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Phase I – year 2022

Scientific report for the 1st year of the PCE project PalRom:

**The dawn of Cenozoic climate changes: The Eocene-
Oligocene terrestrial bio-events in Romania, part of the
European geological Heritage**

YEAR I ACTIVITY

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1. Achievements in the first phase according to the objectives mentioned in the implementation plan

The main objectives have been divided into the following steps:

Ob.1. Preparation of specimens existing in the collections of Babes-Bolyai University and the correction of the systematic determination for some specimens.

Ob.2. To collect new fossils from new areas of interest in order to diversify the valid material for study and to identify new fossil sites.

Ob.3. Detailing the anatomy of some vertebrate taxa by micro-scanning.

Ob.4. The study of taphonomy in different fossil localities (e.g. north-western part of the Transylvanian Basin).

Ob.5. To create a database of fossil assemblages, stratigraphic ranges of taxa, distribution area and relationships between taxa.

Ob.6. Providing details on the sedimentological context, primarily based on mineralogical studies and sedimentary structures, for all the studied areas.

Ob.7. Reconstructing Palaeogene terrestrial ecosystems in Romania, highlighting the main biotopes.

Ob.8. Comparison of the identified ecosystems with each other and with equivalent, similar ecosystems in Europe and other parts of the world, in order to better understand their evolution.

The achievement of the objectives can be seen in the list of activities completed according to the Phase 1 plan below. Complex and demanding field campaigns were carried out throughout the part of the year when the grant became operational, i.e. from the start of the project in June until November, when field work was no longer possible due to climatic reasons. Some campaigns were also carried out in intervals when they overlapped with scientific events (symposiums and national/international conferences) in Romania, precisely in order to maximise the efficiency of the costs accumulated during the year in the respective components of the project. All these campaigns are explicitly specified below. The fact that we managed to overlap some field periods with the scientific events we referred here, helped us to effectively check - in some cases - local

museum collections, and also to add field prospections in the vicinity of these localities, where sedimentary deposits with geological ages of interest for the project are outcropping, i.e. where the Eocene/Oligocene boundary can be found, particularly in the continental domain.

1.1. Preparing materials (existing and newly collected)

The actual research started by preparing fossil material already existing in the own collection of the Laboratory of Paleotheriology and Quaternary Geology of the "Babeş-Bolyai" University of Cluj-Napoca, but also from established collections, such as that of the Brukenthal Museum in Sibiu. Already known sediments from less well investigated areas, such as Suceag, Morlaca, Hodiş, Treznea etc., have been prepared in order to obtain rich concentrations of relevant microfossils, particularly vertebrates. At the same time, new field campaigns were carried out in areas such as Bociu (Cluj County), Sutoru and Zimbor (Sălaj County), which are suitable for the investigation as they have geological ages of interest for the subject. Of course, the most interesting area in these aspects is the north-western part of the Transylvanian Basin, but we also turned our attention to the extreme southern part of this basin. On the basis of the new material collected during this phase of the project - after all, much too short: the project started considerably later than anticipated, for reasons beyond our control - we can say that we have reached significant preliminary results, particularly in terms of interpretations of some palaeobotanical elements. The vertebrates resulting from the research/prospecting and excavations in 2022 are still being prepared, but they are already very promising in terms of their rarity, their systematic classification that completes the knowledge of this part of Europe, and their palaeogeographic and palaeoclimatic messages.

1.2. Bibliographical documentation

The documentation started by collecting basic geological bibliographical references in Romania [publications of the Geological Institute of Romania (Memories of the Institute, Reports of the Meetings, Yearbook of the Geological Institute, journals of the Technical and Economic Studies series, and specialized journals on Mineral Deposits, Mineralogy, Paleontology, Petrology,

Stratigraphy, and Tectonics and Regional Geology)], but also from other countries. In-depth bibliographical studies were also carried out by consulting old manuscripts from the 18th-19th centuries, in order to establish stratigraphic correlations concerning the formations of North-Western Transylvania, and to verify the appartenance of these formations to models already established in the geological literature. A number of older publications relating to Transylvania were identified in the Central University Library of Cluj-Napoca.

1.3. Field activities

Field campaigns have been carried out since the start of the project over a large geographical area of Romania. The detailed research carried out was based on our conceptual models, verified by geological-palaeontological surveys followed by systematic excavations in the various areas of major interest for the project.

In a first stage, part of the team travelled to Târgu Mureş and Alba Iulia, not only to consult the museum collections, but also to prospect a large part of the surrounding areas that could and do offer palaeogene fossils *in situ*, but also reworked in subsequent, geologically younger deposits.

A period of prospecting followed over a large area of Alba County, during which we systematically covered a series of routes - selected on the basis of an established methodology - in search of Oligocene deposits appearing on geological maps. We have identified the deposits in the field, and in the imminent future we will determine the relevance of their fossiliferous contents, in the context that we will be able to identify in the mentioned deposits also fossiliferous levels accumulated in continental environments.

In the area of the Eastern Carpathians, in the counties of Neamt and Bacau, we have carried out several field campaigns (Appendix 1., Fig.1.), in an attempt to find areas of the Eocene/Oligocene boundary, and to consult museum collections. At the same time, we managed to discover vertebrate fossils - other than fish - in marine environments, which reached those deposits precisely thanks to the proximity of the old emerged areas. These will be studied in the coming periods with a view to publication.

An illustrative example demonstrating the influence of emerged areas in the vicinity of a Palaeogene marine sedimentary basin is provided by the collections of the Brukenthal Museum in Sibiu, which contains crocodile teeth (Appendix 1., Fig.2.) collected mainly in the 19th and early

20th century. These teeth come from Turnu Roşu (a locality known under the more historically justified toponym of Porceşti) and are currently accepted for publication in an ISI-indexed journal. The results are surprising and provide important new elements for the diversity of Palaeogene crocodylians in this part of the European continent. The small collection of isolated crocodylian teeth from the Sibiu museum collected from marine deposits in the specified locality probably documents an attritional association that originates from several individuals of different sizes and ontogenetic ages. Morphological analyses indicate that we were dealing with heterodont dentitions, which included at least five morphotypes (gracile caniniform, lanceolate triangular, broad conical, gracile conical and with low crowns). We have associated these teeth with the Gavialoidea on the basis of a number of morphological characters that are common to these crocodiles and to the primitive Gavial representatives known from the Early-Middle Eocene deposits of western Europe and North Africa. The Turnu-Roşu Gavians represent a new group for the known palaeogene faunas of Romania, which reached the land areas of southern Transylvania in the Middle Eocene, probably on routes provided by the newly rising chains of the Carpathian orogen after the terminal Cretaceous ("Laramic") tectogenesis. Possible scenarios that may explain the origin of the southern Transylvanian Gavial may be linked to the existence of a west-east migration route, or a direct migration from North Africa, there starting from a close ancestor of *Maroccosuchus*, reported from the western Tethysian region. This contribution of ours brings new elements to European palaeobiogeography.

Excavations in the continental deposits at Morlaca (Appendix 1., Fig.3., 4., 5.) have brought us considerable satisfaction in terms of the richness and diversity of fossil material. Fossils recovered from the concentration level are being prepared. They come from the Nadăş Valley Formation (Priabonian) and prove migration processes of large mammals that predate the "Grande Coupure" event in terms of geological time. For these mammals, a southern migration route from Asia to Europe via Anatolia, Thrace and the Carpathian chain (a continental unit known in European Palaeogene palaeogeography as Balkanatolia; Tissier et al., 2018, Licht et al., 2022) must be accepted.

Part of the collection of the Crişurilor County Museum in Oradea was examined for paleogene fossils, and some laboratory preparations were carried out there as well (especially those of great fineness, for which there was no adequate instrumentation at the Cluj university).

The surroundings of Cluj-Napoca have not been ignored either, as this is the site of world-famous outcrops. Reference localities such as Rădaia (Annex 1., Fig.6.), Mera and Suceag, as well as areas within the municipality in question were monitored continuously (weekly). Such monitoring has not been without use, a good example being the discoveries of sirenian bones (Annex 1., Fig.7.) that we have made in the bed of the river Someș and which are currently accepted for publication in a BDI indexed journal.

Other areas of particular geological importance have been covered. These include localities such as Bociu (Annex 1., Fig.8.), Zimbor (Annex 1., Fig.9.) or Sutoru (Annex 1., Fig.10.). Their investigation remains to be continued in the following years of the project, given that these localities are mainly outcrops of continental deposits typical of river plains, where the sedimentary fills of the channels may be attractive for fossils of large mammals and other macrovertebrates. The latter two localities may provide interesting data for post 'Grande Coupure' events.

1.4. Determination of taxa, identification of local tafocenoses

Most of the fossils discovered this year, both in some museum collections and in the field, are still being prepared and determined. These include several forms of relatively large terrestrial and marine mammal remains (e.g. sirenians, brontotherians, anthracotherians, etc.) but also smaller terrestrial mammals. Reptiles and other relevant vertebrate forms are not included (chelonians, small reptiles, etc.). Determinations have also been made on carophytes from the Rupelian at Suceag (in publication), as well as on carophytes of middle to upper Eocene age from localities such as Bociu, Treznea and Stana. As is well known, carophytes can provide essential clues to the ages of deposits thanks to marker taxa, but also to the freshwater aquatic depositional environments. In some cases, we may have reworked carophytes in coastal littoral deposits (Bociu). Although not originally envisaged, we have concluded that some forms of invertebrates (molluscs) will also be of interest to the project, as they can be found right at the Eocene/Oligocene boundary, and provide additional new environmental information over that known to date.

1.5. Reconstruction of palaeobiocenoses by correlation with depositional environments

Preliminary geological and palaeontological analyses carried out so far have led us to deduce differences in systematic diversity in the Eocene-Oligocene interval between the north-western Transylvanian Basin and the southern sector of the same basin. One such example is provided by the crocodylians in the associations under discussion: gavials are not reported from north-western Transylvania, from where we have data only on the presence of alligators (*Diplocynodon*). Such a differentiated distribution is an argument for different food chains in the two areas under discussion. A possible explanation could derive from the effects of the Bartonian crisis, during which gradual distribution restrictions from north to south are also recorded in western Europe: thermophilic survivors remain only in the southern sectors, those representatives disappearing from the recorded biodiversities. Transylvania could be a similar example in Eastern Europe. Fossil provenances reflect a palaeoecologically preferential distribution in terrestrial environments of the river plain type, especially in sedimentary fills of river channels, as can be seen in the Priabonian at Morlaca. In such localities, red-bed deposits predominate. Morlaca provides a provocative example of deposits accumulated near a major fracture, with implications that we will provide in the publications to follow.

1.6. Inventorizing fossil taxa and recording assemblages and distribution of taxa

The fossil taxa determined concern on the one hand certain plants such as the rupelian carophytes from Suceag, and on the other paleogene vertebrates. We have already mentioned the attribution to gavialoids of the Turnu Rosu crocodile fossils. On the other hand, from Morlaca we can point out: the presence of two forms of titanotherians (one very large, similar to the Asian genus *Embolotherium*, and a second, medium-small, which may be close to *Dolichorhinus*), an antracother that can be associated with *Prominatherium dalmatinum*, an amynodont determined as *Aminodontopsis* aff. *bodei* (known sampling was considerably enhanced, particularly by dentition and postcranial elements of sub-adult specimens). To these are added other elements to be determined. The associations are clearly attritional, which is why we are discussing a tafocenosis. Reconstructing a biocenosis involves more knowledge, including plants and non-vertebrates, but

also more elements that are attributable to fossil vertebrates. Such work can only be based on more extensive and lengthy work throughout the project. The field period was far too short, due to the long delay (half a year) in starting the project.

1.7. Determining relationships between taxa and environments

At this stage, we can only provide concrete but limited information on studies that have already been carried out, whose results are accepted for publication or are in the process of being published. Thus, we can state with certainty that crocodilian teeth from Turnu Rosu (Porcești) prove the presence of freshwater taxa, with individuals at the time of death in various ontogenetic stages. They fed particularly on fish and, although we consider them to be species that prefer freshwater environments, it would not be excluded that the specimens may have had some tolerance to brackish environments. However, on the basis of the obvious signs of rolling (transport), we can rather consider that the teeth were transported after decomposition by a local hydrological system (river) to the marine deposits where they were found, most probably from the southern branch of the region (Făgăraș Mountains).

As for the charophytes (in publication) from Suceag, their presence in the Rupelian deposit brings new information regarding the palaeobiogeography of the area, but also the Eurasian palaeobiogeography. The same fossiliferous level, together with its extensions towards the municipality of Cluj-Napoca, has also yielded in the past a rich series of fossil vertebrates. Therefore, on the basis of otoliths the fishes *Enoplophthalmus* sp., *Hemitrichas* sp., *Dapalis angustus*, *D. transylvanicus*, *D.* sp., *Dicentrarchus* (=Morone) sp., *Lepidocottus* (= "g. *Eleotridarum*") sp., and "g. aff. *Lesueurigobius*" sp., which are species indicative of fresh and brackish waters (Reichenbacher & Codrea, 1999). Amphibians include proteids (*Mioproteus gardneri* and *Latonia* sp.), palaeobatrachians (*Albionbatrachus oligocenicus*) and ranids (*Pelophylax* sp.) (Codrea & Fărcaș, 2002; Fărcaș, 2011; Venczel et al, 2012; Venczel & Codrea, 2018). Reptiles include anguids (Anguidae indet.), anguiliids (*Eoanilius* sp.), boids (cf. *Bransateryx* sp.), chelonians (*Tryonix* sp., *Chinemys strandi*), and crocodilians (*Diplocynodon* sp.) (Codrea & Fărcaș, 2002; Fărcaș, 2011; Codrea & Venczel, 2020). Birds are represented by Anserinae indet. and *Rallicrex kolozsvarensis* (Codrea & Fărcaș, 2002). Mammals are represented by insectivorous erinaceous (?*Neurogymnurus* sp.), cricetid rodents (*Paracricetodon* sp.), a

?condylarth (*Kochictis centennii*), entelodons (*Entelodon* aff. *deguilhemi*, Entelodontidae indet. cf. *Paraentelodon* sp.) and anthracotherians (*Antracotherium* sp, *Elomeryx borbonicus*) (Rădulescu & Samson, 1989 and references therein; Codrea & Fărcaș, 2002; Fărcaș, 2011). The carophyte species determined together with an expert collaborator from the University of Barcelona were systematically classified as *Harrisichara* aff. *tuberculata*, *Sphaerochara* aff. *hirmerii*, *Lychnothamnus pinguis* forma *pinguis*, *L. pinguis* forma *major*, *L. praelangeri*, *Nitellopsis (Tectochara)* aff. *merianii* (Appendix 1., Fig. 11.). These carophytes are together indicative of lacustrine waters and floodplains, and by the fact that strictly gyrogonites with an intensely rolled character have been found, but not fragments of stems or utricles, we can state with certainty that in the Suceag area of today, ca. 31-20 Ma. ago, a vast hydrographic network had developed, coming from the Gilău Massif and flowing in the form of an estuary, towards the eastern part, into the Oligocene Sea.

1.8. Analysis of rocks in thin sections and determination of main rock types and depositional facies

We are currently analysing the mineralogy of some metamorphic rocks from Morlaca to determine the source areas in order to better outline the palaeogeography of the area. We are able to highlight there the participatory absence of banatitic eruptive rocks, which we will explain in the publications that follow. At the same time, in the same area we also identified levels with lacustrine limestones (Appendix 1., Fig.12.), with a considerable development, which can be similar to those known from other areas of Transylvania also from palaeogene deposits (e.g., Rona, Horlacea). What makes them interesting for studies is their Priabonian age. The petrographic and sedimentological analyses that will follow are as exciting as possible regarding their genesis. For the time being, their areal extension beyond the limits of Morlaca, particularly to the south-east, but also to the north, at Hodiș, needs to be studied. For these we have considered facies determination, in order to be able to identify what events led to the accumulation of fresh water in this geological episode.

1.9. Complex sedimentological analyses

Complex sedimentological analyses are currently being carried out, of course, on the Morlaca area, but also on the levels of Bociu, Suceag and the Cluj-Napoca area. These are still in their early stages, as the work for such analyses is painstaking and several steps need to be taken in order to obtain concrete results on the sedimentological evolution of a small-scale outcrop. Together with the data we will obtain from local palaeontological and geological studies, but also with global data from the same geological periods, we will be able to characterise precisely the way the areas of interest evolved, which will help us to better visualise the palaeogeographical development of these areas in a global palaeoclimatic context.

1.10. Establishing main assemblages, correlating different formations, creating palaeoecological graphs

In our approaches we confirm and accept the existence of sedimentation areas in northwestern Transylvania, which as demonstrated by already published data (e.g., Popescu, 1984) but also by results already obtained by us, are correlated. Northwestern Transylvania has the advantage of palaeogene sedimentation dominated by marine deposits, but repeatedly intercalating continental episodes. The continental ones signify emergence stages with considerable areal extensions, which can be correlated with relative ease. What differentiates them refers to more discrete aspects, such as the better drained character in certain river plains vs. the more flooded, with telmatic tendencies in other sectors, as can be seen for example in the case of the Priabonian formations of Valea Nadasului and Turbuța. In the case of the latter, the presence of fish from the Embassy group differentiates it from the former, where such representatives were not encountered. During the development of our research we had justified hopes to distinguish specific taxa, with value for correlations at medium to large scales (regional, continental, intercontinental).

1.11. Complex analysis of the results: comparison of Romanian ecosystems with their European equivalents, identification of the specificities of the Romanian ones, correlation with other ecosystems in order to understand their origin and evolution.

This objective is at an early stage and more data is needed on the main geological sections under investigation. A number of data have already been collected on outcrops and successions from abroad (Czech Republic, France, Germany, Turkey, Bulgaria, etc.) and contacts have been established with colleagues who have accumulated experience on outcrops of continental origin in Europe and in the country.

Having said that, we consider that we have achieved the proposed objectives, with small changes from the originally proposed route, changes that occurred both due to the delay in the start of the project and due to the budget funds that had to be relocated to 2023. Thus, having known in advance the objective reason given, as far as Ob.3. is concerned we can say that we have the materials ready for the proposed analyses, but we will do them at the first opportunity in year 2 of the project.

2. Results and dissemination

As mentioned above, I have attended some 11 symposiums and conferences. Among them, at the international congress in Plovdiv (Bulgaria) our work was highly appreciated by the scientific community (Annex 1., Fig.19.) specialized on the subject. In addition, we participated in two scientific events for the public, and in a workshop on geological reserves in Romania. As far as publications are concerned, we count 5 abstracts, two BDI indexed articles and two ISI indexed articles. The last of the two ISI indexed articles is still in the formulation stage at the time of reporting, but will be submitted for publication by the end of December (2022). We can thus say that we are meeting the deliverables for 2022, and even more, we have exceeded the total number of planned deliverables.

2.1. Conference participations

International conferences

- Codrea A.V., Venczel M., Solomon A.Al., Bordeianu M., Veress L., Fărcaș C., Florică Ș., Cerchia C.. Aflorimente ilustrative pentru evenimentul ”Grand Coupure” în NV-ul Transilvaniei. Conferința de Comunicări Științifice cu Participare Internațională ”Preocupări recente în cercetarea, conservarea și valorificarea patrimoniului cultural”, ediția XVI, 22-24 Iunie 2022, Târgu Mureș, România. Prezentare în plen. (Appendix 1., Fig.13.)
- Girbau J.S., Bordeianu M., Codrea V.A., Solomon A.Al.. Fossil charophytes from the Oligocene of Suceag (Cluj County, Romania). Biostratigraphic implications. Conferința de Comunicări Științifice cu Participare Internațională ”Preocupări recente în cercetarea, conservarea și valorificarea patrimoniului cultural”, ediția XVI, 22-24 Iunie 2022, Târgu Mureș, România.
- Veress L., Bordeianu M., Codrea V.A.. Preliminary data on the eocene sirenians from Someș-Dig (Cluj-Napoca, Romania). Conferința de Comunicări Științifice cu Participare Internațională ”Preocupări recente în cercetarea, conservarea și valorificarea patrimoniului cultural”, ediția XVI, 22-24 Iunie 2022, Târgu Mureș, România. (Appendix 1., Fig.14.)
- Solomon A.Al., Venczel M., Fărcaș C., Codrea V.A.. Distribuția multituberculatelor koganoidae în intervalul Cretacic-Paleogen pe teritoriul României. Conferința de Comunicări Științifice cu Participare Internațională ”Preocupări recente în cercetarea, conservarea și valorificarea patrimoniului cultural”, ediția XVI, 22-24 Iunie 2022, Târgu Mureș, România. (Appendix 1., Fig.15.)
- Codrea A.V., Venczel M., Solomon A. Al., Bordeianu M., Fărcaș C., Veress L.. Paleogene terrestrial vertebrates of Transylvania – key for a better understanding of the ‘Grande Coupure’ Event. 100th Anniversary of the Carpathian-Balkan Geological Association,

XXII International Congress of the Carpathian-Balkan Geological Association (CBGA), 7-11 September 2022, Plovdiv, Bulgaria. (Appendix 1., Fig.16.)

- Girbau J.S., Bordeianu M., Codrea A.V.. The charophyte flora (aquatic plants) from the Suceag Oligocene fossil site (western Transylvanian Basin, Romania). Biostratigraphy, palaeoecology and palaeobiogeography. 100th Anniversary of the Carpathian-Balkan Geological Association, XXII International Congress of the Carpathian-Balkan Geological Association (CBGA), 7-11 September 2022, Plovdiv, Bulgaria.
- Veress L., Codrea A.V., Bordeianu M.. Mapping the Paleogene sirenians in Transylvania. 100th Anniversary of the Carpathian-Balkan Geological Association, XXII International Congress of the Carpathian-Balkan Geological Association (CBGA), 7-11 September 2022, Plovdiv, Bulgaria. (Appendix 1., Fig.17.)
- Codrea A.V., Solomon A. Al., Bordeianu M., Fărcaș C.. Eocene-Oligocene Perissodactyls of Romania, a short overview. 100th Anniversary of the Carpathian-Balkan Geological Association, XXII International Congress of the Carpathian-Balkan Geological Association (CBGA), 7-11 September 2022, Plovdiv, Bulgaria. (Appendix 1., Fig.18.)
- Codrea V.A., Venczel M., Solomon A.Al.. New data related to the multituberculate mammals from Romania. Oltenia Museum Craiova, Department of Natural Sciences. The Scientific International Conference "Museum and Scientific Research", 15-17 September 2022, Craiova, Romania.
- Veress L., Codrea V.A.. Catalogue of the fossil sirenians in the collection fo the Museum of Paleontology - Stratigraphy of Babeș-Bolyai University. Muzeul Regiunii Porților de Fier. Simpozionul Internațional Drobeta, 21-23 Septembrie 2022, Drobeta Turnu Severin, Romania.

National conferences

- Girbau J.S., Bordeianu M., Codrea A.V., Solomon A. Al., Fărcaș C.. Eocene charophytes from Treznea: preliminary results. Paleoeological and bisotratigraphical implications. Complexul Muzeal Bistrița-Năsăud, Secția de Științele Naturii. Conferința națională de comunicări științifice, ediția XXVIII, 11 Noiembrie 2022, Bistrița, On-Line. (Appendix 1., Fig.20.)

Conferences for the public

- Codrea A.V., Bordeianu M.. Lumea după dinozauri: O istorie zbuciumată. Noaptea Cercetătorilor, 30 Septembrie 2022. Clădirea Casino din Parcul Central, Cluj-Napoca. (Appendix 1., Fig.21.)
- Codrea A.V.. Evenimente climatice paleogene din România: mărturii legate de vertebratele terestre. Societatea Geologică a României. Săptămâna Geologiei, 18 Octombrie 2022, Sala AES, Universitatea Babeș-Bolyai, Cluj-Napoca. (Appendix 1., Fig.22.)

Workshops

- Codrea A.V.. Situri paleontologice cretacic superioare și paleogene de referință din Transilvania: Prezent, perspective. Conferința Rezervații geologice din România. Evaluare, geoconservare, Interpretare. 24-25 Noiembrie 2022, București. (Appendix 1., Fig.23.)

2.2. Publications

Abstracts

- Codrea A.V., Venczel M., Solomon A. Al., Bordeianu M., Fărcaș C., Veress L., 2022. Paleogene terrestrial vertebrates of Transylvania – key for a better understanding of the ‘Grande Coupure’ Event. 100th Anniversary of the Carpathian-Balkan Geological Association, XXII International Congress of the Carpathian-Balkan Geological Association (CBGA), ABSTRACTS, p. 63., Plovdiv, Bulgaria.

- Girbau J.S., Bordeianu M., Codrea A.V., 2022. The charophyte flora (aquatic plants) from the Suceag Oligocene fossil site (western Transylvanian Basin, Romania). Biostratigraphy, palaeoecology and palaeobiogeography. 100th Anniversary of the Carpathian-Balkan Geological Association, XXII International Congress of the Carpathian-Balkan Geological Association (CBGA), ABSTRACTS, p. 65, Plovdiv, Bulgaria.
- Codrea A.V., Solomon A. Al., Bordeianu M., Fărcaș C., 2022. Eocene-Oligocene Perissodactyls of Romania, a short overview. 100th Anniversary of the Carpathian-Balkan Geological Association, XXII International Congress of the Carpathian-Balkan Geological Association (CBGA), ABSTRACTS, p. 64, Plovdiv, Bulgaria.
- Veress L., Codrea A.V., Bordeianu M., 2022. Mapping the Paleogene sirenians in Transylvania. 100th Anniversary of the Carpathian-Balkan Geological Association, XXII International Congress of the Carpathian-Balkan Geological Association (CBGA), ABSTRACTS, p. 71, Plovdiv, Bulgaria.
- Codrea V., 2022. Situri paleontologice cretacic superioare și paleogene de referință din Transilvania: Prezent, perspective. Rezervații geologice din România – Evaluare, Geoconservare, Interpretare. București, 17-20.

ISI publications

- Venczel M., Codrea A.V., Trif N., 2022. Eocene gavialoid teeth from Southern Transylvania with notes on the diversity of Paleogene crocodylians from Romania. North-Western Journal of Zoology, nwjz.22gz05. **Accepted for publication.**
- Girbau J.S., Bordeianu M., Codrea A.V., 2022. Charophyte flora from the rupelian Suceag fossil site (Transylvanian Basin, Romania). – in writing. Will be sent to publication by December (2022).

BDI publications

- Veress L., Bordeianu M., Codrea V.A., 2022. Some new data on the Eocene sirenians from Cluj-Napoca Someș-Dig (Transylvanian Basin, Romania). *Marisia. Natural Sciences New Series* 2(2022). **Accepted for publication.**
- Veress L., Codrea A.V., 2022. List of fossil sirenians housed in the Museum of Paleontology-Stratigraphy, Babeș-Bolyai University, Cluj Napoca. *Drobeta XXXI*. **Accepted for publication.**

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- Codrea V.A., Venczel M., 2020. The fossil record of Palaeogene crocodylians in Romania: preliminary data. *Nymphaea, Folia naturae Bihariae*, 46-47: 67-82.
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3. Summary for 2022

The achievements of the first phase have mostly met expectations, with no insurmountable obstacles. With the exception of one objective (Ob.3.), all the others have been successfully achieved, and will be completed in the following milestones. The specified objective was not achieved not for reasons related to the team and its work, but for reasons related on the one hand to the budget rectification, but also to the undesired delay in starting the project.

All the activities mentioned in the project for the first phase have been completed, and the results will be completed in the following period and even before then (in the form of publications).

The field trips have proved to be valuable, as the project team has managed to collect a large amount of fossil material in terms of quantity and diversity. The geological and palaeontological information collected in the field or acquired through bibliographical and sedimentological studies will be brought together in future phases, which will add to the existing knowledge. All the initiated analyses are going as expected, and will yield results as long as they are continued.

We have also managed to identify fossils in some museum collections, which are of particular interest for the project. On a few occasions, we have carried out field trips in parallel with the examination of museum collections, at intervals coinciding with symposiums/conferences. We were thus able to attend some sessions without incurring additional costs, thus saving some money in the project budget.

We were able to participate with 11 papers in international and one national congress/conference/symposium. Among the international ones was the largest Carpathian-Balkan Geological Congress held in Plovdiv (Bulgaria), where they were appreciated by the experts. We also participated in two events to popularise science, and a workshop on geoconservation.

Among the publications of the project we mention: 5 abstracts, of which 4 in English; 2 articles in BDI indexed journals, accepted for publication; 2 ISI indexed articles, of which one is accepted for publication, and the second will be submitted for publication by the end of December (2022).

Considering the above, it is worth mentioning that we will meet the criteria as soon as possible, if not exceed them.

Project director, Vlad A. CODREA

