se superposent et parmi lesquelles les eaux (résiduelles et vados) ont circulé en descendant. Ces eaux ont dissous, incluant dans la solution, à l'aide du dyoxide de charbon, les éléments et les substances chimiques mentionnés.

A Izvoarele, les formations d'où les concrétions en grès et les calcarifères (septariile) proviennent sont constituées par des grès sablonneux, compactes, fossilifères, d'une granulation très fine et par des marnes calcarifères fossilifères. Parmi les deux types de roches qui se trouvent à jour dans le lit mineur du Danube, sur la rive droite, le nombre des exemplaires de mollusques est très grand, en formant des couches lumachelliques. Les couches respectives ont une position presque horizontale, avec une inclinaison difficilement à saisir vers la terre ferme; vers le fleuve elles sont rompues et dévoilent leur épaisseur et leur formation géologique. Elles sont grosses de 0,5-2m et visibles seulement quand les eaux du Danube sont très basses.

En sortissant du lit mineur du fleuve, les formations sarmatiennes n'apparaissent plus dans la rive haute (environ 4m), escarpée, formée de loess, qui couvre les marnes calcarifères et les grès sablonneux, fossilifères.

De cette "falaise sarmatienne", située sur la rive droite du Danube, sous le loess, le fleuve a rompu et a détaché des fragments de roches et concrétions qu'on voit seulement lorsque le niveau de l'eau est très bas.

Les concrétions d'Izvoarele sont les seules concrétions fossilifères mentionnées jusqu'à présent en Roumanie. Si tout de même, autres occurrences pour ce touritoire existent avec des concrétions fossilifères, celles d'Izvoarele se font remarquer par une riche macrofaune de mollusques.

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La systématique des 19 espéces de bivalves et 6 espéces de gasteropodes identifiés dans le Sarmatien d'Izvoarele (concrétions postbassarabiennes) est présentée avec des détails convernant la distribution stratigraphique pour chaque taxon identifié :

Classe : **BIVALVIA**

Famille :**MYTILIDAE**

Genre : **Modiolus** Lamarck, 1799

Modiolus incrassatus (D'ORBIGNY)

2000 Modiolus incrassatus (D'Orbigny, 1844) - Chira, p.93, Pl. IX, fig.6

Distribution stratigraphique : Sarmatien du Bassin du Danube et de la Vienne : Sarmatien inférieur

Famille : **CARDIIDAE**

Genre : **Cardium** Linne, 1758

Sous-genre : **Cerastoderma** Poli, 1975

Cerastoderma (Obsoletiforma) obsoletum obsoletum (Eichw).

1935 Cardium obsoletiformis Kolesnikov, p. 95-96, Pl. XII, f.9-11

1936 Cardium obsoletum Eichw. - Freidberg, p. 151, tabl. 24, fig. 7-10

1976 Cerastoderma (Obsoletiforma) obsoletum obsoletum (Eichw)–Ilina, Nevesskaya, Paramonova, p. 232, 233, tabl. I, fig. 37-48

1979 Cerastoderma obsoletum (Eichw.) - Nevesskaya, Bagdasaryan - Goncharova, p.894

1985 Cardium obsoletum Eichw. - Kóray, p.55, Pl. II, f.13-18, Pl. VI, f. 7d

1998 Obsoletiforma obsoleta (Eichw) - Emilia Munteanu, Mihai - Tudor Munteanu, p. 103

2001 Obsoletiforma obsoleta (Eichw.) - Ţibuleac, Pl. II, f. 25a, b.

Distribution stratigraphique: Sarmatien inférieur du Bassin de Vienne, Bassin Panonnien, Bassin Ponto-caspien, Plate-forme Moldave, bassarabien-Dobrogea de Sud.

Genre : **Cerastoderma**, Poli, 1975

Cerastoderma (Obsoletiforma) vindobonense vindobonense (Partsch, Laskarev)

1935 Cardium vindobonense (Partsch) Lask. - Kolesnikov, p. 84-85, Pl. IX, f. 1-6

1971 Cardium vindobonense vindobonense Laskarev - Svagrovsky, p. 138, Pl. 2, f. 1-6

2000 Cerastoderma vindobonense vindobonense (Partsch, Laskarev) - Chira, p. 108-110, Pl. IX, f. 2

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2001 Obsoletiforma vindobonense (Partsch) – Ţibuleac, Pl. I, f. 26

Distribution stratigraphique: Sarmatien inférieur du Bassin de Vienne, Ukraine et la Plate-forme Moldave

Cerastoderma (Obsoletiforma) vindobonense jekeliusi (Papp)

1954 Cardium vindobonense jekeliusi n. ssp. – Papp, p.54, Pl. 14, f. 4-6

1974 Cerastoderma vindobonense jekeliusi (Papp) – Papp, p. 361, Pl. 14, f. 4

2000 Cerastoderma vindobonense jekeliusi Papp, 1954 – Chira, p. 110, Pl. IX, f.2

Distribution stratigraphique: Sarmatien du Bassin de Vienne et de la Dépression Transylvanie

Cerastoderma (Obsoletiforma) latisulcum latisulcum (Muenster)

1971 Cardium latisulcum Muenster – Svagrovski, p. 141, Pl. 4, f.1-7

1974 Cerastoderma latisulcum latisulcum (Muenster) – Papp, p. 360, Pl. 13, f. 68

2000 Cerastoderma latisulcum latisulcum (Muenster) – Chira, p.111, Pl. IX, f.5

Distribution stratigraphique: Sarmatien ("couche avec Ervilia" et "couche avec Mactra") du Bassin de Vienne, Sarmatien d'Ouest de la Dépression de Transylvanie

Cerastoderma (Obsoletiforma) Wiesenensis Papp, 1954

1954 Cardium wiesenense n. sp. – Papp, p. 77, Pl. 15, f.5-7

1974 Cerastoderma wiesenense (Papp) – Papp, p. 362, Pl. 14, f. 16

Distribution stratigraphique: Sarmatien du Bassin de Vienne et d'Ouest de Transylvanie

Cerastoderma (Obsoletiforma) aculeatum platovi (Bog.)

1905 Cardium platovi – Bogatchev, p.184, Pl. III, f. 1-11

1979 Acanthocardium platovi Bog. – Nevesskaya – Bagdasarian – Goncharova, p. 895

1985 Cardium (Acanthocardia) aculeatumi platovi Bogatchev - J. Kókay, p. 58, Pl. IV, F. 10-14, Pl. V, f. 1-2

Distribution stratigraphique: Badenien supérieur et Sarmatien de Paratethys central et estique

Cerastoderma (Obsoletiforma) lithopodolica (du Bois) ou (Dub.)

1983 Cardium lithopodolicum n.sp. – F. du Bois de Montpéreux, 50 m, p. 62, Pl. VII, f. 29

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1903 Cardium lithopodolicum Dub. – Laskarev, 21, p. 75, Pl. III, f. 21-22; Pl. IV, f. 23-24

1935 Cardium lithopodolicum Dub. - Kolesnikov, p.102-103, Pl. XIV, f. 7-10

2002 Obsoletiforma lithopodolica Dub. – Brânzilă, p. 37, Pl. I, f. 2

Distribution stratigraphique: Sarmatien de la Platforme Moldave, de l'Ukraine et de Russie.

Cerastoderma (Obsoletiforma) planicostata (Atanasiu et Macarovici)

2002 Obsoletiforma planicostata Atanasiu et Mac. – Brânzilă, p. 37-39, Pl. I, f. 6

Distribution stratigraphique : Sarmatien inférieur de la Plateforme Moldave

Cerastoderma (Obsoletiforma) Kolesnikovi (Davit.)

2002 Obsoletiforma kolesnikovi Davit. – Brânzilă, p.37-39, Pl. II, f.12

Distribution stratigraphique : Sarmatien d'Ukadne ; Sarmatien moyen de la Plate-forme moldave

Cerastoderma (Obsoletiforma) barboti (Hoern.)

1935 Cardium barboti – Kolesnikovi, p. 117, Pl. XVII, f. 19-23

2002 Obsoletiforma Barboti (Hoern.) – Brânzilă, p. 37-39, Pl. II, f. 13-14

Distribution stratigraphique : Sarmatien d'Urkaine, de la Russie; Sarmatien moyen de la Plateforme Moldave

Cerastoderma (Obsoletiforma) ingrata (Koles.)

1998 Obsoletiforma ingrata (Koles.) – Emilia Munteanu, Mihai - Tudor Munteanu, p. 105, Pl. I, f. 4

Distribution stratigraphique : Sarmatien d'Urkaine et de la Russie, Bassarabien supérieur de Dobrogea de Sud (central-estique)

Cerastoderma (Plicatiforma) plicata plicata (Koles.)

2001 Plicatiforma plicata plicata (Eichw.) –Ţibuleac, p. 76, Pl.I, f.21

Distribution stratigraphique : Sarmatien du Bassin de Vienne ; Sarmatien inférieur de l'Ouest de la Plate-forme moldave

Cerastoderma (Plicatiforma) plicata kasinkenze (Koles.)

2001 Plicatiforma plicata Kasinkense (Koles.) – Ţibuleac ; p.77, 80 ; Pl.I, f.22

Distribution stratgraphique : Sarmatien d'Urkaine et de la Russie ; Sarmatien inférieur de l'Ouest de la Plateforme Moldave

Cerastoderma (Plicatiforma) plicatofittoni (Sinz.)

1935 Cardium plicatofittoni Sinzov – Kolesnikov, p.114-15, Pl. XVII, f.6-9

1998 Plicatiforma plicatofittoni (Sinz.) – Emilia Munteanu, Mihai-Tudor Munteanu, p.101-106, Pl. I, f.1

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2001 Plicatiforma plicatofittoni (Sinz.) - Ţibuleac, p.73-82, Pl.I, f.24a, b.

Distribution stratigraphique : Sarmatien inférieur et moyen de Paratethys

Suprafamille Mactracea Lamarck, 1809

Famille : **Mesodesmatidae** Gray, 1839

Genre : **Ervilia** Tuton, 1882

Ervilia dissita dissita (Eichwald, 1830)

1935 Ervilia dissita Eichw. - Kolesnikov, p.39-42,Pl. III, f.9-16

1974 Ervilia dissita dissita (Eichw.) – Papp, p.366, f.1-5, 7-14

2000 Ervilia dissita dissita (Eichw.) – Chira, 2000, p.114-116, Pl.VIII, f.1a-2c, 4, 6a, 6b

2001 Ervilia dissita (Eichw.) - Ţibuleac, p.73-83, Pl. I, f.3

Distribution stratigraphique : Sarmatien inférieur et moyen de Paratethys

Famille : **Mactridae**

Genre : **Mactra** Linné, 1767

Mactra (Podolimactra) eichwaldi (Lask.)

1935 Mactra eichwaldi Lask. – Kolesnikov, p.46-48, Pl.IV, f. 1-4

2001 Mactra (Podolimactra) eichwaldi (Lask.) – Ţibuleac, p. 73-83, Pl. I, f. 8a, b; 9; 10

2002 Mactra eichwaldi Lask. – Brânzilă, p.33-40, Pl. I, f. 14,15

Distribution stratigraphique: Sarmatien inférieur et moyen de Paratethys

Mactra (Sarmatimactra) vitaliana vitaliana (d'Orb.)

1935 Mactra vitaliana d'Orbigny - Kolesnikov, p. 54-55, Pl. VI, F. 1-3

2001 Mactra (Sarmatimactra) vitaliana d'Orb. –Ţibuleac; PL. I, f. 11

2002 Mactra vitaliana vitaliana d'Orb. – B. Ionesi, D. Bordei; Pl. I, f. 4-7,10-12

2002 Mactra vitaliana d'Orb. – Brânzilă: Pl. II, f. 7

Distribution stratigraphique: Sarmatien moyen de Paratethys

Mactra (Sarmatimactra) palassi Baily

1935 Mactra pallasii Baily – Kolesnikov, p. 52-54, Pl. V, f. 5-8

1998 Mactra pallasi (Baily) – Emilia Munteanu, Mihai-Tudor Munteanu, Pl. II, Fig. 1

2001 Mactra (Sarmatimactra) palassi Baily –Ţibuleac, Pl.I, Fig. 12a, b

Distribution stratigraphique : Sarmatien supérieur d'Ukraďne, de Russie ; Bassarabien de Medgidia ; Bassarabien inférieur de la Plate-forme moldave ;

CLASSE GASTROPODA

Sous-classe : **PROSOBRANCHIA** Milne – Edwards, 1848

Ordre **ARCHAEOGASTROPODA** Thiele, 1925

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Suprafamille **Trachacea**
Famille **Trachidae**
Genre **Trachidae**
Genre Gibbula Risso, 1826
Gibbula (Rollandiana) picta (Eichw.)
2000 Gibbula (Rollandiana) picta (Eichw.) - Chira, Pl. VII, fig. 10a -11c
Distribution stratigraphique: Sarmatien d'Autriche et d'Hongrie; Sarmatien de la Dépression de Transylvanie
Gibbula subbaltro Kolesnikov
1935 Gibbula subbaltro – Kolesnikov, p.201-2002, Pl. XXVI, fig. 1-3
Distribution stratigraphique: Sarmatien d'Ukraine et de Moldavie
Ordre **CAENOGASTROPODA** Cox, 1959
Suprafamille **Rissoacea**
Famille **Hydrobiidae**
Genre **Hydrobia** Hartmann, 1822
Hydrobia elongata (Eichw.)
1935 Hydrobia elongata Eichw. – Kolesnikov, p.214-215, Pl. XXVII, fig. 18-21
1999-2000 Hydrobia elongata (Eichwald) - Bica Ionesi, Liviu Ionesi, Viorica Munteanu, p. 227, Pl. IV, fig. 9a-b
2001 Hydrobia elongata (Eichw.) - Ţibuleac, p. 82; Pl. II, fig. 28
Distribution stratigraphique: Sarmatien supérieur d'Ukraďne et de Moldavie ; Sarmatien de la Plate-forme de Moldavie

Hydrobia stagnalis stagnalis (Basterot)
1954 Hydrobia stagnalis stagnalis (Basterot) – Papp, p. 26, Pl.3, fig. 12, 13
2000 Hydrobia stagnalis stagnalis (Basterot) –Chira, p. 122, Pl. VII, fig. 14a,b
Distribution stratigraphique : Sarmatien du Bassin de Vienne (« couches avec Ervilia ») et du Bassin Pannonien ; sarmatien inférieur et moyen de l'Ouest de l'Ukraine, Sarmatien de la Dépression de Transylvanie.
Famille **Rissoidae**
Genre **Mohrensternia** Stoliczka, 1868
Mohrensternia inflata inflata (Höernes)
1935 Mohrensternia inflata M. Hörn. – Kolesnikov, p. 211-212, Pl. XXVII, fig. 3-6
2000 Mohrensternia inflata inflata (M. Höernes) – Chira, p.123-124, Pl. X, fig. 3
Distribution stratigraphique: Sarmatien inférieur d' Autriche, de l'Hongrie, de l' Ukraine, de Slovaquie, de Bulgarie

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En Roumanie l'on a identifié dans le Sarmatien inférieur des Bassins Borod, Beiuş, Mehadia et dans la Dépression de Transylvanie.
Suprafamille **Cerithiacea**
Famille **Potamididae**
Genre **Potamides** Basterot
Potamides nimpha (Eichw.)
2001 Potamides nimpha (Eichw.) – Ţibuleac, Pl. II, fig. 17a, b, 18a, b
Distribution stratigraphique: Sarmatien du Bassin de Vienne et du Bassin Pannonien. En Roumanie l'on a identifié dans le Sarmatien inférieur de la Plate-forme Moldavie.

DISCUSSIONS

La faune de mollusques identifiée dans les concrétions calcarifères et en grès d'Izvoarele est dominée par les byvalves Cardiidae. On constate la même domination dans les aires pannoniennes, daciques et certainment ponto-caspiennes, fait déterminé par la réduction de la salinité en Paratethys. Les influences salines conduisent à une impréssionnante diversité de formes en Sarmatien. Ainsi qu'il y a 14 familles de mollusques (Ilina et al., 1976), parmi lesquelles les **Cardiidae** ont, dans le Sarmatien inférieur et moyen (Olteanu, 1999), 90 espèces du genre **Cerastoderma**, avec les sous-genres **Plicatiforma** (10 espèces), **Obsoletiforma** (50 espèces), **Inequicostata** (20 espèces), **Planacardium** (10 espèces). Les **Limnocardiidae**, un autre exemple présentent ont pendant le Sarmatien 100 formes, groupées en 40 genres et sous-genres (Olteanu, 1999). Radu Olteanu (1999) decrivait l'evolution de cette faune par « l'inconstance et la mobilité en temps et espace », « processus exubérants de diversité » qui defini une « Cascade de formes difficilement à ranger », comment dit Radu Olteanu (1999), qui ajoute autres expressions bien choisies pour la faune de mollusques de Sarmatien.

En 1935 Kolesnikov fait , à la base des côtes, 18 profiles-type. Plus card, Radu Olteanu (1998-1999) présente l'ontogénie et la philogénie des Limnocardidae de Sarmatien et malgré tout cela l'evolution de ce groupe reste incomplète et confuse pour beaucoupde paléontologues.

Ce qu'il faut retenir est le fait qu'il y a seulement un affleurement de concrétions en grès avec de la macrofaune de mollusques sarmatiennes. Le grand nombre d'exemplaires de bivalves et de gastropodes est digne de l'atention et de l'intérȩt des paléontologues.

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Fragment d'une concrétion formée d'une agglomération de formes appartenant au genre *Cerastoderma*

Fragments de concrétions en grès détachées sur le plan de stratification et d'agglomération des espèces *Cerastoderma (Obsoletiforma) obsoletum obsoletum* (Eichw.), *Modiolus incrassatus* (d'Orb.), *Gibbula pseudorollandiana* (Koles.) etc

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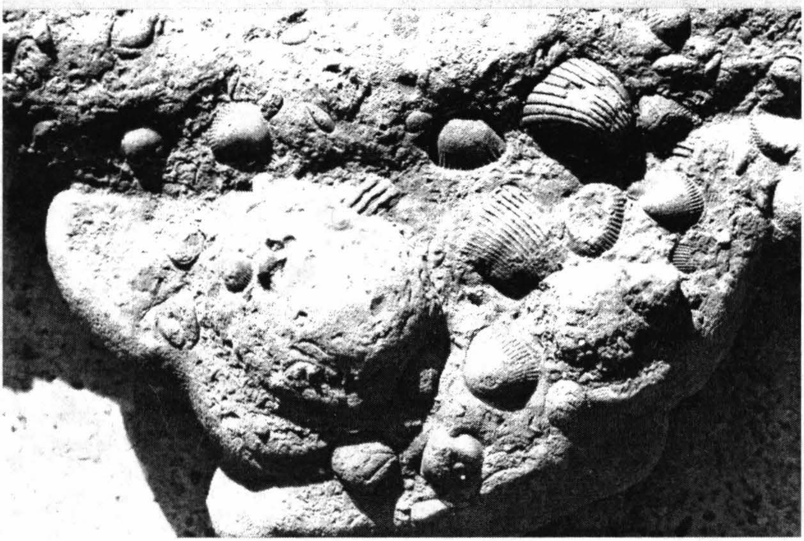
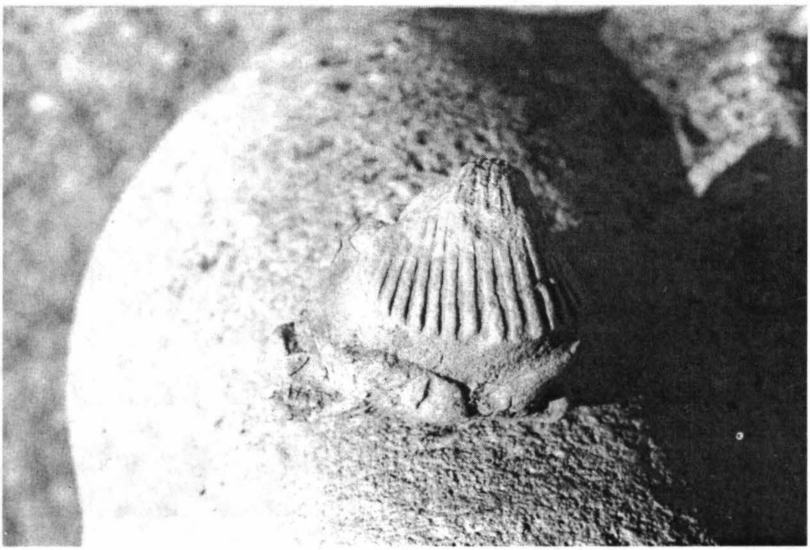


Concrétion en grès avec des moulages d'especèces de *Cerastoderma*



Cerastoderma (Plicatiforma) plicatofittoni (Sinz.)
sur un fragment de concrétion en grès

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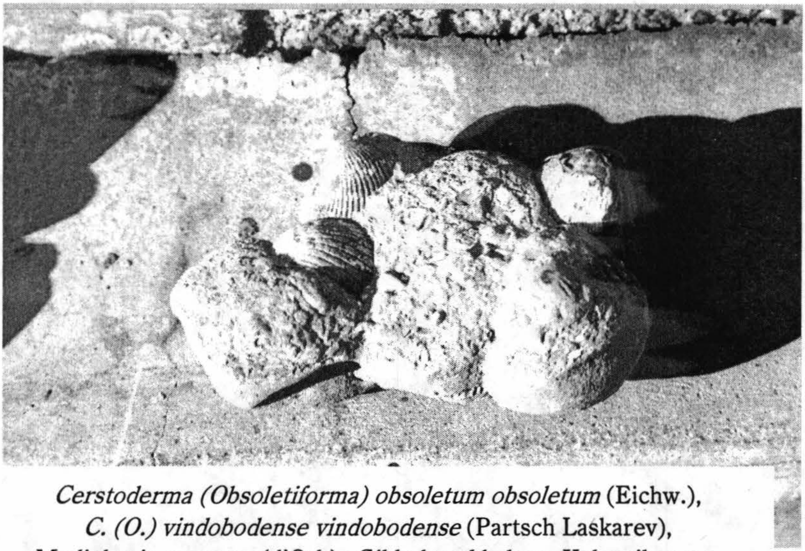

Cerstoderma (Obsoletiforma) obsoletum obsoletum (Eichw.), *C. (O.) vindobodense vindobodense* (Partsch Laskarev), *Modiolus incrassatus* (d'Orb), *Gibbula subbalatro Kolesnikov* etc., sur un fragment de concrétion en grès

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Studii şi cercetări, Geologie – Geografie 9, 2004, Bistriţa, p. 61-72

THE WILD BOAR (*SUS SCROFA* LINNÉ) FROM THE EARLIEST MIDDLE PLEISTOCENE FROM SUBPIATRĂ (BIHOR DISTRICT)

Vlad CODREA*, Ovidiu BARBU*

Abstract. Some bones belonging to the wild boar (*Sus scrofa*) originating from the early Middle Pleistocene locality Subpiatră (Bihor district) are described. The majority of bones suggest the existence of large-sized individuals. The presence of the wild boar in Subpiatră faunal assemblage indicates a dense forested environment with deciduous trees and humid tendencies. It is according well with the previous paleoenvironment markers already studied (micro- and large mammals, herpetofauna, clay minerals). The wild boar was rarely reported form the various Pleistocene localities from our country and is even more rare in the Middle Pleistocene sites from Romania.
Key words: wild boar, early Middle Pleistocene, Subpiatră (Western Romania), paleoenvironment.

Introduction

As the whole territory of our country, Transylvania hosts extremely few Middle Pleistocene localities: that explains the scarcity of data concerning such faunal assemblages and only a rough draft of the related bioevents. For the Apuseni Mountains, a relatively new locality is Subpiatră, discovered in '89 of the former century. Subpiatră is a small village located not very far from the Aleşd town, in Vad-Borod Depression. It is well known mostly for the limestone mined there in a large quarry belonging now to Holcim Group Romania society, positioned on the western slope of the hill Coasta cu Pietriş.

As it is already known, the Middle Pleistocene fossil-bearing site from Subpiatră is related to a pothole, probably completely filled with red clay sediments. It was excavated in the urgonian limestone (Barremian) belonging to the Bihor Unit succession, in the Northern Apuseni Mts. During the

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mining of the limestone, due to the opencast blasting operations, the pothole filling sediments were spread on a large surface (over than 3000 sq. m.). In this manner, the succession of the potential sediment levels contained in the pothole remains unknown, and the fossils represented by a large amount of bones, is only a mixture of fragmented elements, devoid of a very clear stratigraphy. However, the studies carried on either on herpetofauna, or on micro- or large mammals, seem to point out that in this pothole we have to deal with a homogenous fauna, belonging to the early Middle Pleistocene (Venczel, 1990, 1991, 2000; Hir & Venczel, 1991, 1992; Codrea & Czier, 1991, 1993; Rădulescu et al., 1997).

Unfortunately, excepting for the rhinos, the large mammals assemblage research never got beyond preliminary studies. However, some large mammals from Subpiatră worth a more advanced attention, because such fossils are really rare in this part of the Europe. Among them, few cranial fragments and a radius fragment document the wild boar. This study is focused on this material.

Abbreviation. TCM – Țării Crișurilor Museum, Oradea.

PALEONTOLOGY

Order *Artiodacyla* OWEN, 1848
Superfamily *Suoidea* COPE, 1887
Family *Suidae* GRAY, 1821
Subfamily *Suinae* ZITTEL, 1893
Genus *Sus* LINNÉ, 1758

Sus scofa LINNÉ, 1758

Referred material: ***TCM 17332*** – left mandible horizontal branch with p2-m3; ***TCM 17333*** – distal radius fragment of a non-mature individual; ***TCM 17339*** – fragment of a right mandible horizontal branch with m3 (damaged)-m2 (broken); ***TCM 17340*** – fragment of the left mandible horizontal branch with m1-m2; ***TCM 17341*** – fragment of palate, with both dental rows, preserving M1-M3.

Measurements (mm; way of measuring according to van der Made, 1991). DAP = greatest length, mesio-distal; DT= greatest width; LDR = length of dental row; L= length

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TCM 17332

	m3	m2	m1	p4	p3	p2
DAP	40.5	24.8	13.0	16.0	16.0	17.5
DT	20.0	16.8	13.5	10.5	7.5	6.0
LDR	129.0					
L p2-p450.0						
L p3-p432.0						
L m1-m3	79.0					

TCM 17333

DAP	41.0
DT	56.5

TCM 17339

	m3	m2
DAP	-	-
DT	20.4	16.5

TCM 17340

	m2	m1
DAP	25.8	17.5
DT	19.0	13.0

TCM 17341

	M3	M2	M1
DAP	41.0	27.0	-
DT ant	25.0	22.0	-

Description. TCM 17332 belonged to an adult specimen: p2-p4 are worn, the m1 is heavy worn and the m3 is medium worn, including the talonid cusps.

The branch is broken just before p2, so the p1 (if ever existed) is missing. The tusk is broken too, but its transversal section can be observed: the outline is typical for the scrofic type.

The pattern of the premolars and molars is the same already described from several Middle or Upper Pleistocene European sites {*e.g.* Jaurens (France; Faure & Guérin, 1983); Weimar-Ehringsdorf, Taubach (Germany; Hünermann, 1975, 1977)}.

The horizontal mandible branch is thick, maximum widening under m2. Three mental foramina are located: ahead of p2 and under p3 and m1.

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The mandible channel collapsed, resulting a hollow on the lingual side, under m3.

The bone is whitish, with a lot of cracks, due to the post-burial history.

Even damaged, the p2 pattern was a simple one, with a higher cusp located in the middle part of the crown and two sharp ridges descending anteriorly and posteriorly from this cusp.

Both p3 and p4 are already worn, but their pattern is the same, with a stylid and two cusps lined up behind.

The m1 is excessively worn: all the cusps wear away by the abrasion.

The m2 has a complex pattern. The buccal cusps (protoconid and hypoconid) as well as the main accessory tubercle are much worn if compared to the lingual cusps. The hypoconulid is also severly worn. If compared with the m2 illustrated by Hünermann (1969) from Süssenborn (Abb. 1 a, b), the tooth from Subpiatră has a more rectangular outline.

The m3 has its peculiar pattern, with three pairs of cusps and a talonid. The talonid is simpler if compared with the specimen figured by Hünermann (1975; Abb. 11) from Weimar-Ehringsdorf.

The morphometry seems to indicate a large form, trough its size very close to the other Middle Pleistocene forms known from Europe (Fig. 1).

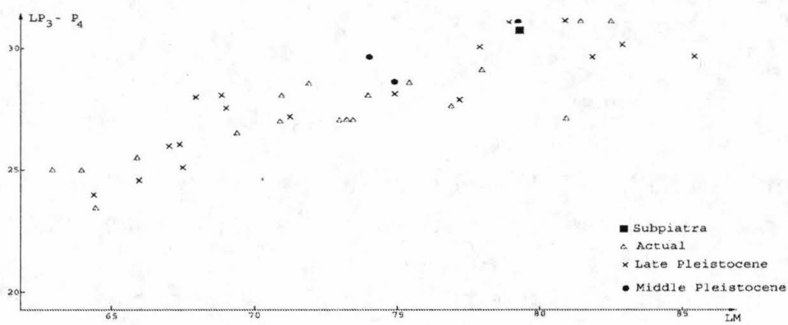

Fig. 1 : Plot diagram illustrating the length of p3-p4 *vs.* length of molars in *Sus scrofa* from different Middle, Upper Pleistocene and actual localities (accordingly Faure & Guérin, 1983, modified).

TCM 17339 represents also a mature individual, however younger than the previous already described: the m2-m3 are less worn. The tusk is considerably smaller: it could indicate that it was probably a female. Both teeth are broken. However, one can distinguish at the m3 smaller accessory

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tubercles located in the transverse valleys, if compared to the previous specimen.

TCM 17340 is just a small mandible fragment, with m1-m2, as well the roots of p4. The p4 was broken due to the peculiar taphonomy, a large crack separating the anterior from the posterior root. The m1 is heavy worn; the m2 metaconid is damaged, as well as the whole hypoconulid and talonid areas. If compared to TCM 17332, these teeth are bigger, but the pattern simpler, because the small cuspules associated to the accessory tubercle in TCM 17332, here is strongly reduced.

TCM 17341 refers to a cranial fragment, slightly deformed. It concerns a fragmentary palate, with both dental rows, preserving M1-M3. Due to the palate deformation, the left row segment is displaced forward. The wearing is usual, stronger on the palatal tubercles and less expressed on the labial ones. If compared to the M3 figured by Hünermann (1977; 232 S, Abb. 1) from Taubach, it seems that the Subpiatră pattern is simpler as concerned the distal area, mainly on labial side, where the number of small cuspules is reduced.

TCM 1733 is just a radius distal fragment, belonging to a non-mature animal: the epiphysis was still not fused to the diaphysis.

STRATIGRAPHY AND EVOLUTION

Sus is a genus occurring in Europe immediately after the lowermost Pliocene. The first species is *S. arvernenis* (= *"Aper" arvernensis* CROIZET & JOBERT 1828; stratigraphic range: MN 14-MN 17), replaced in the Late Pliocene (MN 16-MmQ 1) by *S. strozzii* MENEGHINI (van der Made, 1994). On its turn the wild boar, *S. scrofa*, which evolved during the Middle and Late Pleistocene in dependency by the climate (its geographic range was controlled by the low temperatures and the snow cover) replaced *S. strozzii* in the Middle Pleistocene (last occurrence of *S. strozii*, in MmQ1, 1.4 Ma ago; van der Made, 1994). *S. scrofa* had an emphatic tendency to develop populations with clear differences in size and weight. That explains the large number of subspecies already described for the actual representatives (Melentis, 1965; Faure & Guérin, 1983), as well as a weight gradient, which values are increasing from the West toward East (Hainard, 1949), with largest specimens living in Carpathians.

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Rădulescu et al. (1997) considered the site from Subpiatră as belonging to the Middle Pleistocene (end of Cromerian, marked by the first appearance of *Arvicola* in Europe).

It worth to be mentioned that the wild boar is rarely reported from the Pleistocene sites from our country. In these circumstances, the *S. scrofa* from Subpiatră can be placed among the oldest representatives of the species ever mentioned in Romania.

Ecology

After nearly two decades of research on the Middle Pleistocene faunal assemblage from Subpiatră, one dispose of a nearly complete evaluation on the ambient which this fauna evolved.

The herpetofauna belongs to euritherm representatives (Venczel, 1990, 1991, 2000). Some snakes, lizards, frogs and turtles document forested areas, with humid areas developed in (ponds, river streams or small lakes).

The small mammals, as well as the large ones, evidence the same habitat. The climate was mild and wet temperate, warmer if comparing with the actual one, evidenced also by the clay minerals (Codrea & Czier, 1993; Hosu & Codrea, 1996).

The wild boar is a very appropriate ecologic marker indicating a mild climate and dense forested areas with deciduous trees accordingly well with the previous environmental reconstructions.

TAPHONOMY

If thinking to the whole vertebrate faunal assemblage, one can presume that the Subpiatră pothole functioned as a trap for animals, mainly for the immature ones, if thinking to the large number of bones belonging to such individuals. However, the majority of wild boar fossils recovered from belonged to mature individuals.

Before the burial, the bones a part of carcasses could be affected by the influence of water streams, or at list a part of the bones should arrived into the pothole carried by the water, because a part of them are not in anatomical connection.

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A part of bones are distorted due the post burial processes, probably to the overburden of the cover sediments. These influences are obvious on all wild boar cranial bones studied, but it is a rule for a lot of other bones originating from Subpiatră.

CONCLUSION

The wild boar is well represented in the Middle Pleistocene Subpiatră vertebrate assemblage. The species rarely occur in such ancient deposits in our country. The study reveals the presence of large-sized individuals.

This species is an excellent environmental marker, indicating a dense forested region, with humid areas, in a mild temperate climate.

The Subipatră pothole was a representative site for the Middle Pleistocene vertebrate faunas from Transylvania. But its discovery was not a fortunate one: the opencast blasting operations destroying integrally its filling sediments represented by a bone breccia. As a consequence, the recovered fossils are a really puzzle, with missing pieces, and after more a decade of researches, a lot of questions are still persisting.

Acknowledgements. Authors are grateful to *Zoltan Czier* (curator at Țării Crişurilor Museum from Oradea) for providing the fossils and for the preparation of some specimens. Dr. *Marton Venczel* (head of Natural Sciences Department from the same museum) gave us a lot of useful information about the site and its related fauna. As always, *Paul Dica* (Babeş-Bolyai University of Cluj) helped us a lot in processing the photographs.

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PLATE CAPTIONS

Pl. I. *Sus srofa* from the early Middle Pleistocene from Subpiatră, Bihor district (TCM 17332*).* Left horizonal ramus with p2-m3: Fig. 1 - outer view; Fig. 2 - crown view; Fig. 3 - inner view.
Pl. II. *Sus srofa* from the early Middle Pleistocene from Subpiatră, Bihor district. (TCM 17339) - fragment of a right mandible horizontal branch with m3 (damaged)-m2 (broken): Fig. 1 - outer view; Fig. 2 - crown view.
Pl. III. *Sus srofa* from the early Middle Pleistocene from Subpiatră, Bihor district. Fig. 1: (TCM 17341) - fragment of palate, with both dental rows, preserving M1-M3, crown view. Fig. 2: (TCM 1733) - distal radius fragment of a non-mature individual, anterior view; Fig. 3: same, distal articular view.

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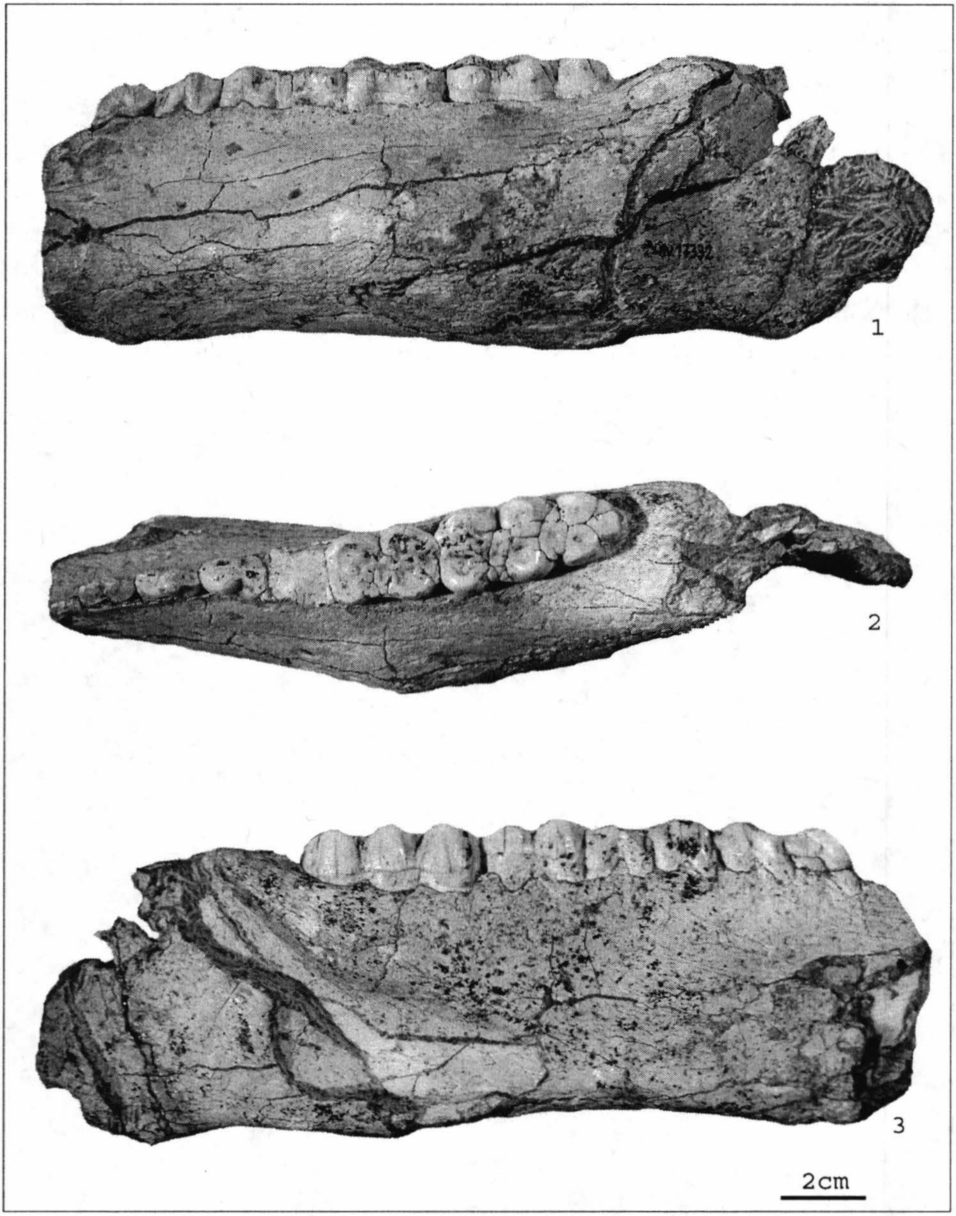

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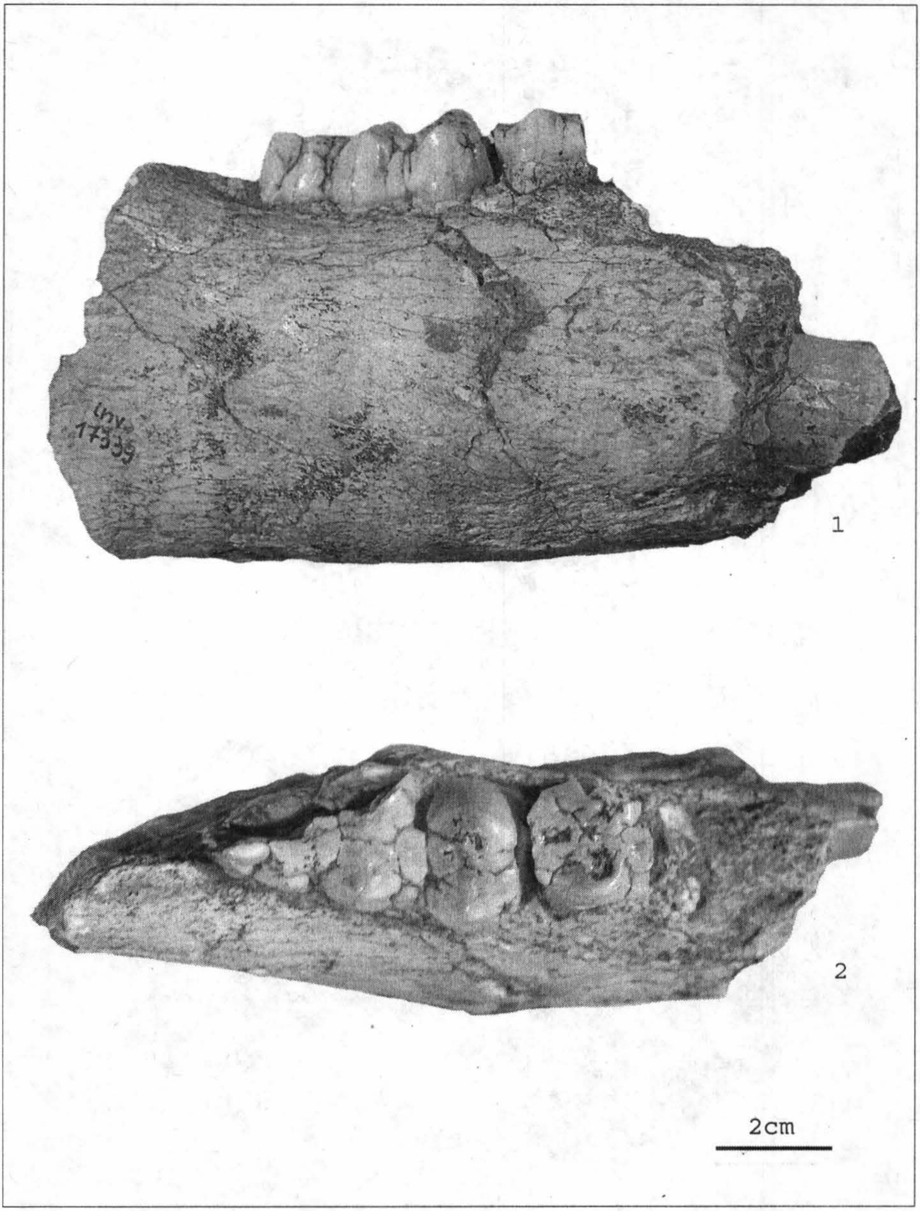

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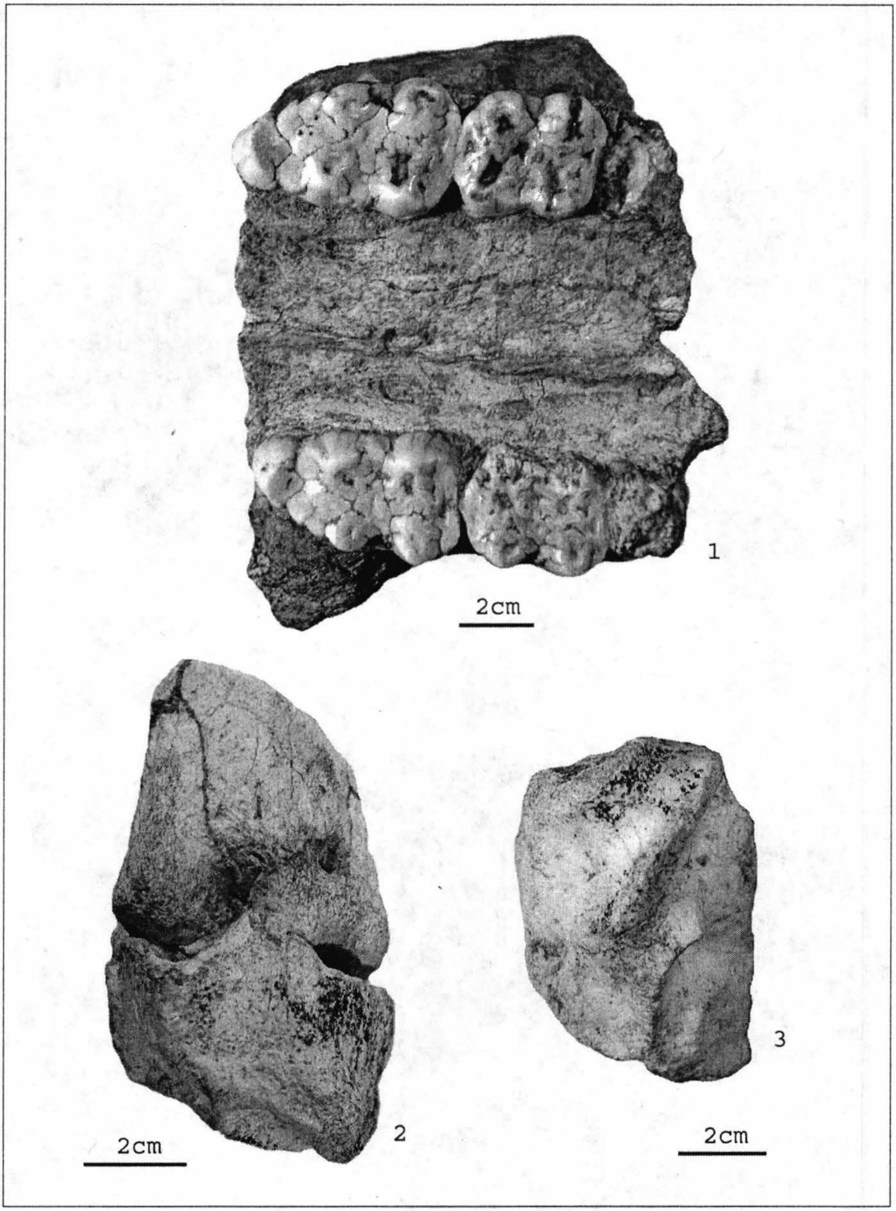

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NEW FLORISTIC ELEMENTS IN THE PONTIAN DEPOSITS FROM BATOTI (MEHEDINTI DISTRICT)

Florina DIACONU*

Abstract. Continuing the searches in the Pontian deposits from Batoti, the number of taxa has grown from 25 to 35 and for the first time it is signalized a new species in the Pontian flora from Oltenia: *Fagus sylvatica* L.

In the tow distinct paleobiotops identified by Ticleanu et al. (2002) are signalized other tow species, as they are:

In the mesophytic from the lower level, the allochton flora with: *Fagus sylvatica* L. *Zelkova zelkovefolia* (Ung.) Buz. et Kolt., *Carpinus grandis* Ung., *Castanea kubinyii* Kovats, *C.* cf. *sativa* Miller and so on, and at the superior level on the high hills with ever green forests of *Pseudotsuga* cf. *taxifolia* B'ritt.

In the carbogenerating swamps: in the seasonally flooded areas were found different species of Salix, and in the areas permanently covered with water of 2 m depth, vegetated *Typha latissima* A. Br. and *Phragmites oeningensis* Al. Br.

Key words. Early Pontian, macoflora, Batoţi exposure, S W Romania

INTRODUCTION

The research of the fossiliferous site from Batoti has obtained as a final result the selection of a floristic epitome with the following taxa: *Glyptostrobus europaeus* (Brogn.) Unger, *Alnus kefersteini*, *Salix varians* Goepp., *Fagus pliocaenica* Saporta, *Quercus pseudocastanea* (Petrescu et al., 2002); *Taxodium dubium* (Sternberg) Heer, *Glyptostrobus europaeus* (Brogn.) Unger, *Platanus platanifolia* (Ett.) Knobloch, *Alnus ducalis* (Gaudin) Knobloch, *A.cecropiaefolia* (Ettingsh.) Berger, *Betula insignis* Gaudin, *Fagus silesiaca* Wallther et Zast., *F. pliocaenica* Saporta, *Quercus kovatsi* Kovacs, *Q. pontica* Koch *miocaenica* Kubat, *Quercus* cf. *macrantheroides* Andreanszki, *Ulmus pyramidalis* Goepp, *Pterocarya paradissiaca* (Ung.) Iljin., *Populus populina* (Brognt.) Knobl., *Byttneriophyllum tiliaefolium* (Al. Br.) Knobl. et

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Kv. (Ţicleanu et al., 2002); ? *Sequoia gigantea* L., *Liquidambar europaea* Al. Braun, *Castanea* cf. *crenata* Sieb. et Zucc., *Carya serraefolia* (Goepp.) Krausel, *Acer integerrimum* (Viv.) Massal, *Vitis teutonica* Al. Braun *Alnus cecropiaefolia* (Ettingsh.) Berger, *Cornus* sp. (Diaconu, 2002). At the moment the Pontian floristic epitome from Batoti contents 25 taxa. By corroborate of the previous researches done by Diaconu et al. (2004) the importance of micro- and macroflora from Batoti (Mehedinti District) in the frame of the Romanian paleofloristic heritage. Thus, through its stratigraphic position, the flora from Batoti represents the only Early Pontian flora described up to now in Romania. Based on the palynological content Petrescu et al. (2002), say that no other similar microflora - as far as richness and diversity are concerned – is know in Romania and its neighboring areas.

Thus, it was necessary to continue the researches to determine new taxa, confirming the importance of paleoflora from Batoti.

PALEOBOTANIC AND TAPHONOMIC CONSIDERATION

The paleoflora material was collected from the deposits the Early Pontian the stratified clays where appear fossil vegetal remains similar to a thick vegetal detritus, which also has foliar impressions. The alternation of the vegetal detritus for a few millimeters in the lower part of very thin (2-3 cm) clay on the sequence of the deposits, pleads for an allochthonous origin of the fossil plant remains, witch, by Ticleanu et al. (2002), have been transported into the basin (delta?) during the autumn floods, from variable distances, possible for several kilometers.

The presence of the vegetal remains of plants with present-day correspondents in marshes indicates their growth in the lakes along the fluviatile flooding plains separated by the main course of the river by fluvial bars, so that they have a hypautochthonous origin, too.

Fossil plants have been collected from the carbonate concretions, too, which appear at certain levels. These carbonate concretions are resulted by $CaCO_3$ cementation of clay silts, they have a high toughness and can be exfoliated along planes which contain very well preserved plant impressions.

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MATERIAL AND METHODS

The macrofloristic material analysis is included in 400 samples of collection found at the Museum Region Iron Gates from Drobeta Turnu Severin. The most efficient method to obtain the best image of the fossil plants remains impressions was the drawing on transparent nylon pellicle at the stereomicroscope. If the contrast between the impression and the rock is obvious, we have can take photos to compare and determine.

SYSTEMATIC PALEONTOLOGY

The morphological and dimensional characteristics of the fossil plants remains identified in Pontian deposits from Batoti are enough to argue their determination, but, now because of the lack of space we shall present the taxa without any descriptions, using only the iconography and the comparison with similar fossil plants from other papers mentioned bellow in the References.

Phyllum PINATAE

Family Pinaceae

Pseudotsuga cf. ***taxifolia*** Britt. (Pl. I, fig. 6)

Material: sample BT – 3

Observations: The shape and size of the acicular leaves, but especially the way that they get narrower and the way that they end, in a short leaf-stalk, our sample looks like a *P. taxifolia* figured by Negulescu & Savulescu (1957: p. 56, fig. 27b).

Occurrence: The species *P. taxifolia* was signalized for the first time by Ticleanu & Paraschiv (2001: p. 364, PI.I, fig. 1), in Pontian deposits from the Lugoj Basin.

The recent correspondent: *P. taxifolia* is a tree with a wide spreading in the North-West USA.

Phyllum MAGNOLIOPHYTA
Class MAGNOLIATAE

Family BETULACEAE

Carpinus grandis Ung. (Pl. I, fig. 7)

Material: one sample BT – 1

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Observations: This taxon represents one of the most frequent spread trees from Ghiuzbaia (Givulescu, 1990, p. 67).
Occurrence: *Carpinus grandis* is one of the most frequent spread fossil taxa from Europe in the Upper Oligocene - Upper Pliocene interval.
The recent correspondent: *Carpinus betulus* L. is a tree from the decidual forest with a geographic area including the Central and Southern Europe, up to Crimea and Caucaz. This tree lives in cold, humid, dusky or sunny valleys, at a high of 100-500 m. Association: *Quercus* and anther decidual stems.

Family FAGACEAE

Fagus sylvatica L. (Pl. II, fig. 1, 2)
Material: samples BT – 12, 170, 175, 204, 206
Observations: The shape and the leaf sizes, the number of secondary veins, the maximum width at the half of the leaf and the undulation side on the edge of the leaf are enough characteristics for determination.
Occurrence: As a fossil, *F. sylvatica* is known from Miocene with a wide spread in Pliocene (Tralau, 1962), in Romania it can be found only in the Pontian deposits from Lugoj (Ticleanu & Paraschiv, 2001)
The recent correspondent: *F. sylvatica*, a tree of high stature, is an exclusive European species, with an area starting from the South of England up to Spain and the South the Scandinavian Peninsula up to the Nister Valley.
Ecological requirements: This taxon can't live with drought and with great frosts; it needs frequent and abundant precipitations.

Castanea cf. ***sativa*** Miller (Pl. II, fig. 3a, 3b)
Material: one sample BT – 308
Observations: This taxon can be compared with the actual *Castanea sativa*, because between these two shapes it no difference.
Occurrence: This taxon is spread in the European Mio-Pliocene, and in Romania, too.
The recent correspondent: *Castanea sativa*, a tree with a height over 25 m, from the forests around the Mediterranean Sea, then in Minor Asia and Caucaz, lives in oak forests or on plains and it has a semishadow temperament.

Castanea kubinyii Kovats (Pl. I, fig. 1)
Material: one sample BT – 126

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Observations: Our sample looks like the one figured by Ticleanu (1984, Pl. III, fig. 2) in Ciocadia, from North Oltenia.
Occurrence: A frequent species in the European Mio-Pliocene paleoflora. It is also wide spread in Romania, too, being signalized from Borsec (Pop, 1936), Cornitel and Valea de Cris (Givulescu, 1957, 1962), Delureni (Givulescu, 1975), Sacadate (Andrae, 1855), Bodos (Staub, 1881), Ciocadia (Ticleanu, 1984).
The recent correspondent: *Castanea vesca* Gaertn. (syn. *C. sativa* Mil.), is a tree that lives in the vegetal formations of the type *Quercetum medio - europaeum*, in the Mediterranean area, Minor Asia and Caucaz.

Family ULMACEAE

Zelkova zelkovefolia (Ung.) Buz. et Kolt. (Pl. I, fig. 2; Pl. II, fig. 1)
Material: one sample BT - 11
Observations: In the paleoflora from Batoti, comparatively with Chiuzbaia, the frequency of this species is reduced.
Occurrence: This species is frequently in the European Neogene paleoflora, but it also was found in China and Japan.
The recent correspondent: Most of the authors have found a similarity between *Zelkova zelkovefolia* and *Z. crenata* Spach - *Z. carpinifolia* Pallas, a tree with 15-25 m height that lives in the river meadow forests from Caucaz and Persia of north, where it appears in association with *Carpinus betulus* and *Quercus castaneaefolia*.

Family RHAMNACEAE

Rhamnus cf. gaudini Heer (Pl. III, fig.2)
Material: one sample BT - 67, 201
Observations: Our impression is different from what Heer said about that *Rhamnus gaudini*: "nervis secondariis utrinque (rarius 8-10)". Because it has 9 pairs of secondary veins it looks more like *R. orbifera* Heer, but even he recognized that the two forms are very similar.
Occurrence: A form spread in Europe from the Medium Oligocene up to the Upper Miocene, in Greenland and North America and in Romania is for the first time signalized at Cornitel in the Pliocene (Givulescu, 1957).
The recent correspondent: Heer mentioned as a present shape a *Rhamnus grandifolius* Fisch. et. Meyer in Caucaz.

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Family POTAMOGETONACEAE

Typha latissima A. Br. (Pl. I, fig. 4; Pl. III, fig. 3, 4)

Material: samples BT - 32, 198

Observations: Our sample is less wide than those figured by Heer, it is more similar with *Typha angustior Sap.*

Occurrence: Species spread during the Tertiary. Pop (1936) admitted that there could have vegetated two types of *Typha* in Borsec, too; still he didn't come to any conclusions because of the material which was not enough conclusive. He admitted that this form had to be seen as cumulative specie as the *Phragmites oeningensis*, is too.

The recent correspondent: It is very similar with the present cosmopolite shape *Typha latifolia* L., a common species which vegetates on the banks of rivers and lakes.

Family GRAMINEAE

Phragmites oeningensis Al. Br.

Material: samples BT - 41

Observations: The preservation state of these leaves is bad and it doesn't allow a detailed examination.

Occurrence: It is a common taxon in Europe for the whole Neogene.

The recent correspondent: *Phragmites communis* Trin., a shape spread in Europe, Asia, America, Australia. *Ph. communis* was signalized as a fossil in the Bulgarian Pliocene (Stefanoff, Jordanoff, 1935).

Family CAPRIFOLIACEAE

Lonicera sp. (Pl. I, fig. 3)

Material: one sample BT - 140

Observations: The shape and nervation remind us of the very variable leaves of the genus *Lonicera* L., Givulescu (1990, Pl. 21, fig. 6).

The recent correspondent: It doesn't have.

PALEOCLIMATICAL AND PALEOPHYTOCENOTICAL CONSIDERATIONS

By corroborate of the previous results of the researches (Petrescu et al., 2002; Ticleanu et al., 2000; Diaconu, 2002) with those from the present paper it concludes that, in the present estate of the knowledge of the Pontian

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flora from Batoti consists of 35 taxa. So that, by this study the floristic epitome of the fossiliferous site from Batoti is filled in with other 10 taxa and for the first time it is signalized a new species in the Pontian flora from Oltenia: *Fagus sylvatica* L.

Regarding their frequency and the way of preservation, it may argue the opinions of the previous scientists about the phytogeographical composition and the aspect of the vegetation in the south-west Oltenia during the Early Pontian.

The taxa added are: *Pseudotsuga* cf. *taxifolia* Britt., *Carpinus grandis*

ts, *Zelkova zekovefolia* (Ung.) Buz. et Kolt., *Rhamnus* cf. *gaudini* Heer, *Typha latissima* A. Br., *Phragmites oeningensis* Al. Br. and *Lonicera* sp.

On the basis of the phytogeographical analysis of the present correspondents in the phytogeographical composition of the Pontian flora from Batoti, may be added the following elements, too: 2– North Atlantic American, 3– East Asian, 1– Caucazian, 2– Central European, 1– cosmopolitan and 1 without localization.

This phytogeographical composition where predominates the North American elements followed by the East Asian, represents a phytogeographycal characteristic of the Romanian flora from the Upper Miocene. Even if now the flora from Batoti represents only 15% from the number of the species of flora from Chiuzbaia in the Upper Pontian (Givulescu, 1990), proportional, the two floras have the same characteristic: the high frequency of the North Atlantic American elements, followed by East Asian elements.

The paleoecological analysis of the species added to the floristic epitome from Batoti argues the existence of the two distinct paleobiotops identified by Ticleanu et al. (2002) which are: a mezophytic one with two levels: the lower one with allochton flora dominated by: Fagus, Castanea, Carpinus, Zelkova, and the upper one on the hills covered with conifer forests of Sequoia, *Pseudotsuga* cfr. *taxiflolia* and a swamp paleobiotope carbogenerating with *Salix macrophyla* in the area seasonally flooded, and *Typha latissima* and *Phragmites oeningensis* are plants from the areas almost permanently flooded.

From the paleoclimatical point of view, the analysis of the new floristic material shown in this paper confirms the conclusions presented by Petrescu et al. (2002), who by palinologycal researches appreciates that the

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climatic parameters are characterized with an annual medium temperature, between 14-15°C and precipitations over 1200 mm/year.

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PLATES

Plate I:

Fig. 1 - *Castana kubinyii* Kovats

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Fig. 2 – *Zelkova zelkovefolia* (Ung.) Buz. et Kolt
Fig. 3 – *Lonicera* sp.;
Fig. 4 – *Typha latissima* A. Br.
Fig. 5 – *Pseudotsuga* cf. *taxifolia* Britt.
Fig. 6 – *Carpinus grandis* Ung.

Plate II:

Fig. 1, 2 – *Fagus sylvatica* L.;
Fig. 3a , 3b – *Castanea* cf. *sativa* Miller

Plate III:

Fig. 1 – *Zelkova zelkovefolia* (Ung.) Buz. et Kolt.
Fig. 2 – *Castanea gigas* (Goepp.) Iljinsk.
Fig. 3 – *Rhamnus cf. gaudini* Heer
Fig. 4, 5 – *Typha latissima* A. Br.

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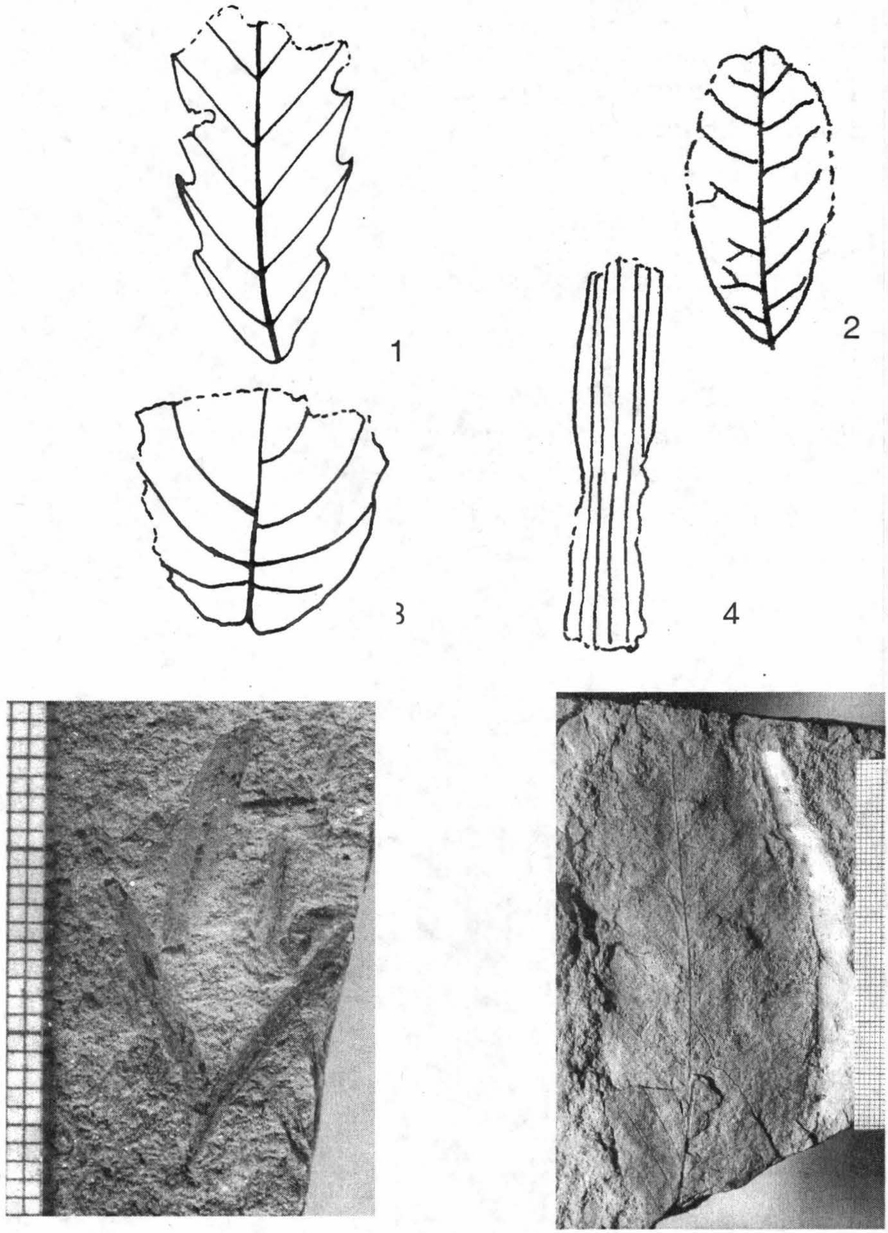
Plate I



1 – *Castana kubinyii* Kovats; 2 – *Zelkova zelkovefolia* (Ung.) Buz. et Kolt.; 3 – *Lonicera* sp.; 4 – *Typha latissima* A. Br.; 5 – *Pseudotsuga* cf. *taxifolia* Britt.; 6 – *Carpinus grandis* Ung.

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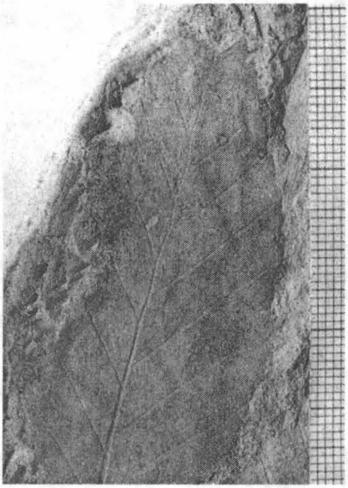
PLATE II



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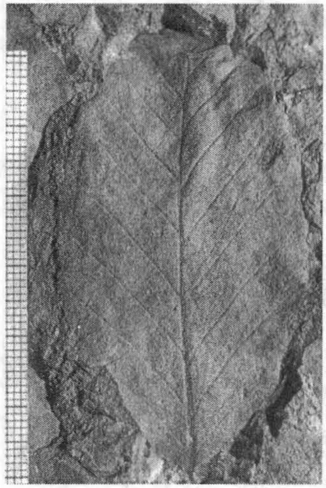

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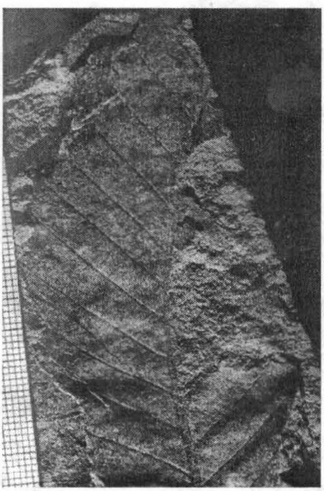
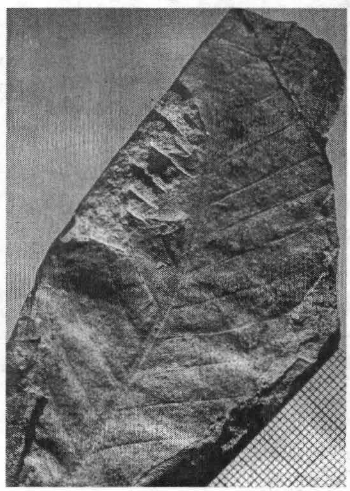


3a



3b

1, 2 – *Fagus sylvatica* L.; 3a, 3b – *Castanea* cf. *sativa* Miller (impresiune – contraimpresiune)

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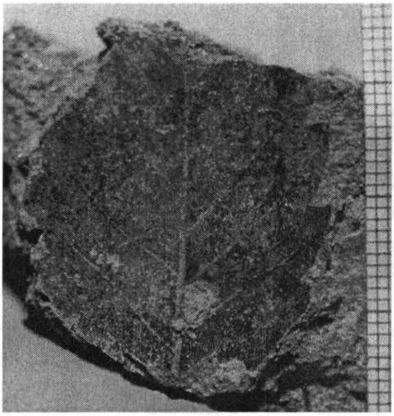
PLATE III



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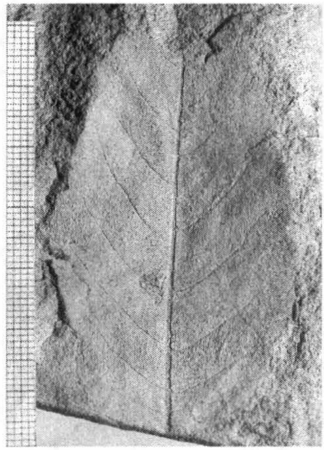

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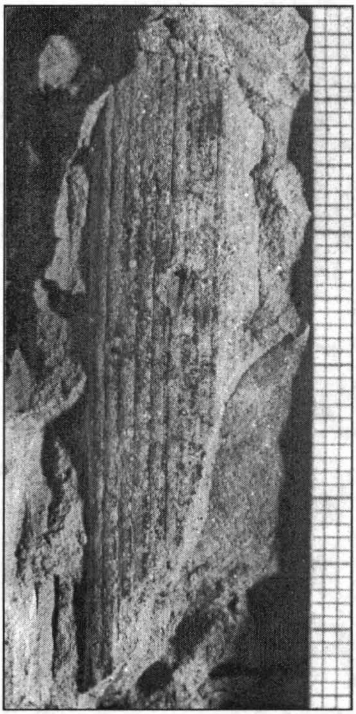

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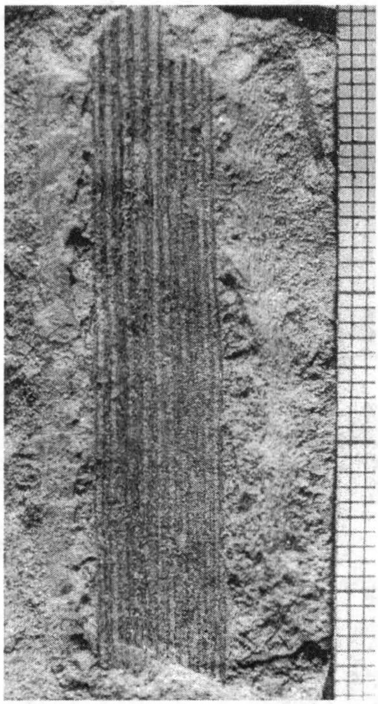

4

1 – *Zelkova zelkovefolia* (Ung.) Buz. et Kolt.; 2 – *Rhamnus cf. gaudini* Heer; 3, 4 – *Typha latissima* A. Br.;

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ASPECTS DE L'HISTOIRE DE LA VEGETATION TARDIGLACIAIRE ET HOLOCENE DANS LE SUD DE LA TRANSYLVANIE

Ioan TANȚĂU*

Abstract. Two sequences of about 8.06 m and 11.90 m, originating from two peat bogs in southern part of Transylvania province (Romania) were pollen analysed (155 and 122 pollen spectra). The vegetation history, supported by 17 C^{14} dates is described since the Late Glacial. At the onset of the Holocene *Ulmus* is the first actor, together with *Betula*. Among the main components of the *Quercetum mixtum* (*Quercus*, *Fraxinus*, *Tilia*, and *Corylus*) that became established almost simultaneously by around 9,000 BP, *Quercus* frequencies rarely exceed 10%. The local establishment of *Carpinus* is about 6,000 BP. Its maximum occurred between 4,500 and 3,000 BP. *Fagus* pollen is regularly recorded since 7,500 BP. Its absolute dominance took place at about 3,000 BP. *Picea* pollen is present since the Late Glacial. The first indications of human activities appear at around 6,200 BP.
Key words: vegetation history, Late Glacial, southern part of Transylvania province.
Rezumat. *Aspecte din istoria vegetaţiei tardiglaciare şi holocene din sudul Transilvaniei.* Au fost analizate palinologic două secvenţe (de 8,06 m şi 11,90 m adâncime), obţinute prin sondarea a două turbării situate în partea de sud a depresiunii Transilvaniei (155, respectiv 122 de spectre polinice analizate). Istoria vegetaţiei, susţinută de 17 datări C^{14} este descrisă începând cu Tardiglaciarul. Începutul Holocenului este caracterizat printr-o vegetaţie dominată de ulm şi mesteacăn. Taxonii ce alătuiesc stejerişurile amestecate (*Quercus*, *Fraxinus*, *Tilia*, şi *Corylus*) se instalează în regiune aproape simultan, în urmă cu 9000 de ani BP. Stejarul, un taxon bine reprezentat în alte regiuni, în zona Avrig depăşeşte rareori 10%. Instalarea carpenului în regiunea studiată se produce acum 6000 de ani BP, iar perioada de maximă dezvoltare are loc în intervalul 4500-3000 de ani BP. Polenul de fag este înregistrat cu regularitate începând cu 7500 de ani BP. Perioada de dominare absolută a vegetaţiei pentru fag începe în urmă cu 3000 de ani BP. Primii indicatori ai activităţii umane apar cu 6200 de ani în urmă, odată cu semnalarea primelor ocurenţe ale polenului de cerale.

INTRODUCTION

Les tourbières d'Avrig (45°43' N, 24°23'E, altitude 400 m) sont situées dans la partie sud de la Dépression de Transylvanie, à environ 2 km au sud-est de la petite ville d'Avrig (département de Sibiu) (Figure 1).

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C'est un vaste complexe de tourbières à *Sphagnum* et à Cypéracées, de plusieurs hectares, développé à la base d'une ancienne terrasse de la rivière Olt. Les tourbières se sont installées dans des petites dépressions, quelques-unes très profondes, résultées soit des glissements de terrain, soit par l'occupation des méandres anteholocènes de l'Olt.

Du point de vue phytogéographique les tourbières se situent dans la province de Transylvanie, caractérisée par la présence des forêts de *Quercus robur* de type central-européen, carpatique et aussi par des hêtraies qui alternent avec des rouvraies. On y rencontre également *Quercus dalechampii, Q. polycarpa* et *Q. pubescens.* Le paysage actuel est caractérisé par des pelouses pâturées.

L'ouest de la Transylvanie est occupé par des prairies steppiques à *Stippa pulcherrima, S. lessingiana* et *S. ucranica* avec les reliques *Nepeta ucranica, Adonis volgensis, Paeonia tenuifolia, Iris humilis, Centaurea trinerva.* Des endémiques comme *Astragalus péterfi, A. transsilvanicus, Salvia transsilvanica, Potentilla recta f. tuberosa* ne font pas défaut.

Les associations végétales principales des tourbières sont: Caricetum rostratae Rübel 1912, Caricetum lasiocarpae Koch 1926 et Caricetum limosae Br.-Bl. 1921. La végétation limitrophe est représentée par l'association Carici elongatae - Alnetum glutinosae W. Koch 1926 (Coldea *et al.*, 1997).

METHODE DE TRAVAIL

Dans son ouvrage sur les tourbières de Roumanie, Pop (1960) signale que la tourbière installée dans le lac de Dionisie fait 9 mètres de profondeur en son centre. Bartmus (1968, 1995) a publié l'analyse pollinique d'une séquence qui provienne de ce lac de Dionisie et dans laquelle il a identifié, pour les niveaux les plus profondes, une phase à *Pinus* avec peu de *Salix* et de *Betula* et aussi avec un bref épisode à *Picea.* Il a attribué cette phase à l'intervalle Préboréal - Boréal.

2 sondages ont été réalisés, à l'aide d'un carottier russe, manuel, de 8 cm de diamètre. L'un, Avrig 1, atteint le fond à 8,06 m; l'autre, Avrig 2, à environ 30 m de Avrig 1, a touché le fond à 11,9 m. Dans les deux cas, les sédiments les plus profonds récoltés sont constitués par une argile grise. La description des carottes est détaillée dans le tableau 1.

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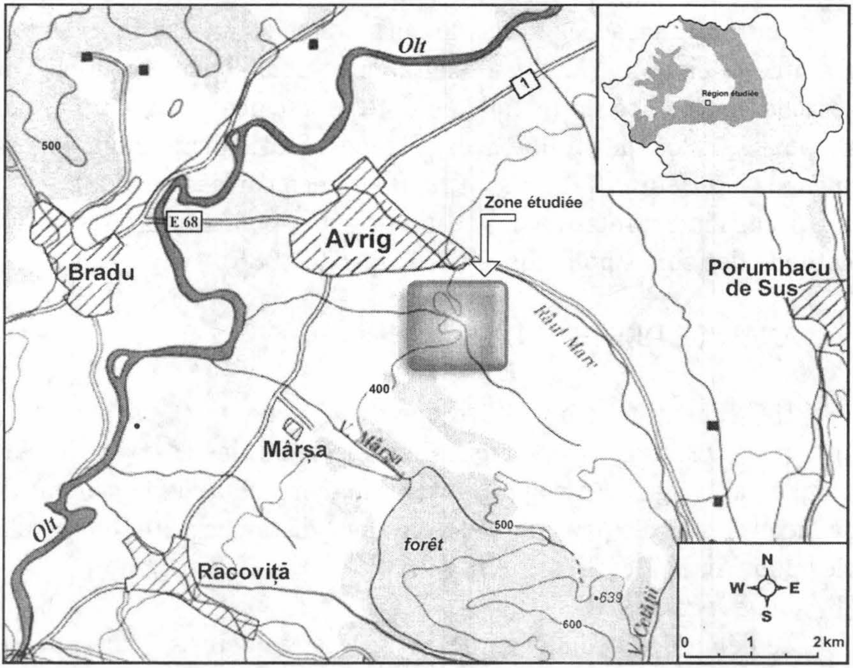

Figure 1 : Localisation de la zone étudiée.

Après l'analyse et la description lithologique des carottes nous avons prélevé des échantillons. Pour le traitement chimique des échantillons nous avons utilisé la méthode de la séparation par liqueur dense Thoulet (Goeury & Beaulieu, 1979).

Les déterminations polliniques ont été effectuées au niveau de famille, de genre ou d'espèce s'il a été possible. Une moyenne de 250 grains de pollen d'arbres (AP=arborum pollen) et le pollen correspondant des herbacées (NAP=non arborum pollen) ont été comptés pour chacune des lames microscopiques.

Les pourcentages ont été calculés par le rapport de chaque taxon à la somme totale du pollen des arbres, des herbacées et de quelques spores aussi. Nous avons également déterminé le rapport AP/NAP pour mieux illustrer le type d'écosystème dominant. Ce rapport apparaît sur les diagrammes polliniques (Figures 2 et 3).

Pour obtenir la représentation graphique nous avons appelé à l'aide du logiciel GpalWin du Laboratoire de Botanique Historique et Palynologie de Marseille (Goeury, 1997).

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Certains herbacées moins importantes ne sont pas représentés sur le diagramme pollinique. Dans les diagrammes polliniques (Figures 2 et 3) les Cypéracées et les spores monolètes ont été exclues de la somme pollinique totale pour le calcul des fréquences relatives. Sur le diagramme pollinique les fréquences inférieures à 0,5% sont représentées par des points.

Dans l'interprétation des résultats sporo-polliniques nous avons utilisé la méthode des zones polliniques (Birks, 1970, 1986).

ANALYSE DES DONNÉES

155 échantillons ont été prélevés et analysés à Avrig 1 (A1), 113 à Avrig 2 (A2); 122 taxons polliniques ont été identifiés à Avrig 1 et 91 taxons polliniques à Avrig 2. En s'appuyant sur la dynamique de la végétation et les fréquences des principaux taxons, on a pu distinguer 20 zones polliniques locales pour Avrig 1 et 9 pour Avrig 2.

Zone locale 1

Le début de la séquence de Avrig 1 est caractérisé par la présence du pollen de *Pinus*, avec de fréquences de l'ordre de 25%, *Betula* (15%); *Juniperus* et *Salix* sont aussi présents dans la région.

Les herbacées steppiques (surtout *Artemisia*) et les Poacées sont très bien représentées dans les spectres de cette zone, qui a les caractéristiques d'une période froide du Tardiglaciaire (probable Dryas Très Ancien).

Zone locale 2

Cette zone est caractérisée par des pourcentages réduits du pollen des arbres. Pareillement à la zone précédente *Pinus, Betula* et *Juniperus* sont les arbres le mieux représentés. Les taux de *Salix* dépassent rarement 1%, mais cet arbre est toujours présent dans la région. *Poaceae* et herbacées steppiques (surtout *Artemisia*) dominent les spectres polliniques.

La datation de cette oscillation climatique (13880 ± 90 ans BP) constitue une première pour la Roumanie et nous permet de l'attribuer au Dryas Très Ancien.

Zone locale 3

Dans cette zone les taux de *Pinus* connaissent une forte progression. Avec des fréquences qui atteignent 50-70%, les spectres donnent l'image d'une forêt claire de *Pinus*. Les taux assez élevés de *Betula* (10%) indiquent la présence locale de ce taxon. Le pollen de *Picea* est présent dans quelques

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spectres avec des fréquences inférieures à 1%. *Salix* présente des taux fluctuants qui atteignent parfois 5%. Toutes les herbacées régressent.

Les deux dates, 12670 ± 70 ans BP et 12360 ± 70 ans BP situent chronologiquement cette zone dans l'interstade Tardiglaciaire (Bölling). Les dates sont peu compatibles entre elles, car elles indiquent qu'un mètre de tourbe se serait accumulé en 300 ans.

Zone locale 4

Durant cette période survient un nouvel épisode de refroidissement, d'assez courte durée. Cet épisode qui n'est représenté que par trois spectres, est caractérisé par la chute des taux de *Pinus* et la progression des taux des herbacées.

Cette oscillation pourrait correspondre chronologiquement au Dryas Ancien (Dryas II), mais comme nous ne disposons que d'une datation qui donne un âge un peut vieux pour une correspondance avec le Dryas Ancien (12360 ± 70 ans BP), nous avons introduit une appellation locale: "Avrig".

Zone locale 5

La végétation retrouve ici les caractéristiques décrites en zone 3, c'est à dire celles de l'interstade Tardiglaciaire. Il faut toutefois mentionner le début de la courbe continue de *Picea* ainsi que des occurrences d'*Ulmus* et de *Quercus*.

Nous avons attribué cette zone à l'Allerød.

Zone locale 6

A la base de cette zone, les fréquences élevées de *Pinus* sont affectées par une brusque progression des taux de *Betula*. Ce taxon atteint 30 à 40% alors que *Pinus* régresse à 20%. On note également une remontée des fréquences d 'herbacées, surtout les Rosacées et *Artemisia*.

La date de 10300 ± 60 ans BP nous conduit à attribuer cette zone à la période froide du Dryas Récent.

Zone locale 7

Elle est caractérisée par un nouveau maximum pour *Artemisia* et les Poacées et par la régression des taux de *Betula*. *Pinus* s'établit à 20 – 30%. On observe aussi des occurrences régulières d'*Alnus* et plus rares d'*Ulmus*, un maximum des Chénopodiacées et la régression des taux de Rosacées. Après un recul au début du Dryas Récent, *Picea* reprend la place vers la fin de cette période. Son apparition pendant une période froide doit être la conséquence d'une migration pendant l'Interstade Tardiglaciaire qui a

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rapproché les populations de cet arbre. Cette zone est, elle aussi, attribuée au Dryas Récent.

Zone locale 8

Dans cette zone qui correspond au début de l'Holocène, les taux de *Pinus* restent à 20%, *Ulmus* est le premier arbre mésophile à se manifester et les taux de *Picea* progressent. Le pollen de *Quercus* et *Tilia* est présent dans quelques spectres. La courbe continue d'*Ulmus* débute à la base de la zone. Les herbacées steppiques régressent (surtout *Artemisia*), mais les Poacées et les Rosacées conservent des taux élevés.

A cette époque, la végétation environnant le site est probablement constituée d'îlots de *Pinus* et *Picea* mêlés de *Betula*. Aux expositions les plus chaudes, c'est *Ulmus* qui se développe. La date obtenue (9670 ± 60 ans BP) confirme son attribution au Préboréal.

Zone locale 9

Une des caractéristiques majeures de cette zone est la régression de *Pinus* et *Betula*. *Picea* et des feuillus mésophiles se substituent à ces arbres pionniers. On observe ici un premier optimum d'*Ulmus* (20%) et l'amorce des courbes continues de *Fraxinus, Quercus, Tilia,* et *Alnus.* Les taux de *Picea* dépassent 5%.

C'est la date radiocarbone de 9210 ± 60 ans BP qui nous a conduit à placer la limite Préboréal – Boréal juste au-dessus du niveau daté (Figure 2).

Zone locale 10

Ulmus atteint ici un maximum avec des fréquences supérieures à 30%, *Fraxinus* est lui aussi à son optimum; *Quercus* connaît une forte progression et l'on note l'amorce d'une courbe continue de *Corylus*. Les taux de *Betula* régressent à 5%. Nous avons attribué cette zone au début du Boréal.

Zone locale 11

Ici s'achève la régression de *Pinus* et *Betula*. *Quercus* et *Tilia* atteignent un maximum, *Fraxinus* reste à un niveau égal à celui de la zone précédente, *Ulmus* est en faible régression; à l'inverse, les taux de *Corylus* augmentent.

Sur la base des deux dates (8550 ± 60 ans BP et 7760 ± 50 ans BP) obtenues sur deux échantillons prélevés, l'un dans la partie inférieure de la zone, l'autre dans la partie supérieure, nous avons attribué ces évènements au Boréal.

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Zone locale 12

Elle est caractérisée par le maximum absolu de *Corylus*, qui marque généralement en Roumanie le début de l'Atlantique. *Picea* reste à des taux bas (5%) et les feuillus mésophiles régressent. Pendant cette période on observe des occurrences régulières de *Fagus*. En fin de zone on observe aussi des occurrences régulières de *Carpinus* et d'*Acer*, ainsi que la première occurrence des céréales. Les taux de *Betula* progressent à nouveau jusqu'à 10%.

La date de 7760 ± 50 ans BP obtenue à la base de la zone, confirme son attribution au début de l'Atlantique.

Zone locale 13

Une régression de *Corylus* et une faible progression des autres taxons de la chênaie mixte (*Ulmus, Fraxinus* et *Tilia*), la progression des taux de *Picea* et l'amorce de la courbe continue de *Carpinus*, quelques occurrences de céréales, sont les caractéristiques majeures de cette zone placée dans l'Atlantique.

Tableau 1

AVRIG 1	
0 - 50 cm	Tourbe à *Sphagnum*, amorphe, brun-brun clair. Limite continue (3-4 cm) avec la couche suivante.
50 - 395 cm	Tourbe à *Sphagnum*, modérément humide, brun clair, fibreuse.
395 - 490 cm	Tourbe à *Carex-Sphagnum*, modérément humide, amorphe, brun-brun foncé.
490 - 518 cm	Gyttja noire.
518 - 680 cm	Tourbe à *Carex-Sphagnum*, modérément humide, amorphe, brun-brun foncé, avec des restes végétaux.
680 - 705 cm	Gyttja noire.
705 - 730 cm	Gyttja argileuse brune.
730 - 745 cm	Transition de gyttja argileuse brune vers une argile organique.

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>745 cm	Argile organique.
AVRIG 2	
0 - 300 cm	Tourbe à *Carex-Sphagnum*, peu évoluée, modérément humide, brun foncé, très fibreuse.
300 - 560 cm	Tourbe à *Carex-Sphagnum*, modérément humide, brun foncé, avec des restes végétaux.
560 - 750 cm	Tourbe à *Sphagnum*, amorphe, noire, peu humide, riche en restes végétaux.
750 - 935 cm	Gyttja noire mêlée des restes végétaux.
935 - 980 cm	Gyttja noire.
980 - 1065 cm	Tourbe à *Sphagnum*, amorphe, noire, peu humide, riche en restes végétaux.
1065 - 1190 cm	Gyttja noire.
>1190 cm	Argile bleue.

Tableau 1: *Description des carottes de Avrig*

Zone locale 14

Les progressions des taux de *Corylus, Carpinus* et *Alnus* sont les seuls événements marquants de cette zone de transition, probablement d'assez courte durée en Avrig 1. Un hiatus, probablement d'assez courte durée lui aussi, interrompt la progression régulière des taux de *Carpinus* et il est probablement la cause de l'effondrement brutal des taux de *Corylus*.

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Tableau 2

Profondeur Avrig1 (cm)	Dates ^{14}C Avrig1	ZONES LOCALES	Zones Avrig1	Zones Avrig2	Dates ^{14}C Avrig2	Profondeur A2 (cm)	Chronologie	ÉTAT DE LA VEGETATION
		23		i	430±30	100, 200	SA	Réduction de *Fagus*, progression de *Poaceae*. Optimum de *Secale*, occurrence de *Zea*.
5		22		h	800±40	300		Courbe de *Secale*, céréales indet. et *Plantago lanceolata*. Chute de *Carpinus*.
		21	u	g		400		Dominance de *Fagus*, progression de *Carpinus*.
		20	t	f		500		*Fagus* dominant, nouvelle régression de *Carpinus*.
		19	s	e		600		Progression des taux de *Carpinus*. *Fagus* reste dominant.
		18	r	d		700, 800, 900		Dominance absolue de *Fagus, Carpinus* continue la régression.
100	3590±40	17	p	c			SB	Progression des taux de *Fagus*, régression de *Carpinus*, notations de *Juglans* et *Secale* en A1.
		16	o	b	3820±40	1000		Maximum de *Carpinus*, régression de *Corylus*. Courbe de *Fagus* et *Abies*, notation de *Secale* en A2, réduction de *Carpinus*.
		15		a	4050±30	1190		
200	5120±50	14	Hiatus / n				AT	Progression de *Corylus* et de *Carpinus*. Hiatus à la limite AT/SB.
		13	m					Réduction des taux de *Corylus*, progression de *Picea*, début de la courbe de *Carpinus*.
300	7760±50	12	l					Maximum de *Corylus*, occurrences de *Fagus* et *Carpinus*. Première notation des céréales.
	8550±60	11	k				BO	Maximum de *Quercus*, palier de *Corylus* (20%).
400	9210±60	10	j					Maximum d'*Ulmus*, optimum de *Fraxinus*. *Pinus* continue la régression.
	9690±90, 9670±60	9	i				PB	Les taux d'*Ulmus* montent à 20%. Début de la courbe de *Fraxinus, Tilia, Quercus* et *Corylus*.
		8	h					Début de la courbe continue d'*Ulmus*, maximum de *Rosaceae*. *Pinus* reste à 20%.
500	10300±60	7	g			TARDIGLACIAIRE	DR	Troisième optimum d'*Artemisia* et *Poaceae* (NAP=70%). Chute de *Betula*, *Picea* présent.
		6	f					Maximum de *Betula*, chute de *Pinus*, maximum de *Rosaceae*.
		5	e				ITG	Nouveau maximum de *Pinus*. Réduction de NAP, *Picea* présent en courbe continue.
	12360±70	4	d				AV	Réduction des taux de *Pinus*, deuxième optimum d'*Artemisia* et *Poaceae* (NAP=60%).
600, 700	12670±70	3	c				ITG	Maximum de *Pinus*. Réduction de NAP, *Picea* présent.
	13880±90	2	b				DTA	Réduction des taux de *Pinus*, premier maximum d'*Artemisia* et *Poaceae* (NAP=70%).
800		1	a					Taux de *Pinus* de 25%, *Juniperus* >1%, *Betula* de15%. *Artemisia*, *Poaceae* bien représentées.

Tableau 2: Correspondance des zones polliniques des séquences de Avrig : DTA-Dryas Très Ancien, ITG-Interstade Tardiglaciaire, AV-oscillation "Avrig", DR-Dryas Récent, PB-Préboréal, BO-Boréal, AT-Atlantique, SB-Subboréal, SA-Subatlantique.

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Zones locales 15 et 16

Carpinus atteint ici son maximum, les taux de *Corylus* régressent fortement ainsi que ceux de *Quercus* et de *Fraxinus*. Un hiatus dans la sédimentation de la tourbe, séparant la zone 15 de la précédente, doit expliquer la montée brusque des taux de *Carpinus* jusqu'à 40%. A cette époque, la végétation locale est essentiellement constituée de charmaies. Plus au sud et à plus haute altitude, c'est *Picea* qui s'installe.

Dans la deuxième partie de la zone A2b on remarque le début de la courbe continue de *Fagus*, absente dans la zone A1o. La cause en est encore une fois un hiatus de sédimentation survenu en fin de la zone A1o, probablement d'assez courte durée et mis en évidence par le brusque décrochage des taux de *Carpinus*.

Il faut signaler ici les premières occurrences de *Secale* et quelques unes de céréales indifférenciées.

Deux dates ont été obtenues pour cette période à Avrig 1: l'une, à la base, de 5120 ± 50 ans BP, l'autre, en fin de zone, de 3590 ± 40 ans BP; elles nous obligent à placer cet épisode dans le Subboréal. Ce qui est confirmé par deux autres dates, obtenues à Avrig 2 (4050 ± 30 ans BP et 3820 ± 40 ans BP).

Zone locale 17

Cette zone, que nous avons aussi attribuée au Subboréal, est marquée par la chute des taux de *Carpinus* jusqu'à 25%, par la progression régulière des taux de *Fagus,* des occurrences régulières d'*Abies* et, en fin de zone A1o, par la première notation de *Juglans*. Cette apparition trop précoce du noyer pourrait être expliqué par une pollution. Les taux de *Corylus, Ulmus, Fraxinus* et *Tilia* sont en régression.

Zone locale 18

Les spectres polliniques témoignent ici de la domination de *Fagus* dont les fréquences atteignent 20 à 25% à Avrig 1 et 30% pour Avrig 2. Le hêtre partage encore son territoire avec *Carpinus* qui occupe les endroits les plus exposés au soleil; ses taux qui oscillent autour de 15 et 20% indiquent la persistance régionale de cet arbre que *Fagus* a remplacé localement. *Abies* se manifeste avec des occurrences régulières. *Juglans* est aussi présent ici.

Les herbacées sont peu abondantes à cette époque mais l'activité humaine est attestée par la régularité des notations de pollen de céréales, *Secale* et *Plantago lanceolata*.

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Zones locales 19, 20 et 21

Ces zones sont caractérisées par des taux très fluctuants de *Carpinus*, de 5% dans les zones A2d, A2f et A1t, jusqu'à 30% dans la zone A2g. Les taux de *Fagus* restent constants.

Des courbes continues de pollen de type *Sparganium/Typha* et de spores monolètes, avec des taux très élevés, prouvent l'affirmation franche d'une végétation palustre. Les fréquences des Poacées sont assez fluctuantes.

Zone locale 22

C'est une zone que l'on note à Avrig 2 seulement. Elle est caractérisée par la chute de *Carpinus* et la forte progression d'*Alnus*. Le début de cet événement est daté à 800 ± 40 BP.

Les taux de Poacées sont aussi en progression. Le pollen de céréales, *Secale* et celui de *Plantago lanceolata,* dont la présence est continue, dépasse souvent 1% en fréquence.

Zone locale 23

Cette zone d'âge moderne est caractérisée comme les zones ultimes de Bisoca et Luci, par une affirmation de l'action anthropique conduisant à un changement de végétation. Les taux de *Fagus* s'effondrent progressivement jusqu'à des valeurs inférieures à 10%. Favorisé par l'ouverture anthropique des milieux forestiers, les Poacées connaissent un fort développement.

Le pollen de céréales indéterminées, *Secale* et *Plantago lanceolata,* est présent en courbes continues. Le pollen de *Zea* est aussi présent à partir de 430 ± 30 BP.

DONNÉES RADIOMÉTRIQUES

Dix échantillons de Avrig 1 et quatre de Avrig 2 ont été datés par la méthode conventionnelle, au Laboratoire du Radiocarbone de Poznan (Pologne). Trois niveaux ont été datés aussi par A.M.S. au laboratoire de Gif-sur-Yvette (France); deux d'entre-elles ont du être rejetées. Ces âges, non calibrés, sont présentés dans le tableau 3 et figurent également à leur niveau, sur les diagrammes polliniques (Figures 2 et 3).

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Tableau 3

Nr. crt.	Échantillons	N° Laboratoire	Âge BP	Observations
AVRIG 1:				
1.	A1-1-120	Poz 777	3.590 ±40	
2.	A1-2-185	Poz 786	5.120 ± 50	
3.	A1-4-320	Poz 778	7.760 ± 50	
4.	A1-5-370	Poz 788	8.550 ± 60	
5.	A1-6-420	Poz 783	9.210 ± 60	
6.	A1-455	Gif A 101.584	9.690 ± 90	
7.	A1-7-470	Poz 780	9.670 ± 60	
8.	A1-8-510	Poz 785	10.300 ± 60	
9.	A1-9-580	Poz 784	12.360 ± 70	
10.	A1-605	Gif A 101.585	10.830 ± 110	rejeté
11.	A1-11-675	Poz 779	12.670 ± 70	
12.	A1-705	Gif A 101.586	11.850 ± 110	rejeté
13.	A1-12-720	Poz 781	13.880 ± 90	
AVRIG 2:				
1.	A2-1-165	Poz 165	430 ± 30	
2.	A2-3-310	Poz 310	800 ± 40	
3.	A2-6-965	Poz 965	3.820 ± 40	
4.	A2-7-1075	Poz 1075	4.050 ± 30	

Tableau 3: Données radiométriques de Avrig.

DISCUSSIONS ET CONCLUSIONS

La première manifestation botanique de la sortie des conditions extrȩmes du Pléniwürm final est connue comme étant généralement une dynamique de colonisation des sols nus, liée à la toute première amélioration thermique de la fin du Würm; il s'agit souvent d'une végétation steppique dominée par *Artemisia* et des Poacées (Beaulieu *et al.*, 1988). Pour cette période qui correspond au Dryas très ancien (Dryas I), identifiée dans la séquence de Avrig 1, l'étude a relevé l'existence d'une telle végétation steppique dominée par *Artemisia* et de Poacées et aussi d'une maigre végétation arborescente ou arbustive, composée principalement de *Pinus*,

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Betula, Hippophae, Juniperus et *Salix*. Une datation de 13880 ± 90 ans BP obtenue pour cette période constitue une première pour la Roumanie.

Le début de l'amélioration climatique de l'Interstade Tardiglaciaire (Bölling), identifié dans la séquence Avrig 1, est caractérisé par une végétation arborescente ouverte dominée par *Pinus* et peu de *Betula* et de *Salix*. La végétation steppique (*Artemisia* et Poacées) est en régression. Des occurrences isolées de pollen de *Picea* prouvent un transport aérien lointain à partir de refuges situés à moyenne altitude.

Un épisode de refroidissement, datée à 12360 ± 70 ans BP est caractérisé par une végétation steppique dominée par *Artemisia* et Poacées. La végétation arborescente qui régresse, se résume à quelques îlots boisés à forte domination de *Pinus*. *Betula*, *Salix* et *Juniperus* sont aussi présents. Cette oscillation pourrait correspondre chronologiquement au Dryas Ancien (Dryas II, appelé aussi par certaines Dryas moyen). Mais comme nous ne disposons que d'une datation qui donne un âge un peut trop vieux pour une correspondance avec le Dryas Ancien, nous l'avons appelée d'un nom local ("Avrig"), en attendant une chronologie plus détaillée.

La végétation de la dernière phase de l'Interstade Tardiglaciaire (l'Alleröd) nous apparaît comme une mosaďque de marais et de pelouses arborées avec *Pinus* et *Betula*. Ce succès s'explique par leur capacité à coloniser en premier la plupart des milieux découverts, secs ou humides.

Le pollen de *Picea*, présent à Avrig en courbes continues témoigne de l'existence régionale de cet arbre dans des refuges glaciaires et d'un début de l'expansion à partir de ces refuges. Le pollen d'épicéa a été identifié aussi dans quelques autres séquences tardiglaciaires des Carpates roumains: Tăul Zănoguţii, Iezerul Căliman (Fărcaş *et al.*,1999), Gutâi (Björkman *et al.*, 2002). Pendant le Dryas Récent la végétation forestière est fortement affectée et s'observe une puissante baisse du taux de pollen de *Betula* et *Pinus*. Poacées et herbacées steppiques, en particulier *Artemisia*, connaissent un regain de succès comme partout ailleurs en Europe du Sud. Ces conditions sont très similaires avec celles décrites pour le site de Tăul Zănoguţii (Fărcaş *et al.*, 1999), dans la partie sud-ouest des Carpates roumaines et pour les sites de Steregoiu et Preluca Ţiganului (Björkman *et al.*, 2002, 2003) dans le nord des Carpates Orientales.

Vers 10000 ans BP *Pinus* et *Betula* répondent rapidement au réchauffement climatique du début de l'Holocčne. Un peu plus tard *Ulmus* et *Picea* s'établissent dans la région et des forêts mixtes se développent.

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L'expansion très précoce d'*Ulmus*, dčs le début du Préboréal, prouve sa présence dans des refuges régionaux, pendant le Tardiglaciaire. Elle est enregistré d'abord dans les zones de basse altitude (vers 10 000 ans BP à Avrig) et puis dans les zone de moyenne et de haute altitude: vers 9800 ans BP dans les Monts Gutâi (Björkman *et al.*, 2002, 2003) et à Tăul Zănoguții (Fărcaş *et al.*, 1999).

L'installation d'autres taxons de chęnaie mixte (*Fraxinus, Quercus* et *Tilia*) se produit après l'expansion d'*Ulmus*. Leur participation au développement des forêts peut varier d'une région à l'autre. *Fraxinus* s'installe vers 9600 ans BP dans la région d'Avrig, tandis que *Quercus* et *Tilia* arrivent deux siècles plus tard que *Fraxinus*.

Picea est l'un des taxons trčs importants de la végétation holocène dans certaines régions de la Roumanie. Il connaît une nouvelle expansion, après celle survenue durant le Tardiglaciaire, vers 10 000 ans BP dans la région d'Avrig, dans les Monts Retezat, dans les Monts Călimani (Fărcaş *et al.*, 1999) et dans les Monts Gutâi (Björkman *et al.*, 2002, 2003), bien avant celle enregistrée dans les monts Harghitei et dans les Subcarpates de la Courbure (9400 ans BP) (Tanțău, 2003; Tanțău *et al.*, 2003a,b).

En Roumanie, l'optimum de *Corylus* n'est pas corrélé avec le Boréal, comme cela est classique en Europe de l'Ouest, mais avec la chronozone de l'Atlantique. L'installation plus tardive de *Corylus* en Roumanie par rapport aux pays de l'ouest, ainsi que son installation plus tardive par rapport aux *Quercus, Fraxinus* et *Tilia* peut indiquer l'absence de ce taxon dans les refuges tardiglaciaires de Roumanie.

L'expansion de *Corylus* est plus tardive dans la région d'Avrig (vers 8500 ans BP), par rapport aux Monts Gutâi (Feurdean *et al.*, 2001; Björkman *et al.*, 2003) et Monts Rodnei (9200 ans BP). Ce décalage peut ętre expliqué par la position géographique de chaque site (latitude, longitude et altitude) et par la distance des sites par rapport aux principales voies de migration.

Un événement qui se produit en plein optimum de *Corylus*, vers 6000-6200 ans BP, est rapportable à une modification de nature climatique ou męme anthropique. Il est d'assez courte durée et on peut le considérer comme synchrone pour les séquences de Avrig, de Mohoş et de Bisoca (Tanțău, 2003). L'événement est caractérisé par une réduction des taux de *Corylus* et par une progression des taux de *Picea* et de celles des taxons de la chęnaie mixte (*Fraxinus, Quercus* et *Tilia*). Il corresponde aussi à l'amorce de la courbe continue de *Carpinus*. On peut remarquer cet événement aussi

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dans la séquence de Tăul Zănoguții, dans les Monts Retezat (Fărcaş *et al.*, 1999), mais il n'est pas mis en évidence par les auteurs. Puisque cette oscillation a un caractère régional nous avons décidé de la nommer "l'oscillation six mille" (Tanțău, 2003).

La Roumanie et une des régions d'Europe ou une phase à *Carpinus* se développe avant l'expansion de *Fagus* (Pop, 1942). Le début de l'expansion de *Carpinus*, qui correspond à la fin de l'optimum de *Corylus*, est daté vers 5500 ans BP dans la région d'Avrig. Dans les Carpates roumaines l'expansion majeure du *Carpinus* est datée entre environ 6500-6700 ans BP dans les Monts Semenic (Rosch et Fischer, 2000), à Tăul Zănoguții (Fărcaş *et al.*, 1999) et dans les monts Apuseni (Bodnariuc, 2000; Bodnariuc *et al.*, 2002; Jalut *et al.*, 2003) et 4000 ans BP à Şteregoiu (Feurdean *et al.*, 2001; Björkman *et al.*, 2002, 2003). Il semble donc y avoir une progression du sud vers le nord de ce taxon.

Les premières occurrences régulières de *Fagus*, signe de la présence de ce taxon dans une région, sont enregistrées trois millénaires plus tard dans les Monts Căliman (Fărcaş *et al.*, 1999) et deux millénaires dans les Monts Rodnei, que dans les Monts Harghitei (Tanțău *et al.*, 2003a) et dans les Monts Apuseni (Bodnariuc, 2000; Bodnariuc *et al.*, 2002; Jalut *et al.*, 2003). Cela suggère que l'expansion de *Fagus* s'est produite à partir des populations situées dans la partie sud, sud-ouest et ouest de l'arc carpatique. L'expansion des forêts dominées par *Fagus* est datée généralement des alentours de 4000 ans BP comme dans la partie sud-est de Pologne (Ralska-Jasiewiczowa et Latalowa, 1996). Des données récentes montrent une âge d'environ 5600 ans BP pour l'expansion de *Fagus* à Ic Ponor, dans les Monts Apuseni (Bodnariuc, 2000; Bodnariuc *et al.*, 2002; Jalut *et al.*, 2003).

Toutes les études palynologiques de Roumanie montrent l'installation très tardive du sapin dans les structures forestières holocènes, pendant le Subboréal. Elle est datée vers 4100 ans BP dans les Monts Semenic (Rösch et Fischer, 2000), vers 3800 ans BP à Avrig et vers 2000 ans BP dans les Monts Rodnei (Tanțău, 2003). L'hypothèse d'une migration à partir des refuges situés dans la Péninsule Balkanique (Pop, 1942) est confirmée par des nombreuses recherches palynologiques effectuées dans cette région. Les résultats obtenus en Grčce (Willis, 1992a,b), en Bulgarie (Tonkov et Bozilova, 1992) et en Slovénie (Culiberg et Sercely, 1996), ont mis en évidence la présence des foręts avec du sapin dans le Postglaciaire précoce, avec une

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avancée de plus de 3000-3500 ans, par rapport aux celles du sud-ouest de la Roumanie.

Les premiers signes de la présence humaine dans la région de Avrig sont perceptibles vers 6000 ans BP (date obtenue par interpolation), avec les premières notations de céréales. C'est presque simultanément avec Ic Ponor (Monts Apuseni) ou les auteurs donnent un âge de 6190 ± 90 ans BP pour les premières occurrences de céréales (Bodnariuc *et al.*, 2002; Jalut *et al.*, 2003). Les céréales sont enregistrées sporadiquement dans les spectres polliniques de Avrig pendant la durée de l'optimum de *Carpinus* et pendant toute la durée de la phase de *Fagus*, leur présence devenant plus régulière dans la deuxième partie de Subatlantique, simultanément avec des occurrences réguličres de *Plantago lanceolata*.

Comme dans beaucoup des régions d'Europe, l'activité humaine a constituée l'un des facteurs qui a favorisé l'expansion et la propagation de *Fagus* (Küster, 1997).

La dernière partie de Subatlantique est la période de l'optimum pour les cultures et pour le pâturage, fait montré par la présence en courbes continues du pollen de *Secale, Plantago lanceolata* et de type *Cannabis*.

Cet ouvrage contribue à un programme européen de datation systématique des séquences polliniques clefs. Le programme a comme objectif l'identification des différenciations régionales de la dynamique de la végétation et la localisation des refuges.

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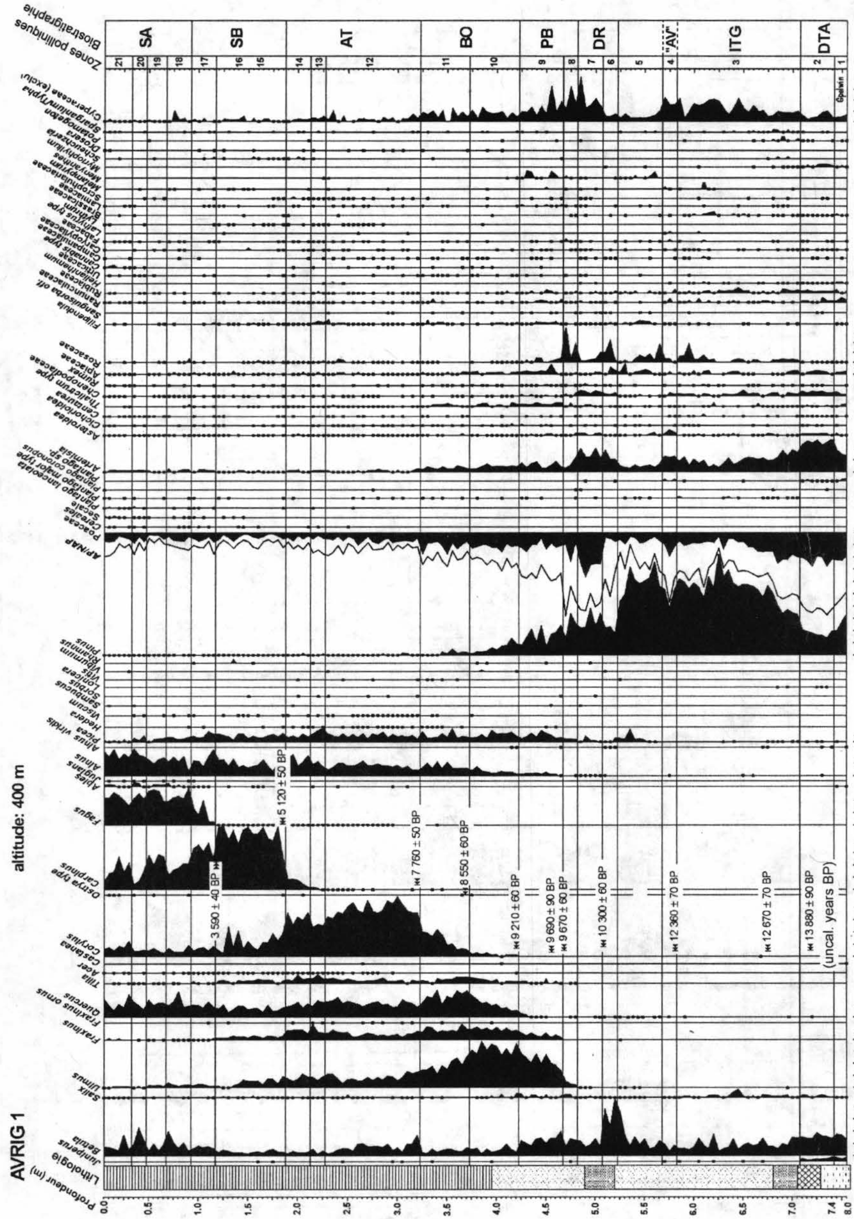

Fig. 2 : Diagramme pollinique simplifié de la séquence Avrig1 : DTA-Dryas Très Ancien, ITG-Interstade Tardiglaciaire, AV-Avrig, PB-Préboréal, BO-Boréal, AT-Atlantique, SB-Subboréal, SA-Subatlantique.

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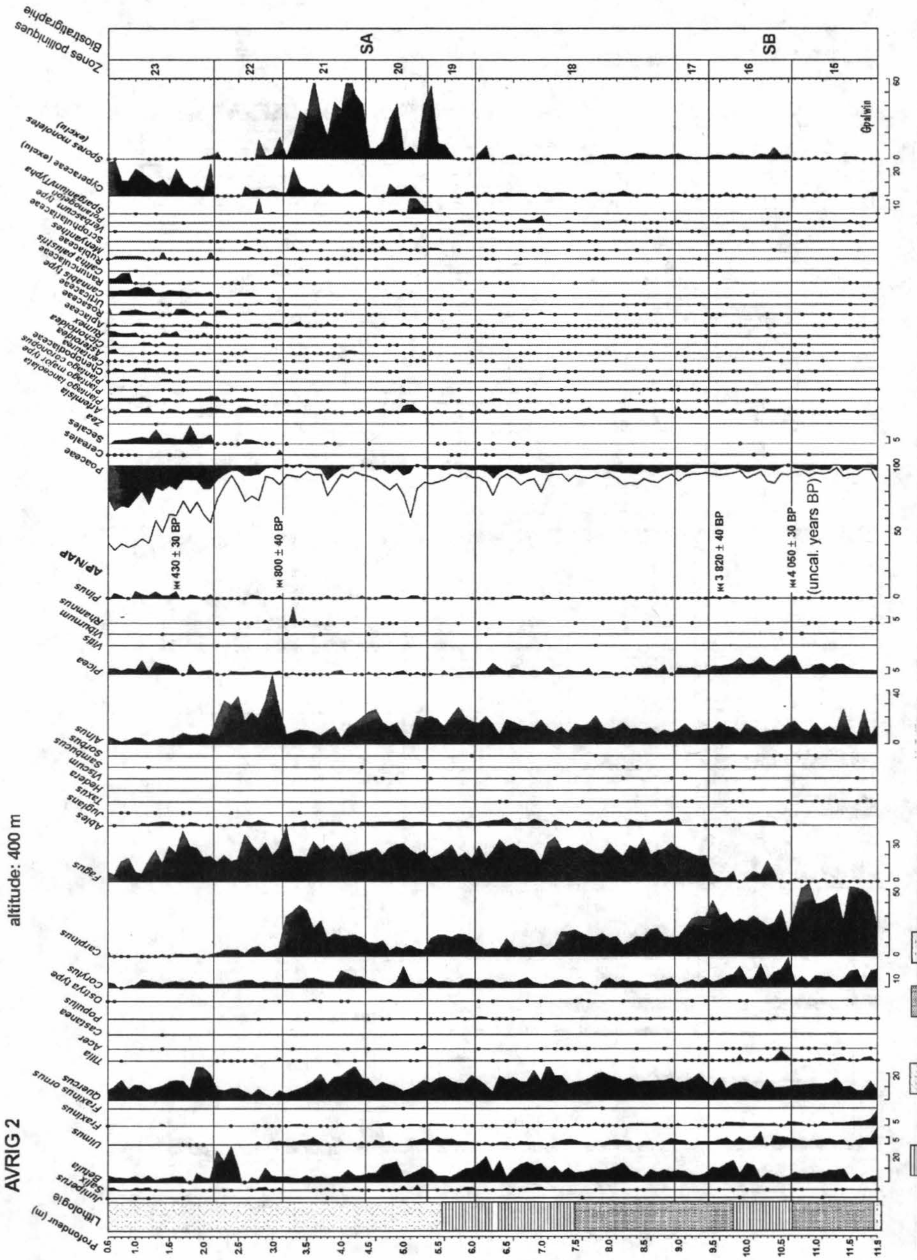

Fig. 3 : Diagramme pollinique simplifié de la séquence Avrig2 : SB-Subboréal, SA-Subatlantique.

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GEMMOLOGY AND PALAEONTOLOGY

Virgil GHIURCĂ*

Résumé: Gemmologie et paleontologie. Au premier regard c'est avec beaucoup de difficulté qu'on peut faire une liaison directe de collaboration interdisciplinaire entre les sciences des pierres nobles et la science des être vivants qui ont vécus dans le passé géologiques à la surface de la terre. Et pourtant, les divers et variés processus diagénetique et les transformations qu'on subis certains fossiles, on conduit, par une série des phénomčnes spécifiques, à la formation d'un matériel avec des réelles qualites gemmologiques.

Parmi ceux-ci nous mentionnons: les bois silicifié (les agates xyloides), les agates fossilifère, les jaspes fossilifères, les silicolites fossilifères d'eau douce, les sèptaries siliceuses, (septarin), des accidents siliceux colorés, les ammonites substitués par de carneol, les radiolaires, les lidiens, des fossiles substituées d'opale noble, l'ambre fossilifères, les ammonites à coquille irisée (ammolit ou korit), les jais, l'ivoire fossilisé et minéralisé (odontolit), etc.

Abstract: At a first glance, it is difficult to recognise a direct interdisciplinary connection between the science of gems and that of the forms of life have once populated the surface of the Earth. However, the diverse diagenetic processes and transformations that affected some fossil rests have sometimes lead, by taking specific path, to the generation of materials with real gem-quality attributes.

Such examples include: silicified wood (xyloid agates), fossiliferous agates and jaspers, freshwater fossiliferous silicolites, silica "septaria" (septarine), coloured siliceous nodules, ammonites replaced by precious opal, fossil amber, iridescent ammonite shells (ammolite or korite), jet, fossilised and mineralised ivory (odontolite) etc.

At a first glance, it is difficult to recognise a direct relationship, or an interdisciplinary connection between the science of gems and that of the forms of life that have once populated the surface of the Earth. However, the diverse diagenetic processes and transformations that affeced some fossil rests have occasionally lead, by taking specific path, to the generation of materials not only showing palaeontological scientic value, but also with real gem-quality attributes.

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If on the one hand Palaeontology can offer to Gemmology some raw materials of interest, Gemmology on the other hand may provide information on the processes that contributed to the conservation of some fossil rests and on their transformations leading to turning them into gemmological materials.

In spite of the fact that the great majority of gemmological materials have a mineralogical nature, lately several types of gemmological materials were provided by palaeontological materials. Basically the variety of fossilisation processes under specific circumstances may have led to the generation of gemmological materials of special interest due to their peliculiar properties (hardness, colour, iridescence, brightness etc.).

The **conservation via silicification of some organic vegetal and animal materials** is of a primary importance. It is well-known through world-wide examples that under special circumstances **tree trunks and branches**, or even some rests of lacustrine plants may be silicified, thus turning into chalcedony (impregnation with a quartz) or opal. These processes preserve the vegetal anatomic structure allowing a further xylotomic or botanical generic identification. Some wood rests may first be submitted to carbonisation; according onb the stage reached by this process, the silicified woods show **grey-blak up to coal-black colours**.

In other cases, the fossil woods turn into silica varieties without a prior carbonisation stage, the resulting colours ranging from white-yellowish to grey. Less often, when the silica-rich fluids contain chromatophore elements (Fe and Mn hydroxides), the silicified wood may display intense and diverse colours, giving birth to the so-called **xyloid agates** (USA-Arizona, or Mureşului Valley). The silicified woods, and especially those showing lively colours are generally used as gemmological raw materials for jewels and decorating or artistic purposes (clocks, small statues, tables etc). In Romania, numerous occurrences are known from the Oligocene sandstone formation or the Neogene volcano-sedimentary formations. In general, most of the silicified vegetal elements finally turn into chalcedony; still there are cases when the process stops at the incipient stage – *i.e.* opal-formatin, as it is the case of the silicified woods from Basarabasa (HD).

A classical example from Australia is the partial replacement –mainly along fissures, of some fir trunks or pine cones with **precious opal** (amorphous opal AG).

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Similar examples of silicification, this time of some lacustrine plants and of freshwater mollusks are known from Romania, especially in the Sarmatian and Pannonian sedimentary deposits in the neighbourhoods of Neogene volcanic formations of the Eastern Carpathians (Harghita-Călimani-Gutin-Oaş volcanic chain) but also of the Apuseni Mountains. Of a special interest are the Neogene Oaş Basin (Tarna Mare, Bicsad, Negreşti, Huta-Certeze, Racşa-Satu Mare county), the Neogene Baia Mare Basin (Seini, Săbişa, Ilba, Băiţa, Valea Borcutului - Baia Mare - Maramureş county), Harghita and Covasna county (Chirui and Baraolt) but also some occurrences from the Apuseni Mountains (Vaţa de Jos, Brad - Hunedoara county). The accumulation of jasper-type opals and lacustrine jaspers from the Brad Sanatorium are worth to mention, due to their homogeneity and chromatic diversity that turn them into a gemmological material suitable for jewelry or art. Due to their rich content of perfectly preserved freshwater flora, and additionally the palynological material, these lacustrine silicolites may provide important paleobotanical information for the reconstruction of the environment during this specific geological stage.

Besides, also the **animal fossil** rests may be submitted to similar silicification processes. Many types of mollusks, bryozoas, corals, echinoids etc. or even vertebrate fragments, dinosaur's eggs were preserved in this way. Among them, of gemmological interest are the following:

Rare lively coloured **fossil agates** occur in the Faţa Băii Conglomerates and the Almaşul Mare Gravel (Zlatna Basin): some *Nerinea* - and coral - containing Mesozoic pebbles have been tatally replaced by coloured silica-rich solutions leading to the formation of beautiful fossiliferous agates, as it is the case of the pebbles and concretions (locally called „bebee") from Brădet (Alba county). Thex may accur wherever such geological formations are known, for example in the Săcărâmb and Brad basins.

Silicified mollusk lumachels may give birth to the so-called **shell-agates** (Muschelachat, at Mesteacăn - Maramureş district), while the **silicified Jurassic coral colonies** from Mureşului Channel are known as **coral-agates** (Korallenachat).

The aragonotised and calcitised snakes from Corund (Harghita county) and the **silicified snakes** from Buciumi (Eocene - Maramureş county), when fully detachable from their host-rock, represent very esthetical „curiosities".

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Also some microfaunal and macrofaunal associations from loose sediments on the bottom of the Mesozoic seas have been subject to silicification: it is how the **brownish fossiliferous jaspers** from Brădet area (Alba county) were formed.

The silicified small-sized nummulites in the Eocene reef facies from the Buciumi limestone quarry (Maramureş county) provide a brownish raw material that is suitable for art objects.

However, the most spectacular process known from the precious opal fields in the sedimentary deposits of Australia is represented by the **total substitution of diverse Cretaceous or younger, continental or marine faunal elements with precious opal** (opal AG). **Forms of *Cyrena* and *Modiolus, Belemnites*,** and ***Anemone*** are cited in the references, having the shells, internal moulds or skeletal parts **fully replaced by precious opal.** Among the superior animal's forms, it is worth to mention the identification of an opalised full skeleton of ***Plesiosaurus***, 1,5 m in lenght, of some lizards, or on fragments of a **fossil horse** (*Protophypus*) **pseudomorphosed by precious opal.**

The substitution of the animal or plant rests by a much harder phase, silica with a hardness of 7, provides the fossils with a longer conservation time as compared to other types of fossilisation processes.

On the other hand, other types of organic gemmological materials, such as **amber** or copalite may constitute during their first stages of formation antiseptic suitable environments for the **conservation of some species of insects, pollen, vegetal efflorescences, fir cones, wood fragments and rarely vertebrates (frogs, snakes).**

Well-known are the diverse insect species preserved in the amber from the Baltic region (Eocene), and especially from the Dominica Island (Oligocene). In Romania, insects in amber are not common, but rests of insects, pollen and fragments of vegetal tissue have been identified in amber from Buzău and Vrancea areas.

Siliceous skeletons of some animals and plants may other times accumulate and give birth to **rocks of some gemmological interest**, such as **menilites, diatomites, spongolites or radiolarites.** Such **silicified diatomites** from Miniş (Arad county), Chiuzbaia (Maramureş county), **menilites and radiolarites** from the Eastern & Southern Carpathians, and the Apuseni Mountains (Drocea Mts.) are well-known. Of a special

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gemmological interest are the variegated and homogenous radiolarites from the Mesozoic deposits of the marginal cuvette of Bucovina, those from Perşani Mts., or from Drocea Mts.

Even the siliceous **nodules** from the (Cretaceous) chalky limestones along the Prut banks (Mitoc-Rădăuţi), from Dobrogea (Basarabi), or from the Jurassic (Kimmeridgian-Oxfordian) deposits in the Romanian Carpathians may sometimes show attractive colours, leading to ascribing a gemmological potential. Such materials have played a significant role in prehistory for the inhabitants of the Romanian territory during the Paleolithic and Neolithic (the archaeological silex). In fact some of the first jewels of those times have used silex as a raw material (amulets).

From the Audia Beds (Black schists zone), part of the Eastern Carpathians flysch units, the **black lydites-jaspers** (the material used for gold-testing) mainly occurring in Sovata area but also in other regions may present a gemmological interest.

The siliceous septaria, assumed to have formed by dissolution of siliceous organisms hosted by freshwater limestones from Rona (?) also represent a suitable gemmological raw material for art objects, which we attributed the name of **„septarin"**.

Concerning the "Black schists facies" we would like to approach an aspect not directly related to the topic of the paper: the famous emerald ores already mined by the Indians from Columbia in Muzo and Coscuez regions and transported to Europe by the Spanish conquistadors are hosted by overthrusted and intensely tectonised "shales noires" (black schists) of a Lower Cretaceous age constituting recumbent folds in the Eastern Cordillera area. As a general rule, emeralds are located in areas rich in calcite veins.

From the black schists from the Eastern carpathians, until now only the "Maramureş diamonds" have been identified in calcite fissures. They are in fact crystal-clear and perfectly crystallized small quartz crystals (1 mm to 1 cm) with hydrocarbon inclusions, showing a gemmological value. Lately, similar crystals of diagenetic quartz up to 6 cm in size have been discovered in the Paleogene flysch of the Slovakian Carpathians (Veliky Lipnic-Fulin M.-2003). It seems that the source of silica for these crystals is related to the **dissolution of siliceous skeletons of some plants an animals** hosted by the black schists.

Even fossils such as ammonites from some occurrences may present gem-quality features, related to processes of microstratification of their

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aragonite nacre. It refers to the gem material known as **ammolite or korite** representing, in fact, the aragonitic nacreous part of the ammonite shell showing coloured **iridescence similar to that of precious opal**. The iridescent shells belong to the species *Plancenticeras meekei* and *P. intercalaris* (up to 50 ca in diameter), found in Cretaceous schists (70-75 milion years) in Alberta, Canada starting with 1960. There is evidence that around 1760 a similar type of ammonite had been discovered in Austria. Such genera of iridescent ammonites are also known from Ukraine, Madagascar and USA (South Dakota), showing optical effects of a precious opal-type.

In Romania, no similar ammonites have been mentioned until now. However, we had the chance to discover in Valea Albă (Remetea Trascău), on a silicified Jurassic limestone fragment, two small ammonites (diameters of 1 cm), perfectly conserved and **fully substituted by red carneol ("pigeon blood")** that were already suitable for gemmological use.

Rarely some small Mesozoic ammonites, fully replaced by pyrite, known from Banat (Svinița area, Mehedinți county) and possibly from other areas also posses a gemmological potential.

Related to the Halsttad facies (Triassic) from the homonymous locality in Austria, it is worth to mention that already during the Iron Age (1500-850 B.C.) ammonite-shaped jewels were produced, inspired by the locally-abundant natural fossil counterparts. It seems that the mould for the melted iron was prepared by using the negative ammonite imprints in the outcropping rocks.

The ordinary **coal** may sometimes represent a gem material, that was used mainly in the past - but not only - for mourning jewelry. Some sapropel coal varieties from Turkey (Gagat), England and Germany known as **jet or gagate** are still surrently used in gemmology. During the Elizabethan period, gagate was in fashion in England for jewelry. In Romania gagate was locally mentioned at Săsciori (Alba county) and sometimes associated to amber in Buzău Mountains (Buzău county).

The fossil proboscidean tuski, or fragments preserved in the fossil ice pockets from Siberia or in the Quaternary deposits of Europe may also be used as gem materials, similar to the present-day ivory (currently, the usage of contemporaneous ivory for jewelry is absolutely prohibited). Some 300-400 years ago the ivory from Africa was processed for jewelry and art objects in large workshops from Dieppe (France). The fossil ivory fragments can be used only if they were not prior submitted to phosphate-depletion or to

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mineralization processes turning them into relatively homogeneous and hardes materials. Ivory is used for jewelry and small art objects that emphasise its specific internal structure (Rhetius lines). The fossilised ivory partly substituted by vivianite has a bluish colour an is known as the gem material **odontolite.**

Finally, some fossilised mollusks or other animals that have esthetical carbonate or phosphate shells may constitute raw materials for jewelry or art, in their natural state or cut and polished. Such examples refer to: isolated corals, mollusks, fish teeth, trilobites, bryozoans, small ammonites, crinoids (fragments), small and flat echinoids (*Sismondia, scutelidae, laganidae*), *nummulites*, small *nerineae* etc. Some types of "landscape" limestones or marls, or sandstone concretions also posses an artistic potential.

It is possible that other types of fossil flora and fauna, that have successively inhabited the Earth, to provide new gem materials in the future.

It is obvious that the gemmological usage of rage and special fossils should be preceded by a scientific evaluation; thus, a prior expert investigation by palaeontologists from the universities in our country is highly recommended.

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GEMMOLOGICAL RESOURCES AND PERSPECTIVES OF THE VÂLCEA COUNTY (ROMANIA)

Virgil GHIURCĂ*

Résumé. Ressources et perspectives d'intéret gemmologique dans le department de Vâlcea (Roumanie). Les formations géologiques génératrices et déténtrices des minéraux et roches aux qualities de gemme du department de Vâlcea, nous offrent une pauvre assortiment coloristique des minéraux, fait qui suite le department par son potential gemmologique dans le cadre du disctrict de Roumanie sur le 22-émé place. Le plupart de resources sont générées par le domaine metamorphique, suivi le domaine sedimentaire et magmatique.
Mots clef: Gemmologie, grenats, disthene, serpentines, eclogite, calcedoine, amber, bois silicifiées.

Abstract: Gemmological resources and perspectives in Vâlcea county (Romania). The gem materials' (minerals and rocks) generating – and hosting – rocks from Vâlcea county provide a limited chromatic range, thus situating this area on the 22nd place among the counties of Romania. Most of the gem resources are related to metamorphic units, followed by the sedimentary and magmatic ones.
Key words: gemmology, garnets, kyanite, serpentines, eclogite, chalcedony, amber, silicified wood.

INTRODUCTION

For a better understanding of the content and goal of this paper, it is necessary to define first some gemmological terms, reffering to gemmological resources and perspectives.

Gemmology is the science of precious and semiprecious stones, and ornamental materials. Being a branch of mineralogy, gemmology mainly concerns the study of gem-quality minerals (diamond, corundum, beryl, garnets), but also some rocks (obsidian, serpentinites, alabaster etc.) are subject of its interest, as well as some organic materials (amber, gagate,

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nacre, pearls etc.). Based on the stipulations of international legislation, the precious stones are classified according to their value and rarity into three main classes:

Precious stones, including only four minerals/varieties: diamond, ruby, sapphire and emerald. These gems are less frequent worldwise, posses a high circulation potential; they are measured in carats (200 mg).

Fine (semiprecious) stones mainly group coloured, transparent or translucent minerals such as: topaz, beryl, tourmaline, amethyst, zircon, precious opal etc.

Ornamental stones refer to translucent or opaque minerals such as turquoise, lapis lazuli, jadeite-nephrite, chalcedony, jasper etc.

Among about 3500 mineral species known in present, about 331 are currently used as gem materials. Chemically, they belong to all the nine mineralogical classes: native elements (diamond, sulphur, gold, silver), sulfides (13 species), halides (6), oxides & hydroxides (65), nitrates, carbonates & borates (30), sulfates, chromates, molybdates & wolframates (9), phosphates, arsenates & vanadates (34), silicates (149), and organic minerals (21).

Based on practical and commercial criteria, the gemstones may be classified into five classes. The first class groups materials frequently used as raw materials for jewels, from diamond to malachite (81 minerals), or for art objects (jade, chalcedony, rhodochrosite, rhodonite etc).

A second class refers only to the „collection minerals" of interest for gem collectors, *i.e.* fine collection gemstones (44), that could also be used for jewelry (andalusite, epidote, vesuvianite, kyanite etc.)

The third class consists only of rare „collection gems" (110 species). They present an interest for collectors exclusively (actinolite, sillimanite, barite, calcite etc.).

In the fourth class some rock types (15) that may be used for ornamental purposes (onyx marble, obsidian, alabaster, fossils etc.) are included.

The last category refers to organic materials (6), especially to organic gemstones (pearls, nacre, amber, corals etc.).

Gemmological resources signify those minerals, rocks or organic materials that can be processed (cut, polished, engraved etc.) as raw materials for jewelry, art or decorative objects. Besides the hundreds of „classical" minerals, currently new species and their varieties showing a

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gemmological potential are still discovered. Their identification depends on the ability of interested people of finding the „hidden beauty" inside minerals and rocks. Some apparently ordinary rocks at a macroscopic scale may reveal unknown esthetical attributes.

The term „gemmological perspective" refers the potential of specific geological formations to generate of to host gem-quality minerals of rocks (lively colours, transparency, brightness, iridescence, adularescence, labradorescence, asterism, opalescence, chatoyance, aventurescence, hardness, wearability etc.).

For example, in Romania it is well-known that the „ophiolitic" basic rocks contain chalcedony, agate & jasper veins and nodules (Trascău-Metaliferi Mts.). The occurrence of similar „ophiolites" in order geological units (ex. Mehedinți, Vâlcan, Perşani Mts.) constitutes an indication for the possible discovery of new areas of gemmological interest. In Romania, the Oligocene Kliwa sandstone from Buzău and Vrancea counties represents the host-rock for amber. The occurrence of this type of deposits as a continuous band in the Eastern Carpathians represent a favorable premise for the identification of new amber concentrations in other counties. The occurrence of „Maramureş Diamonds" (small, clear and bright quartz crystals) is related to the black Audia schist from Bocicoiu Mare (Maramureş); the development of the same strata along the Eastern Carpathians is thus a premise for the identification of new similar gem materials, as already proven by the occurences from other regions (Odjula, Covasna county). The serpentinic rocks are known worldwide as hosts for jadeite-nephrite, chloromelanite, peridot, precious grossular etc.; possible that a more detailed study of the Romanian serpentinites will evidence also here the presence of some of these minerals.

At the beginning of the diamond prospecting in Yacutia, such premises were taken into account, in particular the presence of kimberlites (the host-rock of diamonds in South Africa) and of the assemblages of specific minerals (pyrope, gahnite, chromite, ilmenite etc.). Up to now, in Romania no kimberlitic rocks are known, but similar rocks (peridotites, eclogites, lamproid rocks) occur in several areas, which may be surveyed in details in this respect.

In conclusion, knowing the classical geological background of some gem minerals in other regions abroad (diamond, rubies, sapphires, emeralds), the prospecting may be extended in areas on the Earth where new ones of precious stones and gems might be identified.

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One of the goals of this study is that of pointing out to the known gemmological resources in Vâlcea county and of suggesting premises related to specific geological formations that may host gem-quality materials. A second aim is related to increasing the awareness and interest of gem collectors for having a closer look on some areas that they may reach on touristic purposes. However the main goal of this paper is to present the current gemmological potential of Vâlcea county for providing a basis for a better local usage of gem materials by companies which are interested in this field.

GEOGRAPHICAL AND GENERAL GEOLOGICAL DATA ON THE REGION

Orography. The varied landscape of Vâlcea county is characterized in the northern part by high mountainous areas followed southwards by sud-Carpathian and pre-mountain hills.

The western end of the mountainous area consists of Lotrului Mts. (Ştefleşti peak, 2242 m), and Căpăţânei Mts. (Buila peak, 1849 m). East from Olt river, Făgăraş Mts. (Negoiu peak, 2535 m, Suru peak, 2283 m) develop. Between the lower parts of the county and the mountain peaks there is difference of altitude of about 2400 m. In the highlands, in the area of confluence of Lotru river (Brezoi – Titeşti), the Loviştei intramontaineous depression is located. The Oltenia sub-Carpathians develop as southwards extended crests, having altitudes between 500-700 m, and being fragmented by N-S oriented valleys. In between the crests, a series of depressionary areas are located (Horezu, Jiblea).

Hydrography. Olt river is the mian collector in the region, including its right side tributaries Lotru, Muereasa, Olăneşti, Govora, Bistriţa, Luncavăţ; south form the county's limit, Olteţ river with its tributary Cerna add to Olt river's course. On the left side, the tributaries are shorter (Câineni, Cozia, Jiblea, Simnic, Stăneasca, Trepteanca).

From a **geological** point of view, the northern part of the county belongs to the Southern Carpathians (the crystalline – Mesozoic Zone), the central part to the Getic Depression and the southern extremity is part of the basement of the Valachian Platform.

Within the crystalline zone, two areas with distinctive evolutions were separated:

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- the Getic Domain, including Făgăraş Mts. (the southern slope) showing southwards a narrow blade of gneisses (Cozia Gneisses delimiting southwards the Lovişte Zone), the Lotru Mts. And Căpăţânei Mts., characterized by the presence of gneisses, micashists, amphibolites, pegmatites, eclogistes and Mesozoic carbonate deposits (Vânturăriţa – Upper Jurassic), and
- - the Danubian Domain (or autochthonous), well-developed west from Voineasa (in the drainage area of Lotru and Latoriţa) dominated by filite and schists, amphibolites associated with granites-granodiorites and partly serpentinised peridotites-dunites. In this region delimited by Voineasa and Ciungetu localities, towards Baia de Aramă, the mesometamorphic crystalline rocks of the Getic Domain are overthrusted on the top of the epimetamorphic units of the Danubian Domain.

South from the crystalline mountainous areas, the Getic Depression is well individualized and it continues southwards until the level of Drăgăşani town.

Extended Upper Cretaceous (conglomerates, sandstones) and Paleogene (Eocene – Upper Oligocene) deposits develop in this area, being well-individualized north from Loviştei Depression and in the proximity of Olăneşti-Sălătrucel. Southwards, Neogene (Aquitanian, Burdigalian, Helvetian, Badenian, Sarmatian and Pliocene) deposits occur, extended till the level of Topolog Valley's confluence. South from this area, Quaternary deposits are dominantly cropping out; only along the deeper valleys, deposits of a Levantine age were identified.

HISTORY OF THE GEMMOLOGICAL - RELATED GEOLOGICAL RESEARCH

A brief presentation on the minerals identified on the territory of Vâlcea county is provided by the monograph of Rădulescu & Dimitrescu (1966), wich presents an inventory of the minerals of Romania without a special mention on the gemmological aspects. Udubaşa et al. (1992) completed and revised this list. Other older or newer papers on the geology or petrography of certain areas from the mountainous or hilly zone may be added, such as those of Murgoci (1898, 1902). From this area a new mineral species, **Lotrite**, was mentioned by Murgoci, that was subsequently

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identified also abroad, where it was called *pumpellyite*. Other contributions belong to Hann (1983, 1987), Hann et al. (1987), and Radu Mircea.

Among the authors that have mentioned minerals of gemmological interest in Vâlcea county one can mention Ackner (1855), who identified in the serpentinites from Coasta lui Rus and Piatra Tăiată varieties of chalcedony which he called nickeliferous chrysoprase. The occurrence of numerous serpentine lenses along the upper course of Lotru and Latorița rivers offers good premises for the identification of new chrysoprase occurrences in other areas.

Marincea & Sabău (1995) studied the beryl from Curmătura-Vidruța (Căpățânii Mts.) and from other 12 Romanian occurrences, but no gemmological considerations are presented. Among other scientific papers on outcrops of gem-quality minerals or rocks but with no experimental testing on the gemmological qualities we mention that of Maieru et al. (1968) who cite Apostoloiu & Diță and show that in the pegmatites from Pietrele Albe, Haneş, Straja and Despina (Lotrului Mts.) beryl crystal may reach 12 cm; they are often associated with monazite, zircon, garnet, apatite and tourmaline. Hann (1981) elaborated a complex study on the eclogites from Căpățânii Mts., but no mention is included on their possible gemmological potential. Hann (1987) mentioned the occurrence of some pegmatites with andalusite and cordierite (cm-long crystals) in Căpățânii Mts., near Cocora peak (located between Ursu peak – west and Văleanu peak – east). The presence of kyanite besides garnets, staurolite and sillimanite was noticed in paragneisses from Lotru Valley and in the Făgăraş Mts., with no gemmological details included.

Istrati (1897) and Istrati & Mihăilescu (1923) indicated the presence of amber at Olăneşti and Cheia within Paleogene sedimentary deposits. Istrati considered that this is a distinctive variety of amber, which he called „muntenite”. Murgoci (1902) in his monograph on the amber from Romania approched again these outcrops which he defined as Eocene; based on the physical and chemical properties, he considered that this amber variety was intermediate between Copalite and Gedanite. Worth to mention is also the fact the Lotru Mts. Host one of the densest network of serpentinites, metaserpentinites and huge lenses of pegmatites (Cataracte) in Romania, which may be related to a series of gem-quality minerals or rocks. The high altitudes of these areas (1500-2200 m), the steep slopes, and their remoteness make the geological prospecting difficult, in spite of – in our opinion – their real gemmological potential.

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GEMMOLOGICAL RESOURCES AND PERSPECTIVES OF THE VÂLCEA COUNTY

The gemmological potential of an administrative unit depends on the presence of a gem-generating geological formation in the region. Among the formations with gemmological potential, magmatic rocks are on the first place, followed by metamorphic and sedimentary ones.

The magmatic formations (intrusive and extrusive) provide the largest mineral ores known worldwide (of plutonic, pegmatitic, and volcanic-hydrothermal origin). The richer content of mineralizers in the fluids, the more complex mineral assemblages resulted. Indirectly, the contact ores located between intrusive bodies and sedimentary or metamorphic or metamorphic rocks (thermal and metasomatic processes) are also included.

Other times, new specific minerals and rocks may form starting from sedimentary or even magmatic formations that were submitted to regional metamorphism (adaptation at higher pressures and temperatures) (for example, crystalline rocks belonging to the metamorphic domain). The ultrabasic rocks may also suffer complex transformations, giving birth to serpentinic rocks which may include new assemblages of a high gemmological interest (jadeite-nephrite, chrysoprase, gem-quality garnets etc.).

The sedimentary formations are usually scarse in gem materials. Still such formations may contain a series of hard, resistant and chemically stable minerals. It is minly the case of the formations hosting reworked diamonds, or of the gem-rich sands and pebbles from Sri Lanka and Myanmar. Moreover, the sedimentary rocks host the largest ores of amber (Baltic Sea, Dominica Island, Vrancea county etc.).

A statistics of the repartition of these three formation types on the surface of Vâlcea county shows that, of a total of ~5705 km^2, about 68,29% (3895 km^2) correspond to sedimentary formations – represented by Mesozoic (~231 km^2), and Paleogene (334 km^2) deposits, the largest area being covered by Neogene and Quaternary deposits (3340 km^2).

The magmatic rocks in Vâlcea county are mainly represented by anatectic granites (~278,28 km^2, representing 4,88%), which anyhow show a reduced gemmological potential due to their metamorphic origin. Basic rocks (peridotites) occur on smaller areas and they are often serpentinised, the larger rock bodies being accompanied by contact phenomena. Some eclogite

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(Căpăţânii Mts.) and pegmatite lenses have to be included. Some of the larger pegmatite lenses, showing an almost complete evolutionary path, present a complex mineralogical assemblage that may suggest a granitic origin. Otherwise, many pegmatite lenses occuring within the Lotru Series were considered by Hann (1987) as having a metamorphic origin. They are assumed to have been generated by either lateral secretions, or by metasomatic anatectic processes.

The crystalline formations occupy about 1530,84 km^2 (about 26,83% of the county's surface). They build-up most of the landscape in Lotrului and Căpăţânii Mts. – where they are represented by Lotru Series (paragneisses, gneisses, migmatites and pegmatitic lenses) in the Getic Domain, and by Drăgşan and Tulişa Series, and serpentines in the Danubian Domain. In the Făgăraş Mts., the metamorphic formations are represented by the Făgăraş Series (Cozia gneisses and Cumpăna gneisses and micaschists with garnets).

1. **The sedimentary formations (3895,88 km^2, representing 68,29%)**

The sedimentary formations in the Getic Domain consist of a distinctive succession, as compared to those in the Danubian one (autochthonous). In the Getic Domain, the mesometamorphic (crystalline) series in Vâlcea county are overlaid by Werfenian deposits (Valea lui Stan), followed by Upper Jurassic ones, developed as a blade in Vânturiţa area. In the same mountainous areas of the county, Albian, Vraconian-Cenomanian and Senonian deposits occur, gradually extended towards Otăsăului Valley (W) and prolonged eastwards over the Olt valley. Southwards, on their top, molasses formations develop in the Getic Depression, which are more extended north from the narrow unit of the Cozia gneisses (Lovişte Depression) and southwards, in Olăneşti-Călimăneşti-Sălătrucel area. These deposits are Eocene, Oligocene (Rupelian-Aquitanian) and Neogene (Helvetian, Badenian, Sarmatian and Pliocene) in age and outcrop on large areas south from Băile Govora.

Within the Danubian Domain (autochthonous), the epimetamorphic schists (of Drăgşan and Tulişa series) are overlaid by Jurassic (breccias – Ciungetu), or carbonate (Malm – Urgonian – Upper Jurassic – Aptian in age) deposits cropping out in the area of Cerna source, at the contact with the forehead of the Getic Nappe.

The only gem materials hosted by the sedimentary deposits are represented by silicified woods, siliceous nodules, amber, gypsum, fossils,

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fossil ivory, septaria and some minerals reworked in the present-day alluvia from magmatic and metamorphic deposits.

The silicified woods. Fragments of broken trunks and branches detached by storms and transported by rivers may sometimes have been preserved by a rapid burial in clayey or sandy marine sediments which prevented their decay by fungi and mucosas. Within the sediments, the fossil wood may be either totally (turning into coal), or partly carbonized, or it may be encrusted and replaced by silica-rich solutions (silicification). As a result, the fossil woods may be originally carbonized and then silicified. In this case the fragments of wood are black in colour and this process usually is hosted by clays. When the host-rock is represented by sands or volcano-sedimentary deposits, the woods usually present yellowish-whitish-grayish colours. Rarely, when the silica-rich solutions contained also chromatophore pigments (Fe hydroxides) they might have imprinted red, brown or even green hues to the silicified wood. The *in situ* (within the host-rock affected by silicification) identification of such fossil wood is of a great scientific importance, because their xylotomic study may provide significant information on the palaeoflora reconstruction during various geological stages. It is recommended that such rests, identified *in situ*, to be submitted to an expert examination. The reworked fragments of silicified wood found in the alluvia, lacking detailed information on the stratigraphical host level, are less important scientifically.

Areas where such wood fragments were found in alluvial pebble are limited to the territory west from Cerna valley, with the east extension in Topologului Valley. These valleys cross Cretaceous, Paleogene and Neogene deposits, thus the fossil woods may have any of these stratigraphic ages. Rarely, Pliocene silicified wood has been identified.

The perfect preservation of the anatomic structures (cell structures, growth rings) turns the fossil woods – especially the black ones, or the diverse coloured ones – into suitable raw materials for art objects. The Pliocene silicified woods mainly consist of opal, while the older ones were already replaced by chalcedony.

Amber. Amber is an organic mineral formed by fossilization of some tree resins (mainly from conifers, but not exclusively). Amber is known as a raw material for jewelry since the Early Neolithic. During the Bronze and Iron ages, amber was the object of a flourishing trade in the Baltic and Mediterranean areas. The oldest amber bead identified in Romania was dated as Upper Neolithic (Vărăşti-Boaian-IL). Important amber ores occur mainly in

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the countries south from the Baltic sea (Denmark, Germany, Poland, Russia) but also in the Dominica Island; in Romania, amber occurs mainly in the Buzău and Vrancea Mts. area.

On the territory of Vâlcea county, the presence of amber was mentioned by Istrati C.I. (1897) at Olăneşti. After more detailed studies, the author (1923) defined this amber as a distinctive variety that he called "muntenite". Murgoci (1902) in his monograph on the Romanian amber redefined the amber from Olăneşti, considering it as a variety similar to Gedanite. Based on field investigations and on materials collected from the brook the left side at the entrance in Băile Olăneşti (from the site called Purdoi) and from the bank of Cheia brook, Murgoci considered that the amber is related to some sandy interlayers within clays, located on the top of a nummulitic level (Eocene). In this area, amber occurs as lens-shaped nodules (up to 10 cm in length and about 3 cm thick). Usually these nodules are cracked and can be easily broken into small pieces with a conchoidal break. The outer surface is moistened, consisting of a gluey oily substance that evaporates in time. Amber has a clear-yellow, such as wine, or a dark red colour. The physical-chemical properties are different as compared to the amber from Buzău (romanite), especially due to the higher content of carbon (85,42%). Its chemical features are similar to those of copalite, but the physical ones resemble gedanite. The presence of amber was also mentioned in the salt massif from Ocnele Mari, where it was assumed to have a secondary origin (reworked amber). A foreign author, Zinchen, also mentioned amber in the neighborhood of Craiova (?), as well as from Băile Olăneşti. The amber from Olăneşti hosted by ands is friable and soft, thus similar to the "burnt" amber from Colti (Buzău) degraded after prolonged exposure to sunlight and weathering. The variety of "burnt" amber is not suitable for gemological usage. It is still recommended to explore in detail the known areas, starting from Pietreni (W) - Băile Olăneşti - Călimăneşti - Sălătrucel (E).

The relatively isolated Eocene deposits, located north from the narrow area of development of the Cozia gneisses in Loviştei Depression may also represent a potential formation for the accumulation of amber nodules. Especially the clayey-coal-rich intercalations are of interest, where compact, unaltered amber might be found.

Siliceous nodules occur sporadically in the Jurassic limestones, from Vânturarița, especially in the western part, where small patches of

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Callovian-Oxfordian limestones occur. These areas are located west from Stogu peak (V. Căprăreasa), north from Buila peak and southwards, along Costeşti Valley. It cannot be excluded that these silicolites might have been used by Paleolithic populations.

Within the Sarmatian deposits occurring as a W-E extended between the Tărăseşti (W) – Oteşani – Păuşeşti – Cernele – Căzăneşti – Copăcelu (E) localities a series of sandstone concretions crop out, presenting esthetical aspects; they may be used as natural ornamental objects in parks and gardens. They are more frequent especially in the Oteşani area (Popescu Aurelian, oral communication). The same author mentions such formations at Costeşti.

The Quaternary loess deposits from Băbeni-Olteţu (Făureşti commune) also host esthetical sandstone concretions, but they are smaller in size thus can be used only as indoors ornamental objects.

The recent alluvia of Lotru and Olt rivers may contain some hard and resistant minerals reworked mainly from pegmtites (beryl, vesuvianite, andalusite, zircon), from serpentinites (chrysoprase, jadeite-nephrite, asbestiform cat's eye), from micaschist and paragneisses (garnets, kyanite), or from sedimentary deposits (septaria, fossils, and fossil ivory).

2. **The metamorphic formations (1530,84 km2, representing 26,83%)**

The mesometamorphic formations are typically occurring in the crystalline Sebeş-Lotru and Făgăraş Series of the Getic Domain, that crop out on extended areas in Făgăraş, Lotru and Căpăţânei Mts. Petrographically, they consist of gneisses, paragneisses, micashists, amphibolites and only on small areas (in Valea lui Stan), epimetamorphic schists (green schists).

The epimetamorphic formations are well-developed especially in the Danubian Domain (autochthonous) in the areas close to the source of Lotru and south from Mănăileasa Valley (Petrimanu, Voineasa, Ciungetu, Târnovu). They constitute the Drăgşan Series (amphibolites, sericite-chlorite schists) and mainly the Tulişa-Latoriţa Series (crystalline limestones, green schists, graphite filites). Within the Tulişa Series, two levels of ultrabasic rocks are known, subsequently transformed into serpentinites. These magmatic rocks are located within the middle horizon of the series, being folded during the formation of the green schists. The upper ultrabasic level is located within the upper, graphite filites level of the Tulişa series.

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Some minerals of gemological interest, such as garnets, kyanite, mica-containing quartz (aventurine), marmoreal limestone, talc schists are hosted by the mesometamorphic units.

Among the autometamorphic rocks, the serpentinites may also host gem-quality materials, such as ordinary and asbestiform precious serpentinites, including their associated minerals: chloromelanite, jadeite-nephrite, precious garnets, benitoite, peridot, sepiolite, talc etc.

Garnets (almandine). The almandine variety of garnet, hosted by the paragneisses and micaschists of the Lotru and Făgăraş Series are often opaque, brown in colour and heterogeneous; they are partly altered and present mica inclusions, making their gemological processing difficult. Due to their high specific gravity and hardness, garnets are naturally concentrated in alluvia, as for example along Cerna, Bistricioara, Lotru, Olt, and Topolog Valleys. The identification of unaltered, homogeneous, translucent, reddish crystals up to 0,5-1 cm in the alluvia requests good observation skills. The presence of such crystals in the alluvia represents a premise for a more detailed prospecting for the identification of the *in situ* host levels. The procedure is time consuming and needs a thorough investigation of all the tributaries of the specific river, until the source is identified. Unfortunately until now only a few persons were interested in this procedure. Many museums from Germany preserve old jewelry consisting of garnets for which a Romanian Carpathian origin was assumed. I personally was asked to provide materials for a comparative study related to the source area for these garnets used for archaeological jewelry. Unfortunately my own collection contained only garnets with poor gemological qualities (opaque, slightly, translucent) from Preluca, Rodna, Arieşului Valley, and Ocna de Fier, besides some low-quality garnets provided by Mr. Carol Strutinski (a total of 10 Romanian occurrences). The investigations performed on these garnets have shown that they do not represent the raw material for the above mentioned jewelry. We still consider that further research may evidence also gem-quality garnets in the Romanian Carpathians.

Kyanite (disthene). The presence of kyanite in the paragneisses and micaschists of Lotru and Făgăraş Mts. was noticed by several authors. However significant concentrations of kyanite (in disthenites) are known especially from Cibin Mts. Similary to the garnets, due to its hardness and chemical stability, kyanite is concentrated in the alluvia after the disintegration of the host-rock. It shows distinctive hardness values along the

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various growth directions (4,5-6,7), and that property gave the name of "disthenos" to this mineral. Due to its bluish-greenish pearly colour, the same mineral was also called "kyanite". In the Vâlcea part of the Făgăraş Mts., kyanite may be identified in the area between Negoiu peak (E) and Olt Valley (W). It is mainly related to the paragneisses and garnet micaschists cropping out in the area of Serbota, Tătaru, Suru and Măgura Câinenilor peaks. In the Lotru Mts. it is present at Cataracte, and on Mănăileasa Valley. Sometimes kyanite may be associated with spodumene, which also may present gem-quality varieties. The methodology used for the identification of the areas rich in kyanite is similar with that presented in the case of garnets. Only the homogeneous, pearly, greenish-bluish, compact crystals, with sizes of 2 cm (length) x 1 cm (width) x 3-4 mm (thickness) are suitable for gemological purposes. In general, when cutting kyanite, it is recommended to pay attention to the different hardness long the main growth directions.

In Lotru Mts., within the gneisses with cordierite and sillimanite, also white quartzites occur showing inclusions of muscovite and biotite that are similar to aventurines. In the same areas, marmoreal limestones may be present.

Serpentinites. The serpentinites are greenish-bluish rocks consisting mainly of minerals from the serpentine group (lamellar variety = antigorite, fibrous variety - chrysotile, also known as chrysotile asbestos), chemically consisting of basic Mg-silicates.

The serpentinites are the products of (metamorphic) transformation of dunites (olivinites) and of other ultrabasic rocks (pyroxenites, hornblendites) containing Mg-silicates sometimes associated with gabbros; the transformation is due to the effects of aqueous solutions. The name comes from the resemblance of the rocks with the skin of green snakes showing black spots.

Serpentinites show a gemmological interest as ornamental rocks (hardness of 2-5), but it is mainly the minerals they host that are worth to mention. First of all the rock varieties used as raw materials for art objects or even for jewelry (lizardite) will be presented, followed by a range of associated minerals of high gemological potential.

The ordinary serpentinites. Most of the serpentine occurrences are located in the Danubian (autochthonous) Domain of the Southern Carpathians within the Lotru Mts. In the same area (Lotru), serpentinites may be interlayered within the metamorphic rocks of the Sebeş-Lotru Series.

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The serpentinites from the Danubian Domain. The compact and homogenous serpentinites with green hues and gold iridescence are very suitable raw materials for ornamental and art objects. In Vâlcea county, two levels of serpentinites located especially in the area of the Lotru and Latriţa sources within the epimetamorphic series of Tulişa are known. The serpentinites of the first level are components of the middle horizon, consisting of green schists, simultaneously folded. Outcrops are known in the upper basin of Lotru Valley at Zănoaga Verde, Coasta lui Rus, Piatra Tăiată, and Pietrelor peak. In the upper catchment area of Latoriţa Valley (Latoriţa, Midlle Latoriţa and Lower Latoriţa) at Cărbunel, Muntinu Mare, Muntinu Mic, and Urdele other outcrops can be found. About 50 outcrops (lenses) of serpentinites are indicated on the geological map. Mândra sheet (scale 1:50000). Along Ştefanu brook (right tributary of Lotru Valley) also asbestiform serpentinites are mentioned. The upper serpentinite level develops on smaller areas at Ştefan Mt. (the source of Latoriţa).

Eastwards, north from Latoriţei Valley and south from Mănăileasa (within the Latoriţa Series, similar to the Tulişa one) several bodies of meta-ultrabasic rocks and serpentinised metabasites are indicated on the geological map, Voineasa sheet, in the area of Petrimanu Mt., Frătoşeanu peak (about 10 bodies); along the overthrust line between the Getic Nappe over the Danubian Domain at Mănăileasa source, other three smaller lenses are mentioned.

Serpentinites from the Getic Domain. South from Vidra dam (Mândra geological sheet) and till north from Latoriţa Valley, numerous serpentinite lenses (about 70) are figured within the mesometamorphic rocks of the Sebeş-Lotru Series, especially in the area of Muntele Mierii (W), Coasta Benghii, Puru peak and Petrimanu (E). It should be mentioned that the landscape is very abrupt and located at high altitudesm thus prospecting teams of at least two well-equipped members are needed. No information is currently known on the gemological potential of these formations, due to the previous lack of interest on these aspects.

The sizes of these serpentinite bodies vary between 1,6x0,4 km (Ştefanu Mt.), 1,2x0,2 km (Coasta lui Rus), 1,2x0,8 km (Petrimanu), 1,5x0,1 km (Frătoşteanu) and a minimum of 0,2x0,1 km.

Gem-quality minerals associated to the serpentinites. The first mention on green minerals with gem-qualities (chrysoprase) within the formations of the Danubian Domain in the region dates back almost 150 years

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ago (Ackner, 1855). From the Banat area, Superceanu & Maieru (1962) have mentioned chrysoprase from Baia Nouă and Bozovici. The presence of another green mineral (chloromelanite, a jade variety) was pointed out by Pavelescu (1981) from the deposits of the Drăgşan Series in Mehedinţi, Hunedoara and Gorj counties, within schists, eclogites or serpentinites. Thus, good premises exist for a more detailed field investigation in the view of clarifying the presence/absence of the green minerals (jadeite-nephrite, chloromelanite and chrysoprase) in the area of occurrence of the serpentinites from Vâlcea county. For enabling a better identification, below we present some of their main features.

Jadeite-nephrite-chloromelanite and chrysoprase. Under the name of "jade", a green material (rock) used – due to its high durability – by man since prehistory (7000 B.C.) for tools and weapons, is known. Jade was considered by the inhabitants of Central America as a remedy for illnesses ("jade" = kidney). In fact, this material refers to two distinctive mineral species, jadeite and nephrite, which show very similar colour and physical characteristics. Macroscopically they are hardly discriminated.

Jadeite is an opaque Mg- and Na- silicate (pyroxene, hardness = 6,5-7) of white, green, red-brown colour, also known as "kidney stone". It shows a fibrous structure providing the mineral with a high durability. The green colour is due to cromium. It is known from the serpentinites from Guatemala, Mexico, Myanmar etc.

Nephrite is an opaque basic Mg-, Ca-, and Fe-silicate (amphibole, hardness = 6-6,5) of dark – or light-green, white, gray-yellowish, red-brownish colours, known as "sickle stone" in the prehistory. Its name originates from *nefros* (=kidney). It has a high durability. Nephrite is more frequent than jadeite and it is related to the same serpentinitic facies- *in situ* or reworked within younger deposits (Myanmar, China, Australia, Poland, New Zealand etc).

Chloromelanite is a jadeite variety occurring within the formations of the Drăgşan Series (Pavelescu, 1981). It has a green colour stained with black due to the iron. It resembles an opaque or slightly translucent, black-spotted hard serpentinite. The presence of chloromelanite has been evidenced in Vâlcan, Retezat, Almăjului and Sebeşului Mts. in epidote rocks with diopside, in eclogites and serpentinites.

Chrysoprase is another green mineral (microcrystalline SiO_2) that is considered to be the most valuable variety of chalcedony; the green colour is

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due to nickel. The hues are variable, from apple-green to clear green, transparency varies from opaque to translucent and sometimes it is black spotted. The presence of chrysoprase was first mentioned by Ackner (1855) from Coasta lui Rus and Piatra Tăiată, within serpentinite venis, as well as from Jiului valley. Superceanu & Maieru (1966) have noticed chrysoprase in the Ni-serpentinites from Banat and Mehedinţi.

The great variety of colours that jadeite and nephrite – gem materials traditionally used in China since millenia – show in general may have prevented the precise identification of these minerals in Romania until now. They also resemble chrysoprase. For clarifying this aspect, a field campaign for collecting all the hard, resistant rocks reworked in the alluvia in this areas known for their serpentinite occurrences would be necessary. Their gemmological potential could be assessed only in the laboratory after a prior suitable processing. This stage should be followed by a scientific (gemmological and mineralogical) expertise for a species identification in each case.

Peridot (olivine and chrysolite) is a transparent Mg-silicate of green-yellowish (olive) colour (hardness = 6,5-7) used as a gemstone since the antiquity. Peridot is fragile and sensitive to presure. It was mentioned from the serpentinised peridotites from Zebirget Island (Red Sea), and it is currently mined from Myanmar (Mogok). In Romania, the presence of nodules of granular olivine in the basalts from Hoghiz and Racoş is well-known. The old references mention peridot crystals at Rupea (Braşov county). It may not be excluded that they occur also in the area of Vâlcea county, associated to serpentinised peridotites.

Benitoite is a basic Ba- and Ti-silicate occuring in metamorphic rocks associated to serpentinites. It has a sapphire-blue colour. Benitoite was mentioned only from USA (Benito, hardness of 6-6,5), where is occurs in geodes besides natrolite.

Asbestiform cat's eye was mentioned in older papers from the mines from Reşiţa (Toth, 1882) and Vâlcan Pass (Ackner, 1855); it is possible that it occurs also in the asbestiform serpentines fram Ştefanu Valley. This materials is in fact an asbestiform serpentine that underwent silicification. A cabochon-type cut may reveal the so-called „chatoyance" optical characterized by gold iridescence due to the fine asbestos or kyanite fibers.

Sepiolite, or meerschaum is an opaque Mg-hydrosilicate of white-yellowish-greenish colour and a low specific gravity (hardness = 2-2,5). It is

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usually associated with Mg-rich serpentinites and opal. In Romania, sepiolite is known from Tisovița (Mehedinți county) and Măgureni (Maramureş county). It is used for „fantasy" jewels due to its high workability.

Talc. Serpentinites may sometimes be affected by talcitisation. The compact, homogeneous varieties (hardness = 1) of yellowish, greenish-violet or even spotted colours may be successfully used for art objects similar to those realized by the Chinese craftsmen.

Precious garnets. Recently, precious garnets related to the large asbestiform serpentinite ores and their associated products have been mentioned by Amabili & Miglioli (2000) from Canada - Quebec (Jeffrey Mine - Asbestos) and by Bedogne et al. (1999) from Val-Malenco, Italy. In Canada, transparent, gem-quality pink and dark-red grossular (rhomboidal dodecahedrons up to 1,5 cm) and dark-green andradite, „demantoid" variety (1,1 cm) sometimes variety (1,1 cm) sometimes associated with diopside, prehnite and wollastonite have been described. In Italy, the crystallized transparent „demantoid" (rhomboidal dodecahedrons), brown-green to clear-green in colour, occurs in vens within serpentinite or it is embedded into a mass of fibrous asbestos (2-3 mm - 1,6 cm). A similar situation is known from the demantoid-containing serpentinites from West Ural Mts. (Polevaja).

In spite of the fact that in Vâlcea county the asbestiform serpentinites are less frequent as compared to Banat area: Rudăria-Berzasca-Buchin (Caraş-Severin county) and Eibenthal-Tişovița-Plavişevița (Mehedinți county), it is still worth to perform a more detailed prospecting especially in the area of development of asbestiform serpentinites from Ştefanu brook, but also in other areas in Parâng and Lotru Mts. Were numerous serpentinites occur. Additional information could be obtained by the study of heavy minerals from the alluvia in the rivers crossing the areas of development of the serpentinites.

Precious varieties of serpentine. The serpentine group of minerlas includes also precious varieties, such as: lizardite (until now identified only in Tismana Valley - Gorj county); the apple-green, black-spotted antigorite; the transparent grass-green williamsite; stichtite - opaque, reddish, a product of alteration of Cr-serpentinites; bowenite, with a high hardness; and bastite, representing a pseudomorph of serpentine after bronzite. Even the asbestiform serpentinites with fine parallel asbestos veins may represent a raw material with real gemmological attributes, as proved by our tests (Tişovița).

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Some marbles may include serpentinites, giving birth to the greenish Connemara and Green antique varieties, well-known ornamental stones.

3. The magmatic formations (~278,28, representing 4,88%)

This type of geological formations occupies a very small area of the Vâlcea county. Magmatic rocks occur only in the crystalline mountain area especially within the Danubian Domain; they are less represented in the Getic Domain of the Southern Carpathians (granites, granitoides, quartziferous diorites, gabbros, and metamorphosed nepheline syenites, ultrabasic and basic rocks). Theoretically many gemmological resources should have been related to this type of rocks; however, until the present only a few minerals are known, and they lack real gemmological attributes.

Among the rocks of gemmological interest one can mention the pegmatites and eclogites from the Sebeş-Lotru Series in the Getic Domain.

Minerals associated to pegmatites. Pegmatites are leucocrate minerals-rich rocks with coarse mineral components. The granitic pegmatites have the composition of alkali-feldspar granites with quartz anorthoclase (microline and perthite-muscovite-pholgopite) as the main components. After a complete evolutionary process, pegmatites may show a more diversified composition, including also beryl, tourmaline, topaz, apatite, garnets, monazite, rutile, andalusite, scapolites, zircon, zoisite etc. in small amounts. The pegmatites usually occur as isolated bodies (dykes, lenses, nests etc.) associated to crystalline schists or granitic plutons. The pegmatites from Lotru Valley have been studied by Radu Mircea. Hann (1987) considers that all the pegmatites from the Southern Carpathians within the Sebeş-Lotru Series have a metamorphic origin, which explains the scarcity of accessory minerals of potential gemmological interest.

Basically, Hann individualizes two pegmatite types: pegmatites generated by lateral secretion, and pegmatites generated by metasomatic anatectic processes. The large bodies of pegmatites and the dykes are thus considered to have been formed as a result of upwards migation of magmatic fluids along fractures with roots in anatectic-palyngenetic bodies, and not in granitic plutons proper. It seems that this interpretation is pertinent also in the case of some pegmatites from the Apuseni Mts.

Hann groups the pegmatites from Lotru Mts. According to their space distribution into five sectors. The largest body (3,5x1 m) is located at Cataractele Lotrului. Within Căpățânii Mts., the pegmatite form alignments starting with Zmeuratu Mt. (W), Gera peak, Preota – Plaiul lui Stan –

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Muntişor Valley. The Făgăraş Series is totally lacking pegmatites. In Lotru Mts., of a potential gemmological interest might be the pegmatites from Pietrele Albe, Haneş/Steaja, where beryl (up to 30 cm) was mentioned (Marincea & Sabău, 1985) besides other minerals: kyanite, spodumene, apatite, diopside, tourmaline, garnets etc., as well as those from Despina (beryl up to 10 cm, besides monazite and zircon, 1-3 mm). In Căpăţânii Mts. of interest would be the pegmatites with andalusite and cordierite from Ursu peak (W) and Cocora and Văleanu (E). It is worth to mention that more than 470 pegmatite bodies are known in Vâlcea county, thus a real gemological potential must be underlined. Some pegmatites contain pink microcline, which may be used as a gemmological raw material.

Eclogites. The eclogites are granoblastic rocks with no schistosity, mainly consisting of garnet and omphacite. The garnet is an intermediary term between pyrope an almandine, while omphacite is a mixture between diopside and jadeite. Most of the eclogite bodies are embedded in crystalline schists, but they may occur also in kimberlites and serpentinites, or along fracture zones. In general they are homogenous, compact and show a chromatic contrast (green and red) rendering them into suitable raw materials for art or jewelry. Eclogites are typical in the Crystalline area in the Căpăţânii Mts. Located NW from the Vânturariţa limestones (Hann, 1981). They might present a gemmological interest. Most of the bodies are concentrated in the catchment area of Bistricioara (W), Bistriţa, Costeşti and Căprăreasa (E) Valley; on the geological map, Vânturăriţa sheet (1:50000) about 32 lenses are mentioned, some associated to amphibolites. The largest body (2x0,6 km) that crops out on Căprăreasa Valley would deserve a detalied gemmological prospecting. Another large lens (1,6x0,6 km) is located NW from Vânturariţa-Buila area. Other relatively large bodies occur on Cristeşti and Bistricioara Valleys.

In the Danubian Domain (autochthonous, characterized by epitamorphic series) of the Lotru Mts. That is overthrusted by the mesometamorphic formations of the Getic Nappe, the magmatic formations are more diverse and occupy larger areas. A series of relatively large granitic and granitoidic bodies occur, associated to serpentinised meta-ultrabasites and metabasites; on smaller areas, quartziferous diorites, gabbros, meta-diabasites and nepheline syenites are also present. Among them, only the ultrabasic rocks that were presented related to serpentinites are interesting from a gemmological point of yiew. Except for some hornfels with epidote,

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garnets, diopside and vesuvianite formed at the contact of some larger bodies of ultrabasic rocks (Mănăileasa, Petrimanu, Urdele), other magmatic formations do not seem to present a gemmological potential. Possibly some small bodies of meta-diabases might host some meta-chalcedonies and meta-agates. Murgoci (1902) has described from such rocks the new mineral, lotrite, which subsequently has been replaced - without justification - with the pumpellyite. In these contact rocks Murgoci identified grossular associated with vesuvianite, epidote, clinozoisite, and lotrite besides other secondary minerals (ilmenite, titanite, rutile, zircon, apatite), assemblage suggestion a skarn formation (granatites with vesuvianite).

On the geological map, Mălaia, Voineasa and Schela sheets (1:50000), some lamprophire veins are mentioned, considered to have been emplaced during the Mezozoic. In NW Australia, in Argyle area, currently the largest diamond ore worldwide is mined from similar rocks, known as lamproites. These are alkaline effusive Krich rocks, with sanidine and/or leucite and phlogopite. Possibly a closer look on the Romanian dykes from Vâlcea county might show similar petrographic compositions.

ARCHAEOLOGICAL CONSIDERATIONS

Keeping into account that most of the county museums preserve valuable archaeological artifacts using minerals and rocks as raw materials, from local historical sites of various ages, it would be useful to perform a comparative study in order to chek the local vs. extraneous sources. A geologist familiarized with the local geology may provide useful information of the source of lithic objects or building materials. For example, in the case of the sickle built-up of microlithic blades of silex from Valea Răii (Râureni, Râmnicu Vâlcea), more detailed information could be provided related to the type of silex, or seven to the location of the source. The same could be done for the lithic objects identified in the Miloştea (Slătioara commune - Neolithic, bronze), and Ferigile (Costeşti commune, IV-VI B.C.) necropoleis or for the old settlements from Govora sat (bronze), not to mention the Dacian settlements from Ocniţa (Ocnele Mari - Buridava) and the Roman castrum and civil settlements from Copăceni, Rădăcineşti (Berislăveşti commune), Titeşti (Perişani - Arutela commune), Bivolari, (Călimăneşti), Stolniceşti (Râmnicu Vâlcea). Besides the lithic objects, also the source of the clay used for ceramics (quarries, outcrops etc.) could be identified.

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Archeologists and historians may in their turn provide details on the dating of the objects or gems identified in various archaeological sites in Vâlcea county. An interdisciplinary approach of archaeology-hystory and geology-gemmology might bring significant new data on the prehistory and old history of various settlements on the territory of Vâlcea county, thus to a better understanding of the various cultures and populations that have consecutively inhabited these areas since thousands of years.

CONCLUSIONS

Even if the actual known gem-materials on the territory of Vâlcea county are not very numerous (amber, silicified wood, siliceous nodules - silicolites, garnets, kyanite, serpentinites, minerals associated to serpentinites, pegmatites, pegmatitic minerals, eclogites etc.), still there are severl geological formations that show good premises for a further identification of potential gemmological materials. In our opinion, four priorities may be drawn, related to: amber, minerals related to serpentinised ultrabasic rocks (jadeite-nephrite, peridot, precious garnets, precious serpentine minerals, vesuvianite, sepiolite, talc, serpentinitic marbles etc.), minerals related to pegmatites (beryl, tourmaline, apatite, andalusite, cordierite, zircon etc.), and eclogites with a gemmological and artistic potential.

For confirming or rejecting these gemmological presumptions, detailed gemmological prospecting would be needed in the catchment areas of Lotru and Latorița. It should be kept in mind that gemstones have small sizes - sometimes below 1 cm - thus good observation skills are necessary. Similary, a special attention should be given to the thousands of pegmatite lenses that might contain gem-quality materials. Our belief is that further gemmological research in Vâlcea county will provide new gemmological resources that may contribute to the economic development of region, by providing raw materials for private workshops for jewelry and art. Those of you who love nature and fieldtrip, and who love minerals, may bring valuable contribution to the knowledge on the gemmological resources in our country.

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NEW SOURCES OF ZEOLITIC VOLCANIC TUFF IN SĂLAJ DISTRICT

Horea BEDELEAN*

Abstract. Large deposits of zeolitic volcanic tuffs are known from the Transylvanian and Şimleu Depressions. The study was focused mainly on the occurrences from Ortelec (Sălaj district). The results have been compared to those obtained on the volcanic tuff from Mirşid. The analytical procedure consisted in optical microscopy, X-ray diffraction (XRD), thermal analyses, and wet chemical analyses. The aleuritic and pelitic tuffs dominate (more distal as compared with the eruption center) in Ortelec area, while at Mirşid the psamitic, vacuolar psamitic and compact pelitic varieties are present. The diagenetic processes in the tuff complex are of halmyrolitic type. The transformation processes which affect mainly the volcanic glass and the alumo-silicatic minerals consist of: zeolitizations (clinoptilolite), argillisations (illite, montmorillonite), silicifications (cristobalite). Clinoptilolite represents 60-90% of the rock at Mirşid, and 40-65% at Ortelec. The outcropping areas at Mirşid and Ortelec are relatively close, but the tuffs show distinctive structural and compositional features (a different degree of volcanic glass devitrification). The eruptions and the accumulation of the material took place in subaqueous conditions. The large amounts of volcanic material is represented by acidic, calco-alkaline lavas resulted in the intense processes of distension of the Transylvanian and Şimleu Depresssion, beginning with the Langhian.
Key words. volcanic tuffs, Ortelec, Mirşid, zeolite

INTRODUCTION

Zeolitic volcanic tuffs are rocks formed by sedimentation and diagenesis of large amounts of volcanic ash, resulted from the explosive volcanic eruptions. This group of rocks is classified at the transition between the results of volcanic (based on the type of particle generation processes) and sedimentary (according to the transport and accumulation mechanisms) processes.

The volcanic tuffs are included into the fine pyroclastic rocks; according to the type of transport, deposition and geometry of the accumulated bodies, the subaerial tuffs may be subdivided into ash-fallout tuffs, ash-flow tuffs, ash-surge tuffs.

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These primary accumulations are often reworked, leading to the formation of reworked pyroclastites that sometimes are embedded in other sediments (epiclastites) giving birth to mixed rocks (tuffites).

In Romania, the main rock-type containing natural zeolites is the zeolitic volcanic tuff of Badenian-Sarmatian age. Large deposits of zeolitic volcanic tuffs are known from the Transylvanian, and Şimleu Depressions since a long time and they were partly exploited for several purposes. In the last decades, new fields of usage such as agriculture and environmental protection, special cements, concrete and synthetic silicate melts brought a new insight in the research of these minerals and their applications.

The aim of the paper is to locate and characterise some zeolitic volcanic tuffs from the eastern part of the Şimleu Depression from a geological and mineralogical point of view.

MATERIALS AND METHODS

The study was focused mainly on the occurrences from Ortelec (Sălaj district). The results have been compared to those obtained on the volcanic tuff from Mirşid, where currently the largest open mine (quarry) for the exploitation of volcanic tuffs in Romania is to be found. Profiles in the main quarries from Ortelec and Mirşid were mapped and representative samples were collected for mineralogical, petrographical and chemical analyses.

The studied outcrops from Ortelec and Mirşid are relatively closely located (at a distance of 3-6 km one from another); however, the tuffs show some distinctive structural-compositional features (various degrees of devitrification of the volcanic glass) that involve specific genetic conditions for the diagenetic environment.

The analytical procedure consisted in optical microscopy, X-ray diffraction (XRD), thermal analyses, and wet chemical analyses. The equipment used was as follows: XRD - DRON-3 Kα with a Cu anticathode; thermal analyses - DERIVATOGRAPH-1500D with an automatic counting system.

GEOLOGY OF THE REGION

The area where the outcrops from Mirşid and Ortelec occur is located in the eastern part of Şimleu Depression, at the border with the

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Transylvanian Depression, at the north-western limit of Meseş Mountains (north from Moigrad village).

Stratigraphically, the studied tuffs are synchronous with the "Dej Tuff Complex" in the Transylvanian Depression, of Early Badenian age. The deposits are layered, often forming banks of an average thickness of 10-15 m. They were slightly affected by tectonic movements, showing a smooth dip towards SW and being bordered by dislocations with a general NE-SW orientation.

In the neighbourhoods of Mirşid locality, the volcanic tuffs crop out in both flanks of Mirşid valley. The local Badenian succession, according to Clichici (1973) is as follows: the Paleogene Lower Variegated Clays (=The Jibou Formation), sandy marls, conglomerates with carbonate matrix, more than 20 m thick sandy marls, conglomerates, grey marls and, on the top, banks of volcanic tuffs with a total thickness of about 10 m.

The main outcrop of volcanic tuffs is provided by the quarry located at about
200 m from the Jibou-Zalău road. The front of the quarry, oriented NE-SW, is about
150 m in width and is 10-20 m high.

This site has been studied in detail by previous authors and it provided the tuff with the most homogenous composition; this was the reason for opening the largest open cast mine and processing plant in Romania for this type of rocks.

In Ortelec area, the volcanic tuff crops out on the left side of Ortelec valley; here it was locally and occasionally mined. The Badenian deposits consist only of volcanic tuff levels. They are thinner as compared to those in Mirşid area, due to their gradual narrowing towards SW.

The structural-geological and compositional features of the tuff level are first presented in detail in this paper.

RESULTS

Macroscopic features of the volcanic tuffs from Ortelec-Mirşid area

The volcanic tuffs from *Mirşid* area – cropping out and mined in the open cast mine – are massive cinerites forming 2-5 m thick banks, with a compact-massive to porous texture and variable particle sizes – from vacuolar psamitic to compact pelitic. Several coloured varieties may be noticed in the

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quarry: white-greyish, greenish and yellowish. Fine Fe hydroxides films and dendrites of Mn oxi-hydroxides formed on the surfaces separating the various banks.

Usually, the volcanic tuffs banks display a specific succession:

a basal massive, macroporous grey-greenish tuff with an uneven fracture;

compact white-greyish aleuritic-pelitic tuffs with a conchoid fracture;

at the top, white-greenish or yellowish pelitic layered tuffs with a splintery fracture and “limonite” films along the cracks.

In *Ortelec* area only one colour variety of tuff can be observed, the white volcanic tuff. The aleuritic and subordinately pelitic tuffs prevail, indicating a better sorting of the material as compared to the tuffs from Mirşid, thus a distal facies from the eruption centre. The banks are thinner, and the levels at the top are layered (well-stratified).

The volcanic tuffs from the studied area are assigned to the “zeolitic” type, with more than 50 % (the average being 70 %) zeolites in the bulk rock at Mirşid, and “tuff with zeolites”, with < 50 % zeolites (in average 30 %) at Ortelec.

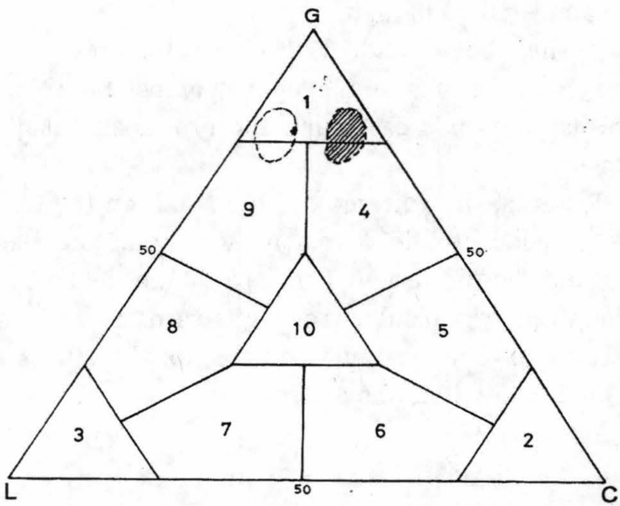

Fig. 1 – Compositional varieties on basis of nature of components of the volcanic tuffs from Mirşid and Ortelec (Sălaj district). (diagram from Anastasiu, 1977)

G = glass ; L=lithic frgments; C = crystals. **O** - Ortelec ● - Mirşid

1 vitric tuff; 2. crystal tuff; 3. lithic tuff; 4. vitric crystal tuff; 5. crystal vitric tuff; 6. crystal lithic tuff; 7. lithic crystal tuff; 8. lithic vitric tuff; 9. vitric lithic tuff; 10. vitric crystal lithic tuff.

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OPTICAL MICROSCOPY

The volcanic tuffs from Mirşid-Ortelec area have a relatively homogenous composition, the small variations referring to the ratio among the chemical elements. According to the C:L:G ratio, the volcanic tuffs in Mirşid area represent the vitric (70 %), and vitric crystal (30 %) types. At Ortelec, most of the tuffs (90 %) are of vitric type, and the rest are vitric lithic type (10 %).(fig.1)

The overall mineralogical composition is uses for defining the petrographical types of tuffs: at Mirşid – rhyodacitic tuffs, at Ortelec – rhyolitic tuffs.

The crystals are below 25 %. The main species are represented by quartz, feldspars (orthoclase and plagioclases), biotite, and hornblende (tab. 1).

Table 1 - The modal mineralogical composition of the volcanic tuffs from Mirşid quarry (Sălaj district)

	Contents (% volume)									
No.	**Glass**	**Crystals**								***Lithic* fragments**
	(G)	**(C)**	*Q*	*Or*	*Pl*	*Bi*	*Hb*	*Fe-OxH*	*C.M.*	**(L)**
M1	70	26	*15*	*1*	*4*	*2*	-	*3*	*1*	4
M2	79	20	*14*	*1*	*3*	*1*	-	*0.5*	*0.5*	1
M3	76	23	*14*	*0.5*	*5*	*2*	*0.5*	*0.5*	*0.5*	1
F2/2	87	12	*10*	-	*1*	*0.5*	-	*0.5*	-	1
F2/3	84	12	*6*	-	*2*	*1*	*0.5*	*2*	*0.5*	4
F7/1	92	7	*6*	-	*0.5*	-	-	*0.5*	-	1

M = samples from the front of the quarry; F = borehole samples in the quarry.
G = volcanic glass, C = crystals, L = lithic fragments.
Q = quartz; Or = orthoclase; Pl = plagioclases; Bi = biotite; Hb = hornblende; Fe-OxH = Fe oxi-hydroxides; C.M. = clay minerals.

Quartz crystals are angular, xenomorphous; the extinction is usually normal, but rarely also undulatory. The quartz grains are usually

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monocrystalline, some are corroded. Their sizes vary between 0.01 x 0.01-0.04 x 0.04 mm. Frequently, the crystals show zeolitic coronas (clinoptilolite).

Feldspars (< 1 %) are represented by both orthoclase and acid plagioclases (the latter presenting polysynthetical twins). Their features are overprinted by alteration processes (argillisation, zeolitisation).

Micas, represented mainly by *biotite* are lamellar, elongated and deformed, and show a brown-yellowish pleochroism. Processes of hydration, Fe-removal, chloritisation, and baueritisation (up to transformation into muscovite) affected the biotite. Pseudomorphs of Fe oxides and hydroxides after biotite lamellae are also present. In some crystals, inclusions of opaque minerals or rutile along the cleavage planes have been noticed.

Hornblende was identified only in samples from Mirşid; it was affected by chloritisation, limonitisation and other types of alteration processes.

Secondary minerals are represented by Fe hydroxides (granular aggregates or films), clay minerals, and zeolites.

Carbonates are rare; they form polygranular aggregates or isolated rhombohedral crystals. Epigenetic carbonates occur in veins and in geodes.

Lithic fragments occur in small amounts and are of metamorphic (crystalline schists, quartzite) and magmatic (andesites from previous volcanic structures) origin. Sedimentary lithoclasts have been also identified, consisting of micritic limestones and siliceous sandstones.

The glass represent the rock matrix (up to 85-95 %). The volcanic glass consists of angular fragments with subparallel branches or "Y"-type shapes. About 40-80 % of the glass is devitrified (zeolitised). The process of zeolitisation also occurs in voids (vacuoles, veins), where the lamellar aggregates of zeolites show a zoned pattern. The zeolites crystals are about 2-10 microns in size, are monoclinic prismatic and have a lamellar habit; the extinction angle is between 3-6°, and the low relief and a very low birefringence in dark grey interference colours are their optical characteristics.

The average bulk **chemical composition** of the rocks from the two occurrences is almost identical (tab.2). It should be noticed that due to the sorting of the primary material and the diagenetic transformations (depletion and enrichment of alkaline and earth-alkaline elements) the chemistry of the tuffs can not be fully correlated with the chemistry of the generating magmas.

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Table 2 - Chemical analyses of some volcanic tuff samples from Mirşid and Ortelec (Sălaj district)

Sample	Oxides (%)								
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	TiO_2	L.O.I.
M.1	65.77	12.23	1.51	2.80	1.70	1.20	0.65	0.25	14.35
M.2	65.33	11.83	1.13	2.94	1.80	1.87	0.48	0.60	14.02
M.3	65.75	11.33	0.65	3.08	1.60	3.01	0.46	0.15	13.97
O.1	71.59	13.03	1.40	2.52	0.80	2.45	1.15	0.20	6.75
O.2	71.73	13.15	1.37	1.79	0.63	2.90	1.45	0.13	6.69
O.3	71.93	13.08	1.33	1.44	0.60	3.30	1.40	0.14	6.59

M – samples from Mirşid; O – samples from Ortelec

The *alkalis* originate from the volcanic glass, feldspars and even biotite. The K^+ and Na^+ contents are higher in the tuff samples from Ortelec, however the K/Na ratio is constantly > 1 in both occurrences. In the volcanic tuff from Mirşid, K^+ and Na^+ are present in smaller amounts, suggesting the continuous depletion under the effect of sea waters. At Ortelec, the depletion was less pronounced, probably due to the temporary contact with sea waters; the recorded values are close to the typical ones for an unaltered extrusive rock (rhyolite).

X-ray diffraction

The X-ray diffraction (XRD) evidenced the presence of the zeolite species *clinoptilolite* in all the investigated samples. Clinoptilolite is in fact the common zeolite in almost all the zeolitized volcanic tuffs occurrences in the Transylvanian and Şimleu Depressions.

Besides it, quartz, montmorillonite and illite, as well as cristobalite in samples from Ortelec were the other species identified by XRD (fig. 2).

At Ortelec, the peaks intensity is low, suggesting the presence of an amorphous matrix (unaltered volcanic glass) in higher amounts as compared to that in the samples from Mirşid. In the same samples it is worth to mention the presence of low temperature (cubic) cristobalite, besides quartz, illite, interstratified clay minerals, and clinoptilolite.

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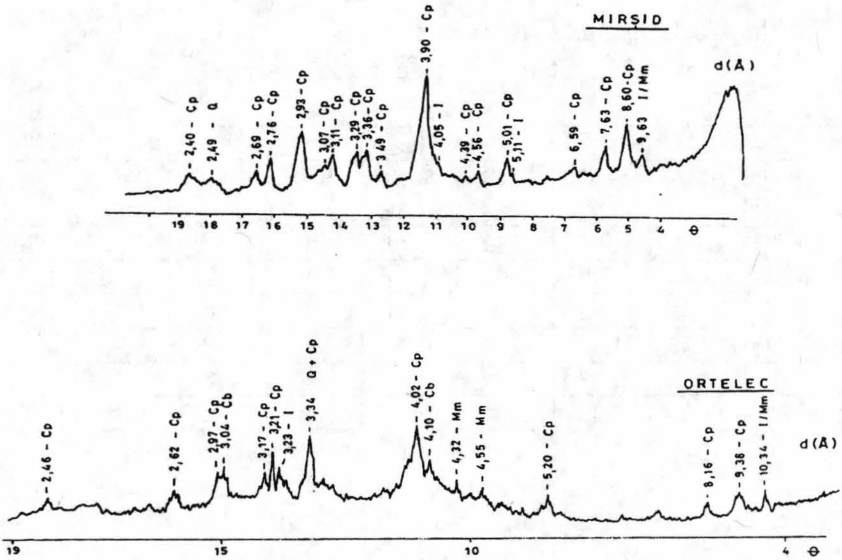

Fig.2 – XRD patterns of volcanic tuffs from Mirşid and Ortelec (Sălaj district).

Cp=clinoptilolite; I/Mm=illite/montmorillonite interstratification; Mm=montmorillonite;
I=illite; Cb=cristobalite; Q=quartz

Thermal analyses

Thermal analysis is one of the most suitable methods for identification of zeolites, especially for discriminating between heulandite and clinoptilolite.

The DTA diagrams evidenced the loss of zeolitic water around 200 ◦C, temperature which is typical for clinoptilolite. The loss of water is continuous, genarating a broad thermal effect (between 125 ◦ and 300 ◦C); it is accompanied by a loss of weight corresponding to the amount of water (fig.3).

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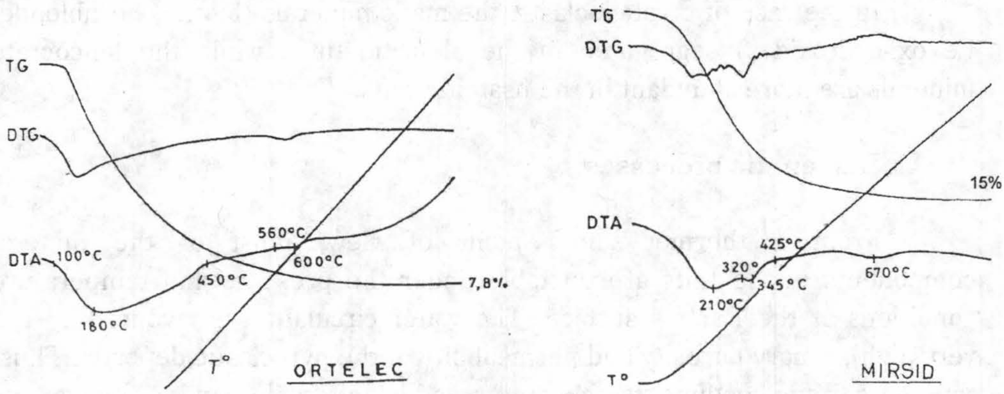

Fig.3 – Thermal analyses on volcanic tuffs from Mirşid and Ortelec (Sălaj district).

The endothermic effects between 450 °C and 600 °C are typical for the release of the last amounts of water preserved in the zeolites structure. Clinoptilolite still preserves zeolitic water up to 700 °C, when the last endothermic effect is recorded.

Due to the small amounts, the clay minerals are not evidenced by thermal analyses.

At Mirşid, as a consequence of the relatively large amounts of clinoptilolite the zeolitic water-related weigth loss between (350 °-700 °C) represents 15% of the bulk rock, while in samples from Ortelec in the same temperature range, the weight loss represents only 7.8%.

Genetic considerations

The pyroclastic rocks from Mirşid-Ortelec are considered to represent *fall-out* tuffs formed by subaerial volcanic eruptions. The volcanic ash was transported by wind, and the deposition (accumulation) was realised under the water surface, being subject to intense diagenesis. The explosive, subaerial nature of the process is documented by the angular, concave-convex shapes of the volcanic glass fragments. During the sedimentation the material is sorted, the process leading to the discrimination of tuff layers with various glass / crystalloclasts ratios.

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In the case of crystalloclasts, the mafic minerals (biotite, hornblende, Fe oxi-hydroxides) segregated in the aleuritic tuffs, while the leucocrate minerals are more abundant in the psamitic tuffs.

Diagenetic processes

From a thermodynamic point of view, most of the mineral components of the tuffs are unstable under the pressure and temperature conditions at the Earth's surface. The water circulation is favoured by the very high primary porosity and permeability of the pyroclastic deposits. Thus, the pyroclastic sediments become readily alterable under exogenous subaquatic conditions (argillisation and zeolitisation occur) and are diagenetically transformed during burial (compaction, cementation, and mineralogenesis).

In the pyroclastic rocks diagenesis takes place in the interstitial space and depends on the relationships between the particles, on the depositional environment (chemistry of the interstitial solutions) and the evolution of the post-depositional processes (compaction, cementation, dissolution).

The intensity of diagenesis depends on several factors: the substrate nature (chemical and mineralogical composition), the chemistry of the solutions, pH, Eh, pressure.

According to Bedelean and Stoici (1984), the diagenetic processes in the "Dej Tuff Complex" are assigned to halmirolysis. These processes refer to the synthesis and transformations taking place under the influence of marine water during all the stages of diagenesis (syngenesis, anadiagenesis, epigenesis).

The submarine alteration processes, i.e. *halmirolysis* is controlled by some relatively constant factors: an alkaline pH $\sim$ 9, temperatures below 100 °C and a high salinity of sea waters.

The hypergenous processes recorded a temporal evolution, starting with syngenesis, followed by the changes due to the alkaline sea environment (halmirolytic transformations) and ending with supergenous-epigenetic modifications.

The transformation processes firstly affect the volcanic glass and the alumo-silicates; according to the XRD, thermal and IR data they are represented by:

- zeolitisation, with the formation of K-clinoptilolite

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- argillisation (illite, montmorillonite)
- silicification (cristobalite, opal-CA)
- calcitisation (calcite)

At Mirşid zeolitisation is the dominat process (in average K-clinoptilolite represents 60-90 % of the rock); it is followed by smectitisation (montmorillonite contents ~ 10-15 %, suggesting a relatively more alkaline pH) and sporadically, calcitisation (probably of an epigenetic nature).

At Ortelec the intensity of diagenetic processes was lower (glass representing between 40-65 % of the rock); the neoformation minerals are, according to the decrease of their frequency: zeolite (K-clinoptilolite) - 30-40 %, clay minerals (illite) - 5-10 %, cristobalite - 2-3 %, sporadically calcite (only in the base layer, where it may reach up to 60 %).

This pattern of distribution of the diagenetic minerals suggest different deposition and transformation conditions for the two occurrences, in spite of the short distance between them. Probably at Mirşid the transformations took place in a litoral epicontinental facies, while at Ortelec they might have been caused by an occasional contact with water in coastal areas of the same sedimentary basin, that led to a reduced intensity of halmirolysis. Another hypothesis may be related to a change of the sea water chemistry due to a fresh water supply from the continent (with a neutral pH), Ortelec area being located at the border of Meseş crystalline unit (being currently under uplift in those times), probably near the shore line; this idea is also supported by the reduced thickness of deposits in this occurrence. Here also the epigenetic processes were more extended in some tuff levels.

The differentiated degree of transformations in horizons belonging to the same stratigraphical sequence is also confirmed by the XRD and thermal data.

Zeolitisation - The formation of zeolites in pyroclastic rocks is the result of the chemical reactions between the volcanic glass and the soluble salts from the interstitial (pore) waters. Zeolitisation mainly affects vitroclasts, that are gradually replaced by prismatic-lamellar zeolite microcrystals. The micron or submicron crystals of zeolites may also fill the voids in the rocks or occur in veins. In the same time the partial substitution of quartz and feldspar crystalloclasts may take place from the borders to the centre, or the deposition of zeolites in microgeodes, as tabular – rarely isometric crystals.

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The identified zeolite species are K-clinoptilolite and Na-clinoptilolite. The devitrification of glass (mainly zeolitisation) is related to the presence of pores, bordered by zeolite (clinoptilolite) crystals with a radial display. Zeolitisation generally affects the whole glassy mass, zeolites replacing glass fragments, the glass in the matrix and even crystalloclasts.

The genesis of zeolitic minerals has to be considered in relationship with the "generating" rock. Previous studies on the genesis of clinoptilolite in the volcanic tuffs from Mirşid-Ortelec area have shown that the geochemical process of zeolite formation took place in parallel to the transformation of the ash into the bulk rock.

Zeolites form by alteration of volcanic glass (halmirolysis) at temperatures below 200°C (until the temperature of the environment is reached) in epigenetic processes under an alkaline pH (~ 9).

The primary alkalis content of the volcanic glass has been high, and their fast release led to high pH conditions in a relatively closed environment. This causes a fast dissolution of SiO_2 at pH < 9 and its enrichment in the tectosilicatic structures, besides Al_2O_3 and alkalis.

The typical zeolite in the tuff assemblages from Sălaj district is **K-clinoptilolite.** This mineral forms micronic centripetal lamellar crystals, inside the glass fragments, the glass core being the last to be replaced. In the pores of the tuff or in the veins the zeolite crystals give birth to zoned, pseudo-amygdaloidal textures, with the idiomorphic, best crystallized crystals oriented towards the centre of the void.

Argillisation mainly affects the vitroclasts. The XRD patterns indicated the presence of illite, montmorillonite, interstratified Na-montmorillonite, Ca-montmorillonite, interstratified mica-illite, illite-montmorillonite etc. (Bedelean et al., 1994).

Silicifications (formation of cristobalite) and *calcitisation* are less represented processes, occuring only in the lower levels.

DISCUTION

The structural and compositional characteristics of the pyroclastic rocks in Mirşid-Ortelec area suggest subaerial volcanic sources and accumulation under submarine conditions.

The volcanic activity had an exclusive explosive nature. For that time interval, no pyroclastic ignimbritic flows have been recorded in the studied

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area, as in the case of the Transylvanian Depression. The formation of the Badenian pyroclastic deposits took place during a very intense volcanic stage, associated to the Styrian tectonic events. Acidic, calc-alkaline lavas resulted from the intense distension processes active starting with the Langhian were the sources of the large volume of volcanic material.

The intrabasinal volcanism that started with the formation of the "Dej Tuff" took place along peri- and intrabasinal crustal fractures (Mârza & Meszaros, 1991).

Concerning the eruption centres that have generated the volcanic material, we agree with Paucă (1962), who had identified a volcanic centre in Lighet Hill close to the village Chilioara, that most probably had an explosive activity, which might have been the source of the pyroclastic material deposited in Şimleu Basin. The large amount of volcanic ash accumulated during the Badenian in both Şimleu Basin and the depressions in its neighbourhood (Transylvanian and Baia Mare Depressions) probably was also generated in the volcanic chain of the Eastern Carpathians, where the volcanic activity has been extremely intense.

The slight vertical and horizontal variation of the chemical composition of the pyroclastic deposits suggests a single major magmatic source for all the areas (Transylvanian, Şimleu and Maramureş Depressions).

The material originating from the subaerial explosive eruptions was spread on large areas probably under eolian circumstances.

The accumulation of the material took place in a marine basin in relatively calm waters. This is suggested by the lack of internal depositional structures and by the common lack of lateral variations. The rocks have a parallel stratification and the individual layers are decimetre-meter thick. Also the rocks are well-sorted, often showing a normal grading.

No marine interlayers have been identified, thus it is supposed that the volcanic activity and the accumulation of the material were continuous, and they took place in the close neighbourhood of the studied area.

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Studii şi cercetări, Geologie – Geografie 9, 2004, Bistriţa, p. 153-157

PARTICULARITIES OF THE MICROSTRUCTURE OF OLD CERAMICS

Voicu DUCA*

THE GOAL OF THE STUDY

The investigation carried out on pre-Roman ceramics collected from Obreja and Râpa Roşie was aimed to evidence the mineralogical and the specific microstructural features induced by ceramics' processing.

ANALYTICAL METHODS

Conventional and unconventional (positive phase contrast) optical microscopy, X-ray diffraction (XRD) and infra red (IR) spectroscopy were used for this study.

RESULTS AND DISCUSSIONS

The presence of carbon in the pores of the ceramics body is often noticed when burning was performed under reducing conditions. Results of experimental work show that carbon may be accumulated also under quasi-oxidising burning.

The non-engobe ceramics is characterized by a superficial, heterogeneous pigmentation at the surface, with hues determined by variable values of the Fe/Ca ratio (for Ca=100) according to a scale ranging from 28-52 – for white and black hues, ~ 228 – for reddish-black, white-red – about 151, black and red 112-133, monochromatic red 170-210 (Noll, 1991).

The superficial colour heterogeneity noticed in the case of some of the investigated samples is the results of a cursory homogenisation of clay, as evidenced also by the various degree of sinterisation of mineral grains in some neighbouring areas.

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Numerous artiefacts are impregnated with carbon in the central area of the ceramic body; at the surface, only a few, darker spots are visible. Other times carbon is missing from the external part of the product (Duca et. Al., 1999 a,b).

Another cause for the heterogeneous distribution of the black pigment is the local variation of the **porosity of the ceramic body**. A faster vitrification of the surface of the non-engobe body, as compared to its central area, is due to the direct contact with the flame.

In the case of englobe, the component minerals are more fusible – due to both the smaller size of the grains, and the adition of CaCO3. A superficial sinterisation process takes place, leading to the same result – a decrease of porosity.

As a consequence, no pores are available in the englobe for the carbon to fill-in. This results in a clear distinction between the areas with a high vitrification degree, as compared to those showing a residual porosity. The vitrified engobe, similarly to an envelope surrounding the ceramic mass, drastically limits the access of oxygen, thus leading to the separation of elementary carbon within the pores of the ceramic body. The porosity measurements carried out on some imported ceramic samples from Obreja and Râpa Roşie confirmed significant differences between the ceramic body and the engobe, as well as between the central part of the body and its surface.

The ceramic body reaches a maximum porosity of 18-20%, and the pores are 26-83μm in diameter. The porosity is controlled by specific grain-sizes, as follows: quartz 3,5-413 μm, feldspar 12-48 μm sericite 7-11 μm, muscovite 9-36 μm, biotite 6-28 μm.

The **engobe** applied over the ceramic body contains small amounts of quartz (<6%) with a maximum diameter of 12 μm, relics of feldspars (<5,3%) up to 8 μm in diameter. The porosity of the engobe records values < 4-6%, in some cases, vitrification causes a massive obstruction of the intergrain spaces, which usually represent <4%. Under such circumstances, some fragments suffer an incipient auto-glazing process - at temperatures above 800°C, catalyzed by alkali-rich minerals such as K-illite or CaO. Certain rations reached between the main mineral components of the clays may lead to low eutectics.

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Ca and Mg contents play an important role during vitrification: chemical analyses indicated values of 4,5-5,1% CaO and of 1,3-1,9% MgO. The cumulative effect of the flux oxides leads to the increase of the glas content up to levels indicated in the X-ray patterns by a specific broad band (at values between 6-18Φ) showing an intensity proportional with the concentration of the glass phase.

The presence of calcium and magnesium in the ceramic body and engobe determine the formation of measurable amounts of gehlenite and wollastonite, and also contribute to the glass formation as a result of the initial flux effect. The studied samples show fine grain-size within the engobe, that constitutes the main cause of a faster melting of the component minerals.

Another interesting aspect refers to the **role of basicity – pB** in the genesis of neoformed minerals. Baltă and Spurcaciu (1985) used this concept in the technique of synthesised silicates investigation; the authors have defined pB as the capacity of cations to be screened by oxygen, according to the degree of disposability of oxygen for electron donation.

For example, wollastonite contains in its lattice two electropositive elements, Ca and Si, showing extremely different pB values - (~88 for Ca and ~47 for Si). The high difference in their pB's (the value of the ΔpB) - besides the presence of Fe and alkalis - leads to temperatures lower than 800 °C for the wollastonite lattice formation. The supply of the third element, Mg from diopside (pB~81 for Mg) causes an increase of the crystallisation temperature at ~950 °C. Small differences are noticed between Mg-Si as concerns basicity: ΔpB =34.

Another example is mullite, a mineral showing ΔpB-15 between Al and Si. The temperature of formation of ordinary mullite, with a ratio of 3Al2O3:2SiO2, compensates the reduced reactivity between the two oxides. Thus, temperatures above 980-1050 °C are usually needed. The ratio between the two oxides changes in the favour of Al2O3 as temperature increases. Still, there are cases when the presence of melting agents such as iron, alkalis etc. sometimes reduces the formation temperature of mullite below 850 °C.

According to several authors, concentrations of CaO>2% in the clay represent strong inhibitors of mullite formation - but no final conclusions have been drawn yet. For example, small amounts of mullite have been detected in two imported sample collected from Obreja.

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The role of the environment inside the kiln may be emphasised by the behavior of diopside: it crystallises at ~800 °C under oxidising conditions, and at ~950 °C under reducing ones.

The main cause for this difference is the decomposition of calcite at - 750 °C under oxidising conditions, while under reducing condition this process takes place at temperatures of ~850 °C. The Ca needed for the wollastonite lattice formation becomes available only after calcite decomposition, this fact causing also the delay of formation of other minerals such as plagioclases - especially anorthite. In the studies samples, the latter probably did not have suitable crystallisation conditions, or it is present in amounts below the detection limit of the XRD (4%).

The microscopical investigation did not evidence the presence of anorthite crystals; if they however formed, they show reduced sizes and are included in the microcrystalline and glassy matrix.

Another aspect of prime importance in the study and reproduction of the burning conditions of old ceramics refers to the usage of wood as combustible: wood gives birth to an environment inside the kiln totally different than that obtained by using liquid or gaseous combustibles. Thus, corrections should be made when temperature evaluations are currently done.

The positive phase contrast study (sample 4 Obreja) revealed the presence of acicular crystals with a refractive index very close to that of glass (nD~1,556) formed within the glass mass at the surface of the engobe. Due to their optical features, these crystals are difficult to detect when using conventional microscopical techniques. This topic will be studied in more details in a further investigation.

The compression induced by the ceramic body to the superficial glass cover, 8-24 μm thick, shows values ranging between 50-80 daN/cm2. Due to its reduced thickness, the vitrified layer formed at the surface of the engobe may crack in some points under the effect of compression. However, in general the effect of the compression within the glass envelope is beneficial for the overall resistance of the ceramic body (Freund, 1965; Duca *et.al.*, 1976).

The contraction taking place during cooling of ceramics is most probably influenced by the presence of cristobalite in concentrations >4%; it refers in fact to a discordered cristobalite tributary to its metacristobalite

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precursor. Sample 4 shows a peculiar microstructure related to burning temperatures obviously higher as compared to the other ceramics bodies.

CONCLUSIONS

The particularities of the imported ceramics identified at Obreja and Râpa Roşie plead for an advanced technique, indicated by:

- a selected grain-size fraction used for obtaining the engobe
- the usage of CaCO3 as flux agent in the engobe composition
- auto-glazing was noticed on both the engobe of the imported ceramics, and some samples of autochthonous ceramics

The following mineral components have been identified: mullite, quartz, gehlenite, diopside, wollastonite, cristobalite.

Among them, gehlenite is unstable; after partial dissolution is causes textural changes and microstructural deterioration. Wollastonite is also submitted to partial Ca-levigation accompanied by gehlenite alteration; this process contributes to the decrease of mechanical resistance of the ceramic body.

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Studii şi cercetări, Geologie – Geografie 9, 2004, Bistriţa, p. 159-164

MICROSTRUCTURE OF SOME RAW CERAMICS MATERIALS AND PLASTERS USED FOR HISTORICAL MONUMENTS

Voicu DUCA*

THE GOAL OF THE STUDY

Ceramic materials, such as bricks, used for several historical constructions: the Clock-tower from Sighişoara, Alba Iulia castle, the Valea Viilor fortified church, the IInd line of fortifications from Cluj have been studied.

The natural alteration-deterioration processes lead to changes in the microstructure of the building materials and to the accumulation of active neoformation minerals. The lack of preliminary petroarchaeometrical assessments for the Romanian monuments is a handicap as compared to the European requirements. The present study continues the series of papers intended to draw the attention of the Ministry of Culture and Religious Affairs on such aspects; if not approached correspondingly, they may severely affect the harmonisation with the international legislation.

ANALYTICAL METHODS

The minerals have been investigated by using optical microscopy and photography (at macro-scale) of typical forms of alteration-disintegration.

RESULTS AND DISCUSSIONS

Specific features related to the raw materials

The source of raw materials for bricks is always represented by a local clay; thus, comparing samples from remote monuments may be difficult sometimes. The clays are characterised by specific mineralogical, and grain-

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size features; however, the clay deposits show several similarities that can be recognised in the final product, *i.e.* the bricks.

The stratiform accumulations of clay are richer in <2μm particles in the top, this part being the most accessible and thus the primary source of raw materials for bricks.

The formation of this grain-size fraction is due to the increase of specific surface as a result of exogenous factors – organic matter supply, variable chemistry of the meteoric waters, contact with circulating waters sometimes rich in carbonates that imprint a basic pH character.

Under the above mentioned conditions, an enrichment in free SiO2 is achieved in the upper zone due to the enhancement of the solubilization of the fine fraction of clay minerals, that favours the montmorillonite generation as a neoformed mineral.

It must be emphasised that below 5-6m depth the amount of salts decreases in correlation with the proximity of the phreatic level, the mobility of the liquid mass becoming the main difficulty for the soluble minerals accumulation. Factors such as the precipitation waters' supply control the amount of salts forming in the pores, process that takes place at the surface of the rock.

The presence of variable amounts of sand, as degreasing agent, significantly influences the clays' contraction in dry conditions, as well as after firing; in the same time it greatly affects the workable plasticity of the raw material when processed. The clay homogenisation before the fabrication of bricks is one of the stages that determines a constant behaviour of the product when baked, and then when used as a building material. Often this homogenisation stage is skipped or it is performed superficially, thus leading to a heterogeneous development of the deterioration-alteration processes in time.

The heterogeneous values of porosity within the same brick, especially the dominance of the fine porosity leads to specific alteration-deterioration processes, less typical for such materials, such as alveoli-formation. The small diameter of the capillaries determine an extremely slow flow of water that may freeze, thus developing pressures over 2000 daN/cm^2. The simultaneous presence of hexagonal freeze-„cells" leads to the dislocation of the material in the centre of the cell that evidences an unidirectional pressure. The walls separating these cells are submitted to a symmetrical efforts, thus they are

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less affected and form a separating surface between the alveoli. Such processes have been identified in the walls consisting the Gate no.2 from Alba Iulia.

Finally, the firing temperature represents one of the factors that, besides the mineralogical composition and the grain-size characteristics determines the microstructure, and thus influences all the physical-mechanical and chemical properties of the product. Firing at low temperatures – little above 800°C, leads to the formation of textures with a pore volume usually above 30%, which dramatically affects the materials' resistance.

The decomposition of clay minerals at temperatures above 550°C with the formation of metakaolinite determines the separatin of Al_2O_3 and SiO_2 with sub-micrometer sizes, the two oxides thus showing a very active reaction surface.

Al_2O_3 resulted after firing has a maximum solubility between 600-780°C, thus it becomes stable only in the metakaolinite fired above 800°C.

SiO_2 resulted from the clay minerals after dehydration at 550°C reacts with the water vapours from the kiln; the maximum dissolution during cooling is reached at about 250°C (Fleming, 1982 in Dove, 1995). The salts present in the clay act as catalyzers of SiO_2 dissolution; the process records maximum values for NaCl concentrations between 4-6% (Fournice, 1983 in Dove, 1995).

Silanol groups form at the contact of SiO_2 with H_2O, that by ionisation produce mobile protons – the process leading to the change of the superficial charge (Parks, 1984, in Dove, 1995).

Very complex processes take place in bricks where salt-containing solutions circulate, an important role being played by $Al(OH)_3$ that determines the decrease of the superficial activity of silica (Dove, 1995). The intensity of Al-sorption between the SiO_4 tetrahedra increases at lower pH values (Iler, 1979, in Dove, 1995).

A similar role is played by the Fe_{2+} and Fe_{3+} hydroxides. The reaction with the surface of the silica grain ends with the formation of a film of Fe hydrosilicate – under oxidising conditions, or goethite – under reducing conditions (Dove, 1995). The microscopical analysis of bricks samples evidences the ubiquitous presence of a film of Fe-oxides around quartz grains; in general this features is inherited from the raw material, in which the Fe hydroxides form films as a results of opposite charges.

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Micas are among the relic materials that undergo superficial transformations; in correlation with the firing temperature, birefringence gradually decreases.

Nagy (1995) identified small holes on the basal surface of micas when water of pH 5,5 at 22°C was present, in which fibrous islands of disordered $Al(OH)_3$ were noticeable. The feature was noticed at micas that were not fired, but it is significantly enhanced in fired micas with frequent structural defects in the thermally-disturbed, thus much more unstable lattice.

The degree of basicity, pB, is one of the factors that causes significant changes at the contact between quartz grains and other minerals. The large difference of pB values at the contact between quartz grains/$Ca(OH)_2$ (portlandite) determines surface reactions within plasters.

The neoformation component in the reaction corona shows the optical characteristics of a mixture of tobermorite $CaO.SiO_2.2H_2O$ and afwillite $3CaO.2SiO.3H_2O$. The presence of $Ca(OH)_2$ besides Na in the saline solutions determines alkaline pH values, thus major consequences on the SiO_2 stability; the latter reacts, giving birth to a mass of hydrated Ca-silicates mobilised along the intergrain spaces.

The incomplete sinterisation of the bricks backed at low temperatures results in an insufficient formation of connections between the relic mineral grains and metakaolinite. The volume of such bricks becomes a space for salt solutions' circulation, that cause a mixed chemical corrosion and provide place for the effect of mechanical pressures generated by salt crystallisation, or by pore water freezing.

The circulation of capillary solutions, interrupted by stages of salt precipitation and crystallisation often transform the bricks' pores into genuine crystal storage spaces – thus into major risks for the historical monuments.

The presence of salts involves major changes in the restoration-conservation projects, due to the need for total replacement of whole areas in the walls. In the absence of petroarchaeometric studies, in many cases salt-saturated bricks are covered by plasters that after short whiles are peeled down under the effect of crystallisation pressures. A classical case is represented by the Steingasser tower from Mediaş (Duca, 2003).

Recently, on the occasion of some investigation concerning the Clock-tower from Sighişoara, gypsum crystals up to 2 mm in length have been identified in the pores of the bricks.

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When such crystals grow, pressures of over 250 daN/cm2 develop; obviously any type of restoration work that does not consider these details is unprofessional, will present further risks and will not justify the costs.

Pressing the clay mass with insufficient degreasing agent amounts and backing at low temperatures will eventually produce the disintegration of the brick body thin films – the cleavage planes resulting from current dissolution processes but also from salt crystallisation. The oriented texture imprinted by this technology diminishes the cohesion along planes located perpendicularly to the applied force, leading to a preferential dilatation along these directions; under cooling, a fissure system occurs that favours the circulation of solutions and that causes all the above mentioned effects. After a relatively short while the bricks are exfoliated, and the monument as a whole starts to deteriorate irreversibly.

CONCLUSIONS

The characteristics of the raw materials that influence the microstructure of the bricks are presented. In parallel, aspects related to the chemical activity of the oxides from metakaolinite are underlined.

The processes that unleash transformations leading to the genesis of neoformation minerals are stressed.

Microstructural changes intensely influencing the properties the ceramic material are assessed.

The present paper is intended to initiate a wider discussion on onse of the chapter of restoration work that currently is SYSTEMATICALLY VIOLATED – it refers to the content of Law 157, of October 7th, 1997 that ratifies the Granada Convention of October 3th, 1985. Article 8 of this law states:

ART. 8.

In the view of limiting the risks of physical degradation of the architectural heritage, **each part assumes the following:**

1. **to support the scientific research for identifying and analysing the damaging effects of pollution** and for defining ways to reduce or eliminate these effects;

ART. 13

For facilitating the application of these politics, each part commits to develop, in the frame of its own political and administrative

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structure, **an effective co-operation, at all levels, between the compartments responsable for conservation**, cultural activities, environment and territorial planning.

ART. 16.

Each part commits to favour the instruction leading to various specialisations and professions **in the field of conservation of architectural heritage.**

The conflict of financial interests between institutions and experts is doubled by an almost hostile attitude of the academic environment towards the Granada Convention, that starting with 2007, besides other European regulations, will be a pre-requisite for any activity related to historical monuments. Not for the first time, initiatives that are meant to set up a curricula in the field of building materials' pathology – essential for training experts on restoration-conservation at European level – are obstructed.

The current deplorable situation is proven by the following facts:

1. petroarchaeometry is not recognised as an independent speciality.
2. petroarchaeometrical studies, a pre-requisite for projects related to monuments – are not included in any type of financed research. Such an attitude reveals major lack of knowledge on elementary principles of material science; no logic justifies decisions of performing restoration works at the surface of materials with an unknown status of deterioration.
3. systematic obstruction from CNCSIS of projects on this topic in the last 6 years.

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Studii şi cercetări, Geologie – Geografie 9, 2004, Bistriţa, p. 159-164

PETROGRAPHY OF THE LITHIC MATERIAL IN THE ARCHAEOLOGICAL SITE FROM STUPINI

Marius HORGA*

Abstract. Archaeological material attributed to several epochs has been identified in the site from Stupini (Bistriţa-Năsăud district), among which lithic material (fragments of grinders, lat. mola manualis), attributed to the Roman period; the latter is the subject of the present paper.

The petrographical and mineralogical study was performed by using the transmission polarising microscope on this sections, and X-ray diffraction. Thus it was found out that two major types of rocks were used as raw materials for the Roman grinders discovered at Stupini: magmatic and metamorphic.

It was noticed that one of the grinder found at Stupini consists of rhyodacitic ignimbrite (sample R12), while the other two ones are of metamorphic origin: a cataclastic micaschist (sample R13) and an ocular gneiss (sample R14).

The source for the rhyodacitic ignimbrite is considered to be the ignimbrite massif from Ciceu, in the neighbourhood of Ciceu-Corabia locality (Bistriţa-Năsăud district).

The raw materials of metamorphic origin, the ocular gneiss and possibly the cataclastic micaschist may originate in the metamorphic rocks of the Rebrea III Lithogroup (Nichitaş gneiss) that are components of the Rodna Mountains.

Rezumat. În situl arheologic de la Stupini (judeţul Bistriţa-Năsăud) au fost descoperite materiale arheologice atribuite mai multor epoci, dintre care un material litic (fragmente de râşniţe), atribuit perioadei romane, face obiectul studiului de faţă.

Studiul petrografic şi mineralogic s-a realizat prin microscopie polarizantă prin transmisie, pe secţiuni subţiri şi prin difractometrie de raze X. Determinările întreprinse asupra rocilor folosite ca râşniţe în epoca romană, descoperite la Stupini, au permis încadrarea acestora la două mari grupe de roci: magmatice şi metamorfice. În urma studiului probelor de râşniţe de la Stupini s-au constatat următoarele: una dintre probe a fost confecţionată din ignimbrit riodacitic (proba R12), iar pentru celelalte două s-au întrebuinţat roci metamorfice de tipul micaşistului cataclazat (proba R13) şi a gnaisului ocular (proba R14).

Ocurenţa materiei prime de ignimbrit riodacitic este masivul ignimbritic de la Ciceu, din apropierea localităţii Ciceu-Corabia, judeţul Bistriţa-Năsăud.

Gnaisul ocular şi probabil micaşistul cataclazat îşi găsesc sursa în metamorfitele Litogrupului Rebra III (gnaisul de Nichitaş), care participă la edificarea Munţilor Rodnei.

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ARCHAEOLOGICAL DATA

The lithic material under study was collected from the Stupini archaeological site, located in the southern part of Bistriţa-Năsăud district. The area is located in the north-eastern part of the Transylvanian Plain, within the unit known as the Transylvanian Highlands (rom., Câmpia de coline înalte a Transilvaniei) (Chintăuan, 2000). The Dacian-Roman site from Stupini is placed north from the homonymous locality, between Stupini and Brăteni, on the left side of Brătenilor Brook, on both sides of Bândei Valley.

The investigated archaeological material (fragments of Roman grinders) has been recovered during the diggings performed in the Dacian-Roman site from Stupini and currently belongs to the Museum Complex of the Bistriţa-Năsăud district. The information on the lithic material is original, no previous studies being carried out on it previousy.

The lithic samples were provided by courtesy of archaeologist dr. Corneliu Gaiu. The archaeological data related to the studies material are according to Gaiu (1999).

The Dacian-Roman site from Stupini, identified in 1995, is located in an area that provided an optimal habitat for the inhabitants of those times, starting with the Bronze Age till the VI-th century a. Chr. (5 dwellings) and VIII-IX-th centuries a Chr. (9 dwellings), with short time intervals of inhabiting hiatus. Until present three research campaigns were carried out in the region, leading to the identification of 27 dwellings, 15 provision pits and two open fireplaces, of which 11 dwellings and 12 provision pits belong to the Dacian-Roman period (Gaiu, 1999).

The Dacian-Roman settlement was established in the first half of the II-nd century as indicated by the identification of a fibula showing a clearly profiled body, similar to those found in other contemporaneous settlements in the province (Gaiu, 1999). The Dacian-Roman site consists of both surface dwellings, and partly underground ones, the latter being more frequent that the first ones. The proivisions pits were located in the neighbourhoods of the dwellings; after their desertion, the pits were covered by various domestic waste, such as: fragments of grinders, ceramic fragments, animal bones, fragments of fireplaces.

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SAMPLES AND INVESTIGATION METHODS

The petrographical and mineralogical analysis concerned a number of 7 samples. Among them, samples R12-R14 were collected from the Stupini archaeological site, while samples M1-M4 represent reference samples used as comparative material for the identification of the ancient sources; the latter were collected from the Ciceu eruptive massif area, in the neighbourhood of Ciceu-Corabia locality (Bistrița-Năsăud district).

Our study was focused on establishing the macroscopic and microscopic features of the investigated samples (microstructure and microtexture), defining the mineralogical composition and the petrographical types, finally leading to the identification of the source areas for the raw materials.

The petrographical and mineralogical investigation consisted in:

- Transmission polarising microscopy on this sections, for defining the physiographic characteristics and mineral composition of the rocks. The equipment used was a Nikon stereomicroscope and a Jenapol transmission polarising microscope.

- X-ray diffraction (XRD) for the identification of the minerals showing less characteristic optical features under the microscope A Bruker D8 diffractometer with Cu anticathode and monochromatic rays of Advance was used.

The specific microscopical and diffractometric features have lead to the establishment of the rock types and their mineralogy. These data offer a good comparative basis vs. the geological materials collected from the region, in the view of the identification of the source areas.

PETROGRAPHICAL AND MINERALOGICAL NVESTIGATIONS ON THE GRINDERS

Petrographically, the samples are diverse in spite of the fact that three grinders samples have been studied (R12, R13 and R14). The grinders fragments represent the „meta” element (Figs. 1,2,3).

*1. **Rhyodacitic ignimbrite** (sample R12)*

Macroscopically, the rock shows a light-greyish colour gradually and locally passing into yellow and bright red due to iron oxi-hydroxides impregnations. The rock has a high hardness, a typical porphyritic aspect and

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a vacuolar texture. Quartz and biotite crystals, as well as milimetre-size lithoclasts are visible within the glassy matrix.

Microscopically, the vitrophyric structure and fluidal texture are noticeable. The matrix consists of shards (fragments of volcanic glass) and pumice. The compaction degree of the rock is variable, from areas with frequent voids filled with lusatite, to compact masses where only the pumice can be individualised. The glass is partly devitrified and the voids are filled with cristobalite and heulandite (Fig. 4).

The crystalloclasts consist of quartz, plagioclases, orthoclase, biotite, and hornblende. Quartz forms hypidiomorphous or xenomorphous crystals and it is partly magmatically resorbed. The plagioclase feldspars are present as hypidiomorphous or xenomorphous crystals, are twinned and sometimes zoned (normal zoning). Some plagioclases develop around cores consisting of crystals richer in anorthite. Orthoclase occurs only accidentally. Biotite is strongly pleochroic and green hornblende is scarce. Apatite, zircon and allanite represent the identified accessory minerals (Fig.5).

Rhyolite or dacite lithoclasts are present in the matrix, consisting of a microcrystalline or hyaline mass, sometimes devitrified; besides, quartzite, silty-clayey sandstone or clayey silt were also noticed. The fragments of sedimentary rocks show various degrees of transformation due to temperature (hornfels-generation).

2. *Cataclastic muscovite-biotite micaschist feldspars (sample R13)*

Macroscopic features. The rock is light-grey in colour and a schistose texture given by the display of the mica lamellae. Locally, red-brownish impregnations (stains) are visible, probably as a result of the rock alteration.

Microscopically, a cataclastic structure (porphyroclastic-type) and a poorly-oriented texture- due to the same effect, are characteristic (Figs. 6,7). The rock consists of quartz, muscovite, Fe-depleted biotite, feldspars, apatite and opaque minerals. Quartz occurs as granoclasts rich in inclusions – most of them fluid ones, showing a poor concentration and orientation trend in general perpendicular or diagonal to the assumed schistosity. Rarely, the inclusions consist of apatite. Often, the quartz granoclasts are fissured and filled by the microblastic groundmass that surrounds them. The microblastic matrix consists of quartz, tiny muscovite and Fe-depleted biotite lamellae, most frequently oriented along various directions; feldspars are scarce. The

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Fe- and Ti- oxides concentrations noticed in the micas are probably the result of Fe-depletion within the biotite.

3. Biotite-muscovite ocular gneiss with garnets and feldspars (sample R14)

Macroscopically the rock is greyish-greenish, and shows an oriented texture.

Under the microscope, a granolepidoblastic structure and a schistose texture were noticed (Figs. 8, 9). The rock consists of quartz, muscovite, biotite, almandine, feldspars, (orthoclase and plagioclases), and apatite. Quartz forms elongated heterogranoblastic lenses, bordered by mica lamellae. Within these aggregates, muscovite lamellae with a diagonal orientation as compared to the schistosity draw an S1-type foliation. The surface of the orthoclase is dull as a result of the kaolinitisation and subordinately the illitisation processes. It was corroded by both the quartz and the plagioclase (oligoclase), which also embeds the orthoclase. Plagioclases are rare, however present in large hypidiomorphous crystals; no twinning was noticed. Almandine is idiomorphous or xenomorphous (granular), and is crossed by numerous veins. Muscovite and biotite occur as well-developed lamellae, moulding the lens-shaped quartz±feldspars. The accessory minerals are represented by apatite (short prismatic crystals), zircon with a pleochroic aureole (as inclusions in biotite) and rare opaque minerals.

Sources areas for the ignimbritic rock

The Ciceu volcanic structure is located in the vicinity of Ciceu-Corabia locality (Bistrița-Năsăud district), at about 20 km north-east from Dej town. In relatively recent papers it was shown that the volcanic massif consists of rhyodacitic pyroclastic rocks of an ignimbritic-type (Mârza and Mirea, 1991; Seghedi and Szakacs, 1991).

For identifying the source areas of the raw materials used by the ancient stone-carvers for obtaining the grinders, samples of rocks outcropping in the neighbourhood of Ciceu massif, from Măgura Ciceului Hill (samples M1, M2, M3 and M4) were collected; their structural, textural and mineralogical features are briefly presented below.

Macroscopically, the ignimbritic rock is dark-grey in colour, sometimes showing a greenish-bluish, brownish or whitish tint; some samples show a

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reddish-brownish pigmentation due to the presence of iron oxides. The rock has a high hardness, and the structure is porphiric. Quartz and feldspar phenocrystals (felsic minerals), besides biotite lamellae are noticeable by naked eye. The texture is porous with a vacuolar aspect; the millimetre- to centimetre-sized vacuoles are elliptical, oriented parallel to the flow direction of the volcanic material, and may contain minerals such as zeolites ± clay minerals.

The surface of the rock is light-grey in colour, as a result of the fast alteration of volcanic glass and of plagioclase feldspars.

Under the microscope, the rhyodacitic ignimbrite is characterized by a vitrophyric (crystallo-vitroclastic) structure. Quartz, plagioclase and subordinately K-feldspar crystals, and biotite – as main minerals, accompanied by zircon, apatite, and allanite as accessory minerals are embedded into a glassy matrix. In the voids, prismatic, granular or fibrous quartz, cristobalite, lusatite and zeolites have crystallized. The matrix is vitreous in general; it consists of glass shards (often compacted) and settled pumice. Sometimes devitrification processes were noticed.

The rock shows a fluidal texture – given by the oriented crystalloclasts and vitroclasts, indicating a mass flow of an unconsolidated mass, in the process of compaction.

The rhyodacitic ignimbrite included a various range of xenolithes of magmatic (fragments of fundamental mass), metamorphic (quartzite), and sedimentary (clays, sandstones, silts, siltites – that have sometimes underwent a significant thermal metamorphism) origin.

DISCUSSIONS AND CONCLUSIONS

The petrographical and mineralogical investigation performed on samples of Roman grinders from Stupini archaeological site lead to the identification of two main rock-types as source materials: magmatic and metamorphic.

Three grinder samples have been analysed (R12, R13 and R14) from this site. One of the samples consists of rhyodacitic ignimbrite (R12), while the other two of metamorphic rocks: an ocular gneiss (R14), and a cataclastic micaschist (R13).

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The source area for the rhyodacitic ignimbrite is easy to identify due to the specific macroscopic features; the source for the other samples can be only assumed and located within a larger area, with no detailed occurrence.

The source for the rhyodacitic ignimbrite is the ignimbrite massif from Ciceu. A variety of light-grey colour with bright red impregnations due to Fe-oxides, or with yellowish stains due to the argillitic alteration has been identified. The investigated rock has a high hardness, and shows porphyritic structure; quartz phenoclasts, biotite lamellae and millimetre-long lithoclasts can be noticed by naked eye. A porous texture with vacuolar aspects is characteristic. The grinder built-up from the rhyodacitic ignimbrite has a light-grey surface as a result of the fast alteration of volcanic glass and plagioclase feldspars. The typical features of this rock (structure and texture, mineralogical composition, alteration patterns) are almost similar to those noticed in the reference samples (M1, M2, M3 and M4), collected from quarries located close to the Ciceu eruptive massif of a Lower Badenian age. We conclude that the raw material used for obtaining some of the Roman grinders identified in the Stupini archaeological site (sample R12) is represented by the rhyodacitic ignimbrite from Ciceu.

The cataclastic muscovite-biotite micaschist with feldspars consists the raw material for sample R13. It is characterised by a light-grey colour and a poor schistosity due to fragmentation under high pressure. Locally red-brownish impregnations are visible, as a result of Fe-depletion in biotite. Sample R14 represents an ocular biotite-muscovite gneiss with almandine and feldspars showing a greyish-greenish colour and a massive texture. The ocular gneiss resembles the Nichitaş gneiss included in the Rebra III Lithogroup outcropping in the Rodna Mountains. The same origin may be assumed for the cataclastic feldspar micaschist.

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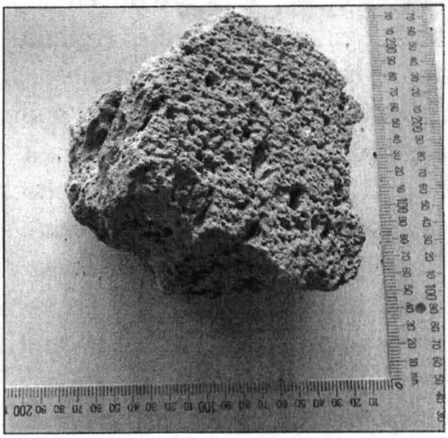

Fig. 1 Fragments of Roman grinder (IInd-IIIrd centuries) – „meta" element, consisting of ignimbritic rhyodacite. Stupini site. Sample R12.

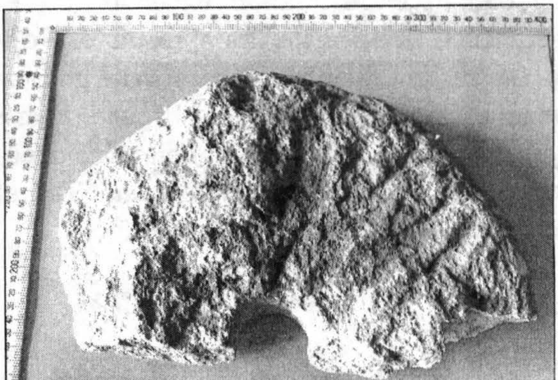

Fig. 2 Fragment of Roman grinder (IInd-IIIrd centuries) – „meta" element, consisting of cataclastic micaschist. Supini site. Sample 13.

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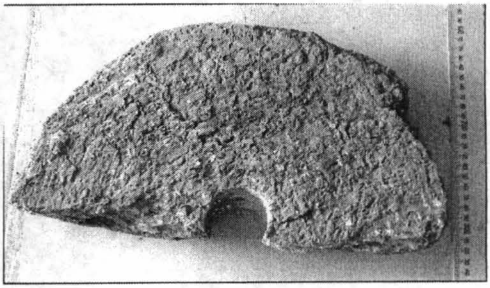

Fig. 3 Fragment of Roman grinder (II^{nd}-III^{rd} centuries) – „meta” element, consisting of ocular gneiss. Stupini site. Sample R14.

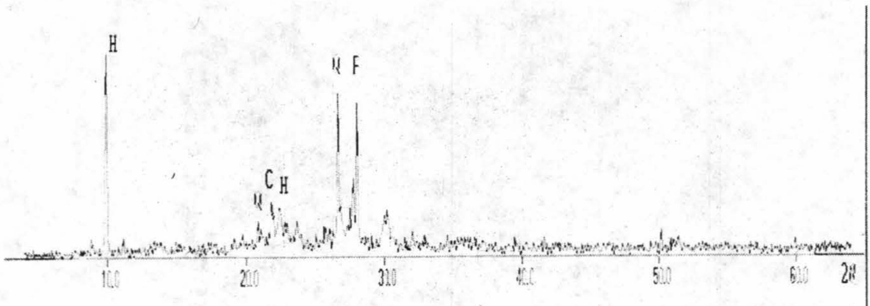

Fig. 4 X-Ray pattern of the powder collected from a void in the rock. Sample R12.Q – quartz; F – feldspar, H – heulandite, C – cristobalite.

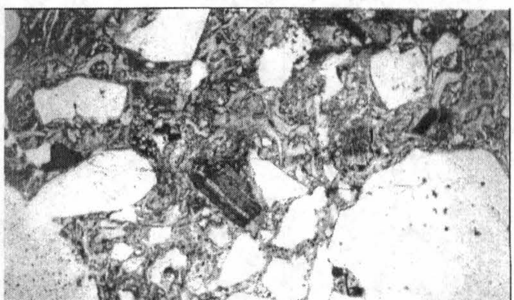

Fig. 5 Rhyodacitic ignimbrite (sample R12). Vitrophyric structure. Phenoclasts of plagioclases, quartz and biotite in a groundmass consisting of compacted glass shards. 1N; 45X.

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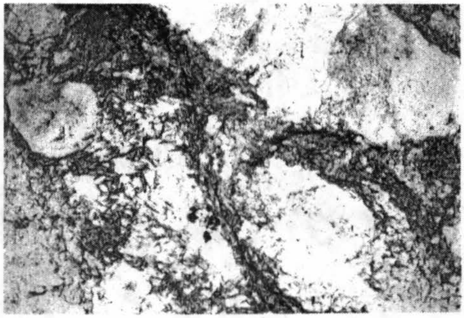

Fig. 6 Cataclastic micashist (sample R13). Cataclastic structure (porphyroclastic-type). 1N; 45X.

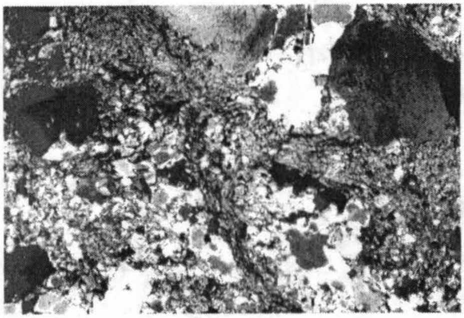

Fig. 7 Cataclastic micaschist (sample R13). Idem Fig. 6. N+; 45X.

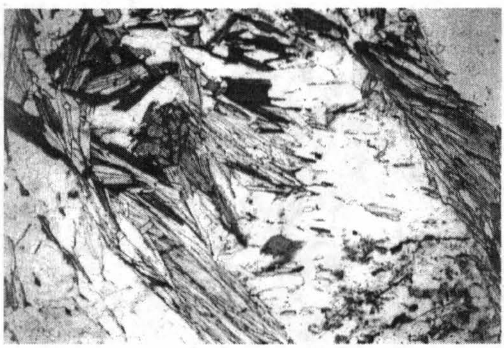

Fig. 8 Ocular biotite-muscovite gneiss with almandine and feldspars (sample R14). Granolepidoblastic structure and schistose texture. 1N; 45X.

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Fig. 9 Ocular biotite-muscovite gneiss with almandine and feldspars (sample R14). Idem Fig. 8. N+; 45X.

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CONSIDERAŢII PRIVIND ACTIVITATEA VULCANICĂ PE TERITORIUL ROMÂNIEI

Ioan BÂCA*

Rezumat. Vulcanismul de pe teritoriul României a fost variat sub aspect fenomenologic şi material, având implicaţii importante în plan morfologic şi structural. Fiecare etapă de închegare a acestui spaţiu a fost însoţită de manifestări vulcanice, dovadă fiind produsele şi structurile specifice care aflorează în diferite zone. Pe baza acestora se pot reconstitui condiţiile geodinamice şi formele de desfăşurare a vulcanismului în cadrul acestei regiuni tectonostructurale. În strânsă legătură cu tectogenezele care s-au succedat în timp şi spaţiu şi cu reflexul activităţilor vulcanice în morfologie se poate distinge un magmatism vechi şi un magmatism nou (fig.1). Magmatismul vechi s-a desfăşurat pe parcursul mai multor cicluri (prebaikalian, baikalian, clacedonian, hercinic), în forme efuzive şi intrusive, iar produsele sale se află metamorfozate sau consolidate intracrustal în cadrul edificiului carpatic şi în Dobrogea de Nord. Magmatismul nou, mult mai complex în ceea ce priveşte formele de manifestare, produsele şi structurile conservate, aparţine ciclului alpin, care a cunoscut, în funcţie de evoluţia proceselor tectonomagmatice, trei faze: ofiolitică, banatitică şi andezitică.

Cuvinte cheie: magmatism vechi, magmatism nou.

Fiecare etapă de închegare a teritoriului României a fost însoţită de fenomene vulcanice, dovadă fiind produsele şi structurile care aflorează în diferite zone. Pe baza acestora se pot reconstitui condiţiile geodinamice şi formele de manifestare a vulcanismului în cadrul acestei regiuni tectonostructurale. În strânsă legătură cu tectogenezele care s-au succedat în timp şi spaţiu şi cu reflexul vulcanismului în morfologie, se poate distinge pe teritoriul ţării noastre un magmatism vechi şi un magmatism nou (fig. 47).

Magmatismul vechi s-a desfăşurat pe parcursul mai multor cicluri (prebaikalian, baikalian, calcedonian, hercinic), în forme efuzive şi plutonice, produsele sale fiind metamorfozate sau consolidate intracrustal în cadrul edificiului carpatic şi în Dobrogea de nord.

În ciclul tectonomagmatic prebaikalian, în faza de expansiune a domeniului de geosinclinal, a avut loc un magmatism iniţial, ale cărui produse au fost metamorfozate în etapele ulterioare, împreună cu sedimentele depuse. Magmatismul sinorogen-plutonic din stadiul tectogenetic a injectat numeroase corpuri abisale sub formă de domuri, stokuri, facolite, etc., alcătuite din

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roci acide de tip pacific (granite, granodiorite, diorite), care se regăsesc în spațiul carpatic (P. Coteț, 1970). Astfel, în Carpații Orientali s-au intrus în această perioadă micile masive granitoide din seria de Hăghimaş-Rarău-Bretila, prezente în Munții Rodnei şi în Munții Hăghimaş (N. Oncescu, 1965, V. Mutihac, 1974). În Carpații Meridionali datează din această perioadă o serie de corpuri localizate în cristalinul getic, cum ar fi plutonii de la Poneasca şi Buchin, din Munții Semenicului, precum şi corpul granitic de la Criva, din sudul munților Poiana Ruscă. În Munții Apuseni pot fi menționate facolitul granitic din Muntele Mare, corpul intrusiv de la Vința-Baia de Arieş şi structurile granitice şi granodioritice de la Mădârzeşti.

În ciclul tectonomagmatic baikalian, odată cu restrângerea domeniului de geosinclinal, a avut loc o activitate eruptivă sinorogenă şi tardiorogenă, care a generat numeroase corpuri magmatice în facies intrusiv, situate în Carpații Meridionali (masivele granitice de Şuşița, Tismana, Nedeiu-Novaci, din Munții Vâlcan şi Parâng, domurile granitice din Retezat, masivul granitic din Muntele Mic, masivul granitic de la Bâsca Fierului, din Munții Făgăraş, structurile granitice din Munții Iezer-Păpuşa şi Lotrului, etc.) şi în Munții Banatului (masivele granitice de Sfridinu, Cherbelezu, din Munții Almăjului, masivul granitic de Cerna, structurile granitice, granodioritice şi dioritice din Munții Codru-Moma, etc.).

În ciclul caledonian produsele magmatismului bazic s-au revărsat pe fundul geosinclinalului carpatic şi au pătruns pe fracturi în masa rocilor metamorfice preexistente, unde au dat naştere unor masive intrusive alcătuite din gabbrouri şi serpentine, cum ar fi masivele de la Iuți, Eibental, Plavişevița, Tişovița, din Munții Almăjului, etc.

În ciclul tectonomagmatic hercinic activitatea eruptivă a fost foarte intensă. Acumulările vulcano-sedimentare au fost metamorfozate în grupa şisturilor ankimetamorfice, reprezentate prion şisturi sericito-cloritoase, metabazanite, metatufite bazice şi acide. Magmatismul plutonic sinorogen, desfăşurat pe fondul unor subducții, a pus în loc structuri abisale şi hipoabisale alcătuite din produse acide, neutre şi bazice, care se regăsesc în Munții Măcinului, Carpații Orientali, Munții Banatului şi în Munții Apuseni. În Măcin a fost injectat în această perioadă un lacolit imens, cu caracter compozit (granite, diorite, gabbrouri, etc.), învelit de formațiuni cristaline şi sedimentare paleozoice. În Carpații Orientali pot fi menționate structurile intrusive din Munții Ciucului, Rarău, Rodnei, Hăghimaş, Pietrosu Bistriței şi Giurgeu, alcătuite din granite, granodiorite, diabaze, gnaisuri, sienite, etc. În

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Munții Banatului se pot aminti masivul granitic de Liubcova-Sichevița, din Munții Almăjului, intruziunile granitice din Munții Locvei, filoanele de alipte, pegmatite şi serpentinite din Munții Poiana Ruscă, etc. În Munții Apuseni au avut loc fenomene magmatice efuzive şi plutonice, sinorogene şi tardicinematice, materializate prin produse şi structuri specifice. Astfel, pot fi luate în considerare masivele de la Bârzava şi Highiş, alcătuite din diorite, sienite şi granite, precum şi produsele vulcanice din cadrul Pânzei de Codru, reprezentate prin curgeri de lave şi material piroclastic acid şi bazic, de vârstă permiană.

Stłructurile magmatice puse în loc de-a lungul ciclurilor tectonoeruptive menționate au, în general, dimensiuni mari şi se impun în relieful actual mai mult prin caractere petrografice decât structurale, dominând prin altitudine, în anumite locuri, zonele înconjurătoare (vf. Peleaga în Retezat, vf. Mândra în Parâng, vf. Cherbelezu în Almăj, vf. Highiş în Zarand, vf. Muntele Mare în Apuseni, vf. Greci în Măcin, etc.). Liniile reliefului sunt greoaie şi masive, iar procesele modelatoare, care au acționat asupra edificiilor de-a lungul timpului, au generat scoarțe groase de alterare şi forme reziduale, reprezentate prin creste accidentale, abrupturi, vârfuri piramidale martori de eroziune, pânze de grohotişuri, etc.

Magmatismul nou, mult mai complex în ceea ce priveşte formele de manifestare, produsele şi structurile create, aparține ciclului alpin, care a cunoscut, în funcție de evoluția proceselor tectonomagmatice, trei faze eruptive: ofiolitică, banatitică şi andezitică.

Cu Mezozoicul începe „etapa carpatică” în evoluția teritoriului țării noastre, pe fondul prefacerilor geotectonice înregistrate la nivel global. Astfel, în Mezozoicul inferior începe fragmentarea marelui continent Pangaea, iar evenimentele majore care declanşează acest fenomen sunt formarea riftului Atlantic şi deschiderea Mării Tethys. În acest proces placa Eurasiatică şi cea Africană sunt împinse într-un sistem de deplasare şi rotire, care a determinat mai întâi o deschidere între ele, cu crearea Mării Tethys, şi apoi o compresie, cu tendința de închidere a geosinclinalului tethysian, înălțându-se, astfel, orogenul alpino-carpato-himalaian. Se pare că deschiderea Mării Tethys, de la est la vest, a generat o serie de procese riftogene care au determinat fragmentarea plăcii esteuropene în mai multe blocuri sau microplăci. Jocul tectonic dintre aceste blocuri, prin mecanisme de expansiune şi compresiune, va contribui la edificarea, în etapele următoare, a lanțului carpatic. În sprijinul acestor ipoteze vin produsele şi structurile

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magmatice mezozoice, care denotă anumite raporturi geotectonice. Astfel, prezența rocilor ofiolitice din Munții Metaliferi, a diabazelor din Podişul Niculițel şi Carpații Orientali, pledează pentru existența unor fenomene de expansiaune, materializate prin deschideri de tip riftogen. Formațiunile eruptive de tip banatitic, intrusive şi extrusive, trădează ample procese de subducție şi coliziune. Prin urmare, rezumând problematica mezozoicului, putem spune că în prima parte a acestei etape tectonostructurale (triasic-jurasic inferior şi mediu) au avut loc procese de expansiune, însoțite de un vulcanism bazic, localizat în riftul Niculițel, în riftul Metaliferilor şi în riftul dacidelor Externe, iar în a doua parte (jurasic superior-cretacic) începe închiderea acestor rifturi, pe parcursul tectogenezelor cretacice, fenomen însoțit de un magmatism subsecvent precoce, de tip banatitic. În cretacicul superior au loc o serie de evenimente geotectonice care vor controla declanşarea şi evoluția vulcanismului subsecvent tardiv, de tip andezitic, până în pragul cuaternarului (subducția de la periferia plăcii esteuropene, subducțiile din Munții Metaliferi, scufundarea blocului transilvan, etc.).

Magmatismul alpin inițial (faza ofiolitică) s-a desfăşurat din triasic până în cretacicul mediu şi coincide cu deschiderea unor rifturi în Dobrogea de Nord (riftul Niculițel), în Munții Apuseni (riftul transilvanidelor, riftul Mureşului) şi în Carpații Orientali (riftul Dacidelor Externe). Procesele riftogene au fost însoțite de erupții vulcanice bazice, care au generat curgeri de lave (diabazice, melafire, porfirite, spilite, etc.), complexe de pillow lava, tufuri şi intruziuni sub formă de lacolite, silluri şi dykeuri (Oncescu, 1965, Mutihac, 1974, Săndulescu, 1984, Rusu, 1996). Aceste produse vulcanice ocupă astăzi poziții subaeriene (Niculițel, Metaliferi, Trascău), sau sunt prinse în formațiunile sedimentare ale învelişului preaustric şi ale flişului cretacic din Carpații Orientali (Maramureş, Rarău, Perşani). În Podişul Niculițel procesele morfosculpturale au creat pe diabaze un relief de culmi plate, teşite şi prelungi, uneori uşor rotunjite, cu aspect de poduri netede sau trepte separate de înşeuări, iar pe porfire s-au format dealuri izolate şi martori de eroziune, cu siluete conice, cupolice şi piramidale (Popovici, 1984). În Metaliferi, relieful modelat pe diabazele asociate cu calcare jurasice şi andezite neogene este şters şi fragmentat sub forma unor dealuri de 700-900m (Coteț, 1970, 1973). În Munții Maramureşului diabazele de Farcău, Rugaşu şi Mihailec mențin prin duritatea lor cele mai mari înălțimi.

Magmatismul subsecvent precoce (faza banatitică) s-a declanşat în Cretacicul superior, odată cu restrângerea riftului Mureşului şi instalarea

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în acest sector a unor subducţii legate de orogenezele subhercinice şi laramice. Manifestările vulcanice calcoalcaline asociate acestor procese s-au derulat în forme extruzive, dând naştere pânzelor de lave andezitice, tufurilor, breciilor riolitice şi corpurilor intrusive (lacolite, silluri, dykeuri), alcătuite din roci pacifice acide (granodiorite, granite, diorite, riodacite, etc.). Aceste produse şi structuri aflorează de-a lungul liniei petrografice banatitice desfăşurate de la Dunăre până în nordul Munţilor Apuseni, fiind prezente în Munţii Banatului (M. Locvei, M. Dognecea, M. Semenic), Poiana Ruscă, vestul Munţilor Metaliferi, sudul Munţilor Bihor şi în Munţii Vlădeasa (Coteţ, 1973). Alături de formaţiunile cristaline şi sedimentare, rocile magmatice banatitice sporesc diversitatea petrografică a zonelor mai sus menţionate, înscriindu-se în morfologia de ansamblu prin forme greoaie, masive, încadrate de văi adânci, iar la nivelul interfluviilor, versanţilor şi văilor generează deformări locale şi rupturi de pantă.

Magmatismul subsecvent tardiv (faza andezitică) se întinde din Miocenul superior până în Cuaternarul inferior şi se leagă de reluarea proceselor compresionale în aria Carpaţilor Orientali şi a Munţilor Apuseni. De asemenea, pentru această perioadă trebuie menţionate şi manifestările vulcanice din câteva zone extracarpatice (Dealurile Ciceului, Podişul Târnavelor, Dealurile Lipovei, Dealurile Buziaşului, Câmpia Gătaiei, etc.), datorate, probabil, unor hotspoturi de mică intensitate.

Restrângerea celor două arii geosinclinale, din Carpaţii Orientali şi din Munţii Metaliferi şi consumarea ultimelor resturi de crustă oceanică sub impulsul mişcărilor stirice din helveţian-tortonian, au determinat declanşarea unui vulcanism calcoalcalin, predominant andezitic, care marchează încheierea evoluţiei celor două orogene (Rădulescu, 1968, Mutihac, 1974, Săndulescu, 1984, Borcoş, 1993). Activitatea vulcanică s-a desfăşurat în forme extrusive şi intrusive, pe parcursul mai multor cicluri, faze şi episoade magmatice, fiind deosebit de complexă sub aspect fenomenologic, petrografic şi structural. Produsele vulcanice, generate în urma erupţiilor explozive şi lente, aparţin seriilor calcoalcaline de arc insular şi sunt reprezentate prin roci în facies extrusiv (riolite, riodacite, dacite, andezite, bazalte) şi prin corespondentele lor intrusive (microgranodiorite, diorite, monzodiorite, gabbrodiorite, etc.). Succesiunea acestor roci în timp şi spaţiu denotă că activitatea eruptivă a fost de tip invers şi uşor recurentă, debutând în forme exploziv-acide şi încheindu-se cu erupţii lente-bazice.

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Pe **bordura vestică a Carpaților Orientali** magmatismul neogen a edificat cel mai lung lanț vulcanic din Europa, care pe teritoriul țării noastre însumează 350-400 km şi se împarte, după trăsăturile morfostructurale şi poziția geografică a edificiilor, în trei grupe:

- **grupa vulcanică de nord**, care include Munții Oaş, Igniş-Gutâi şi Lăpuş, cu produse şi structuri predominant extrusive, asociate cu intruziuni;
- **grupa vulcanică centrală** sau **intermediară**, care cuprinde arealul muntos reprezentat prin partea centrală a Munților Țibleş, sud-estul Munților Maramureşului, partea de sud a Munților Rodnei şi Munții Bârgău, cu produse şi structuri exclusiv în facies intrusiv;
- **grupa vulcanică de sud**, compusă din Munții Călimani, Gurghiu, Harghita şi Perşanii de Nord, cu produse şi structuri predominant extruzive, la care se alătură şi structuri intrusive.

În zona fragilă a Munților Metaliferi, la nord şi nord-vest de cicatricea constituită din asociațiile ofiolitice triasic-cretacice, activitatea vulcanică neogenă a format două arcuri insulare:

- un arc **sudic**, localizat pe linia Căpâlnaş-Zam-Vorța-Almaşu Mare;
- un arc **nordic**, situat pe linia Pătârş-Şoimuş-Buceava.

Erupțiile vulcanice s-au declanşat pe fracturi apărute în interiorul munților încă din stadiul de expansiune a fundului oceanic şi reactivate în timpul subducției neogene. Cele mai importante dislocații ar fi falia Mureşului şi falia Brad-Săcărâmb-Beiuş, cu extensiuni spre nord-vest, înspre depresiunea Panonică, care ar fi controlat, probabil, întreaga activitate magmatică din acest sector (Berbeleac, 1985). Vulcanismul a fost de tip central-liniar, putând fi grupat pe cinci zone: Brad-Săcărâmb, Zlatna-Stănija, Bucium-Roşia Montană-Baia de Arieş, Valea Mureşului (Bretia-Sârbi-Lesnic-Vețel) şi Hălmagiu-Pâncota (Ivanovici, 1969, Posea, 1974).

Caracterele geochimice ale produselor magmatice din Metaliferi şi Carpații Orientali sunt asemănătoare, fapt care subliniază consanguinitatea acestora prin apartenența la acelaşi fond magmatic, cu origine şi evoluție comună (Rădulescu, 1968, Peltz, 1971).

Manifestările extrusive din Carpații Orientali au dat naştere unor structuri specifice reprezentate prin stratovulcani bogați în lavă (Mogoşa, Ostoroş, Harghita, Luci, Cucu, etc.), vulcani de lavă, cu dimensiuni mari (Gutâi, Răchitiş, în Munții Harghita, Holmu-Piatra Cerbului, Colnic, Holmu Mare, Holmu Mic, în Munții Oaş), vulcani piroclastici, cu dimensiuni reduse (Măgura de la Oraşu Nou, în Oaş), platouri de lavă Văratec în Munții Lăpuş,

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Perşani, Izvoarele în Gutâi) şi platouri vulcanogen-sedimentare (platourile Călimanilor, Gurghiului şi Harghitei).

Activitatea intrusivă a pus în loc numeroase structuri de tip hipoabisal, variate ca dimensiuni, forme de zăcământ şi compoziţii petrografice, aflate în diferite stadii de exhumare. Corpurile magmatice cu dimensiuni mai mari şi forme mai reprezentative (lacolite, microlacolite, stokuri, dykeuri) se reflectă în plan morfologic printr-un relief de masive şi măguri cu aspect conic şi prin influenţe locale la nivelul culmilor, versanţilor şi văilor.

Peisajul geomorfologic al munţilor vulcanici din România se distinge prin trăsături specifice, cum ar fi:

- complexitatea morfostructurală, rezultată din întrepătrunderea produselor vulcancie generate în faze diferite de erupţie;
- etajarea morfologică, datorată prefacerilor morfosculpturale intense (etaj de culme, etaj de versant, etaj de vale, etaj de glacisuri şi piemonturi);
- alternanţa formelor înalte (culmi, platouri, măguri, masive), cu zone mai joase, periferice (culoare de vale, depresiuni tectono-erozive, etc.);
- parametrii morfometrici cu valori mari, care impun un potenţial morfodinamic ridicat;
- varietate de forme şi microforme de origine fluvială, denudaţională, periglaciară şi antropică.

Aşa cum arătam mai înainte, în timpul neogenului şi a cuaternarului inferior au avut loc fenomene magmatice şi la exteriorul Carpaţilor. Prezenţa produselor şi structurilor vulcanice în Dealurile Ciceului, Podişul Târnavelor (Dl. Şona), Dealurile Lipovei (Lucareţ), Dealurile Buziaşului (Vişag), Câmpia Gătaiei (Gătaia), etc., se datorează unor procese distensionale care au afectat fundamentul cristalin al acestor zone, favorizând, probabil, prin intermediul sistemelor de fracturi, acţiunea unor hot spoturi. Erupţiile de tip fisural sau central s-au desfăşurat subacvtic şi subaerian, în forme explozive şi lente, pe parcursul mai multor faze magmatice, generând produse specifice (ignimbrite şi tufuri riodacitice în Dealurile Ciceului, andezite în Dealul Şona, bazalte la Lucareţ şi Gătaia). Asemenea centre de erupţie cu caracter exploziv, alături de vulcanii din Carpaţi, au contribuit, probabil, la acumularea formaţiunilor tufogene intercalate în depozitele sedimentare ale bazinului Transilvan

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(Filipescu, 1943, Stanciu şi Stoicovici, 1943, Savu şi Nichita, 1972, Mârza şi Mirea, 1991).

Reflexul morfologic al acestor structuri vulcancie extracarpatice este variat. Astfel, în Dealurile Ciceului, pe formaţiunile riodacitice, a fost modelat un relief sub forma unui aliniament de coline şi măguri, la 600-700m, dispus pe direcţia NV-SE, iar bazaltele de la Lucareţ formează un platou, în cadrul căruia se disting suprafeţe plane dispuse în trepte (trappe), fapt care trădează suprapunerea curgerilor de lave. De asemenea, pe aceleaşi produse a fost fasonat un relief de dealuri care ar putea reprezenta centrele de erupţie de odinioară, cu aspect de vulcani-scut.

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CÂTEVA CONSIDERAŢII CU PRIVIRE LA EVOLUŢIA RELIEFULUI PE STRUCTURILE MAGMATICE INTRUSIVE DIN GRUPA CENTRALĂ A LANŢULUI VULCANIC NEOGEN DIN CARPAŢII ORIENTALI

Ioan BÂCA*

Rezumat. În funcţie de particularităţile morfostructurale lanţul vulcanic neogen de pe bordura vestică a Carpaţilor Orientali se împarte în trei grupe. Grupa nordică include Munţii Oaş, Igniş, Gutâi şi Lăpuş şi este alcătuită din produse şi structuri predominant extrusive, grupa centrală este reprezentată prin produse şi structuri în facies exclusiv intrusiv care aflorează în cadrul munţilor Ţibleş, Maramureş de sud-est, Rodna de sud şi Bârgău, iar grupa sudică aliniază Munţii Călimani, Gurghiu, Harghita şi Persanii de nord, fiind constituită din produse şi structuri predominant extrusive. Aceste condiţionări litostructurale s-au răsfrânt în plan morfologic prin apariţia unui relief specific, de conuri şi platouri vulcanice în cadrul grupelor de nord şi de sud, şi de măguri şi masive magmatice în grupa centrală. Articolul de faţă se referă la evoluţia reliefului din acest ultim sector care s-a desfăşurat pe parcursul a trei etape morfogenetice: etapa magmatismului intrusiv, etapa exhumării structurilor intrusive şi etapa perfectării morfologice a acestora.
Cuvinte cheie: magmatism intrusiv, relief vulcanic.

În evoluţia reliefului pe structurile magmatice intrusive din grupa centrală a lanţului vulcanic neogen din Carpaţii Orientali, respectiv arealele muntoase Ţibleş, Toroiaga, Rodna de Sud şi Bârgău, se disting trei etape morfogenetice majore: etapa magmatismului intrusiv, etapa exhumării structurilor eruptive şi etapa perfectării morfologice a acestora. Ultimele două se împletesc, dar le-am separat, din punct de vedere metodologic, pentru a sublinia anumite faze morfogenetice.

Etapa magmatismului intrusiv se desfăşoară în pannonian, pe fondul activităţii vulcanice de la bordura vestică a Carpaţilor Orientali. Punere în loc a corpurilor magmatice s-a făcut pe parcursul mai multor faze şi episoade eruptive, fapt care se regăseşte în caracterul compozit al structurilor şi în configuraţia acestora. Intruderea topiturilor silicatice a avut loc pe linii de slabă rezistenţă a fundamentului cristalino-sedimentar, respectiv falii,

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fracturi, plane de șariaj, bolți de anticlinale, capete de strate, etc. caracteristicile căilor de acces (lărgime, profunzime, configurația pereților și a acoperișului) se reflectă în forma de zăcământ a corpurilor intrusive (lacolite, microlacolite, stokuri, silluri, dykeuri, stâlpi, etc.) și în fizionomia creștetului și flancurilor acestora, fapt care a direcționat ulterior procesele modelatoare.

În alcătuirea structurilor intrusive intră roci eruptive intermediare cu caracter bimodal (acid, bazic), situație care arată procesele geodinamice care au afectat fondul magmatic de natură cuarț-dioritică, pe parcursul ascensiunii lor pe căile de acces (amestec, diferențiere, contaminare). Daintre rocile acide pot fi menționate microgranodioritele, dacitele, andezitele cuarțifere, iar dintre cele bazice se pot aminti andezitele, dioritele, etc. Pe măsura consolidării magmelor, în condiții subcrustale, s-au conturat anumite elemente structural-microtectonice, cum ar fi fisurația primară, care a determinat fragmentarea puternică a maselor magmatice inițiale. Acest fapt va avea o importanță deosebită în desfășurarea proceselor morfogenetice ulterioare (meteorizare, evacuare, sculptare a formelor), datorită desfacerii rocilor de-a lungul fisurilor în separații cu aspect poliedric (bancuri, blocuri, prisme, elemente mărunte), deosebit de mobile. Mișcările tectonice pliocen-cuaternare au accentuat aceste fisuri și au creat dislocații noi, fragmentând structurile și condiționând, într-o anumită măsură, morfologia lor.

Etapa exhumării structurilor magmatice intrusive s-a derulat prin procese morfosculpturale selective, pe parcursul a două faze principale, în contextul prefacerilor morfologice care au afectat regiunile în care acestea au fost puse în loc. Prima fază, în care se produce decopertarea părților superioare ale corpurilor intrusive, mai importante ca dimensiuni și forme, se petrece în pliocenul inferior și coincide cu perfectarea suprafețelor de nivelare Mestecăniș în Munții Maramureșului, Plaiurilor II în Țibleș și Zâmbroaia în Bârgău. Procesele erozionale au afectat, în multe locuri, și formațiunile magmatice, nivelând flancurile structurilor eruptive, intersectând creștetul unor corpuri de dimensiuni mai mici sau pătrunzând chiar în interiorul unor edificii intrusive, cum este cazul pe văile Novăț și Secu în Toroiaga sau Izvorul Neted în Țibleș. Spre finele pliocenului inferior structurile magmatice proaspăt exhumate dominau relieful modelat prin procese de planație și pedimentație deluvială, având aspectul unor masive și măguri bine integrate morfologic și funcțional în peisaj.

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Cea de-a doua fază de decopertare a corpurilor intrusive debutează sub impulsul mişcărilor rhodanice din ponţianul superior, care declanşează procesele modelatoare fluviale contribuind la sculptarea complexelor de vale şi la fragmentarea vechilor suprafeţe de nivelare. Acestea vor rămâne suspendate sub formă de culmi, măguri şi muncei în funcţie de particularităţile litostructurale şi morfosculpturale locale. Prin adâncirea râurilor structurile eruptive sunt puternic incizate, fapt care determină schiţarea configuraţiei lor orohidrografice, dezvelirea părţilor mai profunde ale acestora şi decopertarea unor corpuri apofizale situate la adâncimi mai mari.

Etapa perfectării morfologice a structurilor magmatice intrusive începe, practic, odată cu prima fază de exhumare a acestora, în pliocenul inferior şi se continuă de-a lungul pliocenului superior şi cuaternarului până în perioada actuală. În acest timp edificiile eruptive vor fi supuse mai multor cicluri de modelare, a căror forme de relief se vor încrusta palimpsestic în acelaşi fond litostructural. Modelarea fluvială declanşată odată cu mişcările rhodanice din ponţianul superior va determina disecarea structurilor intrusive, fragmentarea suprafeţelor de nivelare desfăşurate în jurul acestora şi schiţarea sistemelor de văi. Reţeaua hidrografică va evolua în acest context prin fenomene de antecedenţă şi epigeneză, în strânsă legătură cu condiţiile litostructurale şi cu poziţia nivelelor de bază locale şi regionale. Cele două faze de adâncire a râurilor sub impulsul mişcărilor rhodanice şi valahe se păstrează în cadrul complexelor de vale sub forma a două nivele de umeri, superiori şi inferiori, mai bine conservate la periferia structurilor eruptive.

Răcirea climatului în pleistocenul superior va supune edificiile magmatice modelării periglaciare, care va contribui la sculptarea unor forme de relief specifice, crionivale şi glacionivale, şi la formarea unei cuverturi de gelifracte, care prin reactivare generează câmpuri de grohotişuri. Modelarea actuală a corpurilor intrusive se desfăşoară sub acţiunea climatului temperat şi a factorului antropogen, care prin activităţile sale de defrişare, păstorit, transport, exploatare minieră, etc., accelerează procesele morfogenetice şi contribuie la apariţia unor forme noi de relief, constituite într-un sistem morfologic deosebit din punct de vedere fizionomic şi funcţional.

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DESPRE TEORIA INTERFERENŢEI GEOGRAFIEI – PLANNING TERITORIAL

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Abstract: -The multitude connections that appear in any geographic sistem, as a result of the connection of its parts, through the intimacy, intensity their lasting and quality provide the system, above all, with the complexe characteristic. Considering a territorial syistem (for eg. a geographic axis), a scale order, complexe, composed of many interdependent subsystems, knowleaga ensureness of the geographic sizes as well as quantifying the geographic connections because main conditions of the territorial planning.
Key words: geografic connection, territorial planning

ASPECTE INTRODUCTIVE.

Multitudinea de relaţii care se stabilesc la nivelul oricărui sistem geografic, ca rezultat al conexiunilor între componentele acestuia, prin intimitatea, intensitatea, durata şi calitatea acestora imprimă sistemului, înainte de toate, trăsătura de *complexitate* (privită ca negentropie, stare de organizare), sau chiar starea de entropie, iar de aici apare nevoia ca orice sistem să intre sub acţiunea activităţii de planning.

Analiza profundă a relaţiilor poate duce la rezultate deosebite, în orice plan de activitate, în special la definirea stării unui sistem geografic. Din punctul nostru de vedere, precizăm că toate sistemele beneficiază în diferite momente de timp de o anume organizare, organizarea fiind starea de moment, o stare dependentă, în schimb prin acţiunea de planning, care reprezintă starea care poate fi, starea potenţială, se elimină dependenţele.

De exemplu, axa geografică Jibou-Zalău-Şimleul Silvaniei-Marghita prezintă o anume organizare, însă prin plănuirea şi planificarea unor pasarele auto-rutiere în locul actualelor puncte de trecere la nivel cu calea ferată, axa îşi schimbă starea (din punct de vedere al transporturilor), intervenind independenţa.

Bineînţeles că şi ceea ce este „după" tot organizare se numeşte, dar cu un nou statut. Planning-ul trebuie să respecte traseul descentralizare-centralizare-descentralizare, traseu care la rândul său respectă strategia descendentă urmată de strategia ascendentă.

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Strategia descendentă abordează problemele de rezolvat de la general la particular, de la mare la mic, de sus în jos. Mai întâi este studiată problema globală (toată axa ca sistem), încercându-se descompunerea ei în probleme mai mici, spre fractal. Apoi se trece la rezolvarea subproblemelor rezultate, în același mod, adică prin descompunerea în sub-subprobleme. Procesul continuă până când se ajunge la probleme a căror rezolvare este cunoscută (sau se poate determina).

Strategia ascendentă este opusa celei descendente, iar rezolvarea unei probleme începe cu rezolvarea detaliilor de la nivelul cel mai mic (chiar ultra structuri, vezi principiile integrării). Soluțiile astfel obținute sunt agregate (dinamic), în vederea rezolvării unor probleme mai complexe. Se procedează la fel până se ajunge la nivelul din vârf, cel al problemei finale. Soluția obținută la acest nivel (prin agrearea tuturor soluțiilor anterioare de pe toate nivelele) este chiar soluția problemei globale.

Problematica analizării relațiilor dintre componentele geografice şi diferite structuri teritoriale nu este nouă, dar a revenit în actualitate datorită efectului pe care îl poate avea asupra asigurării datelor necesare procesului de planning teritorial.

Identificarea, perceperea, analiza şi evaluarea relațiilor funcțional coexistente permit într-o oarecare măsură înțelegerea funcționării arhitectonicii unui ordin scalar geografic. Considerând axa unui sistem teritorial, un ordin scalar (sistem geografic) unitar şi complex, compus din numeroase subsisteme independente, cunoaşterea şi asigurarea proporțiilor geografice, precum şi cuantificarea corelațiilor geografice devin condiții indispensabile ale planning-ului teritorial.

Corelațiile simple pot fi exprimate prin proporții, iar corelațiile speciale şi cele de detaliu caracterizează raporturile dintre sisteme, subsisteme şi alte unități de rang inferior, dar şi conexiunilor din interiorul acestora. De altfel, ansamblul tuturor corelațiilor geografice se manifestă în starea de echilibru geografic, stare rezultată dintr-un sistem determinat de factori naturali, sociali şi economici.

Spre exemplu edificiul daco-roman de la Porolissum (Moigrad), care este o locație geografică-istorică în axă, este un răspuns geografic, de tip planning, la o problemă a istoriei, o corelație tipică.

Pentru explicarea (şi cu toată critica pe care o va suporta probabil această idee din partea istoricilor, care arată că raționamentul a fost cel strategic), precizăm că amplasarea, adică planning-ul, a fost determinat de

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organizarea spațiului geografic local în acele momente, adică nu se poate trece cu vederea corelația dintre *andezit* (Dragoş I., 1965), la care se adaugă calcarul care asigură îmbinarea (integrarea).

Desigur că şi pentru rolul strategic se găseşte explicație, dar acesta era din start anihilat în lipsa rocii vulcanice la zi. În această conjuctură favorabilă geografilor, andezitul probează fondul de acumulare geografic, iar construcția în sine probează răspunsul planning-ului teritorial.

Aprofundând expresivitatea noțională, în scopul înțelegerii clare a termenului de corelație geografică, trebuie notată şi accepțiunea dată de Mac I. (2000), termenului, definit ca *„relație de existență reciprocă în care componentele nu pot exista în afara celorlalte şi între care există anumite raporturi de dependență, susținere şi conlucrare"*.

Acceptând şi conotațiile noțiunii prin prisma celor două sensuri şi anume:
- *în sens teoretic* – corelația este definită ca fiind „legătura de dependență între fenomene cu caracter de masă sau între caracteristici cantitative sau calitative diferite ale elementelor care compun un ansamblu", şi,
- *în sens practic* – corelația este definită ca fiind „raportul măsurabil între două sau mai multe variabile", demersul corelațional apare facil, inteligibil şi coerent.

Fenomenologia corelațională ne obligă la o serie de precizări:
- constatarea corelației geografice ca fenomen nu implică în mod necesar cauzalitatea, (ex. NATO, este pe de o parte cauză, iar pe de altă parte este obiectiv. Avem obiectiv în cauză);
- intensitatea corelației geografice este măsurată de un coeficient care permite comparații între fenomene;
- metoda corelației geografice este folosită în analiza fenomenelor atunci când legătura între variabile nu apare în mod evident. Legătura există, este firesc că există, dar trebuie demonstrată.

Prin aceste precizări nu se urmăreşte negarea perceptelor anterioare, ci doar întregirea accepțiunii noționale, astfel eliminâdu-se riscul neacoperirii în întregime a semnificației noțiunii. De altfel, inteligibilitatea trăsăturilor prin care corelația ca termen şi ca fenomen deopotrivă intră în sfera abordărilor geografice, demonstrează *larghețea* de care poate beneficia termenul în noua cuprindere ştiințifico-geografică.

Nu trebuie realizată o sinonimie a conceptelor amintite anterior (planning, plănuitor, planificator, geografie, geograf), dar trebuie evidențiat faptul că *geografia* ca forma de acumulare şi operația de *planning* ca formă

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de consum prin modelare a *teritoriului* de orice natură ar fi ea, *există în corelație*.

Planning-ul teritorial.

În definirea conceptului de planning există mai multe orientări de dimensiune teoretică (sigur funcție de o serie de factori), dintre care ne rețin atenția câteva:

Vladimir Trebici, în lucrarea „*Demogarfia regională și urbanismul*" vorbește de o nouă disciplină care se conturează pe plan mondial și anume – *Analiza regională*- care cuprinde: sociologia rurală și urbană; geografia localităților; teoria dezvoltării economice și sociale optime; arhitectură și urbanism; ecologie.

Vasile Rausser definește conceptul ca fiind o activitate conștientă de control, coordonare și îndrumare a desfășurării proceselor în vederea obținerii unor rezultate cu o configurație dinainte stabilită. Prin planning se poate înțelege, o activitate continuă prin care se urmărește punerea la punct a unor căi adecvate de control a unui sistem, după care se face monitoring-ul sistemului pentru a observa dacă efectele sunt cele dorite sau este nevoie de măsuri ulterioare.

Pavel Apostol consideră că planificarea constă în emergența gândirii prospective pe termen lung, adică organizarea prezentului în scopul obținerii rezultatelor scontate. Același autor arată că planning-ul este o activitate continuă, conștientă și negentropică, adică organizează, ordonează sistemul care astfel ar evolua spre dezorganizare, spre dezordine, spre echiprobabilitatea stărilor potențiale.

Gustav Gusti înțelege prin planning o înlănțuire de procese care urmăresc evoluția organismului teritorial constând în diagnoza și prognoza sistemului.

Robert Auzzelle arată că planning-ul teritorial reprezintă modul de convergență al științelor și totodată domeniul lor de aplicare.

Benedek Jozsef scrie că planning-ul înseamnă planificarea și cuprinde atât politicile teritoriale cât și conceptul de amenajare teritorială.

Planning-ul teritorial, deziderat a noilor orientări tehnico-științifice, ca măsură a gradului de înțelegere a viitorului, este definit de o serie de *fundamente* operațional-funcționale. Astfel, o planificare înseamnă:

- a decide în vederea responsabilităților viitoare;

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- a stabili o serie de obiective cu caracter imperativ ce trebuie urmate pentru îndeplinirea acestei activităţi;
- a preciza măsurile ce trebuie urmate pentru îndeplinirea acestei activități;
- a controla modul în care toate acestea conlucră pentru îndeplinirea finalităţii diagnostic prognozate a compexului temporo-spaţial respectiv.

Grefând activitatea de planning teritorial în practică, spre exemplu în cadrul axei, aceasta trebuie să răspundă elaborării principalilor *indicatori* în dezvoltarea şi armonizarea geografică a teritoriului prin:

- coordonarea activităților la nivel macroscalar (de axă), cu dezvoltarea la nivel microscalar (unitățile elementare ale axei);
- studierea potențialului geografic al axei (ape subterane, combustibili, roci de construcție, potențial uman etc.);
- studiul condițiilor naturale, sociale şi economice;
- analiza şi evaluarea tuturor caracteristicilor, specifice fiecărei zone şi localități, pentru obținerea unui set de ansamblu, de date şi informații (studii regionale, monografii).

Studiile concrete devin *repere* ale planning-ului teritorial şi urmăresc pentru axă analiza:

- locului şi a dimensiunilor resurselor de materii prime şi combustibili;
- condițiilor hidrogeografice;
- posibilității de asigurare cu energie electrică, termică, psihică etc;
- resurselor şi a structurii populației şi a forței de muncă;
- situației fondului funciar şi locativ;
- caracteristicilor oraşelor, comunelor şi satelor cu privire la circulație, unități socio-culturale, servicii.

În altă ordine de idei, ca parte integrantă a operației de modelare teritorială *prognoza* în activitatea de planning teritorial în axă cuprinde:

- elaborarea unei concepții privind dezvoltarea unor rețele optime de flux de substanță, energie şi informație între localități (locații), şi în interiorul lor;
- elaborarea unor studii de perspectivă (alternative), de factură demografică (optimul populațional), şi sociologică (optimul profesional);
- prognoze aupra balanțelor materiale, spirituale şi valorice din punct de vedere a forței de muncă (populație activă, populație aptă de muncă, forța de muncă viitoare);
- diferite alte calcule privind resursele de materii prime, combustibili, energie, apă etc.

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În toată această grea şi dificilă activitatea, nu trebuie omise următoarele *aspecte* ce țin de viitorul axei:
- gestionarea rațională a resurselor care să satisfacă viabilitatea acestora, corelată cu cerințele de refacere a calității lor;
- asigurarea unei dezvoltări durabile, prin eficientizarea „existenței", a prezentului în mod echilibrat, durabilitatea sprijinită pe vocație economică, socială, culturală şi istorică, dar şi pe turism;
- armonizarea relațiilor între:
  - ❖ localitate – teritoriu, subsistem-sistem;
  - ❖ localitate – mediu, subsistem-suprasistem;
  - ❖ teritoriu – mediu, sistem-suprasistem;
- adaptabilitatea structurală şi complementaritatea funcțională;
- nemodificarea structurilor existente de valoare, păstrarea şi gestionarea adecvată, precum şi înlănțuirea aspectelor funcționale.

În concluzie, activitatea de planning teritorial în axă comportă o serie de etape şi planuri intermediare, determinate de natura obiectelor urmărite şi având în vedere potențialul mijloacelor disponibile de la care se pleacă şi potențialul mijloacelor ce pot fi achiziționate ulterior (import, tehnică locală, idei noi etc.)

Prin operația de planning teritorial în axă se realizează o mai utilă concordanță între obiectele propuse şi scopurile de răspuns (prognoza va fi diferită de răspuns), avându-se în vedere:
- adecvarea mijloacelor şi acțiunilor la obiective;
- repartizarea în timp a oportunităţiilor (operaționalitate);

Termenul de planning are aşadar largi rezonanțe în diferite sfere ale ştiinței. *Integrarea* în sfera de abordare geografică, termenul primeşte o retuşare de ordin gnoseologic, acesta prin combinare cu termenul de „teritoriu". În acest nou cadru, prin teritoriu trebuie înțelese diferite ordine scalare de la micro la macro scară. Astfel, operațiunea de planning teritorial devine un mod de concretizare a geografiei în teritoriu, operație opusă abstractizării.

Totuşi, trebuie făcută o mică distincție între geograf şi planificator, în sensul că geograful trebuie privit din punct de vedere ştiințific iar planificatorul din punct de vedere tehnic. Doar corelația geografie-planning (se poate oare vorbi de geoplanificator şi de geoplanigrafie..!!), răspunde dezideratului sub care se desfăţoară o operație cu finalitate cum este activitatea de modelizare teritorială.

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Planning-ul teritorial este un proces ce are ca finalitate (are apect teleologic, adică reflectarea repetată a interacţiunilor cu fixarea lor, fiind opus finalităţii), armonizarea şi funcţionarea la standardele optime a unui ordin scalar. În timp, acest proces a stat în atenţia specialiştilor din varii domenii: politicieni, economişti, sociologi etc.

În înţelesul geografic, foarte apropiat de această operaţie este metodologia şi arsenalul de care face uz regionarea geografică, dar cu unele diferenţe, prin aceea că regionarea stabileşte anumite „porţiuni teritoriale" în funcţie de criterii bine stabilite, cum ar funcţionalitatea, omogenitatea, continuitatea etc., iar planificarea teritoriului trebuie să răspundă rolului său de „modelator" al teritoriului printr-o intervenţie oportună, printr-un raţionament bine gândit, iar nu în cele din urmă trebuie să răspundă unei „gândiri sănătoase" în perspectiva viitorului. Tocmai aici apare diferenţa, deoarece regionarea răspunde prezentului din trecut, iar planificarea trebuie să răspundă viitorului din prezent. Activitatea de planning teritorial dispune de o bază geografică nelimitată.

Modelarea teritoriului axei trebuie să urmeze unele *momente* necesare sub forma unei abordări *integrale*. Primul pas îl constituie *analiza mediului* (plan-orizontal şi vertical) ce înconjoară axa, după care palierele de analiză urmează un traseu de la microscară spre complex. Se ridică unele ce vizează importanţa geografiei pentru planning-ul teritorial în axă.

În general, dar şi într-un mod mai particular, geografia prezintă o mare importanţă, ce izvorăşte din necesitatea de principiu a planificatorului, şi anume faptul că operatorul teritorial trebuie să înţeleagă peisajele existente înainte de a încerca să le contureze şi modeleze.

Această afirmţie vine să consolideze rolul geografului în acţiunea de planning teritorial întrucât ignorarea naturii şi a opiniei trebuie să lase locul cunoaşterii naturii şi persuasiunii.

Cu toate acestea, continuă să mai existe cazuri în care factorii decizionari cu planning-ul teritorial aparţin altor domenii ale vieţii publice, sau şi mai negativ, nu fac apel la geografi. Urmările acestor ignoranţe (poate nesincronizări), sunt vizibile sub ochii noştri, iar finalităţile sub toate aspectele pe care le pot îmbrăca sunt nefaste (exemplu – afectarea locuinţelor din cartierele rezidenţiale noi ale oraşelor din axă de către alunecările de teren).

În contextul geografic al temei prezente, *planning-ul teritorial* ca modelare a teritoriului axei prezintă o serie de *aspecte* definitorii, de la care trebuie pornit, şi de care trebuie ţinut cont:

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- planning-ul teritorial reprezintă expresia folosirii conştiente, raționale a geografiei teritoriului axei luat în studiu (intervenții în funcție de disponibilitatea axei);
- planning-ul teritorial trebuie să fie o măsură de înțelegere a viitorului (pentru proiectele de viitor în axă);
- ca remodelare a teritoriului axei, planificarea este necesară şi posibilă datorită existenței unor premise geografice fie de ordin natural, economic sau organizatoric (resurse, industrii, regiuni);
- activitatea de planning teritorial cuprinde elaborarea unor programe pe termen lung dar şi organizarea şi armonizarea tuturor caracteristicilor geografice pentru unitățile scurte de timp (aducțiunea apei de la Gilău sau posibil din Someş);
- la realizarea unei planificări eficiente, durabile şi viabile este necesară o riguroasă fundamentare ştiințifică, tradusă prin studii, calcule, analize etc (PATIJ, PATR, PUG);
- ca operație logică şi legică, planning-ul teritorial trebuie să parcurgă un traseu pornind de la analizele efectuate dinspre nivel micro spre nivel macro;
- cooperarea între factorii (de stare, de decizie etc) din teritoriu;
- urmărirea, evaluarea şi intervenția dirijată a rezultatelor pe etepe.

Model al corelației dintre Geografie şi Planning teritorial.

Studiul sistemelor are ca scop perfectarea metodelor de modelare cu intenția identificării şi optimizării celei mai bune alegeri (momentul electiv) din mai multe opțiuni posibile în activitatea practică, de altfel obligatorie într-un astfel de studiu.

În cadrul corelațional (Geografie- Planning teritorial), Geografia, Planning-ul şi Teritoriul formează un sistem cu numeroase conexiuni directe şi inverse (feed-back-uri), sistem ce este alcătuit din două substructuri operaționale, dintre care una, şi anume Planning-ul Teritorial se referă la activitatea efectorială, iar cealaltă, şi anume Geografia, are rol de reglaj asupra primei.

Aceste două substructuri se află în interconexiune şi interdepedență relativă una față de cealaltă, astfel se explică posibilitatea pe care o au aproximativ toate sistemele de a elimina parțial efectul unor perturbații la care sunt supuse de către condițiile mediului înconjurător, prin capacitatea lor de autoreglare şi autoorganizare. În lipsa substructurii reglatorii

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(Geografia), sistemul are tendința de a se deregla, sau astfel apus crește dezorganizarea (entropia), acestuia.

Înăuntru sistemului teritorial, există de regulă o serie de conexiuni directe și inverse cu caracter *discret*, pe care specialistul (în cazul nostru planificatorul geograf), poate și trebuie să le cunoască pentru a stăpâni în acest fel întregul proces.

Datorită prezenței *autoreglării*, sistemul axei are un caracter cibernetic, aspect ce introduce o serie de *proprietăți* ale sistemului , și anume:

- sistemul devine *controlabil*;
- este un sistem *reglabil* din punct de vedere a temporo-spațialității sale;
- fiind pretabil la îmbunătățiri (ajustări), sistemul devine un sistem *structurabil*
- axa este un sistem *cuplabil* între subsistemele sau substructurile lui.

Toate aceste precizări întăresc argumentația prin care caracterul de autoreglare protejează sistemul corelațional al axei de *degradare*. Spre exemplu, dacă sistemul teritorial al axei, planning-ul nu urmează *un program corelat* cu geografia, rapid i se vor degrada structurile componente și chiar vecinătățile înconjurătoare.

Ce trebuie reținut din acest model, este marea frecvență pe care o are autoreglarea în natură dar și în activitatea umană, ca o manifestare a interacțiunii dintre cauză și efect, dar și faptul că nu putem face abstracție de probabilitatea de apariție a unor factori perturbatori în sistemul teritorial al axei. Cunoașterea acestor aspecte, ne conduce într-un mod preliminar la cunoașterea gradului de entropie în axă și în final, la evaluarea gradului informațional (organizarea).

Încercarea de reprezentare a evoluției corelației *Geografie – Planning Teritorial* o pornim de la afirmațiile lui L.A. Zadeh, care constată că sistemele prea complexe sau problemele slab definite nu admit o analiză precisă. El enunța următorul principiu al incompabilității:

„*Pe măsură ce complexitatea unui sistem crește, abilitatea noastră de a face afirmații (scrise, grafice) precise și încă semnificative asupra comportării lui scade, până se atinge un prag dincolo de care precizia și semnificația devin caracteristici care aproape se exclud reciproc*".

Cu alte cuvinte, vaguitatea este inerentă sistemelor corelațional *Geografie–Planning Teritorial* ar fi un sistem foarte complex, dar nici să facem abstracție de complexitatea sa crescând odată cu evoluția (trecerea de la omogenitate incoerentă la eterogenitate coerentă) care îl definește.

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RUMÄNISCH SANKT GEORGEN – GEODEMOGRAFISCH-HISTORISCHE ANHALTSPUNKTE

Mircea MUREŞIANU*

Abstract. The favourable physical-geographical conditions, the presence of gold and silver deposits, the mining and the transit over the mountains determined the appearance, at the foot of the Rodna and Bârgău mountains, of some durable and prosperous human settlements, from which later spread many of the habitats along the rivers Someş and Ilva. Among the ancient settlements in the superior basin of the Someşul Mare there is the settlement Sângeorz, respectively the present town Sângeorz-Băi, for the time being the biggest human settlement in this basin.
Sângeorz' settling history and the temporal-spatial evolution of the village site present on the one hand common features with the other habitats of the Someşul Mare valley and on the other hand distinct characteristics, many of them unique in the Romanian geographical space.
Key words: Romanian Sângeorz, ancient, present, evolution of the village.

HISTORISCHE ASPEKTE

Die menschliche Gesellschaft aus dem Raum des oberen Beckens des Großen Somesch und implizit Sankt Georgens ist, dank wichtiger archäologischen Funden, noch seit der Vorgeschichte beurkundet. Die Entdeckung einer nichtperforierten Axt neolithischen Alters bei Rodna und von zwei perforierten Äxten, ebenso neolithisch, auf dem Gebiet des Dorfes Maieru, neben den auf dem Gebiet von Sankt Georgen gefundenen Jaspisscherben, aus der Bronze-Zeit datiert, berechtigen uns die Tatsache zu schätzen, das die Bewohnung durch beständige Bevölkerungen in diesem geografischen Raum seit Jahrtausenden ununterbrochen stattfindet, lange bevor der ersten urkundlichen Erwähnung der ältesten Ortschaft des Gebietes, Rodna, im Jahre 1235.

Wenn in der dakisch-römischen Periode das obere Becken des Großen Somesch sich entweder an der Peripherie der großen römischen Provinz oder (größtenteils) außerhalb dieser befand, fuhr das Leben der Einheimischen mit Sicherheit fort. Beweis dafür steht der in der Rodna-

* Liceul din Rodna, jud. Bistriţa Năsăud

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Gegend entdeckte goldene Ring, der in der ehemaligen Sammlung der Grafen von Bethlen aufgezeichnet wurde.

In den sechs Jahrhunderten der Übergangsperiode von dem Altertum zum Mittelalter (ab dem Aurelianischen Rückzug bis im 10. Jahrhundert), gekennzeichnet durch das Eindringen der sukzessiven Wandervölkerwellen (Slawen, Petschenego-Kumanen und, später, Mongolisch-Tatarische Horden) widerstanden die Einheimischen all diesen Invasionen, ihr ethnisches Wesen, ihre lateinische Sprache und die essentiellen Elemente ihrer Kultur bewahrend.

Wenn wir über die archäologische Bestätigung dieser sehr düsteren Periode im Raum des Rodna-Tales nur im kleinen Maße sprechen können (die bei Anieş gefundenen 46 Bronzemünzen aus den 4. – 5. Jh. bestätigen die Anwesenheit einer einheimischen Bevölkerung in diesem Raum), so ist das nur wegen den fehlenden Ausgrabungen und systematischen Forschungen.

Die Periode des frühen Mittelalters (10. – 14. Jh.) zeichnet sich durch das Eindringen der Ungarn in Siebenbürgen und, implizit, in der Gegend des Rodna-Tales, durch die Kolonisierung der Sachsen bei Rodna und um Bistritz, durch verheerende Invasionen der Mongolisch-Tatarischen Horden, aber auch durch das Erscheinen der feudalen Grundbesitze und das Aufzeichnen der ersten urkundlichen Bestätigungen einiger Siedlungen aus dem Gebiet aus.

Die Sankt Georgener Anfangsgeschichte ist eng mit der Anwesenheit des Bergwerkzentrums, des Marktes und der RODNAER Burg, uralte, in 14 km Entfernung gelegenen Ortschaft, verbunden; die hiesige Bergabbauungen sind aus ältesten Zeiten erwähnt, da Rodna eine dakische Metallurgie- und Residenzstadt ist.

Die erste urkundliche Bestätigung der Siedlung Sankt Georgen datiert aus dem Jahr 1245 – SANCT GURGH – in einer in „MONUMENTA REGNI HUNGARIAE“ veröffentlichter Urkunde, durch die der König Bela IV. den szeklerischen Komitatsgrafen beauftragt, das Gebiet der Gemeinden aus dem Rodna-Tal einzunehmen und nach den Rechten und Immunitäten die die Bewohner dieses Gebietes noch aus alten Zeiten hatten zu verwalten, und aus den Einkommen soll er jährlich dem königlichen Schatzamt 130 Goldmark geben.

Im Jahr 1440 figurierte Sankt Georgen zwischen den unter der Herrschaft des Feudalen Jakale von Kusal (Jors von Kusal) eingetretenen

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Ortschaften, und 1475 ist die Siedlung dem bistritzer Magistrat untergeordnet, dank den Vorschriften des Dekrets Matia Corvins aus 1475.

Eine Urkunde aus dem Jahr 1518 spricht vom Wojewoden Toma als Führer von Sankt Georgen und seinen Umgebungen, und die Einfügung des Rodna-Tales unter der Herrschaft von Petru Rareş, Herrscher der Moldau, ebenfalls im 16. Jahrhundert, einbezieht auch Sankt Georgen, für eine kurze Zeitspanne, im politischen Verwaltungsraum der Moldau.

In der Zeitspanne 1762 – 1851 wird die Ortschaft militarisiert, Moment in dem die Wahrnehmung und Nutzung der hiesigen Heilwässer beginnt.

Im Jahr 1960, am 30 Dezember, wurde Sankt Georgen zur Stadt erklärt und wurde eine Badekurort-Stadt, eine wahre Entspannungs- und Gesundheitsoase.

GEODEMOGRAFISCHE ANHALTSPUNKTE

In der wertvollen Arbeit „Povestea Comunei Sângeorz-Băi" („Die Geschichte der Gemeinde Rumänisch Sankt Georgen") zeigt Iustin Sohorca das bei der Gründung der Siedlung drei Menschenkategorien beigetragen haben: „...die Einheimischen, über denen man sehr wenig kennt, die Einwanderer, die aus der Ebene auf der Suche nach Weiden kamen und eine Handvoll Menschen aus dem Osten, möglich Jäger, unter der Führung des genannten Dan", die sich am Pleşu-Fusse niedersetzten an den Ufern des Tales genannt „Tal des Dan", ein Toponym das bis heute erhalten blieb.

Es gibt toponymische, ethnisch-kulturelle und onomastische Argumente welche die Tatsache beweisen, das die analytischen und interpretativen Studien Iustin Soharcas sich bemerkenswert der Basisstruktur der Sankt Georgener Bevölkerung annähert, aber die realen Umstände aus dem Sankt Georgener geografischen Raum sind viel komplexer.

Die Besiedlung gewisser Punkte aus dem heutigen Verwaltungsraum der Stadt Rumänisch Sankt Georgen scheint antik, vorrömisch zu sein; man bemerkt mehrere Phasen, die wir in drei Perioden mit drei unterschiedlichen Menschengruppen einordnen könnten:

Die einheimische Bevölkerung, die annehmlich von den alten, auf diesen Gebieten lebenden thrakischen Stämmen (Karpen, Bastarnen, freie Daker etc.) abstammt. In der Zwischenkriegszeit haben Dimitrie Gustis

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Soziologie- und Anthropologieforschungsteams eine perfekte Korrelation zwischen dem Alter einiger sehr alten Sankt Georgener Familien (Gogotă, Bărcanu, Buzdugan, Uscatu, Başcă etc.), dem beträchtlichen Alter einiger Ortsnamen („Dealul lui Gogotă" – „Gogotă's Berg", „Poienile Bărcanului" – „Bărcanu's Schneise", „La Buzdugan" – „Zum Buzdugan", „Poiana Uscatului" – „Uscatu's Schneise", „La Başcă" – „Zum Başcă" etc.) und der besonderen, „dakischen" Physiognomie einiger Vertreter dieser festgestellt.

Die eingewanderte Bevölkerung kam aus dem Gebiet der Siebenbürger Heide auf der Suche nach Weiden, als Transhumanzweiden praktizierende Schäfer von welchen die Mehrzahl mit der Zeit hier sesshaft wurde. Andere kamen als zeitweilige Bevölkerung im Frühling, um die religiöse Feier des „Sângeorz" – „Sankt Georg" und zogen dann im Herbst, um die Feier des „Hl. Dumitru", nach dem „Auslöschen" der Alpinweidesaison weg. Daher blieb im Weiden des Rodna-Gebirges (vor allem im Sankt Georgener Gebiet) der bis heute erhaltene Brauch eingebürgert, das diejenigen die sich als Schafhirten anstellen Frühlings zu „Sankt Georg" ihre Arbeit annehmen und im Herbst zum Hl. Dumitru abgeben. Es scheint, das von hier der Name der Ortschaft (Sankt Georgen) selber herkommt, der erstmals in einer rumänischen Variante in 1598 als SÂNDGEORZ vorkommt.

Dann wurde auf mündliche Weise die Tatsache übermittelt, das irgendwann, in uralten Zeiten, unter den einheimischen Sanktgeorgener die Ankunft auf diesem Gebiet, aus dem Osten, einer Gruppe fremder Menschen, die die Jagd mit der Ächtung zu verbinden schienen, unter der Führung eines Anführers genannt Dan, die sich letztendlich in Sankt Georgen niederließ, am Fuße des Pleşa-Gebirges, links des Somesch, auf dem Tale das bis in den heutigen Tagen den Namen „Dan's Tal" trägt, großen Aufruhr bereitete.
Mit der Zeit mischten sich die einheimischen Familiengruppen mit den Neulingen, mit den Einwanderern und verursachten bedeutende demografische Wachstümer und, implizit, die Besiedlung der ganzen Aue des Großen Somesch, der Ursprungszone des Borcutului-Tales, sich durch Rodungen und Ausschwärmen auch auf dem Cormaia-Tal ausdehnend.

Unter den in Sankt Georgen später niedergelassenen Einwanderer (15. – 19. Jh.) sind die der Familien Turcanu (hier aus der Türkenzeit geblieben), Siminic (aus der Reckenteker Umgebung um Siebe zu verkaufen gekommen), Bâltean („turca" tanzend, aus Sicul Gherlei zum Anlass der Winterfeiern gekommen), Ciocan (aus Ciocăneşti – Bukowina um Hämmer –

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rum. ciocane – zu verkaufen gekommen), Moldovan (hier als Flüchtlinge aus der Moldau nach einer Dürre- und Hungerperiode angekommen) etc.
Der Toponym „Tataren-Tal“ („Valea Tătarilor”) erinnert an dem Drama der rumänischen, sanktgeorgener Autochthonen, verursacht von dem Einfall der plündernden mongolisch-tatarischen Horden im 13. Jahrhundert. Es gibt einige Meinungen, die von der Physiognomie und Onomastik einer besonderen Gruppe der sanktgeorgener Bevölkerung bestätigt sind, denen nach ein Teil der eingedrungenen Tataren in Sankt Georgen geblieben sind, wurden sesshaft und wurden assimiliert. Es scheint das in der sanktgeorgener onomastischen Landschaft häufig vorkommende Personennamen, wie: Ogâgău, Ivu, Cârcu, Ciociu, Utal (Utalea, romanisiert) tatarischer Herkunft sind.

Die kolonisierte Bevölkerung wurde hier zur Zeit der Kolonisierung Rodnas durch bei der Abtei aus Rodna um das Jahr 1150 zum Zweck der Wiedererlebung des Bergbaus und der Bewachung des Rotunda (Rodnei)-Passes zu Nutzen der ungarischen Könige gesetzte Benediktiner Mönche (teutonisch, nach älteren Quellen, und Sachsen, nach Quellen letzter Zeit) gebracht. Selbst die Volksform „Sângeorz” ist eine Rumänisierung des sächsischen Sankt Georgen, wahrscheinlich verbunden mit der Feier des „Sângeorz”. Da es eine Zusammensetzung mit „Sankt“ abendländlicher Herkunft ist, ist der Oikonym Sângeorz gänzlich verschieden von den anderen alten somescher Namen menschlicher Habitate, die Anwesenheit der sächsischen Kolonisten in der Gegend verratend.
Es gibt desgleichen onomastische und toponymische Argumente welche die Anwesenheit einiger Gruppen Kolonisten slawischer (russischer) Herkunft aufweisen, in mehreren Etappen wegen politischen Verfolgungen, Hunger und Krankheiten hergekommen. Die Namen einiger Familien aus Sankt Georgen sind russisch (ruthenisch) oder zeigen die Angehörigkeit dieser an das russische Volk: Haliță, Sohorca, Zamhira, Bilica, Bâznog, Rus, Rusoaia, Rusca, Lucuța, Miria, Lazurea etc. Der größte Teil der hier in verschiedenen Etappen angekommenen russischen Kolonisten wurde von der einheimischen rumänischen Bevölkerung assimiliert, doch sie behielten gewisse physiognomische Züge und besondere ethnisch-kulturelle Aufführungen.

Autochthon oder allochthon, die Menschengruppen die während der Geschichte die sanktgeorgener Bevölkerung zusammengesetzt haben, haben aktiv beim Erscheinen eines Habitatherds beigetragen der sich in der Zeit von einigen im sanktgeorgenen geografischen Raum zerstreuten Kernen zur

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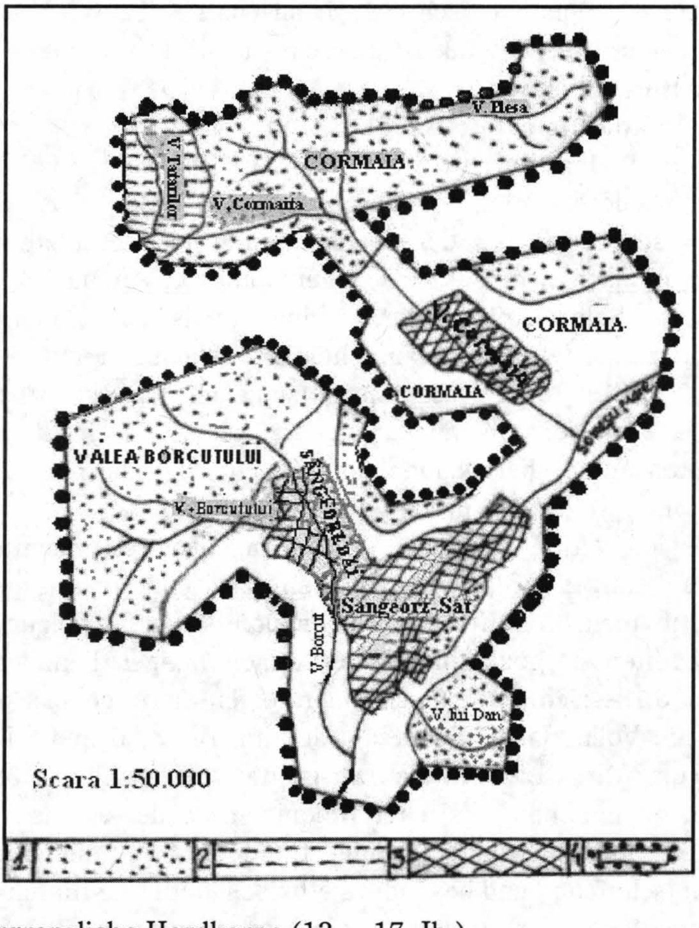
heutigen binuklearen Geometrie entwickelt hat, mit einem kräftigen Areal im Tal des Großen Somesch und ein anderes im Borcutului-Tal, denen sich das wahre suburbane Areal Cormaia anschließt.

Die ersten Herdkerne wurden im Osten der heutigen Ortschaft gegründet, im Ort genannt „Pe sub Coastă" („Unter dem Abhang"), dann im Norden, auf der „Rogină" („Rost") und, im kleineren Maße, auf den Tälern Borcut und Cormaia, Punkten aus denen der Herd oft aus dem Weg der Barbaren und der Überschwemmungen ging.



1. Vorgrenzliche Herdkerne (13. – 17. Jh.)
2. Niederlassungsareal der Mongolo-Tataren (13. Jh.)
3. Der Herd nach dem „Auslöschen" der Militärgrenze (1870)

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4. Areal des heutigen Herdes

Die zeitlich-räumliche Evolution des Herdes der Stadt Rumänisch Sankt Georgen

Nach der Militarisierung und der Standhaftung eines ruhigen, friedlichen und sicheren Umfeldes zeichnet man eine kräftige Wanderungswelle der Bevölkerung samt Haushalt von den erwähnten anfänglichen Habitatskernen gegen dem Areal der alten Holzkirchlein von „Über dem Wasser" („Peste Apă"), und desgleichen in der Gegend der gegenwärtigen orthodoxen Kirche und sogar auf dem Borcutului-Tal auf, was zur Entstehung eines polinuklearen Herdes führte.

Der Herd erhielt sein dem heutigen ähnliches Kontur in der zweiten Hälfte der Militärgrenze, und auf den topografischen Karten aus dem Jahre 1870 sind die beiden Habitatskerne, Sankt Georgen Dorf und Sankt Georgen Borcut, schon konturiert, mit Formen die den gegenwärtigen nahe sind.

Der Sankt Georgener Herd zeichnete sich bis zur Zeit der Grenze durch einen hohen Zerstreuungsgrad der Höfe aus, und danach, am Ende dieser, wurde die Siedlung kompakter, mit linearem Aspekt und kleinen Konzentrationskernen entlang der Somesch-Achse. Inzwischen kann man oberhalb der Konfluenz mit dem Borcutului-Tal das tentakelartige Aussehen des Habitats erkennen.

Im Raum dieser uralten somescher Siedlung kannte die Bevölkerung eine rhythmische, oszillatorische Evolution, abhängig von den Wohlstands- oder Regressionsperioden, den Blühe- oder Drangsalperioden, mit wichtigeren Wachstumswerten und –rhythmen in der letzten Hälfte des 20. Jh.

Wenn wir auf Grund der Konskriptionen und Volkszählungen die numerische Evolution der Bevölkerung der Stadt Rumänisch Sankt Georgen verfolgen, stellen wir eine Kräftige Besiedlung der Ortschaft nach dem Jahr 1720 (als es über 1100 Einwohner hatte) fest, bei einer Zahl von 1980 Einwohnern im Jahr 1764 reichend und war so, nach Einwohnerzahl, die zweitgrößte Siedlung der Zeit nach Bistritz, trotz der Tatareninvasion aus dem Jahr 1717 die zahlreiche somescher Siedlungen verwüstet und verwirrt hat.

Zwischen der „Josephinischen" Volkszählung aus 1784 – 1786 (als die Bevölkerung 2050 Einwohner zählte) und der statistischen Konskription aus dem Jahr 1830 (1930 Einwohner), kannte die sanktgeorgener Bevölkerung eine bedeutsame Regression, sowohl wegen der Notauswanderung einiger

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sanktgeorgener Familien in der Moldau wegen der erdrückenden militärischen Pflichten, als auch wegen der Teilnahme der Grenzer an den napoleonischen Kriegen oder wegen den Pest- oder Choleraepidemien. Die selben Ursachen veranlassten das geringe Bevölkerungswachstum in der Zeitspanne 1830 – 1850, so das im Jahr 1850, bei der vor dem „Auslöschen“ der Militärgrenze vorgenommenen Volkszählung Sankt Georgen nur 2179 Einwohner hatte.

Wenn die Wachstumsrhythmen bis 1930 (3812 Einwohner) bescheiden erhielten blieben, so verdreifachte sich die Bevölkerungszahl in den folgenden sieben Jahrzehnten, mit der Badekur in voller Entwicklung, mit der Verbesserung der materiellen und der hygienisch-sanitären Bedingungen der Bevölkerung, und zählt gegenwärtig fast 10.500 Einwohner (auch wenn im Jahrzehnt 1992 – 2002 das Wachstum unbedeutend war, da Sankt Georgen sich den regressiven demografischen Tendenzen die auf Landesebene stattfinden nähert.

Tabelle: die numerische Bevölkerungsevolution der Stadt Rumänisch Sankt Georgen

Volkszählung oder Konskription	1720 – 1721	1784 – 1786	1830	1850	1930	1966	1992	2002
Einwohnerzahl	1154	2050	1930	2179	3812	6693	10280	10446

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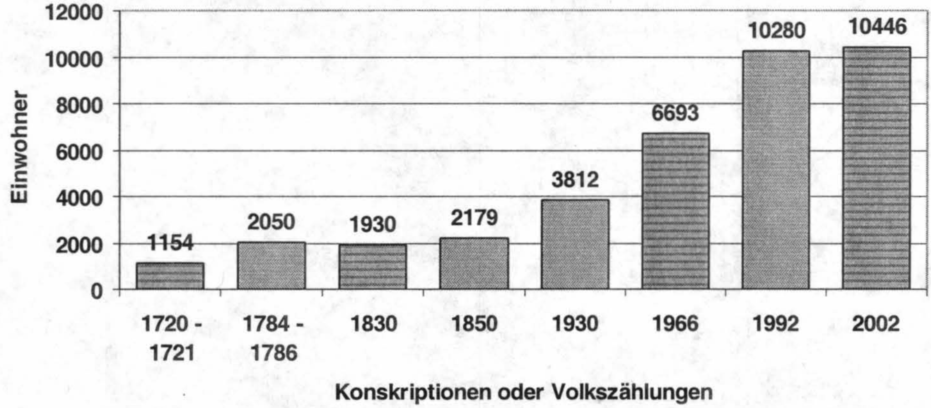

Die Bevölkerungsevolution des Sankt Georgens zwischen 1720 – 2002

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UTILISATION OF NATURAL SOURCES IN BALNEOTHERAPY IN ROMANIA
- HISTORIOGRAPHICAL DATA -

Radu CRIŞAN*

Balneotherapy occupies an important place within complex therapy, addressing itself to the human body by means of elements, which have a favourable or unfavourable influence upon it. This influence is conditioned by the intensity of those particular factors, as well as by the character of special therapeutic mechanisms. Balneotherapy has had a constant use in time, unlike drug therapy that has known periods of maximum use as well as periods of renunciation for the same drug. That is to say, the therapy with physical agents is the oldest, evolving from an empirical phase and simultaneously developing with the other sciences (with which it has great contingencies) up to the present scientific phase.

About 2500 years ago, Herodot, the father of history, mentioned some aspects concerning the balneary treatment in antiquity. The Greeks particularly appreciated thermal waters, also having an important influence upon the Romans who, in their turn, had great interest in them.

The starting point of balneology in our country is certified as far back as antiquity. The Dacians and later on the Romans used the healing effects of mineral and thermal waters for therapeutic reasons (I.H. Crişan, 1977). The Romans intensely exploited the mineral and thermal springs at Geoagiu. The antique name is Germisara, toponimical of Dacian origin, inherited and transmitted in this form to the Roman epoch as well. The etymology of the word is "germ"= warm, and "sara"= water. Thus, the meaning is warm water. Dr. Igna N., who describes an altar dedicated to Esculap and Hygia, discovered in 1939, originally documented the use of those waters.

Recent archaeological research works in this watering place (Pescaru A., and Pescaru E., 2001) have brought new data, good proof among others also being the eight votive slates made of gold and dedicated to the healing

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and protective deities of thermal waters: *Diana, Hygia* and *Nimphae*, (Piso, I., Rusu, A., 1990). The thermal waters at Călan-Aquae were used by the Romans, a fact proved by the embedded inscription in the church wall . The thermal waters at the watering place Herculane were also known and very probably used both by Dacians and Romans. On the occasion of the building of modern houses, Roman republican coins were discovered, coins from the Ist. Century A.Chr., and from the time of the Emperor Augustus. It was there that an inscription was also discovered (CIL, III, 1561) which says that Iunia Cyrilla "was saved from a long infirmity by the power of waters"(Crişan, I., H., 1977).

Historical data regarding the precious mineral waters in our country are presented by Berlescu E.(1998) and Pricăjan A.(1999). The authors review the various stages of the use of mineral and thermal waters in Rumania. They mention the places having long balneary tradition from antiquity up to our days, as well as the beginnings of scientific balneology in our country, when many balnear places, which use these important natural resources with therapeutic effects, are certified.

In some medieval documents several healing waters in our country are mentioned. Among these Băile Felix watering place stands apart. The place was initially called Băile Sfântului Martin, and has known a special development since 14th century. Doctor Gebb Francisc from Oradea analysed the thermal waters there for the first time in 1731, also pointing to the way in which they were supposed to be used.

In the 17th century, the chemist Georg Wette from Sibiu describes the publications of the Leopoldine Academy "*Miscellanea*", (1673-1674), the salty waters at Bazna.

Samoil Kölesčri (1663-1732), doctor of the town Sibiu, by means of his paper on mineralogy, "*Auraria romano-dacica*", Sibiu, 1717, brings new information regarding mineral springs in Traiana Dacia used in balneotherapy. Pasquale Garofano, an Italian learned man, refers at length to the mineral waters in Banat, publishing three editions of the work entitled "*De Thermis Herculanis super Dacia detectis, disertatio epistolaris*" (Vienna, 1737; Mantova, 1739 and Utrecht, 1743).

We'll also mention some of the papers belonging to scientists in Transylvania, who analysed from a chemical and physiotherapeutic point of view different mineral waters in the second half of the 18th century. Thus, Wagner Lukas (1739- 1789), doctor in Braşov, in his doctoral paper

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"*Disertatio inauguralis medico-chimica de aquis medicatis Magnis Principatus Transylavaniae*", published in Vienna, in 1773, analysed the chemical composition and medical recommendations regarding some springs of mineral water in Transylvania. Barbenius, J.B., published in Sibiu, in 1792, the paper entitled "*Chemische Untersuchungen einiger merkwürdigen Gesund- und Sauerbrunnen des Sekler-Stuhls Háromszék in Siebenbürgen*". In this paper the results of some chemical investigations are presented, results of some well-known springs of mineral water, in the south-eastern part of Transylvania.

Nyulas Francisc's work "*Az erdélyországi orvosvizeknek bontásáról kőzőnségesen*" (On mineral waters in Transylvania), published in Cluj, in 1800, brings important contributions to the settling of research methodology in balneology. The author offers us the first quantitative analyses of the mineral waters in the Rodna area, being one of the first scientists in world literature who pointed out the presence of manganese (Mn) in these mineral waters and, at the same time, as a priority, he presents the positive effect of mineral waters containing carbon dioxide (CO2), (Spielman, I., 1957).

Chintăuan, I., (2002), basing his rersearch on bibliographical sources in the 19th century, puts up-to-date from a scientific and inter- disciplinary viewpoint the unusual value of mineral waters not only in Sângeorz-Rodna area, but also in some other areas in the district Bistriţa-Năsăud, where numerous springs of mineral water, including salty waters (the latter being found especially on hills) had been already traced in the 19th century. The author shows the most important mineral waters, where they are, and their therapeutic effects.

During the 19th century, the number of works increases, and they bring new, particularly useful information regarding the therapeutic use of mineral waters in Transylvania. We mention here only a couple of the works published during the period under discussion: Gergely, A., - "*De aquis de thermis minerales terre Siculorum Transilvaniae*"(1811), Bélteki, Z., - "*Conspectus sistematico practicus aquarum mineralum Magni Principatus Transilvaniae*" (1818), and Pataky, S., - "*Descriptio phisico- chimica aquarum mineralium, Transilvaniae*" (1820). The well-known scholar from Transylvania, Orbán Balasz, in his encyclopaedic work "*A Székelyföld leirása*" (Description of the Szeckler country), published in 1869, presents both watering places and cure agents in the south-eastern part of Transylvania.

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The first paper on balneology, written in the Rumanian language, is the one belonging to doctor Popp Vasile, entitled "*Despre apele minerale de la Arpătac, Bodoc şi Covasna*" (On mineral waters at Arpătac, Bodoc and Covasna), published in Sibiu, in 1821. This paper has a fundamental importance both from a medical and historical viewpoint, representing the very beginning of a new literary branch and of Rumanian medical terminology.

There also is rich information about the other side of the Carpathians. In Moldavia, the first data regarding the use of mineral waters at Şarul Dornei belong to Hacqet, R. In 1788-1789, he published the results of his investigations. About the same period (1796), Wolf, A., analysed the mineral waters in the Neamț area. A little bit later, Plusk, I., analyses from a physical-chemical viewpoint the mineral waters at Borca, publishing his results in 1811 and 1814. Widman, C., publishes in 1847 data concerning the use of mineral waters at Balta Albă. In 1859, Deleanu, St., adds further scientific remarks to the knowledge concerning the mineral waters at Olăneşti.

The efficacy and qualitative superiority of mineral waters in Rumania are two themes in doctor Episcopescu's paper "*Apele metalice ale României Mari*"(On metallic waters in Big Rumania) (1857), which deals both with physiological and therapeutic effects in case of water (general remarks), and especially of mineral waters. Fătu, A., adds some further information to speciality literature, published in his papers "*Despre întrebuințarea apelor simple şi apelor minerale ale Moldovei*" (On the use of simple waters and mineral waters in Moldovia) (1851), and "*Despre apele minerale din România*" (On Mineral Waters in Rumania) (1874).

At the end of the 19th century, medical literature also approaches balneary cure agents at the Black Sea seashore. Among many scientists, Kistengeanu, P., published his work entitled "*Manual pentru uzul băilor de mare*" (Guide for the Use of Sea-Baths) (1881). We stress upon the fact that since the first half of the 19th century in the most important watering places, the existence of physicians is also certified (Pricăjan, A., 1999).

At the beginning of the 20th century, Saabner, T.A., with the two editions (1900 and 1906) of his monographic works: "*Apele minerale şi stațiunile climaterice din România*" (Mineral Waters and Health Resorts in Rumania) becomes the father of Rumanian balneology. In his monographic paper, the author presents geological, botanical and zoological data, as well as chemical and physiological estimations on the agents of balneary cure, which

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represent very important information for specialized literature. The Balneology Institute founded in 1923 by doctor Theohari, A., (1873-1933), next to The Therapeutics Clinic of the Brâncovenesc Hospital, meant to be a qualitative leap in the development of Rumanian balneology. Dr.Theohari and assistants studied many mineral springs. During the Inter-War period, some other departments of balneology were founded by Dr. Sturza Marius (1876-1954), in Cluj, in 1931, and in Iasi, in 1924 (the department was founded by Dr. Tudoranu, Gh.,(1892-1963)). In these departments there were investigated scientific methods specific for experimental and clinic balneology. (Bologa and assistants, 1972).

Chemical analyses on the mud in seaside and continental lakes were made by Saligny, A., and Georgescu between 1883 and 1890. To these we may also add the studies of Costăchescu, N., and Bujor, P., in 1927.

Historical data regarding the rational use of medicinal peat in balneotherapy are given by Pop, E., in 1928 and 1956. The author presents several balneary and climatic bathing places where peat has been used since the 19th century: Vatra Dornei (since 1880), Leghia (1881), Borsec (1889), Câmpulung Moldovenesc (1925). At Vatra Dornei, Băile Malnaş and Geoagiu medicinal peat is prepared with mineral water, and has been done as such ever since the end of the 19th century. Since about the same period peat has been used combined with mud and water iodine, all got from Bazna. During the Inter-War period, there also appeared the first information about the use of peat and mineral waters in balneotherapy, at Băile Someşeni.

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SIBIU – CENTRU TURISTIC POLARIZANT ÎN SUD-VESTUL TRANSILVANIEI

Virginia GHERASIM*, Nicolae DAMIAN*

Abstract: This article intends to present the touristic objectives and the ways of optimising them as far as Sibiu is concerned as an important touristic centre in the S-V of Transylvania. It does not aim at the description as such of the touristic objectives but at their integration in the touristic circuit and at the optimization of the tourism activities. This article has in view the presentation of the impact of these objectives upon the territory.
Key words: touristic centre; the optimization models; small touristic places.

Dăltuite de slovele istoriei pe frontispiciul unor *edificii de lumină*, începuturile oraşului Sibiu îşi contopesc esenţa printre gândurile vizitatorilor de ieri şi de azi. Dar oare şi a turiştilor de mâine?

Poate fi considerat Sibiul un centru turistic polarizant în sud-vestul Transilvaniei? Va reuşi el să dea din nou viaţă zidurilor împovărate de trecut şi să-şi înalţe dintre pietrele prăfuite izvorul de armonie pentru tot ceea ce înseamnă material şi imaterial?

Iată doar câteva dintre gândurile care ne-au condus pe calea înţelegerii fenomenului turistic în această parte de ţară.

INDICATORI DE ANALIZĂ A ROLULUI TURISTIC POLARIZANT AL UNUI CENTRU TURISTIC

Un centru turistic îşi defineşte specificitatea într-un anumit teritoriu printr-o serie de determinante geografice integrate sistemic mediului ambiant care trebuie monitorizate permanent pentru o prognoză geografică obiectivă şi cu consecinţe pozitive asupra activităţilor turistice viitoare.

„*Centrele turistice* – aşa cum remarca în anul I. Mac – *se caracterizează prin concentrarea pe teritoriul lor a unui număr mai mare sau mai mic de obiective turistice, de obicei de acelaşi tip (naturale sau antropice), care dispun de o mare putere de atracţie. În aceste centre turistice se remarcă*

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dotările pentru cazare. În această categorie se includ aşezările urbane (ex.: Braşov, Sibiu, Cluj-Napoca), dar şi alte sisteme teritoriale".

Există o gamă extrem de largă de indicatori, din analiza cărora se poate stabili rolul turistic al unui centru turistic. Printre aceştia se numără următorii:

favorabilitatea poziției geografice;

valoarea calitativă şi cantitativă a potențialului turistic natural şi antropic;

originalitatea şi diversitatea ofertei turistice;

gradul de dezvoltare al infrastructurii şi transportului – în funcție de care se poate calcula raza de atracție turistică a centrului turistic respectiv, realizată pe baza izocronelor;

capacitatea de cazare şi alimentație publică;

calitatea serviciilor turistice;

numărul populației active ocupate în turism;

numărul de vizitatori/obiectiv turistic cu un grad de atractivitate ridicat;

numărul de înnoptări înregistrate în unitățile de cazare turistică;

nivelul calitativ şi cantittiv al strategiilor de promovare turistică etc.

În cele ce urmează vom încerca însă să identificăm, pe baza cercetării celor mai semnificativi indicatori geoturistici, doar impactul obiectivelor turistice cu un potențial deosebit asupra circulației turistice în oraşul Sibiu, calitatea raportului dintre cererea şi oferta turistică, precum şi posibilitățile de optimizare a activităților menite să pună în valoare valențele turistice ale acestora.

1.1 Favorabilitatea poziției geografice. Oraşul Sibiu, municipiu reşedință de județ, situat în Depresiunea Sibiului, pe terasele Cibinului, la o altitudine medie de 415 m, beneficiază de o poziție geografică extrem de benefică pentru activitățile turistice. Prin peisajul depresionar modelat de factorii naturali şi antropici la contactul dintre unitățile deluroase ale Podişului Transilvaniei şi Carpații Meridionali, prin poziția sa la intersecția unor importante artere de comunicație naționale şi internaționale, oraşul Sibiu are deja câteva premise care îi conturează rolul său important în dezvoltarea fenomenului turistic din sud-vestul Transilvaniei:

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- apropierea de zona etnografică „Mărginimea Sibiului" (generatoare a unui turism rural şi a agroturismului); de staţiunile Ocna Sibiului, Bazna (turism balneo-climateric) şi Păltiniş (turism montan); de arii naturale protejate – ex.: Rezervaţiile paleontologice Calcarele eocene de la Turnu Roşu şi Calcarele cu hipuriţi de la Cisnădioara (turism ştiinţific);

- situarea oraşului la distanţă de până la 50 km faţă de obiective turistice antropice cu caracter de unicat – ex.: Muzeul de icoane pe sticlă de la Sibiel; Cetatea ţărănească din sec. XV de la Cristian etc., de locuri de naştere şi de creaţie a unor personalităţi care s-au făcut remarcate atât în plan naţional, cât şi internaţional – ex.: Casa memorială Emil Cioran din Răşinari (turism cultural) etc.

Sibiul reprezintă un important nod feroviar şi rutier. Se află la o distanţă de 10 km de Ocna Sibiului, pe calea ferată şi de 16 km pe DJ 17; la 45 km pe calea ferată şi 43 km pe DN 14 de Copşa Mică; la 56km pe calea ferată şi 55 km pe DN 14 de Mediaş; la 84 km pe calea ferată şi 77 km pe DN 1 de Făgăraş; l 92 km pe calea ferată şi 72 km de Alba Iulia, la 99 km pe calea ferată şi 99 km pe E81 de Râmnicu Vâlcea. Căile de comunicaţie care traversează acest oraş determină aşadar legături cu celelalte centre turistice importante ale Transilvaniei: Alba Iulia şi Cluj-Napoca, Sighişoara şi Târgu Mureş, Braşov, dar şi cu vechile provincii istorice, ca de ex.: Muntenia, prin Valea Oltului, cu bogatul lor patrimoniu cultural şi religios.

Sibiul beneficiază şi de existenţa unui aeroport, care însă, din păcate, efectuează doar curse Sibiu – Munchen şi Munchen – Sibiu, linia aeriană Sibiu – Bucureşti fiind în prezent închisă. Se preconizează modernizarea Aerogării Sibiului, Consiliului Judeţean Sibiu încercând să găsească în prezent soluţii pentru îmbunătăţirea infrastructurii şi serviciilor aeroportului.

1.2. Originalitatea, diversitatea şi valorificarea principalelor obiective turistice antropice. Atestat documentar în anul 1191, oraşul Sibiu deţine în prezent un adevărat tezaur muzeistic şi istoric, la care se adaugă numeroasele edificii religioase, culturale şi spaţii de agrement, care constituie puncte de atracţie turistică deosebit de valoroase, apreciate la scară naţională şi internaţională, atât prin numărul obiectivelor turistice existente pe unitate de suprafaţă, cât şi prin valoarea lor culturală.

Aşa cum am subliniat mai sus, studiul de faţă nu-şi propune însă o prezentare detaliată a acestora, ci o scurtă trecere în revistă a valenţelor lor

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turistice, din perspectiva optimizării acțiunilor de intensitate a valorificării celor mai importante obiective turistice.

Partea centrală a Sibiului, *Oraşul de Sus*, prezintă o originalitate deosebită prin existenţa celor trei pieţe „legate organic" între ele – Piaţa Mare, Piaţa Mică şi Piaţa Huet – dar şi cu *Oraşul de Jos*, prin Piaţa Aurarilor şi Pasajul Scărilor – str. Turnului.

Obiectivele turistice cele mai importante care fac parte din patrimoniul cultural al oraşului Sibiu şi care înregistrează fluxuri de turişti însemnate sunt următoarele:

1.2.1. Muzeul Naţional Brukenthal (fondat în anul 1790 şi deschis pentru prima dată publicului în anul 1817) – cuprinde în prezent:

- *Palatul Brukenthal* – situat in Piaţa Mare - cu Galeria de Artă (alcătuită din Galeria de Artă Naţională, Galeria Europeană şi Cabinetul de Stampe) şi Biblioteca (cu numeroase colecţii, dintre care cele mai importante sunt: Colecţia de manuscrise vechi; Colecţia de incunabule; Colecţia de carte rară străină din sec. XVI – XVIII; Colecţia de transilvanice; Colecţia de cartografie; Colecţia de garfică documentară).

Colecţia de stampe, dar şi biblioteca muzeului ar putea genera un turism cultural-ştiinţific. Pentru intensificarea valorificării turistice a patrimoniului cultural de care dispune acesta propunem deschiderea către public a Bibliotecii, care în prezent funcţionează cu circuit inchis, pentru a putea fi consultate la sala de lectură lucrările existente – în număr de cca 280.000 cărţi, din care 386 sunt icunabule (Al. Avram, 1998). Menţionăm doar câteva dintre acestea: „Breviarul Brukenthal" (scris pe pergament), „Geografia lui Strabo" (1473), „Istoria lui Pliniu cel Bătrân" (1498), „Cazania lui Varlaam" (1643) etc.

Sugerăm de asemenea, prezentarea în holul de la intrarea în Palatul Brukenthal a unor promo-uri gen poster pentru celelalte muzee care fac parte din Muzeul Naţoional Brukenthal, respectiv pentru:Muzeul de Istorie şi Muzeul de Istorie Naturală – cu Muzeul de Farmacie şi Muzeul de arme şi Trofee de Vânătoare.

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- *Muzeul de istorie* – organizat în cel mai important monument de arhitectură civilă gotică din Transilvania, construit la sfârşitul sec. XV şi cunoscut sub numele de Primăria Veche (în care a funcţionat acesta între anii

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1549 - 1948) a fost deschis spre vizitare în anul 1948. Se află la intersecţia străzilor de legătură dintre Piaţa Huet şi Piaţa Mare. Aceasta cuprinde în circuitul expoziţional permanent: Medalii şi decoraţii; Breslele sibiene; Cabinetul numismatic (colecţia deţine 60.000 de monede antice şi medievale); arme şi armuri (întreaga colecţie conţine peste 1900 de piese); Mişcarea naţională şi culturală din Transilvania; Lapidarul antic şi medieval; Sticlărie transilvană în epoca modernă.

Remarcăm integrarea acestui muzeu în largul spectru cultural al Sibiului. Anual în curtea muzeului, care beneficiază de o acustică perfectă, au loc spectacole de teatru şi muzică (medievală, flamenco etc) în cadrul Festivalului Internaţional de Teatru. Organizarea acestui festival la Sibiu şi deschiderea sa către formele de artă neconvenţională - prin piese de teatru jucate în spaţii alternative, cum sunt: Biserica fortificată de la Cisnădioara, curtea Muzeului de Istorie, Piaţa Mare, zidurile cetăţii etc - pune foarte bine în valoare obiectivele sale turistice, poate chiar mai bine decât o campanie de promovare turistică.

- Legătura dintre Piaţa Mare şi Piaţa Mică este realizată de un pasaj de trecere pe sub Turnul Sfatului. După multă vreme în care a fost închis, fiind inaccesibil publicului, acest turn a fost redeschis pentru o perioadă, oferind turiştilor panorame deosebit de frumoase asupra Sibiului, exponatele cu caracter istoric nefiind însă foarte bine inegrate spaţiului interior. În prezent, datorită lucrărilor de reparaţie care se execută în acea zonă a oraşului, acesta este din nou închis pentru public. Propunem ca după ce va fi redeschis să fie organizată, la intrare, în prima sală, o expoziţie cu vânzare de obiecte de artă, de etnografie etc.

- În Piaţa Mică se află *Muzeul de Istoria Farmaciei*, organizat în clădirea monument istoric din 1568, cu elemente gotice şi renascentiste, care generează prin profilul său un *efect de unicat* în spaţiul transilvănean. Structura sa - oficiu, laborator şi expoziţie homeopatică - se grefează pe aceea a unei foste farmacii, numită „La Ursul Negru" (1568), exponatele sunt originale, iar mobilierul folosit pentru prezentarea acestora este vienez. Cele peste 6600 de piese provenite din sec. XVI - XIX, din 67 de surse, respectiv din 32 de localităţii ale ţării, sunt concentrate însă într-un spaţiu care considerăm că este prea redus ca suprafaţă pentru a putea fi puse cu adevărat în valoare. Trebuie remarcat faptul că muzeul nu se bucură în prezent de

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aprecierea pe care o merită, probabil şi datorită poziției sale, insuficient de bine semnalată prin indicatoare, a inexistenței unor proiecte de genul „porților deschise" (care ar putea fi puternic mediatizate prin mass-media). Printre „atuurile" sale se numără şi prezența celor 2900 de exponate homeopate, care reprezintă rezultatul activității părintelui homeopatiei, Christian F. Hahnerman, ca medic, la curtea baronului Samuel von Brukenthal. În curtea clădirii unde este organizat în prezent Muzeul de Istoria Farmaciei a funcționat prima stație de observare meteorologică.

- *Muzeul de Istorie Naturală* – inițiat de Societatea Ardeleană de Ştiințe Naturale din Sibiu în anul 1849, situat pe str. Cetății, dispune în prezent de colecții deosebit de valoroase, ca de pildă: herbarul J. Lerchenfeld, de la sfârşitul sec. al XVIII-lea (cu 1811 piese); herbarul M. Fuss (cu cca 29.000 piese); colecția ornitologică F.W. Stetter; colecția entomologică Dr. E. Worell (peste 95.000 de piese); colecția de fluturi Weindel (cca 7000); colecția paleontologică Breckner (cu 7000 de piese); colecția mineralogică Dr. E. Bielz (cu 1400 piese) etc.

În holul muzeului se organizau, până în anul 2001, expoziții temporare vizând sistematica mineralogică, însă datorită faptului că muzeul dispune de o serie de colecții extrem de diverse şi mari şi că vechea expoziție permanentă prezenta doar specimene zoologice, s-a hotărât montarea în holul respectiv a unei expoziții cu caracter permanent de Sistematică mineralogică, cu caracter preponderent didactic. Ca urmare a acestui fapt, muzeul nu mai dispune în prezent de o sală de expoziții temporare, dar beneficiează periodic de sediul actual al Galeriei de Artă Contemporană (situat pe str. Tribunei). Aici a fost organizat în acest an, în perioada decembrie 2002 - aprilie 2003, de către Muzeul Național Brukenthal – prin Secția de Ştiințe Naturale, în colaborare cu Complexul Muzeal Bistrița-Năsăud şi cu Universitatea Lucian Blaga Sibiu – Catedra de Conservare-Restaurare expoziția „Natură şi artă. Concrețiuni grezoase şi grafică", un dialog fascinant între material şi imaterial, între arta sufletului naturii şi cea a sufletului uman. În pliantul de promovare a acestei expoziții, Dr. Ioan CHINTĂUAN scria: *„Concrețunile grezoase au devenit piese muzeale de puțină vreme, iar Muzeul Bistrița este primul din lume care a colectat astfel de roci, alcătuind o colecție, de asemenea, unicat (...). Multe imagini, multe chipuri, într-o lume de piatră, însuflețită doar de jocul de lumini şi umbre dat de zi sau noapte. Atracția concrețiunilor este cea a frumosului, a ciudatului, pe care acesta o posedă. Formele lor ne-au silit să le*

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dăm un nume; o puteți face și dumneavoastră. Este dreptul nostru de a arăta și numi frumosul natural sau cel creat de noi. Exponatele, simple, îngemănate, înmugurate, concrescute, constituie unele dintre numeroasele frumuseți ale naturii, pe care le putem aduce lângă noi, lângă frumusețile făcute și astfel să fim împreună..."

Originalitatea acestei expoziții s-a datorat și faptului că Muzeul de Istorie Naturală a adus lucrări plastice de grafică artistică, inspirate de aceste forme, realizate de studenții Facultății de Conservare-Restaurare din cadrul Universității Lucian Blaga.

Menționăm, de asemenea, participarea Muzeului de Istorie Naturală Sibiu cu eșantioanele de aur nativ ale Baromnului Samuel von Brukenthal (colecționate în sec. XVIII), la realizarea expoziție de mineralogie intitulată „Aurul Transilvaniei", organizată de Muzeul de Mineralogie din Baia Mare, între 26 septembrie 2003 - 20 martie 2004, acțiune care contribuie la promovarea colecțiilor sale pe plan național.

- *Muzeul de Arme și Trofee de Vânătoare* – inaugurat ca expoziție în 1966 și reorganizat în anul 1981 în sediul actual, situat în afara cetății, pe strada Școala de Înot, prezintă istoricul apariției armelor de vânătoare, dar și numeroase trofee medaliate, care reflectă diversitatea vânatului din România. Acest muzeu ar putea fi integrat într-un circuit turistic care să vizeze turismul cinegetic, practicat în județul Sibiu, deși ne-am dori ca impactul cu omului prin acest tip de turism asupra ecosistemelor să fie cât mai redus.

Raportul dintre cererea și oferta turistică a obiectivelor turistice prezentate anterior se reflectă în numărul de vizitatori care se înregistrează într-o anumită perioadă de timp. Conform datelor furnizate de Muzeul Național Brukenthal, numărul turiștilor crește de la an la an. La sfârșitul anului 2002, de exemplu, numărul total al turiștilor care au vizitat acest muzeu – la nivelul tuturor secțiilor sale – a fost de 72.966 (tabelul nr. 1), în timp ce în primele trei trimestre ale anului 2003 s-au înregistrat deja 52.091 vizitatori (tabelul nr. 2).

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Tabelul nr. 1. Numărul de vizitatori înregistrați de Muzeul Național Brukenthal în anul 2002

Nr. crt.	Muzeul	Adulți	Elevi	TOTAL
1.	Galeria de Artă	24.933	23.248	48.181
2.	Muzeul de Istorie	5.334	8.479	13.813
3.	Muzeul de Istorie Naturală	1.063	9.909	10.972
	TOTAL	31.330	41.636	72.966

(Sursa: Muzeul Național Brukenthal, 2003)

Tabelul nr. 2. Numărul de vizitatori înregistrați de Muzeul Național Brukenthal în primele trei trimestre ale anului 2003

Nr. crt.	Muzeul	Adulți	Elevi	TOTAL
1.	Galeria de Artă	17.160	15.183	32.343
2.	Muzeul de Istorie	3.720	5.961	9.681
3.	Muzeul de Istorie Naturală	1.111	8.956	10.067
	TOTAL	21.991	30.100	52.091

(Sursa: Muzeul Național Brukenthal, 2003)

Analizând datele prezentate în tabelele 1 şi 2, se observă faptul că în anul 2002 şi în primele trei trimestre ale anului 2003, obiectivul turistic cel mai vizitat dintre cele trei componente ale Muzeului Național Brukenthal a fost Galeria de Artă, între numărul vizitatorilor adulți şi cel al elevilor nefiind o diferență la fel de mare ca aceea existentă în cazul Muzeului de Istorie şi, mai ales, a Muzeului de Istorie Naturală. Ne-am întrebat de ce turiştii care vizitează Galeria de Artă nu sunt interesați să cunoască şi exponatele din celelalte muzee şi care ar fi soluțiile pentru dinamizarea activității acestora. În această idee, propunem inițierea unor acțiuni care să imprime mai multă viață acestor lăcaşe de cultură şi istorie, de ştiință şi cunoaştere. Pe lângă caracterul didactic foarte pronunțat pe care îl au, poate ar fi necesară organizarea unor lansări de carte; a unor Cercuri Ştiințifice care să coopteze atât elevi, cât şi studenți din unitățile de profil şi care să-şi desfăşoare şedințele în cadrul muzeelor respective, unde ar putea fi invitați şi colegii,

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părinții, rudele, prietenii acestora, iar acest moment ar fi un bun prilej de vizitarea exponatelor muzeelor. Ar putea fi continuată ideea îmbinării dintre poezia naturii, reflectată în diversele sale ipostaze în Muzeul de Istorie Naturală, tumultul momentelor păstrate din timpuri străvechi de exponatele Muzeului de Istorie şi de talentul artiştilor plastici în formare (din cadrul Şcolii de Artă şi a Facultății de Conservare-Restaurare din Sibiu), prin crearea de noi expoziții pe diverse tematici, care ar atrage numeroşi vizitatori etc.

1.2.2. Complexul Național Muzeal ASTRA

În anul 2000, cu prilejul organizării Expoziției de etnografie „Călător la izvoarele Nilului - Franz Binder 1820-1875" - de către Muzeul „Astra" Sibiu, Muzeul de Etnografie Universală „Franz Binder", Centrul Cultural „Lucian Blaga" şi Muzeul Orăşenesc Sebeş, județul Alba, sub auspiciile Ministerului Culturii - prof. univ. dr. Corneliu BUCUR menționa în broşura de promovare a acesteia următoarele: *„Sibiul deține în patrimoniul său cultural-artistic valori inestimabile ale culturii universale, unele dintre acestea de celebritate în lume - cum este şi colecția africană, realizată în a doua jumătate a secolului trecut de Franz Binder (...). Descoperirea şi valorificarea muzeală în cadrul unui muzeu destinat culturii popoarelor lumii primul de acest gen din România - a acestor colecții reprezintă o importantă deschidere spre cultura universală"*.

În cadrul acestui complex muzeal vizitatorii pot descoperii, de asemenea, identitatea etnoculturală a românilor, prezentată în Muzeul Civilizației Populare Tradiționale ASTRA, a transilvănenilor în Muzeul Civilizației Transilvane ASTRA, a saşilor în Muzeul Culturii Populare Săseşti „Emil Siegerus".

Muzeul de Etnografie Universală Franz Binder - situat în Piața Mică, inaugurat în anul 1993, prezintă expoziția permanentă „Cultura şi arta popoarelor lumii", care cuprinde piese deosebit de valoroase (statuete din fildeş, arme de vânătoare africane, o mumie cu sarcofag din timpul Ptolomeilor etc.). Muzeul deține trei spații de expunere pentru diverse .

1.2.3. Muzeul de locomotive cu aburi - a fost inaugurat în anul 1994 şi cuprinde pęste 35 de exponate. Dintre acestea 7 locomotive sunt

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funcţionale şi sunt utilizate cu prilejul diverselor manifestări organizate în Sibiu şi împrejurimi.

1.2.4. Dintre **spaţiile de agrement** cele mai reprezentative ale oraşului Sibiu menţionăm:

- Parcul Sub Arini – extins pe o suprafaţă de 30 ha, cuprinde peste 80 de specii de arbori şi arbuşti, dintre care 33 exotice. Este inegrat turistic nu doar peisajul pe care îl creează sau prin efectul reconfortant pe care îl generează, ci şi prin existenţa unor structuri turistice de cazare şi alimentaţie publică, dar şi de agrement: Bazinul Olimpia, numeroase terenuri de sport (tenis, fotbal, piste de atletism), Patinoarul artificial; în apropierea sa se află Stadionul municipal şi Sala Polivalentă „Transilvania"
- Un alt parc, care reprezintă de fapt metamorfozarea unui ecosistem natural într-unul antrpopizat, este Pădurea Dumbrava (desfăşurată în partea de sud-vest a oraşului pe o suprafaţă de 990 ha), unde se află Muzeul Civilizaţiei Tradiţionale Populare ASTRA, Grădina Zoologică (înfiinţată în anul 1929, cuprinde cca 330 specii), la care se adaugă şi structurile de cazare turistică (camping, han), lacul cu debarcader etc.
- Parcul Cetăţii, prin amplasarea sa între zidurile cetăţii, deşi se desfăşoară pe o suprafaţă relativ redusă, poate avea un efect reconfortant asupra turiştilor. Pentru a completa oferta turistică a părţii centrale a oraşului Sibiu propunem transformarea Zidurilor Cetăţii, cu cele trei turnuri ale sale, în Galerii de Artă, cu caracter privat, cu workshopuri sau şcoli permanente de artă, cu cafenele artistice (la fel ca Art Cafe-ul aflat la subsolul filarmonicii). De asemenea, considerăm că Turnul Gros ar putea fi transformat în Filarmonică.
- Pentru reducerea poluării existente în oraşul Sibiu, propunem realizarea unei centuri de protecţie, alcătuită din vegetaţie, care pe lângă efectul benefic asupra organismului uman, va avea efecte pozitive şi asupra esteticii oraşului: turistul care intră în Sibiu, mai ales dinspre Şelimbăr, are o privelişte dizgraţioasă a blocurilor din cartierele limitrofe; blocurile contrastează puternic cu arhitectura cetăţii medievale. În plus, existenţa unei duble centuri – rutieră şi de vegetaţie – va facilita construirea de structuri turistice de cazare (popasuri, hotele, campinguri etc.)

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1.2.5. Manifestări cultural-aristice care determină fluxuri însemnate de turişti

- Festivalul Internaţional de Teatru –
- Festivalul Medieval „Cetăţii Transilvane" - 29 - 31 august 2003
- Festivalul verii etc

Pentru dinamizarea activităţilor turistice în sezonul rece, propunem organizarea în perioada Sărbătorilor de Iarnă a Festivalului Iernii, în Piaţa Mare şi Piaţa Mică.

Capacitatea de cazare turistică din oraşul Sibiu

Nr. crt.	Tipul unităţii de cazare	Categoria			
		1 stea	2 stele	3 stele	4 stele
1.	Hotele	1	4	3	1
2.	Motele	2	-	2	-
3.	Pensiuni	4	6	1	1
4.	Bungalouri	1	1	-	-
5.	Cabană	1	-	-	-
	TOTAL	9	11	6	2

(Sursa: Ministerul Turismului, 2002)

Se observă faptul că cele mai numeroase sunt cele din categoria de 2 stele, ceea ce reprezintă un factor nefavorabil pentru activităţi turistice de calitate, ca de altfel şi numărul total al unităţilor de cazare turistică existente, respectiv 28, nesatisfăcător pentru un centru turistic cu un patrimoniu atât de bogat şi diversificat ca cel al Sibiului şi cu un real potenţial de dezvoltare în viitor.

Starea actuală a principalelor obiective turistice care alcătuiesc patrimoniul arhitectural al oraşului Sibiu.

Valorificarea turistică, la nivelul la care aceasta s-ar fi putut realiza, a fost împiedecată şi de aspectul dezolant creat de degradarea în numeroasele puncte de interes a zidurilor cetăţii Sibiului. În prezent însă, sub coordonarea Primăriei oraşului, s-au demarat o serie de lucrări de recondiţionare a acestora, în locurile de mare atracţie turistică, ca de exemplu: în Piaţa Mare (unde se desfăşoară şi lucrări de refacere a reţelelor de apă şi canalizare!) – la

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sediul Primăriei (fosta clădire a C.E.C.-ului); pe strada Ocnei, unde se refac zidurile cetăţii; la Pasajul Scărilor; la Turnul Sfatului etc.

În rândurile de faţă am surprins numai o parte din determinantele geografice care ar putea imprima oraşului Sibiu un rol turistic polarizant în sud-estul Transilvaniei.

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RECENZII

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Starea lumii se concentrează de această dată asupra problematicilor discutate şi concluziilor la carea s-a ajuns în cadrul Summit-ului Mondial care a avut loc la Johannesburg, în ceea ce priveţte dezvoltarea durabilă.

Structurată pe 8 mari capitole, lucrarea debutează cu o scurtă cronologie, foarte bine realizată, a principalelor transformări care determină modelarea viitorului nostru planetar, de la modificările climatice şi pierderea diversităţii la schimbările geopolitice care au loc pe plan mondial.

Aspectele abordate sunt extrem de diverse şi prezentate într-o manieră de înaltă ţinută profesională, astfel la finalul lecturii cititorul îşi va putea forma o nouă viziune asupra lumii, asupra importanţei şi necesităţii dezvoltării durabile.

Dintre problematicile abordate menţionăm: fragmentarea şi pierderea habitatelor de către păsări; legătura dintre poulaţie, femei şi biodiversitate; modalităţi de combatere a malarie; pledoarii pentru un viitor energetic; eliminarea dependenţei de minerit; angajarea religiei în căutarea unei lumi durabile etc.

O carte fascinantă, o lucrare de cercetare de înltă ţşinută ştiinţifică a lumii actuale, dar mai ales de prospectare a orizontului timpului viitor al planetei noastre ! Remarcăm atât complexitatea problemelor prezentate, cât şi calitatea informaţiilor oferite.

Virginia GHERASIM

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Lucrarea are deschidere spre noile orizonturi ale geografiei, care se întrezăresc pe plan mondial în pragul mileniului III, răspunzând, astfel, unor solicitări. Acest studiu vizează o axă geogafică amplasată din punct de vedere administrativ la contactul dintre judeţele Sălaj şi Bihor şi suprapusă morfologic Dealurilor Silvaniei şi contactului dintre acestea cu Câmpia de Vest. Autorul motivează elaborarea acestei lucrări prin „nevoia de cunoaştere integrată a realităţilor naturale, sociale şi economice ale axei". Integrarea, ca formă superioară de abordare a fenomenelor geografice, reprezintă „interacţiune, inetrcondiţionare, interdependenţă şi cooperare" între sistemele geografice, relevând permanent diferitele transformări de ordin calitativ din cadrul mediului.

Studiul este structurat pe trei părţi, care la rândul lor sunt alcătuite din mai multe capitole şi subcapitole, cu concluzii la final. Partea întâia stabileşte, pe parcursul a patru capitole, bazele conceptuale ale lucrării. Capitolul I (Geografia integrată) defineşte conceptul de geografie integrată şi precizează principiile şi tipologia integrării geografice, concluzionând că „geografia este un tot integrat care constă din elemente, relaţii, structuri, dinamici, procese, fenomene, sisteme, funcţionalităţi şi finalităţi (...), echilibre, metode, modele, etc.". Capitolul II (Dimensiunea geografică) dezvăluie parametrii cantitativi şi calitativi care definesc sistemele geografice ale axei, respectiv mărimea, întinderea, desfăşurarea, etc., iar capitolul III (Elemente ale planning-ului teritorial în axă), subliniază aspectele definitorii ale operaţiunilor de planning în cadrul axei şi precizează modelele corelaţiilor dintre geografie şi planning-ul teritorial (modelul exponenţial, modelul feed back, modelul sinusoidal, modelul complementar, etc.). Capitolul IV (Axa geografică Jibou-Zalău-Şimleul Silvanie-Marghita) defineşte conceptul de axă geografică, prezintă structura axei, stabileşte relaţiile din cadrul axei şi conturează diferitele stări ale integrării geografice în axă (înglobarea, uniune, incluziune, fuziune, apartenenţă, nonapartenenţă, suprapunere, adaptabilitate, simultaneitate, convergenţă).

Partea a doua se ocupă, de-a lungul a trei capitole, de suporturile geografice ale axei. Capitolul I (Dimensiunea istorică a axei şi a contiguităţii

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axei), scoate în evidență încărcătura istorico-geografică a axei silvano-someşene şi aduce o serie de lămuriri cu privire la toponomia din această zonă. De asemenea, se acordă un spațiu mai larg oraşului Zalău, considerat „un model al dimensiunii istorice" în limitele axei, care este analizat sub aspest toponimic şi istoric. Capitolul II (dimensiunea naturală a axei), precizează resursele naturale care caracterizează spațiul axei (poziție geografică, substrat, relief, mediu hidro-atmosferic şi biopedologic), iar capitolul III (Dimensiunea social economică a axei), completează tabloul personalității geografice a axei, prin prezentarea resurselor umane, care se constituie într-un sistem bine integrat funcțional în cadrul axei.

Partea a treia a lucrării se referă, în cinci capitole, la Starea axei. Capitolul I (Conceperea problemei), schițează mediile teritoriale din cadrul axei, încărcătura şi starea lor. În capitolul II (Procese şi fenomene de risc geografic în axă), autorul realizează o tipologie a riscurilor geografice în axă, conturează metodologia de dimensionare a riscurilor şi propune câteva modele ale identificări, evaluării, controlului şi prognozei stărilor de risc din acest spațiu de referință. Capitolul III (Dezvoltarea durabilă a axei), trasează principiile geografice ale dezvoltării durabile, preziontă factorii determinanți ai dezvoltării durabile şi schițează modelelecare integrează dezvoltarea durabilă în axă. Capitolul IV (Depresiunea Zalăului: risc şi dezvoltare durabilă), propune un studiu de caz asupra depresiunii Zalău structurat pe trei părți (cadru natural, riscuri geigrafice, dezvoltare durabilă), iar în capitolul V (Zonarea geografică integrată a axei) propune patru modele de zonare a axei, în funcție de formă şi dispunere, de încărcătură teritorială, de necesitățile durabile şi modelul reprezentării complexe a zonării axei, toate însoțite de grafice şi tabele.

Studiul se încheie cu un rezumat consistent în limba engleză şi cu o bibliografie variată, care include 316 lucrări de specialitate. Sunt demne de menționat prezentarea grafică deosebită, coerența limbajului, conținutul ştiințific al figurilor şi varietatea lor (grafice, schițe, tabele, scheme).

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