"Alexandru Ioan Cuza" University of Iași
Faculty of Geography and Geology
Department of Geology

GRIGORE COBĂLCESCU
1831 - 1892

MIRCEA SAVUL
1895 - 1964

GEO-IAȘI – 2024

Scientific Symposium

BOOK OF ABSTRACTS

Editor: Paul Țibuleac

IAȘI, ROMANIA

ANALELE ŞTIINŢIFICE ALE
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(SERIE NOUĂ)

G E O L O G I E

Book of abstracts

GEO-IAȘI-2024

Scientific Symposium

OCTOBER 25-27 – IAȘI, ROMANIA

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PROGRAMUL SIMPOZIONULUI

25 Octombrie 2024
SESIUNEA DE DESCHIDERE
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EXPOZIȚIE DE FOTOGRAFII
HOLUL DEPARTAMENTULUI DE GEOLOGIE

COMUNICĂRI PE SECȚIUNI

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Secretar: Smaranda SIRBU-RADASANU

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Alocuțiuni de închidere

26 octombrie 2024

APLICAȚIE PRACTICĂ

Obiectiv geologic: FOMAȚIUNEA DE HANGU (PIPIRIG -PLUTON – Județul NEAMȚ)

Traseu: Iași-Pașcani-Tg. Neamț-Pipirig-Pluton-Mănăstirea Agapia-Tg. Neamț (Cetatea Neamțului, Humulești)-Iași

27 octombrie 2024

IAȘI – ISTORIE ȘI CULTURĂ

9.00-9.30 – Tur ghidat: Muzeul „Colecțiilor Paleontologice Originale” din cadrul Facultății de Geografie și Geologie, corp B, etaj 2, Departamentul de Geologie – dr. Sergiu LOGHIN

9.30-10.00 – Tur ghidat: Muzeul de Mineralogie și Petrografie „Grigore Cobălcescu” din cadrul Facultății de Geografie și Geologie, corp B, etaj 2, Departamentul de Geologie – Conf. dr. Andrei BUZATU

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PREZENȚA SPECIEI *SCHIZOGALERIX SARMATICUM* (EULIPOTYPHLA) ÎN MIOCENUL SUPERIOR DE PE PLATFORMA MOLDOVENEASCĂ (ROMÂNIA)

Dumitru-Daniel BADEA[1*], Bogdan-Gabriel RĂȚOI[1] & Mihai BRÂNZILĂ[1]

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Cuvinte cheie: Erinaceidae, Vallesian, Turolian, Insectivora

Studii recente au semnalat prezența unor fosile de noi mamifere terestre în depozitele sedimentare (nisipuri și argile) aparținând Miocenului superior din partea de nord-est a României (Konidaris et al., 2024). Atât în depozitele Basarabianului superior (Badea et al., 2023a), cât și în cele din Khersonian și Meoțian (Badea et al., 2023b), au fost identificate fosile aparținând unor mamifere de mici dimensiuni (rozătoare, lagomorfe și insectivore).

În lucrarea de față, sunt prezentate fosilele atribuite speciei *Schizogalerix sarmaticum* (Lungu, 1981), care este un reprezentant al Familiei Erinaceidae, Ordinului Eulipotyphla, un precursor al aricilor de azi, fără spini.

Peste douăzeci de dinți izolați (inferiori și superiori) aparținând acestei specii au fost prelevați din depozitele a șase aflorimente din Platforma Moldovenească (Bârnova, Bohotin-Moșna, Deleni, Rediu, Dracseni, Dolhești).

Schizogalerix este unul dintre cele mai răspândite genuri de insectivore în Miocenul Europei de Sud-Est, fiind găsit încă din Biozona MN 5 în Austria, iar cea mai recentă apariție a genului fiind menționată în Pliocenul timpuriu, Biozona MN 15 în Grecia (Rzebik-Kowalska and Nesin, 2010).

În România (Platforma Moldovenească), prima menționare a speciei *Schizogalerix sarmaticum* este în MN 9 (Vallesian), în depozitele de la Bârnova (Badea et al., 2021), iar cea mai nouă în MN 11 (Turolian), în sedimentele de la Dolhești (Badea et al., 2023b).

Prezența speciei în asociațiile faunei continentale este importantă pentru caracterizarea paleomediului, deoarece acestea sunt indicatori ai pădurilor relicte, adesea în apropierea corpurilor de apă (Rzebik-Kowalska and Nesin, 2010).

Studiul este în derulare, date ulterioare urmând a complete răspândirea, paleomediul și tendințele evolutive ale acestei specii între MN 9 și MN 11.

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POSSIBILITIES OF SEPARATION AND RECOVERY OF CERTAIN METALS FROM SECONDARY RESOURCES – PRELIMINARY CONSIDERATIONS

Roxana BĂLTEANU[1] & Dumitru BULGARIU[1,2]

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Keywords: secondary resources, separation and recovery, strategic metals

Introduction

In the category of ”secondary resources" are included: (i) poor ore deposits (which cannot be economically exploited with current technologies); (ii) mining tailings (from settling ponds/dumps); (iii) certain alluvial deposit categories; (iv) different types of industrial and household waste (Constantinescu & Anastasiu, 2017). The interest in "secondary resources" has grown exponentially in recent years amid the worsening raw materials crisis, socio-economic and geopolitical changes, and the imperative measures for the protection and sustainable management of the environment. Consequently, different methods (ecological and non-disruptive towards the environment) capable of separating and valorizing useful components have been developed (especially for strategic industrial metals) from different types of secondary resources (Arndt & Ganino, 2012; Nusheh et al., 2012. The present study on the separation and recovery of certain metals of industrial interest from local secondary resources was occasioned by this context.

Methodology

The present study was carried out from the Dealul Negru tailing pond (Fundu Moldovei mining area, Eastern Carpathians, Romania), and its main objectives were the following: (i) establishing the optimal conditions for efficient separation (with a view to further valorization) of certain metals of industrial interest (Cr, Mn, Co, Ni, Cu, Zn and Pb) through three procedures: electrodeposition with photovoltaic current sources, extraction in a biphasic aqueous polyethylene glycol system (PEG 4000) – $(NH_4)_2SO_4$ – KCl, and adsorption on low-cost biomass (waste from the industrial processing of mustard); (ii) estimation of the applicative potential of the separation method tested. The work methodologies and analysis methods employed were taken from the specialized literature.

Results

The experimental results obtained by us (Tab.1) indicate a good separation for Zn, Ni, Cu, Co, and Cr, but weaker for Mn and Pb for all three methods tested, in agreement with the results in the literature. The selectivity factors have very low values, which shows that the separation methods tested are not selective, and, thus, under our working conditions only a "group separation" of the metals can be achieved. A remarkable fact is that, when applying the three separation methods, a phenomenon of synergism appears, which manifests itself with a slightly higher intensity in the case of electrodeposition with graphite electrodes and in that case of adsorption on low-cost mustard biomass. The manifestation of this phenomenon seems to have beneficial effects in the context of the recuperative separation of metals: (i) even if the selectivity is low, an advanced recovery of metals can be achieved; (ii) under conditions of synergosm a series of trace metals, present in the tailings sample in concentrations < 5 μg/g (Sb, Ga, Ge, As, Sn, Cd, In, Ti, Bi, V, Ag, Te, Au, etc.), can be separated and concentrated. For example, in electrodeposition separation with graphite electrodes, in cathodic deposits Cd, Bi, and Ti accumulate in concentrations > 25 μg/g, while in the nodic deposits Sb, Ga, and Ge accumulate in concentrations > 60 μg/g. When separating by extraction in aqueous biphasic systems, in the phase rich in polyethylene glycol as well as in the r separation by adsorption on low-cost mustard biomass, Cd, Ga, V, In, Ge, As, Ti, and Au accumulate in concentrations > 30 μg/g.

Tab. 1 The results obtained in the separation of common industrial metals from flotation tailings

Metals	Tailings* [μg/g]	Electrodeposition with photoelectric cells		Extraction into ABS system		Adsorption on mustard biomass	
		R [%]	S	R [%]	S	R [%]	S
Cr	97	83.80	0.1420	86.15	0.1383	90.82	0.1444
Mn	744	77.43	0.1312	80.42	0.1291	75.67	0.1203
Co	81	89.27	0.1513	92.08	0.1478	97.39	0.1549
Ni	53	96.16	0.1629	95.63	0.1535	98.14	0.1561
Cu	908	90.63	0.1536	93.51	0.1501	96.05	0.1527
Zn	351	98.51	0.1669	96.77	0.1553	98.21	0.1562
Pb	935	54.36	0.0921	78.39	0.1258	72.57	0.1154

** The concentration in the tailings sample. R – separation efficiency in relation to the concentrations of metals in tailings. S – the selectivity of the separation.*

Conclusions

The advanced recovery and valorization of useful components from secondary resources require the development of new high-efficiency separation methods and procedures (economically-feasible), both easy to adapt and implement in practice, and ecological (environmentally-friendly). The three test separation procedures satisfactorily meet these requirements. According to the existing data, it would be much more efficient (and more ecological) to "couple" these separation processes into a single method, which would give them a better application potential.

The suitability of the three separation processes for the recovery of common metals from flotation tailings is presented in the table below:

Specifications	Electrodeposition with photoelectric cells	Extraction into the system ABS	Adsorption on mustard biomass
Cr	++	++	+++
Mn	+	++	+
Co	+++	+++	+++
Ni	+++	+++	+++
Cu	++	+++	+++
Zn	+++	+++	+++
Pb	-	+	+

(-) the procedure is not suitable; (+) poor suitability; (++) good suitable; (+++) very good suitability. The following aspects were taken into account when making these estimates: yields and selectivity of separations, process adaptability, application potential, level of satisfaction of ecological requirements, and relative costs.

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CONSIDERATIONS REGARDING THE POLLUTION WITH PLASTIC MATERIALS OF SOILS IN THE MUNICIPALITY OF IAŞI

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Keywords: plastic materials, pollution, soils from urban areas

Introduction

The problem of environmental pollution with plastic materials (PM) is difficult to tackle not only because of its complexity, but also because of its multiple correlations between it and other current environmental problems: climate change, degradation of the soil cover, etc. Current studies focus on marine and oceanic systems, with a focus on microplastic pollution. The pollution of terrestrial environments (soils, freshwater aquatic systems, etc.) has not benefited from the same interest, being being regarded only as the sources of PM for marine and oceanic systems. Recent studies have shown that PM wastes are eliminated mainly in terrestrial environments, and the abundance of PM in these environments is at least the same order of magnitude as in marine and oceanic environments (Hurley et al., 2020). This aspect has diversified the perspectives and nuances of the approach to the problem of the pollution of terrestrial environments with PM from perspectives and with various nuances. The present study on the PM pollution of the soils in the city of Iaşi is also included in this context, having two main objectives: (i) determination and typological differentiation of PM in soils; (ii) establishing the main sources of PM for the studied area and their correlation with the abundance and typology of PM.

Methodology

The present study was carried out in the metropolitan area of the city of Iaşi (Romania), in the Păcurari, Alexandru cel Bun, and Dacia neighborhoods. Twenty-one soil samples were collected as follows: (i) 16 surface samples (0–30 cm) – 5 samples from the periurban area and 11 samples from the urban area; (ii) 5 samples from a soil profile (made in the Păcurari neighborhood). For the analysis of PM in soils, there is no standard methodology and no unitary way of expressing the abundances. The PM analysis was carried out according to its own methodology compatible with the procedures used in current studies. The main stages of the present study were the following: (i) dispersal of soil aggregates and degradation of organic matter – treatment with 30% KOH–NaClO solution (50 ml per 20 g of soil) in a sonication bath, followed by disaggregation in a sand bath; (ii) separation of PM by dry sieving, followed by treatment with NaCl (1.2 g/cm^3) and $ZnCl_2$ (1.55 g/cm^3) solutions; (iii) identification and dosage of PM – was achieved by optical microscopy, molecular absorption spectrometry in IR and UV-VIS, gas chromatography coupled with mass spectrometry (Bläsing and Amelung, 2018).

Results

For the soil samples from the studied perimeter, both the total content of plastic materials (TC-PM) and the diversity of forms of occurrence vary within wide limits (tab. 1; 2), with significant differences between the periurban area and the urban area, but without highlighting clear trends in the distribution and accumulation of MP. In the periurban area, the TC-PM is approximately twice as high as in the urban area, a somewhat contradictory observation compared to other data in the literature data but explainable taking into account the physical-geographical characteristics and local socio-economic particularities. In the case of the soil profile, the variation of TC-PM on depth is atypical and non-systematic, due to the frequent changes in the lithology and, in particular, the incorporation different types of waste in the soil.

Tab. 1. The total content [mg/kg] of plastic materials and the main textural and morphological forms of occurrence for the studied soils

Sample no	TC-PM	Textural forms			Morphological forms		
		MiPM	MsPM	MaPM	Particles	Fragments	Fibers
Periurban area							
Minimum	590.58	271.48	272.74	15.63	166.96	279.11	129.51
Maximum	1011.49	548.54	475.59	69.42	455.54	420.48	139.82
Average	763.92	375.65	348.37	39.66	292.02	336.99	134.92
Urban area							
Minimum	63.77	51.21	12.54	0.02	14.99	22.68	24.92
Maximum	889.07	400.47	455.28	44.10	365.32	358.65	207.52
Average	378.63	227.01	142.56	9.02	109.09	168.86	100.68
IS.4 ground profile							
Minimum	353.05	269,69	83.36	0	313.63	143.30	140.44
Maximum	827.29	480.50	389.24	13.15	69.30	339.77	221.99
Average	589.25	359.79	225.20	4.26	158.82	250.35	180.08

TC-PM – the total content of plastic materials. MiPM – microplastic (5 mm – 1 μm). MsPM – mesoplastic (5 mm – 2.5 cm). MaPA – macroplastic (> 2.5 cm).

Compared with data in the literature, the TC-PM values reported in the present study are higher. Our study targets a broader range of PM, while the existing studies focus, almost exclusively, on microplastic.

Conclusions

According to the TC-PM values, the PM pollution of the soils in the studied perimeter is neither very bad, nor slight. The soils studied are polluted with PM (but we cannot specify the degree or level of pollution, because there is not yet a classification with specified quantitative limits), and this phenomenon can no longer be ignored or approached with superficiality.

Tab. 2. The contents [mg/kg] of the main chemical varieties of PM determined in the soils of the studied area

Sample no.	PO	PS	PCL	PES	PA	PU	RUB	OPM
Periurban area								
Minimum	286.58	19.93	16.40	153.12	7.75	6.79	8.18	19.32
Maximum	427.05	102.95	52.90	311.69	41.57	93.56	57.13	100.68
Average	323.90	54.26	30.17	203.42	23.28	44.71	27.58	56.62
Urban area								
Minimum	37.26	0.91	0.55	22.30	0.61	0.50	0.70	1.13
Maximum	505.88	27.65	23.92	209.10	25.07	28.81	38.41	70.68
Average	212.74	11.25	7.12	103.62	7.59	8.64	9.73	17.95
IS.4 ground profile								
Minimum	150.75	3.28	1.09	147.50	4.10	2.09	1.13	2.68
Maximum	316.08	38.14	31.19	246.28	22.25	24.24	33.67	68.75
Average	230.30	15.05	11.48	200.83	9.76	12.42	12.27	23.47

PO – polyolefins. PS – polystyrenes. PCL – chlorinated polymers. PES – polyesters. PA – polyamides. PU – polyurethanes. CAU – rubbers (copolymers). OPM – other plastic materials (especially from the resin category).

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SEMNIFICAȚIA PETROLOGICĂ A UNOR ASOCIAȚII INTIME DE MINERALE

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Cuvinte cheie: cristalizarea magmelor, generații de plagioclaz, amestec de magme

Marea majoritate a intercreșterilor minerale (granofirice, grafice, myrmeckitice, pertitice etc.) sunt datorate unor mecanisme cum ar fi cristalizarea simultană la eutectic, fenomene de dezamestec, de substituție, reacții solid + fluid, etc.

Studiul adestora ne permite să determinăm condițiile de cristalizare a magmelor care sunt la originea lor. Un caz interesant este o intercreștere formată din trei generații de plagioclaz care conțin incluziuni de minerale feromagneziene cum ar fi hornblenda verde și biotitul. Această asociație a fost pusă în evidență în roci magmatice formate în urma unui proces de amestec incomplet (*mingling*) între două magme de compoziție foarte diferită. Studiul acestei asociații ne-a permis să reconstituim procesul de amestec incomplet între cele două magme, istoria întregului proces fiind înregistrată în compoziția și arhitectura acestei asociații intime.

CONTRIBUȚIA ZĂCĂMINTELOR DIN BAZINUL MINIER BAIA MARE LA CONSTITUIREA PATRIMONIULUI MUZEULUI JUDEŢEAN DE MINERALOGIE "*VICTOR GORDUZA*" BAIA MARE

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Cuvinte cheie: zăcăminte hidrotermale, activitate minieră, colecții muzeale, minerale

Muzeul Judeţean de Mineralogie „Victor Gorduza" din Baia Mare este o instituţie de cultură, aflată în subordinea Consiliului Judeţean Maramureş, a cărei menire este colecţionarea, conservarea, cercetarea şi valorificarea în scopul cunoaşterii, educării şi recreerii, a mărturiilor materiale ale existenţei şi evoluţiei cadrului geologic, în special mineralogic, al zonei de nord-vest a României. Instituţia a luat naştere acum aproape cincizeci de ani, odată cu înfiinţarea Secţiei de Ştiinţele Naturii în cadrul Muzeului Judeţean Maramureş.

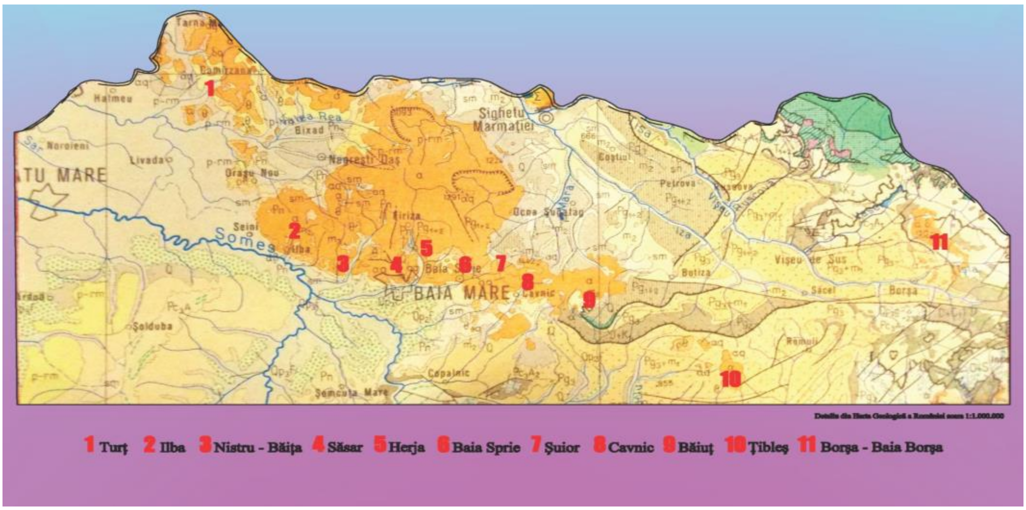

Fig. 1 Localizarea perimetrelor miniere, din partea de nord-vest a României, asociate lanțului vulcanic Oaş-Gutâi-Ţibleş şi zonele adiacente, de unde provin bunurilor culturale ce constituie patrimoniul Muzeului Județean de Mineralogie „Victor Gorduza" Baia Mare.

Structural, de la bun început, patrimoniul cultural s-a edificat pe patru colecţii: minerale, fosile, minereuri şi roci. Fiind prin definiţie un muzeu de mineralogie, volumul primei categorii este şi cel mai mare, reprezentând 83,3% din totalul eşantioanelor. Celelalte trei colecţii se subscriu temei principale, contribuind la completarea imaginii contextului geologic. Toată colecţia mineralogică provine din lucrările subterane de explorare şi exploatare a minereurilor neferoase, din cele unsprezece perimetre din așa-numitul bazin minier al Băii Mari şi din zonele adiacente acestuia.

Diversitatea mineralogică de excepţie a zonei Baia Mare este datorată vulcanismului neogen. Generat de subducţia Plăcii Europene sub două microplăci continentale, Alcapa şi Tisza-Dacia (Csontos, 1995), el s-a manifestat prin două tipuri distincte: unul acid (ignimbrite riolitice) și unul intermediar (andezitic, Kovacs & Fülöp, 2003). Vulcanismul andezitic, desfăşurat în perioada Badenian superior - Pannonian între 13.4 şi 7.0 Ma (Pécskay et al., 1995) a fost însoţit de o intensă activitate metalogenetică. Aceasta s-a desfăşurat în două etape pe parcursul Pannonianului: 1) prima etapă în Pannonianul inferior (11.5-10.0 Ma), în cadrul a două câmpuri metalogenetice, Ilba-Nistru și Săsar-Dealul Crucii, incluzând zăcăminte polimetalice și, respectiv, auro-argentifere; 2) etapa a doua în Pannonianul superior (9.4-7.9 Ma), incluzând zăcămintele polimetalice din câmpul metalogenetic Herja-Băiuț (Kovacs et al., 1997). Activitatea metalogenetică a generat zăcăminte hidrotermale de tip epitermal *low-sulfidation*, predominant filoniene.

Zăcămintele hidrotermale filoniene, asociate vulcanismului neogen din zona Baia Mare, conţin asociații minerale complexe și bogate; aproximativ 150 de minerale au fost identificate și descrise (dintre care, 10 minerale pentru prima dată în lume), aparținând claselor elemente native, sulfuri și sulfosăruri, oxizi și hidroxizi, halogenuri, carbonați,

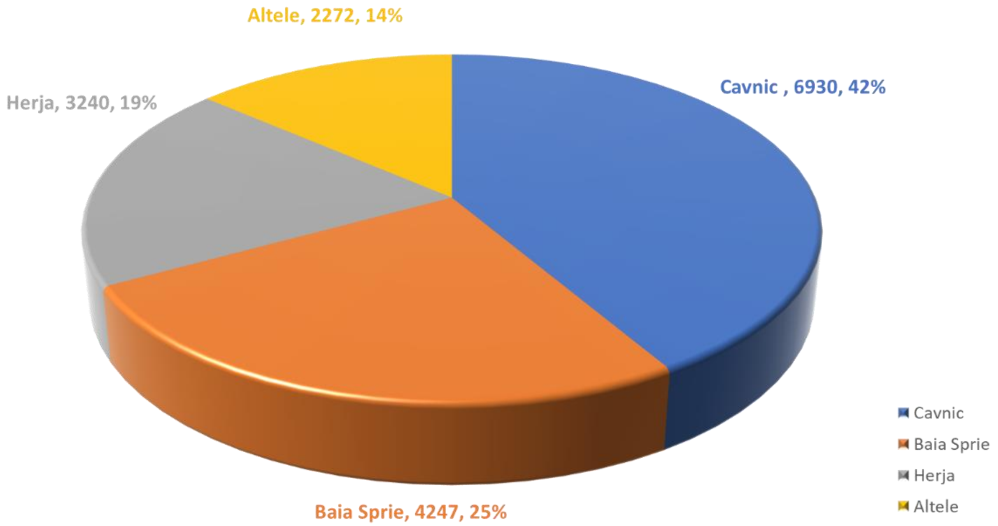

Fig. 2 Repartizarea patrimoniului mineralogic, între principalele zăcăminte.

sulfați, wolframați, fosfați și silicați. Cele 16.689 de piese, din cadrul Colecției de Mineralogie, provin (în ordine descrescătoare) din următoarele zăcăminte: Cavnic, Baia Sprie, Herja, Săsar, Băiuț, Nistru, Turț, Șuior, Ilba, Țibleș și Baia Borșa.

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PHOTOGRAMMETRY AND 3D PRINTING. A CASE STUDY FOR MUSEUM COLLECTION ENRICHMENT AND PRESERVATION

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Keywords: museum collections, 3D fossils, 3D printing, paleontology, photogrammetry

In most cases, museum collections are based on specimens collected from local outcrops. From a scientific point of view, these are very important and represent a pivot point for any direction a scientist may take. From a visitor's point of view, however, the scientific collections may not present the same interests as well-known and publicized specimens. Therefore, a museum must create a balance between scientific exhibits and those dedicated to the public. The methods used in the present study (photogrammetry, 3D modeling, 3D printing) used in this paper are trying to prove how a museum could enrich its collection, offer the visitors interaction with the exhibits preserve the originals, and also bring forth new ways to present the macro and micro world of paleontology.

In the present study, we used photogrammetry techniques to create 3D models for different specimens, 3D modeling techniques to clean and prepare 3D models for printing and assembly, and 3D printing techniques to create tangible models. After these processes were finished, we assembled and painted the printed models to create the final specimens using copper wire, a heat gun, special glue, and paint.

FURNICI FOSILE DIN DEALUL BLĂNARULUI (VLĂDICENI, IAȘI). CONSIDERAȚII PRIVIND STAREA LOR DE CONSERVARE ȘI POSIBILITĂȚILE DE IDENTIFICARE

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Cuvinte cheie: furnici fosile, insecte fosile, Sarmațian mediu, Miocen superior

Acest studiu, aflat în derulare, se axează pe catalogarea și descrierea furnicilor fosile (Hymenoptera, Formicidae) descoperite (Ionesi et al., 2020) în situl fosilifer Dealul Blănarului (Vlădiceni, Iași). Situl fosilifer a fost datat la Basarabianul superior (Ionesi et al., 2005) şi este unul din puţinele din România care conţine fosile de insecte. Marea majoritate a fosilelor sunt artropode terestre (în principal insecte, dar și arahnide), dintre care furnicile sunt grupul cel mai bine reprezentat. Fosilele de furnici diferă mult în ceea ce priveşte gradul de prezervare, existând un gradient de la cele la care este vizibil doar conturul specimenului până la cele la care sunt vizibile detalii precum o parte din nervurile aripilor sau dentiția mandibulelor. Nici o fosilă nu are păstrate elemente fine precum sculptura segmentelor corpului, iar stabilirea numărului exact de antenomere este dificilă; pețiolul, element important în sistematica familiei Formicidae, este vizibil doar la puține impresiuni. Acest lucru face identificarea sau descrierea acestor fosile greu de realizat, deoarece criteriile de determinare specifică sau generică includ examinarea unor detalii care în multe cazuri nu au fost păstrate.

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FIRST REFERENCES TO GEMS IN THE OLD TESTAMENT

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Keywords: Septuagint, Moses, Judgment chest, High Priest, precious and semi-precious stones

The Old Testament includes 39 canonical books, received by the Church to be inspired by God and 14 non-canonical books, but recommended by the Church to be read and practically includes the teachings that were revealed by God to people through Moses and through the prophets, chosen and guided men by the Holy Spirit, who lived before the coming of Jesus Christ into the world (Chirilă et al., 2018).

The *Septuagint* is a Greek translation of the original Hebrew Bible from the 3rd to 1st century BC. The name "Septuagint" comes from the Latin *septu gint*, which means "seventy" and refers to the number of Jewish scholars who worked on the translation.

The first mention of a gem in the Bible is found in Genesis: 2 – The Lord's Day of rest. Man in the middle of the world and heaven. The first family - (Genesis 2, 12) "and the gold of that country is good; there is also the bdeliu and the *onyx* stone". We find the following mentions in Exodus (Exodus, 24) - Moses ascends Mount Sinai a second time (Exodus 24, 9) "And Moses and Aaron, Nadab, Abihu, and seventy of the elders of Israel" (Exodus 24, 10) "and they saw the place where the God of Israel sat: under His feet was like a bed of *sapphire* slabs, as pure as the depths of heaven"; (Exodus, 25) - Arrangements for the tabernacle of the congregation: the ark of the testimony, the table of shewbread, the candlestick with seven arms (Exodus 25, 7) "*sardius stones* and *precious stones* to put on the ephod and the priest's breastplate" (Bible, 2012).

The Bible's most famous and debated reference to precious stones refers to the sacred breastplate of the high priest of the Israelites, also known as "the breastplate of Aaron (brother of Moses, the first High Priest)" and "the breastplate of judgment". In the Old Testament we see how God commanded Moses and said: "Take Aaron and his sons with him, the clothes, the anointing... Then he clothed Aaron with the chiton (tunic), girded him with a belt and put on with the ephod (cloak), and girded it with the ephod's girdle, and after that he put the hoshen (breastplate) on him, and in the hoshen he put the Urim (showing) and Thummim (truth). On his head he put the mitre, and in front of it the golden tablet, the diadem of holiness..." (Leviticus 8, 1-2, 7). The ephod was made of two parts, one covering the chest and the other the back. The two parts were joined by two shoulders (Exodus 28, 7). The first function of the ephod was to support the breastplate (the central piece of the high priest's garments), which was attached to it by means of 4 links (Exodus 28, 23) (Bible, 2012). The Judgment Chest was a piece richly decorated with gold, blue, purple, scarlet and fine linen, resulting in a square of about 20x20 cm. In front were four rows of three different precious stones, in agreement with to the number of the tribes of Israel. The role of the 12 precious stones was not to beautify the high priest, but to show God's interest in each of the 12 tribes (tribes) of Israel: Reuben, Simeon, Levi, Judah, Dan, Naphtali, Gad, Asher, Issachar, Zebulun, Joseph, Benjamin. Each precious stone was identified by a word from ancient Hebrew, the original language of the Old Testament, on each of which was written the name of one of the 12 tribes. God wanted Aaron to wear the "breastplate of judgment" to symbolize that the high priest represented the people before God: "Whenever Aaron enters the Holy Place, he will bear the names of the children of Israel on his heart ... as a continual remembrance before the Lord" (Exodus 28, 29). It was also called "the breastplate of decision" because the Urim and Thummim, which were associated with the breastplate, were used to determine God's will in various matters. The original text of the Hebrew Bible and the meaning of many ancient Hebrew words are now largely lost. Our knowledge of the Old Testament as presented in the many English versions of the Bible is based on 2,500 years of scientific interpretation of the Greek, Aramaic, and Latin translations. Not surprisingly, the identity of the breastplate gems has become confused. Modern English versions of the Bible give a total of over 40 different identities for the 12 jewels of the breastplate. Most are modern gem names, minerals and varieties of minerals, along with some archaic English names and some untranslated Greek and Latin names. Being a first-generation translation, the *Septuagint* is the most direct linguistic link with the identities of the gems (precious stones) on the breastplate (Bădiliţă et al., 2004).

Rabbi Bahiya Ben Asher (Rabbenu Bahiya) (1255–1340) described in his commentary on the Tetzave pericope, chapter 28, the properties of Hoshen stones - "avney hoshen": "Know that it is written in the books of the wisdom of nature that all the precious stones marked and of the vine there are only twelve and they are the forerunners of all the other stones" (Berliner, 2020).

In the Tanakh, the Hebrew Bible, the following gemstone is listed for each of the twelve tribes of Israel. They are, in the 1st row, *red jasper* (*sardius*), *citrine quartz* (*topaz*), and *emerald*; in the 2nd row, *ruby* (*carbuncle*), *lapis lazuli* (*sapphire*), and *rock crystal* (*diamond*); in the 3rd row, *golden sapphire* (*ligure*), *blue sapphire* (*agate*), and *amethyst*; in the 4th row, *yellow jasper* (*chrysolite*), *golden beryl* (*onyx*), and *chrysoprase* (*jasper*) (Manutchehr-Danai, 2009).

In the *Septuagint - Genesis, Exodus, Leviticus, Numbers, Deuteronomy*, volume coordinated by Badiliţă et al., 2004, the following are mentioned as part of the 12 stones on the breastplate: *sard, topaz, emerald* (first row); *anthrax, sapphire* and *jasper* (second row); *liguria, agate* and *amethyst* (third row); *chrysolite, beryl* and *onyx* (fourth row). On the other hand, in the Bible printed under the guidance and care of His Beatitude Teoctist (Publishing Office of the Biblical and Missionary Institute of the Romanian Orthodox Church, 2005) the following gems are mentioned: *sard, topaz, emerald* (first line); *ruby, sapphire* and *diamond* (second row); *opal, agate* and *amethyst* (third row); *chrysolite, onyx* and *jasper* (fourth row).

In a linguistic study, Nicolae (2013) analyzes the terminology of jewelry in Romanian Bible translations and uses the following names for the 12 minerals on the breastplate: 1.

sard; 2. *topaz*; 3. *emerald*; 4. *Ant(h)rax*/*ruby*/*bdelium*; 5. *sapphire*; 6. *jasper*/*diamond*; 7. *ligurion*/*opal*; 8. *agate*; 9. *amethyst*; 10. *chrysolite*; 11. *onyx*; 12. *beris*/*jasper*.

Harell (2011) took a different approach to identifying the gems on the breastplate. A specialist in the archaeological geology of Egypt and the Middle East, the author believes that the 12 gems mentioned in the Old Testament as part of the breastplate are: 1. *carnelian*; 2. *peridot*; 3. *turquoise*; 4. *red garnet* (a member of the almandine-pyrope series); 5. *lapis-lazuli*; 6. *chrysoprase*; 7. *amber*; 8. *agate*; 9. *amethyst*; 10. *yellow chalcedony*; 11. *aquamarine*; 12. *onyx*. While not answering all the questions about the identity of the gems on the breastplate, Harrell provides convincing identifications for many of the stones and narrows down the possibilities for others. At the very least, his work provides fascinating insight into the gemstones that were actually used in biblical times.

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VOLCANIC ACTIVITY IN THE GUTÂI MOUNTAINS; EVOLUTION AND GENESIS. A REVIEW

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Keywords: andesites, $^{87}Sr/^{86}Sr$ ratios, magma mixing, geothermobarometry, volcanic plumbing system, lithospheric mantle

The Gutâi Mountains belong to the Neogene-Quaternary volcanic chain of the Romanian Eastern Carpathians. They represent one of the most studied geological areas of Romania due to their complex volcanism and coeval metallogeny. The geochronological, volcanological, geochemical, isotopical, mineral chemistry and geothermobarometry data published during the last decades have changed the perspective on the genesis and evolution of the Miocene volcanism from the Gutâi Mountains. Geotectonically they are located at the eastern tip of ALCAPA, at the contact with the Tisza-Dacia and East European lithospheric plates.

Two types of volcanic activity have been established in Gutâi Mountains (Kovacs and Fülöp, 2003): 1) A felsic/rhyolitic caldera-related volcanism at the inception of the volcanic activity (!5.4 Ma), when a complex sequence of ignimbrites and associated resedimented volcaniclastics, subsequently covered by younger volcanics, had been emplaced in the southern part of the Gutâi Mts. (Fülöp, 2003); 2) An intermediate/andesitic volcanism developed along the 13.4-7.0 Ma time-interval (Pécskay et al., 2006), when a variety of volcanic rocks, ranging from basalts to rhyolites and dominated by andesites, were emplaced covering the entire area of the Gutâi Mts. The intermediate or andesitic volcanism had produced more than 90% of the volcanic rocks during a multiphase activity with a climax between 11-9 Ma. It comprises four stages based on temporal evolution (Kovacs et al., 2017). The most voluminous volcanic complexes were emplaced during the first two volcanic stages. The intermediate volcanism started in the Badenian (13.4-13.2 Ma), when pyroxene andesite lava flows and a dacite extrusive dome was emplaced in the southeastern part of the Gutâi Mts. The volcanic activity of the first stage continued with the pyroxene andesite lava flows, predominantly emplaced subaqueously during the Badenian-Sarmatian time (13.1-12.0 Ma). The second volcanic stage developed during the Pannonian (11.6–9.0 Ma), when a series of intermediate and acidic volcanic rocks were emplaced within the entire area of the Gutâi Mts. During this stage, a series of simple and composite volcanoes and extrusive domes rose, and high volumes of lava flowed. Consequently, thick volcaniclastic successions (e.g., thick and extended lava flows from the northern part of the Gutâi Mts.) filled up volcano-tectonic depressions. A total of nine volcanic complexes were assigned to the second stage of the intermediate/andesitic volcanism based on temporal, spatial, and compositional affinities (Kovacs et al., 2017). This stage started with a dome-building phase in the southern part of the volcanic area, with the large Dănești-Cetățele composite dome (11.6 Ma) as the most representative, followed by the emplacement of the andesitic complexes (11.6-9.9 Ma) in the central and southeastern part of the Gutâi Mts. The longest activity is related to the Mogoșa composite volcano (11.4-9.5 Ma) from the southern part of the volcanic area. The second stage of the intermediate volcanism had its climax between 10.0-9.0 Ma, when a very large volume of volcanic products emplaced in the northern part of the Gutâi Mts. Several andesitic volcanoes (Rotundu, 9.8-9.7 Ma and Igniș, 9.5-9.0 Ma) and large dacitic (Pleșca Mare, 9.3 Ma) and andesitic (Gutâi, 9.3-9.0 Ma) extrusive domes grew up in this major volcanic phase. Numerous shallow subvolcanic intrusive bodies (dykes, sills, small laccoliths) of various compositions and textures, dated between 11.8-9.0 Ma (Kovacs et al., 2013), occur mainly in the southeastern part of the Gutâi Mts. and are assigned to the intermediate volcanism. A small composite andesite-dacite intrusive structure, the Laleaua Albă magmatic complex (8.5-8.0 Ma, Kovacs, 2002) from the central-southern part of the volcanic area, represents the third volcanic stage. The fourth volcanic stage, the Firiza basaltic complex (8.1-7.0 Ma, Edelstein et al., 1993) comprised several small intrusive bodies of olivine-bearing basalts, developed exclusively in the central part of the Gutâi Mts.

The volcanic rocks from the Gutâi Mts. indicate subalkaline compositions and a medium to high-K character. They show typical features of a subduction-related magmatic arc: LREE-enrichment and negative Eu anomalies in the chondrite-normalized REE diagrams and strong enrichment in LILE and significant HFSE depletion in the NMORB-normalized diagrams, as well as the negative correlation of the Sr–Nd isotopes. They also have high Rb contents (50-180 ppm) and high 87Sr/86Sr ratios (0.7069-0.7112), and show a positive correlation of the LILE elements ratios (e.g., Rb/Sr), or LILE/HFSE elements ratios (e.g., K/Nb, Rb/Nb), with differentiation indexes (e.g., SiO2, Rb) which suggest the involvement of strong crustal assimilation by assimilation fractional crystallization (AFC) processes during magmatic differentiation (Kovacs et al., 2017). Mineralogical, textural, and geochemical data of many volcanics from the Gutâi Mts. record magma mixing/mingling processes in their formation (e.g., disequilibrium textures, sieve-textured plagioclases, high-Mg zoned clinopyroxene and amphibole xenocrysts close to corroded quartz crystals, quartz crystals with pyroxene coronas, Kovacs, 2002; Kovacs et al., 2017, 2021; Jurje et al., 2014). The magmatic source for the volcanic rocks of the Gutâi Mts. was a lithospheric-enriched mantle, previously modified by a melted sediment subduction component (Kovacs et al., 2017). A recent geothermobarometric study based on the geothermobarometers for amphiboles and clinopyroxenes from the main volcanic structures has indicated variable conditions for their crystallization in multi-level magma storage reservoirs. The different crystallization depths for the various amphiboles and clinopyroxenes, as constrained by the P–T data, indicate magma sources scattered throughout the entire crust, from very deep locations (27–33 km) near the lower crust–lithospheric mantle boundary (MOHO=33–35 km), up to shallow levels in the upper crust (2-5 km, Kovacs et al., 2021). Complex volcanic plumbing systems, comprised of multi-level, interconnected intra-crustal magmatic reservoirs, were inferred for many volcanic structures in the Gutâi Mts. The presence of numerous very deep magmatic reservoirs in several volcanic structures across the entire time-interval of the volcanism provides evidence for a main, deep magma reservoir (“deep hot zone”) that acted as a “MASH zone” at the crust–mantle boundary beneath the volcanic area (Kovacs et al., 2021). The petrogenesis of the volcanic rocks involving AFC processes and magma- mingling and -mixing was controlled by the architecture of the volcanic plumbing systems revealed for the main volcanic structures in the Gutâi Mts.

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THE ROLE OF MAGMA-MIXING AND -MINGLING IN THE PETROGENESIS OF THE LALEAUA ALBĂ MAGMATIC COMPLEX (GUTÂI VOLCANIC ZONE, EASTERN CARPATHIANS)

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Keywords: composite dyke, dacite, xenocryst, sanidine, mafic enclave, disequilibrium texture

The Gutâi Volcanic Zone (GVZ) belongs to the East Carpathian volcanic range developed in the north-western part of Romania. Intermediate/andesitic multiphase volcanism took place here during the Miocene (13.4–7.0 Ma). The Laleaua Albă magmatic complex in the central-southern part of the volcanic area represents the third volcanic stage of the intermediate volcanic activity (8.5-8.0 Ma, Kovacs, 2002). It comprises four small-sizes dykes which pierce through the Gutin Serpentines volcaniclastic complex. The two largest of them represent sub-parallel composite dykes: *Laleaua Albă* (ca. 1 km long) and *Biserica lui Vlaicu* (ca. 300 m long), both composed of an external zone of microporphyric/aphyric andesite and an internal (core) zone of macroporphyric dacite, with extremely intricate contact features between the two rocks types. The mineralogical composition of the dacite consists of sanidine macrocrysts (up to 5 cm), large-sized plagioclase, quartz and biotite and smaller-sized amphibole and pyroxene phenocrysts. In the andesites, excepting sanidine, the same phenocrysts are present, much smaller in size, whereas quartz and biotite are sparse. Abundant mafic microgranular enclaves (MME) of very different sizes (up to 90 cm) occur in the dacites. Two main compositional types of MME were recognized: 1) amphibole>clinopyroxene type with typical diktytaxitic texture (the most abundant) and, 2) clino-pyroxene>amphibole type (Kovacs and Fülöp, 2010). Chemical composition and texture of the mineral assemblages in both dacites, andesites, and MME place constraint on the magma-mingling and -mixing rock-forming processes (Kovacs, 2002; Kovacs and Fülöp, 2010; Kovacs et al., 2013, 2017, 2021; Naumov et al., 2014). Characteristic features include: similarly high Mg# (70–89) clinopyroxene, mainly chromian diopside (as frequent crystal clusters in dacites and andesites) and high Mg# (71-84), high Al (11.6-15.5) amphibole (magnesiohastingsite, sadanagaite and pargasite) in the MME (as phenocrysts), dacites and andesites (as xenocrysts); multiple plagioclase populations in

both dacites and andesites – An_{70-90} as xenocrysts in andesites and as antecrysts (cores) in dacites (phenocrysts in MME); An_{55-70} as phenocrysts in andesites and antecrysts in dacites; and An_{28-48} (mostly 28–38) typical for dacites; ubiquitous disequilibrium textures of the plagioclase phenocrysts: strongly oscillatory, normal and reverse zoning with many recurrences and sieve textures with resorption zones; resorption embayments in the large-sized sanidine crystals; clinopyroxene coronas on quartz phenocrysts (only in the andesites). In a recent geothermobarometric study (Kovacs et al., 2021), similar pressures for the amphiboles and clinopyroxenes were obtained in all three lithologies, suggesting similarly deep crystallization levels (23–33 km) from the mafic magmas. This confirms that these mafic minerals were incorporated into the dacites and high-silica andesites via magma-mingling and -mixing processes. The geochemical data also assert the involvement of magma-mingling and -mixing in the petrogenesis of the two rock-types of the composite dykes. A pathway of mixing processes between melts of basaltic composition, similar to that of the MME, and silicic composition, similar to that of the dacite is shown in geochemical diagrams (e.g., Rb–Rb/Sc, Th–Th/Sc). If the basaltic composition corresponding to the gabbroic MME could be considered as the mafic end-member, the acidic end-member might correspond to the silicic composition of the dacite granophyric groundmass in equilibrium with sanidine, sodic plagioclase, quartz and biotite.

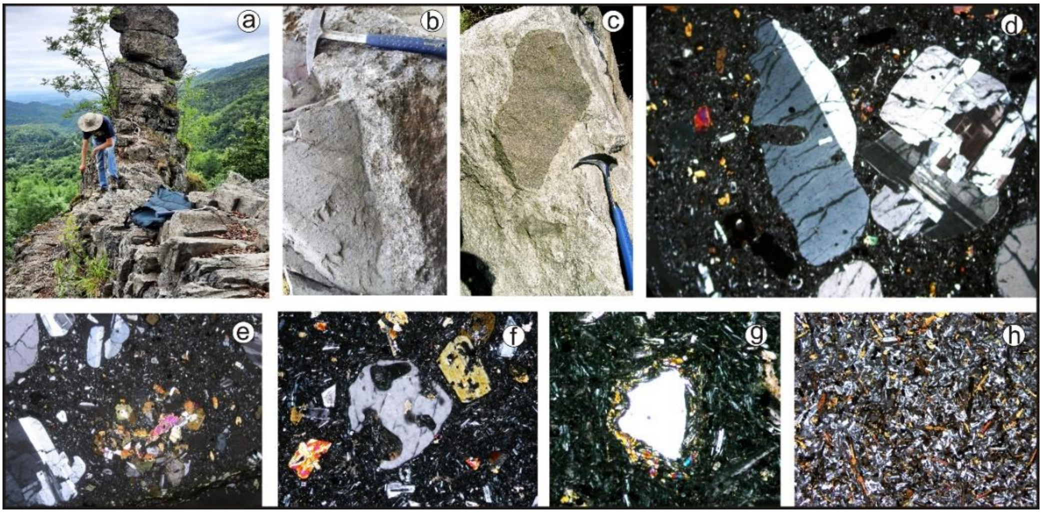

Fig. 1. Macroscopic and microscopic aspects of the magmatic rocks in the Laleaua Albă complex. a) Biserica lui Vlaicu composite dyke with person pointing to the contact between andesites (on the right) and dacites (on the left); b) Sharp contact between aphyric andesite and macroporphyric dacite; c) Large-sized microgranular gabbroic enclave/MME in dacite; d) Resorption embayments of large-sized sanidine crystals (N+); e) Cluster of clinopyroxene xenocrysts in dacite; f) Strongly corroded quartz phenocryst, and clinopyroxene and amphibole xenocrysts in andesite; g) clinopyroxene corona on quartz phenocryst in andesite (N+); h) Microgranular amphibolic-type mafic enclave/MME (N+).

This silicic composition could be similar to that of the melt inclusions found in large quartz phenocrysts in dacite (72-76 wt % SiO_2, Naumov et al., 2014) and with that of a felsic enclave with graphic texture (potassic feldspar and quartz intergrowths) hosted in dacite (77 wt % SiO_2). The deep-origin mafic magmas intruded in the shallow level magma reservoir (possibly a felsic crystal mush) and mixed with highly differentiated and much colder melts generating the two hybrid rocks observed, andesite and dacite. This genetic model is fully consistent with the architecture of the volcano plumbing system highlighted previously for the Laleaua Albă magmatic complex (Kovacs et al., 2021).

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MATERII PRIME HIGH-TECH PENTRU ENERGIA EOLIANĂ. ECONOMIE VS. ECOLOGIE

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Cuvinte cheie: energie regenerabilă, offshore, onshore, bioxid de carbon, mediu, climă

În trecut carburanții clasici (cărbune, țiței, gaz metan) au constituit sursa principală de energie pentru consumul casnic și industrial. Prin arderea acestor materii prime sunt emanate cantități mari de bioxid de carbon (CO_2), cu influență toxică asupra mediului și climei. Dintre alternativele actuale (energie nucleară, fotovoltaică, solartermie, bio-, hidro,- și geotermie, hidrogen), energia eoliană ocupă primul loc. O viitoare sursă importantă de energie o va constitui hidrogenul.

Pentru producția energiei eoliene, care nu produce CO_2 , sunt necesare cantități mari de materiale de construcție (beton, oțel, materiale plastice), cantități considerabile de elemente chimice rare (aluminiu, cupru, zinc) și critice (pământuri rare [TR], telur, litiu etc.).

Prezentarea de față arată concepția turbinelor eoliene ca sursă modernă de curent electric.

CHIHLIMBARUL: „PIATRA” CARE ARDE

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Cuvinte cheie: rășină fosilă, spațiul baltic, Colți, geneză, ocurențe, paleontologie

Chihlimbarul este o rășină fosilă, produsă de diferite plante în timp geologic. Ocurențe de vârste foarte diferite (Carbonifer-Cainozoic) sunt cunoscute pe toate continentele. Chihlimbarul din spațiul baltic este cantitativ cel mai important.

Datorită proprietăților sale fizico-chimice caracteristice, chihlimbarul este cunoscut din timpuri preistorice în toate culturile omenirii. Încărcarea electrică, mirosul specific plăcut, arderea și densitatea (plutește în apa de mare) evidențiază această rășină fosilă. Varietatea/diversitatea considerabilă de culori este fascinantă. Utilizarea chihlimbarului în știință (paleontologie), artă și religie, industria de bijuterii, dar și în producția de lacuri speciale, conferă chihlimbarului și o importanță economică, fapt care are influență asupra prețului. Din acest motiv, pe piața internațională au apărut multe falsuri și imitate.

Deși în România sunt relativ puține ocurențe (Colți, Buzău), chihlimbarul românesc este bine cunoscut, sub diferite denumiri, în literatura de specialitate internațională încă din 1881.

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QUICK LOOK ON PETROLEUM SYSTEMS FROM ROMANIA

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Keywords: basin modeling, source rock, reservoir, seal, migration, charge

Introduction

„*The Science of Petroleum*" (1938) certifies that, in 1857, Romania became the first world producer of oil with a production of 275 tonnes officially registered in the international statistics. Not accidentally, in 1857, near Ploiesti, the Mehedinţeanu brothers founded the world's first oil refinery, and Bucharest became the first city in the world to be lit with kerosene lamps. After more than 160 years of modern oil history, more than 400 fields are listed in Romania, and more than 13,000 wells are still active. Yet, where did the millions of oil barrels come from, how was the petroleum accessed, and more importantly, where can it be found?

In 1972 at the AAPG Annual Meeting in Denver, Colorado, Wallace Dow and Jack Williams introduced the concept of "petroleum systems" which geochemically correlates crude oils to specific source rocks. After more than 20 years, in 1994, Leslie B. Magoon and Edward A. Beaumont established the modern meaning of the petroleum system concept in AAPG Memoir 60, "*The petroleum system – From source to trap*". "Generation-migration-accumulation", "critical moment", and "the pod of active source rock" were important new terms introduced in the concept.

Methodology

In Romania, the concept of "petroleum system" concept was quickly adopted by petroleum geologists, but its application was limited due to the lack of information technology and experienced users. Anyway, over the last 20 years, 3D seismic, high-tech tools for geochemical and petrophysical analyses have become daily used to identify the petroleum system elements (source rock, carrier bed, reservoir, and seal). Specialized basin modeling software has been intensively used in reproducing the petroleum system processes (petroleum generation, migration, and charge) and eventually estimating the location, volumes, properties and composition of new potential petroleum accumulations.

Various geological data (stratigraphy, tectonics, geothermal regime, rock and hydrocarbon properties) have been integrated into basin and petroleum system models. In the last 20 years, several basin and petroleum system modeling projects have been carried out on nearly all the sedimentary basins of Romania. Numerous amalgamated petroleum systems have been identified in Romania due to the complexity of its geological configuration.

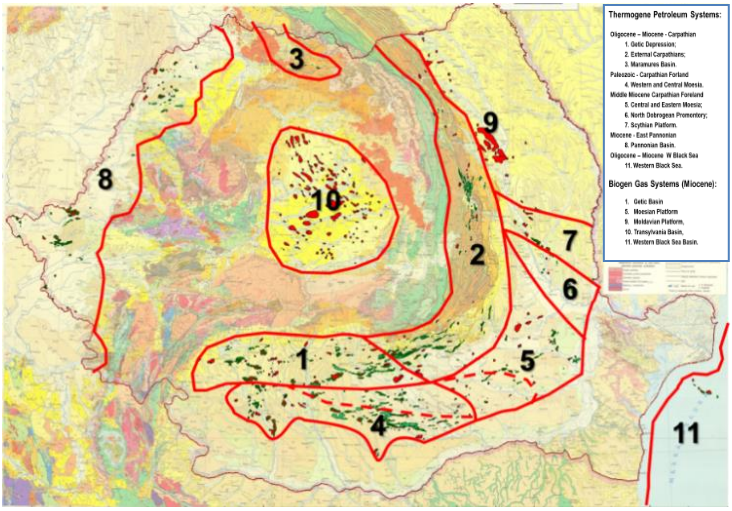
Results

Source rocks have been geochemically identified in the Paleozoic formations (Silurian, Devonian, Carboniferous), locally Mesozoic (mid-Jurassic) and Miocene (Badenian, Sarmatian) of the Carpathian foreland units (Moesian, Scythian and Moldavian Platforms). Oligocene and Miocene black shales have been responsible for generating huge amounts of hydrocarbons in the fold-and-thrust Carpathian belt units (Getic and Transcarpathian basins, Tarcău, Marginal Folds and Subcarpatian nappes), but Eocene and Cretaceous shales could be also contributors. Badenian, Sarmatian, Pannonian, Meotian and Pontian shale from the Miocene basins of Romania (Dacian, Pannonian, and Transylvanian) are responsible for generating thermal hydrocarbons as well as biogenic gas. Last but not least, Oligocene – Miocene black shales (Maykop) from the Black Sea basin are the main producers of thermal hydrocarbons, and Middle-Upper Miocene shales are responsible for biogenic gas on the Romanian offshore.

Most geochemically-analyzed source rocks are poor to fair, but some are good to very good. Various kerogen types were identified from lacustrine and marine to land plants. Mixtures of kerogen types are also common. The geochemically analyzed source rocks are in various stages of maturity (from immature to over-mature).

According to the results of geochemical age-related biomarker specific analyses and compound specific isotope analyses, the Romanian oils are generated by Paleozoic and Tertiary source rocks. Some oils could be associated with a Mesozoic source rock, or could represent mixtures of Paleozoic and Tertiary-sourced oils.

Using basin modeling tools, several generation kitchens have been identified, complex migration processes have been simulated and charging processes have been reproduced on the structural and stratigraphic traps belonging to Paleozoic, Triassic, Jurassic and Cretaceous reservoirs from Moesian Platform, Paleogene and Miocene sandstones from Carpathian thrust units, Miocene and Pliocene sandstone from the Miocene basins, or sandstone and siltstone from Black Sea offshore.



Conclusions

The map of Romania oil and gas accumulations looks amazing, and the petroleum exploration is still promising after 160 years of exploitation. Several petroleum systems are geochemically-proved and sustained by basin modeling tools and numerous oil and gas accumulations are still undiscovered.

Where can oil be found?

"*Where oil is first found is in the minds of men*."[1]

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[1] Wallace Pratt, 1885–1981, founder of the American Association of Petroleum Geologists.

A SYSTEMATIC APPROACH TO THE DIGITAL INVENTORY AND SCORING OF ROMANIAN GEOSITES. PRELIMINARY RESULTS

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Keywords: Romanian geological heritage, geosite database, evaluation system, geosite conservation

Introduction

The present study is a contribution to an ongoing project (PN 23-39-03-01) aiming to inventory and promote the geological heritage sites of national and international importance found on Romanian territory, with the goal of enhancing their protection and sustainable use. Because of the rather uncoordinated efforts to perform a unitary inventory and evaluation of geosites nationwide, our project initiated a systematic approach toward a standardized methodology, specifically tailored to Romanian conditions. This included creating a digital database of geosites and designing a methodology through which the scoring algorithm for assessing both geosite heritage value and degradation risk was established.

Despite the efforts of the scientific community to create a single, universal quantitative method for assessing the heritage value of geosites, dozens of methods have been devised and applied worldwide for assessing geosites with specific purposes. Although there are several studies that compare quantitative assessment methods (e.g., Mucivuna et al., 2022), there is still no research in the country that compares the application of one method to that of another. Considering this fact, during this phase of the project we carried out the following: (i) a quantitative assessment of the geo-scientific value, the risk of degradation and the need for action for the protection of the inventoried geosites using the method described by Lagally & Loth (2017); (ii) a quantitative assessment of the scientific, educational and touristic value, as well as the risk of degradation of the inventoried geosites using the method described by Brilha (2016); (iii) a comparison and a critical analysis of the results obtained through the two methods; (iv) a preliminary ranking of the inventoried geosites.

Methodology

In the current phase of the project, we have decided to use the list of protected areas published by the National Agency for Environmental Protection (ANPM) as a starting point in order to prevent the database from being flooded with less relevant geosites. We have identified 469 protected natural areas of geological importance, including 4 scientific reserves and 181 natural monuments.

In order to systematize the geodiversity elements selected for the characterization of Romanian geosites, 12 content categories were defined. These are: (1) stratigraphy and sedimentology; (2) salt deposits; (3) paleontology; (4) igneous petrology/volcanology; (5) metamorphic petrology; (6) exokarst geomorphology; (7) endokarst geomorphology; (8) glacial geomorphology (including glacial lakes); (9) hydrogeology; (10) active geological processes; (11) mineralogy; (12) soils. These categories are also in agreement with the IUGS Geological Heritage Site list. Geosites that have both historical and cultural value (e.g. the Măgura Călanului Dacian quarry, the medieval mines from Rimetea, the Roman mines from Roșia Montană etc.) were not included in the present inventory, requiring specific criteria which will be described in subsequent papers.

The geologic age (epoch/series) of each geosite was specified according to the International Commission on Stratigraphy (2018). Additional information, such as coordinates, national or nature park affiliation, current condition, and a brief geological description, was also included in the database built as part of this project.

The next step was the assignment of values (points) to the evaluation parameters according to the two methods for the quantitative evaluation of geosites selected (i.e., Lagally & Loth (2017); Brilha (2016)). In assigning values to the various parameters, we we have striven to be as objective as possible. However, subjective influences based on personal preferences could not always be avoided, but such influences are minimal and they do not significantly affect the final score and the placement in one value category or another.

Results

An MS Excel template was created to streamline database entry and assign values to evaluation parameters. It automatically calculated final scores for the scientific, educational, and touristic values of geosites, as well as degradation risk. We chose MS Excel templates for user-friendly data input and geosite additions.

A separate MS Access database was developed to facilitate statistical analysis, generate diverse reports, and create hierarchies. This database enables photo insertion and the automatic generation of geosite sheets for the 469 currently included.

The majority (48%) of geosites were associated with carbonate rocks and karst processes. Other significant types included paleontological sites (17%), sedimentary rocks (13%), and magmatic processes (6%).

The geosites with the highest geo-scientific value are the Scărișoara Cave in the Apuseni Mountains, as well as the primary geosites within the Hațeg and Buzău Land UNESCO Global Geoparks. These geosites also face a high or even significant risk of degradation and require substantial protection.

Geosites identified as having high geo-scientific value through the Lagally & Loth (2017) methodology consistently exhibit high or very high scientific values when assessed by means of the Brilha (2016) methodology. While most of these geosites also offer significant educational and touristic potential, some are limited by factors such as accessibility (e.g., Peștera Răsuflătoarei, Peștera Liliecilor, Făgăraș Mountains) or public interest in complex scientific concepts (e.g., Bujoarele Fossiliferous Site). Despite variations in ranking methodologies, the core group of geosites with high heritage value remains relatively stable.

The degradation risk for these geosites is generally moderate, requiring only basic protective measures. This is foreseeable, given their location within protected areas.

Conclusions

Modern geosite inventory and evaluation methodologies can be effectively applied to the geological heritage of Romania, which is characterized by a rich geodiversity, spanning from Proterozoic-Paleozoic to Quaternary. A systematic approach ensures consistent assessment and comparison of diverse geosites.

The selected methodologies can be adapted to various scales, from small-scale features (e.g., Izvorul Intermitent Călugări) to extensive areas (e.g., Abruptul Prahovean), accommodating diverse geological contexts. Compared to Brilha (2016), Lagally & Loth (2017) method offers a simpler, more flexible approach, suitable for the preliminary evaluation of numerous geosites and the selection of the most significant. This method efficiently integrates geo-scientific significance, public interest, rarity, and site condition.

The Brilha (2016) method, involving 22 parameters, can be labor-intensive for large-scale assessments. Subjectivity in scoring can introduce higher variability, sometimes requiring adjustments. The recommended indicators may not adequately account for all field conditions, particularly in the case of extensive geosites. Moreover, for inaccessible geosites, such as caves, or those with difficult access, like high mountains, assigning scores for educational or touristic value is impractical.

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BIOSTRATIGRAFIA DEPOZITELOR MIOCENE DE LA COSTEȘTI, JUDEȚUL IAȘI (PLATFORMA MOLDOVENEASCĂ)

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Cuvinte cheie: Foraminifera, Mollusca, Sarmațian

Prezentul studiu evidențiază din perspectivă biostratigrafică mai multe deschideri aflate în partea nord-vestică a localității Costești, județul Iași (Platforma Moldovenească). Cercetările efectuate în această regiune au vizat, cu precădere, analiza macro- și micropaleontologică a depozitelor sarmaţiene și, apoi, semnificația biostratigrafică a taxonilor identificați. Necesitatea acestui studiu a fost impusă de informațiile sumare din literatura de specialitate referitoare la aflorimentele din zonă (e.g., Trelea, 1969), care sunt în extinderea sudică și sud-estică a unor zone similare mai bine cunoscute (e.g., Ștefan, 1989; Ionesi, 2005) și, probabil din această cauză, mai puțin cercetate. Totuși, studiul are caracter preliminar, avându-se în vedere noi deplasări în teren, și, de asemenea, probe paleontologice în lucru.

Succesiunea sedimentară din zona Costești este inclusă în două unități informale propuse de Ștefan (1989) pe baza cartării depozitelor sarmațiene care aflorează imediat spre nord: „Argilele și nisipurile de Băiceni" și „Calcarul oolitic inferior de Hărmănești" (Basarabian inferior). Corelarea s-a efectuat pe baza similitudinilor litologice și faunistice ținându-se seama de dispoziția monoclinală (cu înclinare foarte mică) a stratelor de această vârstă din Platforma Modldovenească.

Pentru studiul paleofaunei din perimetrul Costești, Iași, s-au prelevat probe din puncte de observaţie situate la distanţă de aproximativ 50 m între ele. Probele provin din ambele unități litologice menționate, atât din argile și nisipuri, cât și din calcare oolitice. Fauna sarmațiană identificată este variată și specifică sectorului Platformei Moldoveneşti situate la est de râul Siret. Până în prezent, am identificat specii de foraminifere (22), ostracode (2), un statolit de *Mysidae*, gasteropode (12) și bivalve (19). Vârsta a fost stabilită pe baza exemplarelor relativ frecvente de *Tapes gregarius ponderosus* (d'Orbigny, 1845) (= *Polititapites ponderosus*) și a unor taxoni index de foraminifere (e. g., *Elphidium macellum* şi *Porosononion subgranosus* - Bica Ionesi, 1991 din Ionesi, 2006). Vârsta este în acord cu lucrările anterioare (Trelea (1969), Ștefan (1989), Ionesi (2003).

Coexistența taxonilor identificați ar indica un facies neritico-litoral, cu ape puțin adânci, al căror nivel oscila (argile -nisipuri - calcare oolitice). Prin eventualele noi specii sarmațiene și datele de ordin sedimentologic și paleoecologic care vor completa acest studiu se vor putea contura mai detaliat caracteristicile mediului de sedimentare al depozitelor din zona Costești – Iași (Platforma Moldovenească).

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EVIDENCE OF PALEOGENE HYPERTHERMAL EVENTS: "NORDIC NUMMULITES" FACIES ON ALPINE-CARPATHIAN FORELAND IN EXOTIC PEBBLES OF OUTER FLYSCH UNITS FROM AUSTRIA TO ROMANIA

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Keywords: Pre-Carpathian forelands, Paleogene hyperthermal events, exotics of nummulitic carbonate/siliciclastic facies

Our collection of exotics includes characteristic detrital Paleogene nummulitic limestones, containing, additionally, fossils (corals, coralline algae, bryozoans), as well as angular clasts of crystalline, sometimes weathered rocks (project DEPOS, statutory task EgzoKarp) from the outer Carpathian flysch units of Poland (the Oligocene of the Skrzydlna tectonic scale in the Lanckorona-Żegocina tectonic windows belt, Silesian unit, Dukla unit), the Czech Republic (the Bystrice tectonic half-window) and Romania (the Vrancea Nappe (=Marginal Fold Nappe), Subcarpathian Nappe). Such exotics are found in all the units we studied: from Dukla to Boryslav-Pokuttia/Vrancea and the Subcarpathian Nappe. The presence of larger benthic foraminifera as an indicator of a tropical sedimentary realm calls for a revision of views on the paleogeography and paleoclimate of the pre-Carpathian flysch basins and fore-Carpathian shelves. Recent studies of beyond-Alpine Eocene sequences in Europe (e.g., Cotton, 2023) suggest the presence of so-called hyperthermal events resulting in the expansion of a group of larger foraminifera towards the higher latitude zone (up to, in extreme cases, the "Nordic Nummulites facies"). Series of these events start around the Maastrichtian/Danian boundary as the Early Danian Dan-C2 event, and from the Late Palaeocene to Middle Eocene (57.5 to 46.5 Ma), a total of 39 hyperthermals – periods of rapid global warming documented by prominent negative carbon isotope excursions (CIEs) have been recorded (Honegger et al. 2020). The last one, the Eocene hyperthermal event (Late Lutetian Thermal Maximum), took place roughly 41.5 Ma, just before the icehouse Oligocene Epoch (Inxauspe-Zubiaurre et al. 2018).

Our study of these exotic pebbles confirms the influence of these episodes on the climatic realm in the pre-Carpathian northern shelves of Carpathians marginal turbiditic basins, being evidence of transgressive onlap sediments with larger forams, locally directly on the crystalline bedrock. Our observations suggest that, prior to the deposition of Paleogene sediments, strong subaerial erosion occurred, as evidenced by the weathering of clasts of crystalline rocks found in detrital limestone exotics, followed by rapid transgression on the eroded bedrock. This transgression, possibly of glacioeustatic nature, may be related to the aforementioned hyperthermal events. The broader, supra-regional scale of transgression (e.g., locally directly onto the older basement from the Eocene molasse formations of Austria and Germany), as well as similar, but resedimented as exotics of shallow-water Eocene nummulitic limestones containing crystalline rock pieces, was confirmed in the external flysch/molasse units of Austria (Wachsberg Zone), Czech Republic, Poland, Ukraine and Romania. Bruderer (1926) wrote about the Lucza site of Early Miocene Sloboda conglomerate (Borislav-Pokutiia unit) in the former Polish territory/present territory of Ukraine as follows: *"**Conglomerats de Sloboda**. Nous considerons ces couches comme une formation d'avant-pays. Parmi les de elements composants des conglomerats nous avons trouve quelques blocs conglomeratiques renfermant d'innombrables Nummulites et des restes de Lamellibranches. Les plus grosses Nummulites ont un diametre de 4—5 cm (Nummulites irregularis?). Dans le ciment de ces blocs on trouve des cailloux cristallins. Il faut done croire que ces blocs a Nummulites ont subi deux temps de roulement: les Nummulites ont probablement ete arrachees d'abord isolement pour s'accumuler dans des poches de la surface crystalline".* Franciszek Bieda described in detail the rich Eocene nummulite fauna of the limestone exotic pebbles from this conglomerate site in Lucza (Bieda, 1931). In Romania, Popescu (2004) and Miclauș et al. (2009) described the occurrence of exotic pebbles with Nummulites in the conglomerates of Gura Șoimului in the Vrancea Nappe and its half-windows. Especially rich in numulites are exotic carbonate pebbles in the molassic Miocene Almașu conglomerate in the Subcarpathians unit (Mirăuţă & Mirăuţă,1964).

In order to confirm the hypothesis regarding hyperthermal events as the cause of periodic northward expansion of larger forams up fore-Carpathian shelves, we plan to study the paleotemperatures of seawater based on the carbon isotopic composition and oxygen isotopic composition of, for instance, calcareous faunal skeletons found in the aforementioned limestones. Since glauconite grains and celadonite (weathered volcanic glass?) clasts are commonly found in these limestone pebbles in the Polish sector, we plan to determine the age of these sediments through K/Ar isotopic geochronology, in addition to biostratigraphic methods.

Our goal is also to reconstruct more extensively, on the scale of the entire Carpathian orogen, the mixed, carbonate-siliciclastic sequences of the Paleogene with larger forams. We plan to use both the shelf carbonates (occurring now as discrete, lithified exotic pebbles in the canyon-fill and submarine fan of Oligocene-Miocene olistostromes and conglomerates (e.g., Sloboda, Gura Șoimului and Almașu/Petricica), and unconsolidated carbonate detritus resedimented to deeper turbidite basins in the form of Paleocene/Eocene allodapic limestones (e.g. Pasieczna Limestone in Poland and Ukraine, and Doamna/Izvor Limestone in Romania), in order to correlate the reconstructed sequences of Paleogene formations. In addition, we intend to We platidentify the type and age of the crystalline bedrock represented by the clasts for the reconstruction of the pre-Alpine framework of the Paleogene basins, as well as to reconstruct the exhumation and erosion processes of the pre-Paleogene crystalline basement using thermochronological methods.

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GEOCHEMICAL ASPECTS OF THE GROUNDWATER TABLE IN THE JIJIA FLOODPLAIN

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Keywords: drinking water quality, physicochemical parameters

The Iași Metropolitan Area, comprising the city of Iași and 26 adjacent communes, represents the most significant urban agglomeration in northeastern Romania, with a population exceeding 600,000 inhabitants. Established two decades ago, the area was designed to facilitate business development, optimize land use management, and enhance the execution of environmental and infrastructure projects.

A key initiative aimed at enhancing the quality of life for the region's inhabitants involved the integration of all localities into the centralized drinking water distribution network. Nevertheless, groundwater extracted from wells remains the primary source for agricultural irrigation and livestock watering. During drought conditions, it frequently becomes the primary, or even sole, source of potable water in certain areas.

This study conducts an investigation of groundwater quality parameters within the eastern section (Jijia Floodplain) of the Iași Metropolitan Area, Romania, through *in situ* analysis of over 100 sampling locations. The primary objective is to assess the extent of contamination and the associated risks of groundwater usage, particularly in the context of urbanization, industrial activity, and climate change, all of which influence groundwater availability and quality.

The methodology employed various analytical techniques, including titrimetric and complexometric methods, supplemented by specialized instruments such as a multimeter, digital titrator, and colorimeter. The parameters analyzed were compared to the thresholds established by Romanian drinking water quality regulations, providing a comparative assessment of their compliance.

The findings reveal considerable variability among samples, with some parameters surpassing the permissible limits.

The conclusions highlight the necessity for ongoing monitoring of the water's physicochemical properties, particularly in areas where values exceed regulatory limits, so as to mitigate adverse impacts on public health and the environment. The study recommends targeted pollution management strategies, such as isolating waste sources and preventing the discharge of wastewater near water resources. Effective collaboration between local authorities, water utility companies, and communities is vital for the improvement of access to safe, high-quality drinking water across the metropolitan area.

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MINERAL WATERS FROM DORNA BASIN

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Keywords: still and sparkling mineral waters, cation budget, nutritional characteristics

Introduction

The mineral waters of the Dorna Basin, well known today, were mentioned for the first time in a document issued in 1410 during the reign of Alexander the Good in 1410, when they were considered "healing waters". Under Austrian rule (1775–1918), the mineral waters from Bucovina led to the development of the first spas in Vatra Dornei and Dorna Candreni localities. Under Romanian rule, the mineral waters are bottled for the first time in 1890, thanks to Victor Babeș. The conservative character of the mineral water seems surprising well-docmented. Comparing the data from the analyses carried out in 1895 (Ludwig and Zeynek), 1935 (Costeanu) and 2012 (SNAM) respectively, we find insignificant content variations for the same source bottled as the Poiana Negrii (data taken from Crasu et al., 1952; Feru, 2012). The mineral waters from the Dorn, Basin, either sparkling or still, are marketed today under different brands. The chemical characteristics of these waters are inevitably related to the nature of the rocks that cantonize them and to the mophetic CO_2 loading for the sparkling variety.

Geological setting

The geology of the region is very complex, ranging from the Crystalline-Mesozoic Unit (Precambrian-Paleozoic) to the Neogene Volcanism Unit. Sedimentary deposits of Eocene- Oligocene age that belong to the Transcarpathian Flysch partially cover the two mentioned geologic units (Balintoni, 2010). The Dorna basin is a tectonic depression that belongs to the Transcarpathian Flysch. It is arranged on two alignments developed along the EW and NS direction, which generates a lobed shape (Pricăjan, 1972).

On the NS alignment, along the Șaru Dornei-Panaci-Drăgoiasa corridor, there is a series of 5 mineral water sources that are bottled and marketed. They are stored up by the crystalline dolomitic limestones of the Rebra Lithogroup (Florea, 2009). Some water sources are enriched in CO_2 that originates from the microdioritic intrusions of the nearby volcanic structures.

On the EW alignment, in the Dorna – Dorna Candreni – Coșna – Poiana Stampei corridor, there is a larger number of springs that are bottled. These still and sparkling mineral waters are recovered from reservoirs with varied lithologies, from crystalline to sedimentary rocks, which give them a compositional diversity. The CO_2 source that provides the effervescent appearance is inevitably linked to Neogene volcanism.

Nutritional characteristics

These properties are very important for commercialized mineral waters. In case of a consumption of 2 L of mineral water per day, there is a significant nutritional intake for Ca, Mg, Na (particular attention should be awarded to the Poiana Negrii source, where we have an 88.45 % Na intake /2 L) and even K. Noteworthy, as well, is the sparkling mineral water from the Paltiniș source, with an intake of 46 % Ca and 38 % Mg. In addition, the relation between Ca and Mg (2-3 molar ratio) is optimal for all Aqua Carpatica and Bucovina, favoring sources which favors the correct absorption of the two ions. The slightly alkaline nature (pH range: 7.08–7.82) of the still mineral waters is another characteristic favorable for the nutrition processes.

Results and discussions

The mineral waters in the NS alignment, bottled under the Aqua Carpatica brand, have very close compositions, even though they come from different sources. The Ca/Mg ratio (approximately 2) denotes a dolomitic component of the crystalline limestones in the reservoir, and the K/Na ratio > 1 highlights the involvement of weathering processes of mica in the mica-schist intercalations. The (Na+K)/TZ+ ratio with values below 0.5 does not suggest significant contribution of silicate weathering to the water cation budget of the still or sparkling mineral water. The Ca/Na: Mg/Na ratio (Gailardet et al, 1999) clearly indicates the link between mineral waters and carbonate reservoirs. In addition, the Ca : 5Mg : 10Si relation (Derron, 1999) confirms the carbonate nature of the rocks that store up the mineral waters from this alignment.

Mineral waters in the EW alignment are more diverse in composition as a result of being stored in a wider variety of rocks. The still waters of this alignment are generally accumulated in the Neogene formations of the Transcarpathian Flysch, e.g., in limestones and conglomerates with sandstone intercalations. This lithology favors a high Ca content in the water composition, which causes the Ca/Mg ratio to reach values higher than 2 (with a maximum of 18). The sparkling waters (Poiana Vinului, Poiana Negrii) that interact with these sedimentary strata, but also with andesitic rocks, are also rich in Ca and poor in Mg. The still and sparkling mineral waters that are accumulated on the fracture system of the Bretila metamorphic Lithogroup and andesitic bodies (F2 Roșu and Fd. Poiana Negrii) are richer in Mg, which leads to the reduction of the Ca/Mg ratio to 2 and 3.9, respectively. The additional Mg source is related to mafic minerals (e.g., Bt, Hb). The relationship between Ca/Na and Mg/Na shows that the still waters from the Izvoru Candreni and Izvoru Alb sources do not occur on the mixing line, which indicates both a silicate and a carbonate source. In this case, the waters are hosted in Eocene sedimentary rocks and the water composition is likely to be modified by exchange processes. For the Poiana Negrii sources, the Ca/Na to Mg/Na relationship supports the dominant contribution of silicate weathering processes as a source for water ions. For the sparkling water from Poiana Vinului, mixing characteristics are observed due to the interaction with both andesites and flysch sedimentary deposits. Deron's diagram denotes that the composition of still and sparkling mineral waters from the EW alignment is in agreement with reservoir lithology.

The water composition was modeled for saturation index of calcite, dolomite or aragonite (Phreeqc v.3). These minerals are undersaturated in most mineral waters. Only the mineral water from two sources displays low capacity to release calcite and dolomite or calcite and aragonite by precipitation. This water feature can be explained by longer residence time within host rocks compared to other sources from the area. A slight calcite and dolomite saturation of the water was found for Haja source, located in crystalline limestones of Rebra group, while a slight water saturation for calcite and aragonite was identified just in Candreni sourse, related to Eocene sediments from Transcarpathian Flysch.

Conclusions

The cation budget of still water is low, closely reflecting the shorter residence time for water into the host rock and, thus, a lower degree of interaction between water and mineral particles. Sparkling mineral water flows deeper and receives mophetic CO_2 which enhances the weathering processes of rock-minerals, giving rise to a higher input of cations. Once ratios like Ca/Na and Mg/Na decrease, more Na-bearing-silicate minerals come into solution and the water budget becomes stronger, but not enough to give rise to secondary mineral precipitation. Only in two sources (Haja and Izv.Candreni) is the mineral water saturated with respect to calcite and dolomite or aragonite.

The mineral water from NS alignment meets the requirements for a high-quality water. The mineral waters in the EW alignment have a more diverse composition, which does not always comply with a healthy diet.

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MAGMA EVOLUTION IN THE GALATEAN VOLCANIC AREA (CENTRAL ANATOLIA, TURKEY) DURING THE MIOCENE

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Keywords: Central Anatolia, Volcanism, $^{40}Ar/^{39}Ar$ dating, Miocene, Turkey

The Galatean Volcanic Area (GVA) is located in the Sakarya tectonic belt of northwestern Central Anatolia, Turkey, south of the North Anatolian Fault, occupying an area of over 8900 km^2 (Fig.1). It consists of basic, intermediate and acid lavas and volcaniclastics generated during the Lower Miocene, and basalts of the OIB type, generated in the late Miocene.

The study is based on new geochemical, Sr-Nd isotopic data, and $^{40}Ar/^{39}Ar$ dating of volcanic rocks from the southeastern-western parts of the GVA, but also integrates all

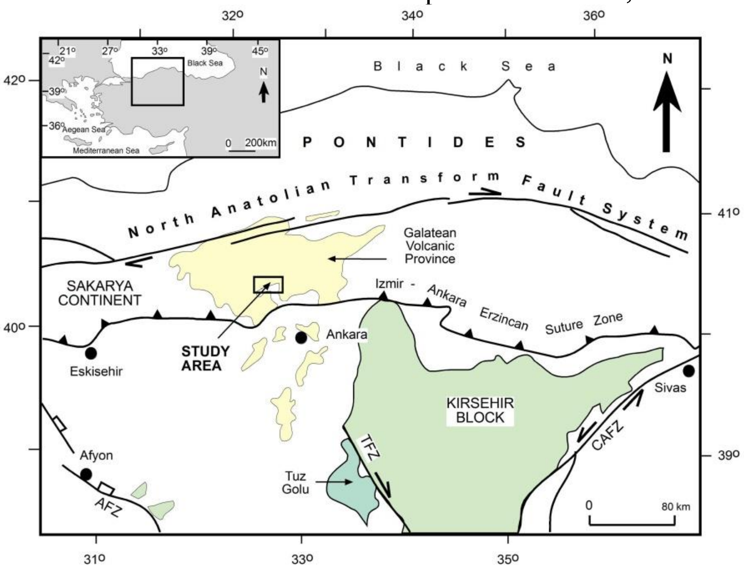

Fig.1. Simplified map showing the present-day configuration, major structures, and location of the study area in central Turkey.

previously available data to understand how magmas evolved in the post-collisional setting. Three groups have been separated. The initial eruptions of the Early Miocene were represented by both acid, rhyolitic rocks that generated domes or pyroclastic deposits (Group 1) and predominant basaltic lavas (Group 2). The latter is also represented by large volumes of basaltic-andesitic, trachyandesitic-dacite/trachydacite lavas, small intrusions and pyroclastic deposits generated between 21-14 Ma. The relatively low $^{87}Sr/^{86}Sr$ ratios (0.705-0.706) of the early rhyolites (Group 1), and all Group 2 rocks, suggest the generation of hybrid melts with variable contributions of mantle- and crustal-derived material. Volcanic activity ends with OIB-type basalts during the Late Miocene (11-7 Ma; Group 3), which show the lowest $^{87}Sr/^{86}Sr$ values (~0.703), suggesting an asthenospheric origin.

The geodynamic model, based on post-Cyprian rollback, results in long-term (22-13 Ma) post-collisional delamination/drip processes supporting magmatism evolution. This magmatism is generated in the lithospheric mantle, with the formation of basaltic and acid hybrid melts showing variable contributions of mantle- and crustal-derived materials in a complex transcrustal magma conduit system. The complex mixture of various intracrustal magmas and fractional crystallization processes generated a very large volume of volcanic rocks. Late Miocene low-volume OIB basalts were asthenospheric melts that experienced local decompression melting during the late stage.

THE ACCUMULATION OF STRONTIUM BY *ALYSSUM MURALE* GROWN ON SERPENTINE SOILS OF THE GULEMAN CHROMIUM MINING AREA, ELAZIG, TURKEY

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Keywords: *Alyssum murale*, Guleman mining area, serpentine soil, strontium, accumulation

Strontium (Sr) is one of the most critical elements in the environment, and its importance is expected to increase, given that it can affect organism development, especially for juveniles exposed to levels above the normal average.

The Guleman chrome ore deposit, located approximately 80 km southeast of the Elazığ Province, is one of the largest in Turkey. The ore is hosted by serpentinite, which displays large outcrops in the region. The soils formed on these parent rocks (serpentinite and chromatite) contain as usually high levels of Ni, Cr, and Co, but have low Sr concentrations.

The present study examined the accumulation and transfer of strontium into 12 *Alyssum murale* samples from the serpentine soils of Guleman. The plant samples were collected with their soil, roots, and shoots. After being washed, dried, and turned into ash at 300º C in a flameless environment, the soil and plant samples were separately mixed with HCl-HNO_3–H_2O, and Sr analyses were performed through ICP-MS. According to the results, the average Sr contents were 10.5 ppm in the soil, 45.1 ppm in the root, and 141.0 ppm in the shoot. The average enrichment coefficients of *A. murale* were 5.10 for root (ECR), 16.4 for shoot (ECS), and 3.18 for translocation factor (TLF). Thus, even if the soils have a low Sr content in the region, Sr is rapidly transported to the roots and shoots of *Alyssum murale* and stored in the plant body. The high amount of Sr accumulated by the plant is probably used to regulate the low Ca and high Mg absorption in the soil where it grows. Therefore, the high Sr in the root and shoot is accumulated to control the elements that the plant needs or are in excess.

We have concluded that *Alyssum murale* has an accumulator character in terms of Sr. Consequently, the plant can be easily used in phytoremediation studies to improve and clean Sr-polluted soils.

PALEOECOLOGIA FAUNEI DE RECHINI DIN CENOMANIANUL PLATFORMEI MOESICE (DOBROGEA DE SUD)

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Cuvinte heie: Cretacic superior, Selachimorpha, România

Depozitele sedimentare ale Formațiunii de Peștera (Platforma Moesică, Dobrogea de Sud) reprezintă unele dintre cele mai importante depozite marine pentru studiul faunelor de rechini mezozoici din România (Gallemi et al., 2011; Trif & Codrea, 2017, 2022; Torcărescu & Călin, 2021). Din punct de vedere litologic, succesiunea sedimentară a formațiunii este separată în cinci unități distincte cu grosimi variabile. La bază apare un microconglomerat alcătuit din cuarț detritic, granule de fosfat și fragmente fosile, o atenție specială fiind acordată resturilor fosile de nevertebrate (Avram et al., 1988; 1993), în timp ce fauna de vertebrate a fost studiată într-o măsură mai mică. Fauna de nevertebrate reprezintă, de asemenea, baza pe care a fost atribuită vârsta Cenomanian Formațiunii de Peștera.

Scopul acestei lucrări este acela de a prezenta noi specimene fosile și informații de ordin sedimentologic, în vederea realizării unui tablou mai complex despre evoluția zonei de interes.

Cariera Peștera este situată la cca. 17 km sud-vest de Medgidia (Județul Constanța). Acest sit este unul important, întrucât resturile dentare de rechini aparțin unui număr divers de taxoni și sunt ușor de colectat, fiind foarte abundente.

Identificarea taxonomică s-a realizat pe baza comparațiilor cu specimene similare din literatura de specialitate (Trif & Codrea, 2017, 2022; Torcărescu & Călin, 2021).

Materialul fosil inclus în acest studiu a fost atribuit următorilor taxoni: Lamniformes indet., *Ptychodus* sp., *Scapanorhynchus* sp., *Carcharias* sp., *Cretalamna* sp., *Squalicorax* sp. Din păcate, natura incompletă a materialului studiat face imposibilă o identificare taxonomică mai precisă. Din punct de vedere sedimentologic, structurile sedimentare identificate sunt: stratificația oblică concoidă la scară mare și medie, stratificația oblică planară la unghi mic, stratificația plan-paralelă, și laminația oblică asimetrică. Dinții de rechin se găsesc în microconglomeratele bazale, caracterizate printr-o stratificație oblică concoidă la scară medie. Analiza faciesurilor sedimentologice sugerează că depozitele cenomaniene de la Peştera aparţin unui sistem deltaic mai extins caracterizat prin albii fluviale de distribuţie.

Un aspect de avut în vedere este acela că mediul în care au fost depuse aceste microconglomerate era unul ce prezenta o energie destul de ridicată, acest lucru afectând și resturile fosile, majoritatea dinților de rechini colectați fiind foarte fragmentați. Totuși, abundența în resturi fosile a nivelului de microconglomerat, impune un studiu mai intens și al altor zone în care acesta aflorează, care va duce la o mai bună înțelegere a distribuției paleogeografice a rechinilor mezozoici în Dobrogea de Sud.

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POTENȚIALUL ROCILOR SURSĂ AL DEPOZITELOR CRETACIC SUPERIOARE DIN FLIȘUL EXTERN CARPATIC (GEOCHIMIE ORGANICĂ ȘI PALINOFACIES)

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Cuvinte cheie: Formațiunea de Hangu, biomarkeri, maturitate termică, Carpații Orientali, Pânza de Tarcău

Carpații Orientali reprezintă o zonă recunoscută pentru potențialul său petrolifer, principalele roci sursă fiind bitumolitele oligocene atribuite flișului extern carpatic (Grasu et al., 2007).

Lucrarea de față propune un studiu complex (geochimie organică și palinofacies) în vederea evaluării potențialului de roci sursă al depozitelor Cretacic superioare încadrate la Formațiunea de Hangu. Au fost prelevate probe din trei secțiuni ale Pânzei de Tarcău, de la nord la sud: Sucevița, Pluton-Pipirig și Brădăcești.

Din punct de vedere geochimic, au fost realizate analize pentru evaluarea conținutului de carbon organic total (TOC) și determinarea biomarkerilor organici (prin gaz-cromatografie – spectrometrie de masa). Pentru evaluarea maturității termice a fost utilizată metoda de reflectanță a vitrinitului și indicele de colorare al sporilor (SCI). Contextul biostratigrafic, precum și condițiile de paleomediu, au fost estimate în acord cu distribuția stratigrafică a biomerkerilor palinologici (dinoflagelate) și, respectiv, palinofaciesul probelor analizate.

Valoarea TOC-ului în probele analizate prezintă o concentrație cuprinsă între 0,5 și 1,45%, indicând un potențial mediu→bun pentru generarea hidrocarburilor (Peters & Cassa, 1994). Rezultatele deduse din analiza biomarkerilor geochimici sugerează un kerogen mixt (tip II, de origine continentală și marină), deși frecvența materiei organice de origine continentală este mai mare. Raporturile Pr/n-C17 și Ph/n-C18 indică în principal un kerogen de tip III (predispus la generarea de gaze).

Din punct de vedere biostratigrafic, a fost identificată o asociație de dinoflagelate reprezentate prin *Odontochitina operculata*, *Alterbidinium varium*, *Cladopyxidium paucireticulatum* și *Deflandrea galeata*, care indică intervalul Campanian superior – Maastrichtian superior pentru depozitele studiate. Palinomorfele de origine terestră includ specimene atribuite grupului Normapolles (*Trudopollis* div. sp, *Oculopollis praedicatus*, *Hungaropollis krutzschii*), în asociere cu diverse gimnosperme (*Pinuspollenites, Araucariacites australis*) și spori de ferigi (*Gleicheniidites senonicus*, *Lycopodiumsporites* sp., *Biretisporites potoniaei*), care au fost identificate anterior în partea superioară a Formațiunii de Hangu (Țabără et al., 2023). Analiza de palinofacies relevă o frecvență ridicată a materiei organice de origine continentală, reprezentată prin fitoclaste translucente (țesuturi vegetale, cuticule), fitoclaste opace (inertinite) și o fracție minoră de materie organică amorfă marină derivată din biodegradarea fitoplanctonului.

Valorile obținute pentru reflectanța vitrinitului variază între 0,54 și 1,15, iar pentru SCI între 4,5 și 6,5, indicând astfel un kerogen matur din punct de vedere al gradului său termic de maturare.

Atât analizele geochimice cât și cele de palinofacies sugerează un mediu neritic proximal al bazinului de sedimentare pentru intervalul Campanian superior – Maastrichtian inferior, urmat de o transgresiune marină în timpul Maastrichtianului superior.

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UPPER CRETACEOUS PALYNOFACIES AND MICROFOSSIL ASSEMBLAGES FROM THE NORTHWESTERN HAȚEG BASIN

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Key words: biostratigraphy, palynomorphs, calcareous nannoplankton, foraminifera, Upper Cretaceous

The present study synthesizes the results of complex geological-stratigraphical investigations carried out along nine geological sections in the northwestern part of Hațeg Basin, in the neighborhood of Ciula Mică, Vălioara, and Boița localities. The main outcropping units in the study area are represented by the marine deposits of the Răchitova Formation (in the Geat Valley succession), as well as by the vertebrate-bearing continental beds of the Densuș-Ciula Formation that covers the central-eastern sectors of the study area.

The largest part of the samples analyzed from the Geat Valley succession was collected from marine deposits (turbidites). These yielded a moderately-abundant calcareous nannoplankton assemblage, dominated by *Watznaueria barnesiae* (>50%), *Micula staurophora,* and *Retecapsa crenulate* (Csiki-Sava et al., 2023). Foraminifers appear with a relatively low diversity and abundance, with reports of taxa such as *Rhabdammina*(agglutinated forms), *Laevidentalina* (small calcareous forms; Fig. 1f), and *Marginotruncana, Globotruncana, Globotruncanita* (planktonic forms; Fig. 1g, h). These marine deposits have also yielded a palynological assemblage with diverse dinoflagellates (e.g. *Isabelidinium microarmum bicavatum*, *Odontochitina costata*; Fig. 1b, c) and continental palynomorphs (*Araucariacites australis*, *Hungaropollis* sp.). The occurrence of the nannofossil *Broinsonia parca parca* (Fig. 1e), together with the aforementioned dinoflagellates, supports the presence of lower to lower-upper Campanian deposits in this sector.

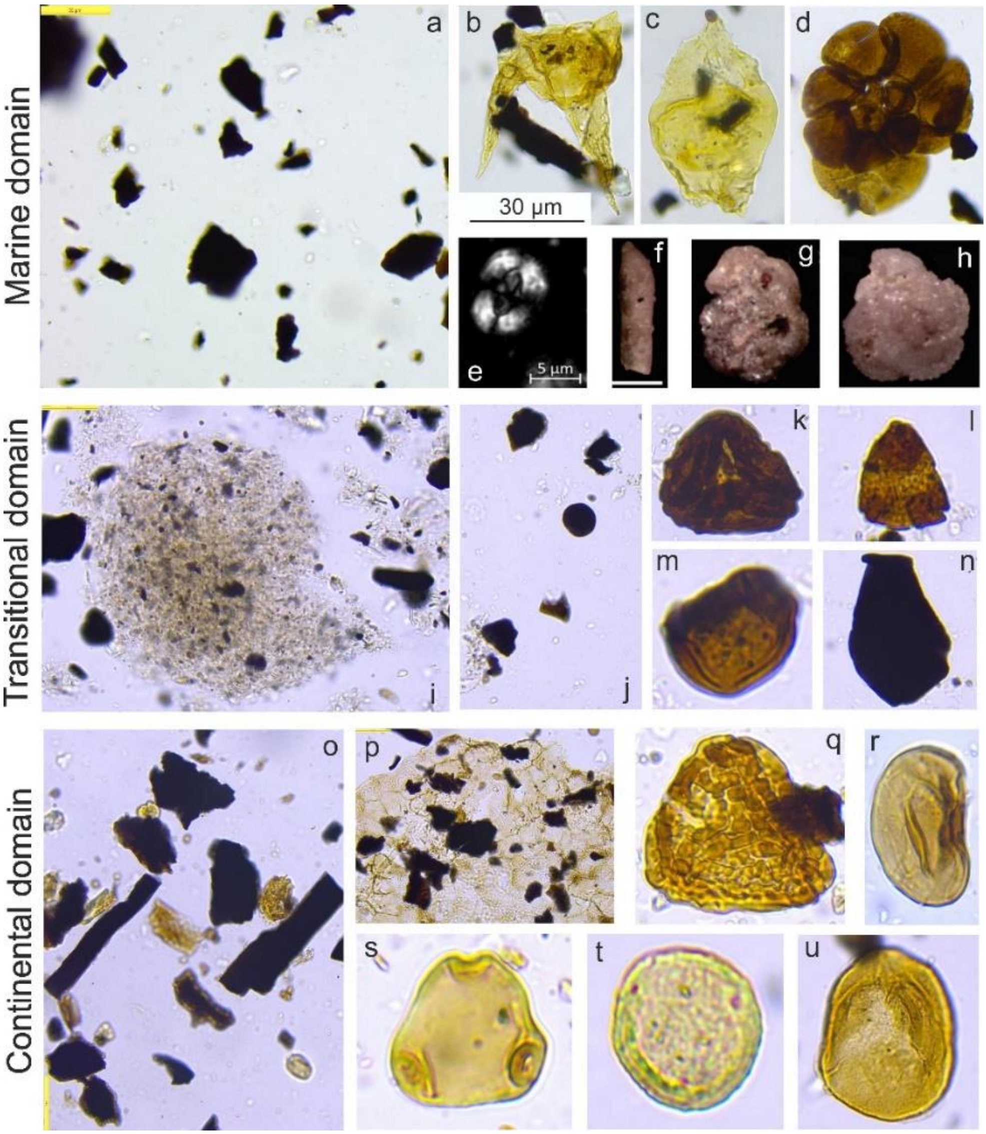

Fig. 1. Organic compounds of the palynofacies and representative marine and continental microfossils identified in the Upper Cretaceous deposits of the northwestern Haţeg Basin; a–h (marine Răchitova Formation, Geat Valley), i–n (transitional domain, Densuş-Ciula Formation, Ispas Valley – Ciula Mică), o–u (continental Densuş-Ciula Formation). a. Small-sized, coaly opaque phytoclasts; b. *Odontochitina costata*; c. *Isabelidinium microarmum bicavatum*; d. foraminifer test lining; e. *Broinsonia parca parca*; f. *Laevidentalina gracilis*; g. *Marginotruncana* sp.; h. *Globotruncanita stuartiformis*; i. Granular amorphous organic matter of marine origin and coaly opaque phytoclasts; j. Coaly opaque phytoclasts with rounded shapes; k. *Cicatricosisporites* sp.; l. *Trudopollis* sp.; m. *Classopollis* sp.; n. Chitinozoa (potentially reworked from Lower Paleozoic); o. Translucent and "lath-shaped" opaque phytoclasts; p. cuticle large in size; q. *Polypodiaceoisporites hojrupensis*; r. *Laevigatosporites ovatus*; s. *Proteacidites* sp.; t. *Subtriporopollenites constans*; u. *Balmeiopsis limbatus*.

The analysis of several samples collected in the upper reaches of Ogrădiilor Valley (west of Vălioara) and Ispas Valley (south of Ciula Mică) suggests a transitional (inner neritic) environment for the outcropping successions. These samples revealed a palynofacies represented by opaque, commonly rounded phytoclasts (> 95%; Fig. 1j) and granular amorphous organic matter of marine origin (Fig. 1i), as well as rare specimens of marine phytoplankton and calcareous nannoplankton, together with continental palynomorphs. Geochemical investigation (using gas chromatography – mass spectrometry) of a sample from Ogrădiilor Valley also confirms the transitional sedimentary environment suggested by the palynofacies and microfossil assemblages.

Most of the palynological assemblages identified from the Densuș-Ciula Formation (Fig. 1q-u) originate from the Vălioara and Boița areas. Pteridophyte spores such as *Polypodiaceoisporites hojrupensis* in conjunction with primitive angiosperm pollen (i.e., *Pseudopapillopollis praesubhercynicus*, *Krutzschipollis crassis*, *Proteacidites* sp.) suggest a latest Campanian – earliest Maastrichtian age for the deposits cropping out in the western Vălioara area. Towards the east, at Boița, the rich and well-preserved palynological assemblage recovered from the Densuș-Ciula Formation consists of continental palynomorphs such as *Subtriporopollenites constans* (Juglandaceae, frequently found), *Trudopollis* div. sp. and *Myricipites*sp. (angiosperms, frequently encountered), alongside *Araucariacites australis* and *Balmeiopsis limbatus* (Araucariaceae), as well as diverse fern spores, and indicates a somewhat younger, early Maastrichtian age for these deposits. The common occurrence of cuticles and woody tissues of large size (Fig. 1o, p) within the palynofacies of these samples indicates a fluvial/lacustrine palaeoenvironment for this part of the Densuș-Ciula Formation.

Acknowledgments

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NEW DATA REGARDING THE HORNLESS RHINOCEROTIDS OF THE EASTERN CARPATHIAN FORELAND (ROMANIA)

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Keywords: Aceratheriinae, radius, radiocarpal joint, Rusca, Păun

The gradual uplift of the last Eastern Carpathians nappe (Pericarpathian Nappe) during the Miocene caused the southeastward retreat of the adjacent Paratethys Sea and the emergence of several successive lands within the Eastern Carpathian Foreland framework (Ionesi et al., 1994). Various terrestrial fauna colonized these lands, among which mammals are predominant (e.g., Bâgu & Mocanu, 1984; Macarovici, 1936, 1958, 1966, 1967, 1978; Macarovici & Trelea, 1966; Rădulescu & Șova, 1987; Codrea & Rățoi, 2014 etc.).

The excavations carried out over the past years (2020-2023) within the Miocene terrestrial outcrops of Vaslui County (ECF) led to the discovery of new large mammal fossils (proboscideans, rhinocerotids, equids, giraffids etc). Isolated and unidentifiable fragmentary bones and teeth predominate within the records. Nevertheless, some fossils could be taxonomically assigned, and have already been the subject of several papers (e.g., Kampouridis et al., 2023).

In the present study, we will describe a partial rhinocerotid radius found in the local quarry of Rusca (Pădureni, Vaslui County), a newly-discovered outcrop hosting Miocene mammal fossils. The fossil-bearing bed belongs to a floodplain succession of Late Khersonian-Maeotian age. Following the comparison with previous records, we will also describe an unpublished rhinocerotid radius mentioned by Macarovici et Trelea (1966) from the Khersonian sand that crops out in the "La Catarg" Quarry of Păun (Iași County).

The radius sin. from Rusca is slightly longer than a shaft half including the distal epiphysis. The anatomical features are quite well preserved. Three articular facets (scaphoid, lunate, and triquetrum/pyramidal) of the radiocarpal/wrist joint expose the distal epiphysis. On the medial-distal side, a large sigmoid notch of the radius for the distal radioulnar joint is obvious. The diaphysis fragment is oval-depressed in cross-section, exposing the fossilized medullar cavity. Towards the distal epiphysis, the dorsal tubercle of the radius or the so-called "Lister's tubercle" is only inferred and displaced towards the lateral side of the radius. Other anatomical details, such as facets of the ligaments and tendons, can also be observed on the bone. The radius dext. from the Khersonian rocks of Păun (Iași District) preserved a smaller diaphysis shaft, generally showing similar morphology.

Rhinocerotids are common mammals among the Miocene fossil vertebrate fauna of the ECF (e.g., Cobălcescu, 1862; Sevastos (1903, 1922 see Codrea, 2000); David (1922, see Sevastos, 1922; Codrea, 2000); Macarovici (1958, 1960, 1978); Macarovici & Trelea, 1966; Trelea & Simionescu (1985); Rădulescu & Șova, 1987; Țabără & Cojocaru, 2001; Codrea & Ursachi (2007); Codrea & Rățoi (2014) etc.)

The rhinocerotid systematics is primarily based on the cranial and dental morphology (Lu et al., 2023, and references therein). However, post-cranial bone particularities are important in rhinocerotid identification. For example, the tridactyl and tetradactyl manus separates the Rhinocerotinae subfamily (tridactyl) from the Elasmotheriinae and Aceratheriinae subfamilies (tetradactyl) (e.g., Heissig, 1989, 2012; Heissig and Fejfar, 2007; Lu et al., 2023).

The distal epiphysis of both radii (Rusca and Păun) exposes a third articular facet with the triquetrum bone typical for the Aceratheriinae subfamily. This subfamily has two tribes, Aceratheriini Dollo 1885 and Teleoceratini Hay, 1902, (Heissig 2012, and references therein), several taxa being regarded recently as a single-genus clade (Lu et al., 2023). For the taxa included in the Teleoceratini and Aceratheriini tribes, the main difference resides in the slenderer bone for the Aceratheriini versus the Teleoceratini (e.g., Heissig, 2012, and references therein). However, our bones are fragments, and the biometric data cannot be used to assign a genus with certainty. Only age could be an accurate indicator: for the Valesian-Turolian, two genera of Aceratheriini have as of yet been documented within the ECF framework, namely *Aceratherium* and *Chilotherium*. Moreover, the *Alicornops* species is coeval with the mentioned taxa, but it is not common in eastern Romania. Consequently, one can only assign the bones to the Aceratheriinae subfamily.

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DISTRIBUȚIA ELEPHANTIDELOR FOSILE PE TERITORIUL JUDEȚULUI TELEORMAN (ROMÂNIA) – SITURI ISTORICE ȘI DATE INEDITE

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Cuvinte cheie: Bazinul Dacic, Proboscidea, *Mammuthus* spp., distribuție paleogeografică

Resturile de proboscidieni sunt cel mai frecvent întâlnite piese fosile aparținând unor vertebrate plio-pleistocene descrise de pe teritoriul județului Teleorman (Apostol, 1968; Apostol & Cacoveanu, 1980). Acestea apar, de obicei, sub forma dinților izolați, de cele mai multe ori ca descoperiri întâmplătoare în cariele exploatate la nivel local sau remaniate în prundișul râurilor majore care traversează această zonă. Există și excepții notabile, în care piese aparținând mai multor indivizi au fost descoperite în același sit, cum sunt cele ale pieselor provenite din curtea spitalului de la Furculești, de la Fabrica de Cărămidă din Alexandria sau din cariera de la Bogdana (Apostol & Cacoveanu, 1980). Piesele descrise în a doua jumătate a secolului al XX-lea (Apostol, 1968; Apostol & Cacoveanu, 1980) au fost atribuite în special taxonului *Mammuthus meridionalis* (raportat din siturile de la Alexandria, Bogdana, Buzescu, Furculești, Găvănești, Izvoarele, Mavrodin, Nanov și Salcia), dar și speciilor *Mammuthus trogontherii* (de la Mavrodin) și *Mammuthus primigenius* (de la Brânceni, Găvănești și Izvoarele).

Pieselor sus-menționate li se adaugă materiale inedite, fie descoperite în ultimii 15 ani de către autorii acestei comunicări, în timpul prospecțiunilor de teren (la Mavrodin – Vasile et al., 2012; la Peretu – Vasile & Torcărescu, 2017; la Brebina – Vasile et al., 2019; sau la Albești – Vasile & Floroiu, 2022), fie identificate în mai multe colecții muzeale, constând în piese descoperite anterior, dar rămase nepublicate (piesele de la Măgura, Piatra, Slobozia Mândra).

Această lucrare prezintă o distribuție actualizată a elephantidelor fosile descoperite până în prezent pe teritoriul județului Teleorman, îmbunătățind și informațiile privind încadrarea stratigrafică a depozitelor din această zonă. Cea mai mare parte a materialului studiat este atribuit speciei *M. meridionalis*, tipică Pleistocenului timpuriu. O singură piesă, de proveniență necunoscută, prezintă caracteristici tipice speciei *Mammuthus rumanus,* care a trait în Pliocenul terminal – Pleistocenul timpuriu. Câteva specimene pot fi atribuite taxonilor din Pleistocenul mijlociu, *M. trogontherii* și *Elephas antiquus*, dar nu a fost întâlnit nicăieri vreun specimen care să poată fi atribuit speciei *M. primigenius*, întâlnită în Pleistocenul târziu.

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EVALUAREA POTENȚIALULUI GEOTERMAL AL ROMÂNIEI

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Cuvinte cheie: câmpuri geotermale; energie regenerabilă; independența energetică

Energia geotermală este căldura generată și stocată în interiorul Pământului, reprezentând o sursă de energie regenerabilă și stabilă, folosită în diverse aplicații. Pământul eliberează această căldură prin conducție și dezintegrare radioactivă, dar majoritatea energiei este prea difuză pentru a fi utilizată eficient, fiind blocată de scoarța terestră izolantă.

România are un potențial remarcabil în ceea ce privește energia geotermală, fiind considerată a treia țară din Europa, după Grecia și Italia (Tudorache et al., 2022). Acest potențial este legat de adâncimea limitei crustă-manta și de existența celui mai lung lanț vulcanic din Europa chiar dacă este inactiv în prezent.

În funcție de temperaturile atinse, pot fi reprezentate mai multe zone (areale și verticale) care pot oferi oportunități semnificative de afaceri.

Harta din figura 1 evidențiază cele mai valoroase zone caracterizate prin temperaturi medii spre ridicate la un interval relativ acceptabil de adâncime și în zone valoroase

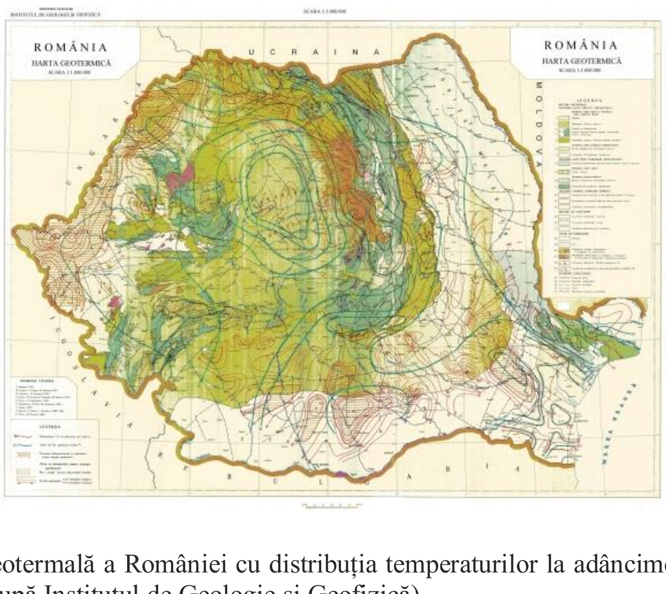

Fig. 1. Harta geotermală a României cu distribuția temperaturilor la adâncimea de 3000 m și fluxul termic (după Institutul de Geologie și Geofizică)

(populate, cu industrie dezvoltată și alți potențiali utilizatori) atât pentru intervalul de temperaturi înalte, cât și medii.

În funcție de temperatură, putem prezenta mai mulți utilizatori finali, după cum urmează:

- temperatură ridicată (160-150^{0}C) adecvată centralelor electrice;
- temperatură medie (110-80^{o}C) ce poate fi utilizată pentru sistemele de încălzire casnică;
- temperatură medie spre scăzută (80-60^{o}C) pentru SPA, agricultură, recuperare secundară;
- temperatură scăzută (60-40^{o}C) pentru pompe de căldură, SPA.

O problemă specială se referă la posibilitățile de utilizare pentru afaceri a puțurilor de petrol abandonate existente.

Principalele câmpuri geotermale, cum ar fi cele din Oradea și Beiuș, prezintă aplicații de succes în încălzirea municipală și în servicii balneare, deși dezvoltarea la scară largă este încă limitată. Provocările în exploatarea energiei geotermale includ condițiile complexe de foraj, gestionarea apei și măsuri de atenuare a impactului asupra mediului, precum activitatea seismică minoră și potențialele emisii de elemente toxice. În ciuda acestor provocări, vasta rețea de sonde de petrol abandonate din România poate să ofere un punct de pornire eficient pentru extinderea sectorului geotermal.

Sectorul geotermal din România deține un potențial considerabil pentru o energie durabilă, cu beneficii în impactul asupra mediului, capacitatea regenerabilă și independența energetică.

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IDENTIFYING VOLCANIC DEBRIS AVALANCHE DEPOSITS IN THE NEOGENE-QUATERNARY CĂLIMANI-GURGHIU-GURGHIU-HARGHITA VOLCANIC RANGE (ROMANIA) USING GEOSPATIAL ANALYSIS

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Keywords: GIS, digital terrain modelling, geochronology

The Călimani-Gurghiu-Harghita volcanic range (CGH), located along the western margin of the East Carpathians in Romania (Szakács and Seghedi, 1995; Seghedi et al., 2019), represents the largest post-collisional volcanic system in Europe. CGH consists of a series of axial composite volcanoes (ACV) surrounded by voluminous volcanic debris avalanche deposits (VDADs).

However, earlier interpretations (e.g., Rădulescu, 1964) assumed two structural units corresponding to two evolutionary stages of the volcanism: 1) an early one, called "volcano-sedimentary formation" mapped at the peripheries of the chain, followed by 2) dominantly effusive axial stratovolcanic edifices. Later, in addition to the volcanological facies patterns, Szakács and Seghedi (2000) identified two large VDADs, named Western Călimani and Vârghiş, which opened a new challenge for volcanic studies in Romanian volcanic areas.

The spatial distribution, source, and volcanological characteristics of the VDADs are obscured by abundant vegetation and the rarity of outcrops, which have limited our ability to integrate these deposits in a coherent evolutionary model of CGH. In order to mitigate this problem, in the present study we identify, deliniate, and characterize the VDADs associated with ACV by combining field observations, petrographic, geochemical, and geochronological data, geospatial analysis, and 3D modelling.

In order to identify various geomorphological features and outline the distribution of volcanic products in areas with limited exposure, we used geospatial analysis on high-resolution digital terrain models (DTM/DEM) throughout the entire CGH. Geospatial analysis was conducted in GIS programs by overlying a high-resolution digital terrain model and georeferenced geologic maps. This approach facilitated the integration of new geologic information from outcrops, geochemical analyses, and geochronological data to achieve the geomorphologic analysis of volcanoes.

Geospatial analysis was carried out using QGIS software. For each volcano with an identified VDAD (Table I), the geometric parameters of the VDAD were measured using a DEM-based 3D model as: Runout length (L), Drop height (H), Deposit length (L_d), Deposit area (A_d), Deposit thickness (T_d).

The extent of each VDAD was done by using geomorphological features, volcanic facies identification in the field correlated with geochronological data.

The main characteristics resulting from the geospatial analysis and other key observations for the studied VDADs and their source volcanoes are summarised in Table 1.

Tab. 1. Main characteristics of CGH volcanic debris avalanche deposits (acc. Seghedi et al., 2023)

Volcano/VDAD	Călimani E	Călimani W	Fâncel-Lăpuşna	Ostoroş	Ivo-Cocoizaş	Vârghiş	Luci-Lazu	Pilişca
Last known eruption[Ma]	~6.7	~6.7	~6.0	~5.7	~5	~4.1	~3.7	~1.5
Scar orientation	SE	SW	S	E	E	S	S	W
Time of VDAD emplacement [Ma]	~7.8	~7.8	~6.8	<5.7	<4.8	~5.15	~4.0	<1.5
Petrography	B, cpx-BA, A	BA, A, D	A, BA	A, (D)	A, (D)	A, D	A, (D)	D, A, BA
Deposit length [L_d, km]	33	57.3	47.7	17.7	21.5	46	18.3	5.5
Deposit area [A_d, km^2]	176.3	582.8	605.3	36.8	124.3	342.7	124.7	2.8
Average VDAD thickness [T_d, m]	150	250	175	40	70	120	60	20
VDAD Drop height [H, m]	1740	2288	2044	761	1349	1838	1028	711
VDAD Runout length [L, km]	40.8	63.0	50.4	17.7	21.5	56.3	28.5	6.1

Abbreviations: B-basalt; BA-Basaltic andesite; A-Andesite; D-Dacite; cpx-clinopyroxene

The sector collapse of Fâncel-Lăpușna (Table 1) resulted in the most impressive volume loss (~39%), whereas other large edifices (e.g., Old Călimani, Ivo-Cocoizaș, Vârghiș, and Luci-Lazu – Table 1) appear to have lost in collapse only 15–32% of their volume. In contrast, the volcanic debris avalanches removed only 3–4% of the smaller Pilișca and Ostoroș volcanoes (Table I; Seghedi et al., 2023).

By correlating the mapped volcanic facies and 3D modelling in agreement with geochronological data, we generated an evolution model of the volcanic processes shaping CGH in space and time. As a result, the morphologic characteristics of VDADs and their various features (toreva blocks, hummocks, displacement directions, etc.) were identified.

Geospatial analysis expanded our knowledge on volcanic facies distribution in CGH and resulted in the identification of six additional volcanic debris avalanche deposits: Eastern Călimani, Fâncel-Lăpuşna, Ostoroş, Ivo-Cocoizaş, Luci, and Pilişca (Seghedi et al., 2023). Consequently, the geospatial analysis is an indispensable tool for understanding the evolution of old volcanoes in poorly-exposed areas.

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THE PROVENANCE OF UPPER JURASSIC- EARLY CRETACEOUS SEDIMENTS FROM THE BUCOVINIAN NAPPE SEDIMENTARY COVER – IMPLICATIONS FOR U-PB GEOCHRONOLOGY OF THE DACIA BLOCK

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Keywords: geochronology, U-Pb, detrital zircons, Eastern Carpathians, provenance

The Bucovinian metamorphic basement (Dacia Block) consists of different peri-Gondwanan terranes - Ordovician magmatic arcs, passive margins and orogenic sutures (Balintoni and Balica, 2013). The (Zr) U-Pb ages of eight samples from magmatic and metamorphic rocks of the Bucovinian basement indicate dominantly Ordovician magmatic events (458-462 Ma). These ages contrast with ages known from Carpathian foreland units (e.g., Danubian and Dobrogea units – 250-340 Ma and 545-620 Ma, Balintoni et al., 2014).

A key question is whether the published data from the metamorphic basement of the Bucovinian Nappes (Dacia Block) is statistically representative from a U-Pb geochronological perspective. We selected two samples from the J3-K1 deposits of the Bucovinian sedimentary cover, namely Lunca and Pojorâta Formations (sensu Băncilă, 1958) also known as *Aptychus* Beds (sensu Grasu și Turculeț, 1973), most probably sourced from the Bucovinian basement, in order to compare the detrital zircons U-Pb ages with the already known ages of Bucovinian basement and eventually to identify any other possible magmatic activity or metamorphic zircon production than the well-known 460 Ma peak.

We obtained relatively similar age distributions. The age distribution range is wider than known, although the dominant peak indicates the same Caledonian events (460-480 Ma). An older Neoproterozoic peak (630 Ma) as well as a younger Triassic peak (240 Ma) were identified, the latter quite clear. While the Caledonian ages confirm those given by Balintoni and Balica (2013), the other two are novelties. The older peak suggests Neoproterozoic events. The younger peak can be correlated with the Ditrău-type continental extensional magmatism that preceded the opening of the Ceahlău-Severin Basin in the Upper Jurassic. Based on the obtained ages, we suggest that the river supplying the analyzed turbidite system had a catchment area overlapping units with different geologic histories, those dated by Balintoni and Balica (2013) being only one of them.65

Our findings are twofold, on the one hand, they exclude the foreland as a source of zircons and, on the other hand, show a more complex history of Bucovinian sources indicating at least two other magmatic or metamorphic zircon production processes.

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