

# AN EARLY EOCENE FRESHWATER TURTLE ASSEMBLAGE FROM THE ȘIMLEU BASIN (NW ROMANIA): PALEOBIOGEOGRAPHIC SIGNIFICANCE

Mátyás M. VREMIR\*

## Introduction

Early Paleogene continental turtles have rarely been reported from Romania. A few unidentified and poorly preserved shell elements of a medium-sized specimen are known from the upper section of the Jibou Formation (middle? Eocene) at Hodis in the Huedin basin<sup>1</sup> (UBBG-Cluj).<sup>2</sup> Other scattered fresh-water turtle fossils have also been mentioned from late Paleocene (latest Thanetian) lacustrine deposits at Rona in the Jibou region (Sălaj County).<sup>3</sup> These belong to a relic pleurodiran dortokid, subsequently described as a new genus and species: *Ronella botanica* Lapparent de Broin 2000.<sup>4</sup> Based on the peculiar morphology of the nuchal region and the preneural-neural configuration, an early Eocene (Ypresian) isolated carapace coming from calcareous carbonatic-shelf deposits at Albești Muscel-Arges was referred to the genus *Paleotrionyx* sp. (Trionychoidea, LPB FGGUB-Bucharest).<sup>5</sup>

Some scattered middle Eocene (Lutetian/Bartonian) fossils have been collected from palaeokarstic infills at Crivadia-Merișor (Hunedoara County) and have been referred to as Testudinoidea indet. (ISER-Bucharest). Middle Eocene trionychid remains, commonly attributed to the genus *Trionyx* (s.l.), have also been recorded from coastal marine deposits at Turnu Roșu in the Sibiu region (NHM-Wien), from the Megheș Valley in the Iara basin (UBBG-Cluj), and from Pietros Hill near Căpușu Mic in the Cluj region (UBBG-Cluj).

The upper Eocene and especially lower Oligocene, continental records are mostly referable to trionychids (*Trionyx* s. l.), although testudinoids („*Palaeochelys-Mauremys*” group) and possible chelydrids are also found at numerous sites, from a range of stratigraphic units across Transylvania, encompassing the early Priabonian-Egerian interval (EME-Cluj, MAFI-Budapest, UBBES-Cluj, UBBG-Cluj).<sup>6</sup>

Of the known Romanian Palaeogene continental turtle faunas, one of the earliest and most diverse assemblages is that from Giurtelecu Șimleului (Șimleu

\* Department of Natural Sciences, Transylvanian Museum Society (EME), Cluj-Napoca, Romania; e-mail: vremirmatyi@yahoo.co.uk

<sup>1</sup> Vremir 2004.

<sup>2</sup> Institutional acronyms referring to the collections in which the specimens are deposited.

<sup>3</sup> Koch 1894; Nopcsa 1905; Vremir, Codrea 1996.

<sup>4</sup> Lapparent de Broin 2000; Gheerbrant *et alii* 2003; Lapparent de Broin *et alii* 2004.

<sup>5</sup> Vremir 2004.

<sup>6</sup> Mlynarski 1966; Vremir 2004.

basin), identified from the upper siliciclastic-argillaceous member of the Jibou Formation (JF2). From a palaeontological point-of-view, this is the first Romanian record of podocnemidids (*Neochelys*) and carettochelyids (*Allaeochelys*), the earliest appearance of testudinoids („*Palaeochelys-Mauremys*” group), and the latest occurrence of the pleurodiran dortokids (cf. *Ronella*). Thus the main importance of this fauna stems from its stratigraphic and palaeobiogeographic significance.

Up until now, very little precise chronostratigraphic and paleontological information has been available regarding the pre-Priabonian Paleogene continental deposits of Transylvania. Similar lower and middle Eocene freshwater turtle assemblages are known from England, the Iberian Peninsula, France, Belgium, and Germany; Giurtelecu Şimleului is thus the easternmost such European record.

In its early stages, the study reported in this paper formed part of my PhD research at the UBBG (*Fossil Turtles of Romania*), interrupted abruptly in the summer of 2000 by the untimely death of my former supervisor, Prof. Dr. Mészáros Miklós.

**Institutional acronyms:** EME - Transylvanian Museum Society, Cluj-Napoca, Romania; LPB FGGUB - Bucharest University, Faculty of Geology and Geophysics, Bucharest, Romania; ISER - Speleological Institute, Bucharest, Romania; MAFI - Hungarian Geological Survey, Budapest, Hungary; NHM - Naturhistorisches Museum, Wien, Austria; UBBES - “Babeş-Bolyai” University, Faculty of Environmental Sciences, Cluj-Napoca, Romania; UBBG - Babeş-Bolyai University, Faculty of Biology and Geology, Cluj-Napoca, Romania.

**Occurrence and age:** Giurtelecu Şimleului - Şimleu basin (Zalău region, Sălaj County, NW Romania): one km west of the village, on the western and southern slopes of Coasta lui Damian cliff, on Viilor Hill (fig. 1); lower part of the Upper Member, Jibou Formation (JF2); Ypresian/basal Lutetian? (MP 8-12?).

Fossil specimens were recovered from four stratigraphic levels (a total of six sub-sites), covering the lower third of the exposed section (a simplified stratigraphic log of which is shown in fig. 2):<sup>7</sup>

- Site 1: red, bluish-spotted silty claystone (western slope; middle section);
- Site 2: red silty claystone (southern slope; middle section);
- Site 3: *ex-situ* (western slope; middle section);
- Site 4a: bluish/gray-redish microconglomerate (western slope; 7 m above site 1);
- Site 4b: red laminated silty claystone (western slope; 3 m above site 4a);
- Site 5: *ex-situ* (western slope; upper section).

**Sample size and description:** 24 exoskeletal elements (UBBG field number: GT1-24),<sup>8</sup> out of which a subset of 9 specimens is described here, belonging to four taxa: a medium-sized podocnemidid (*Neochelys* sp.); a medium-sized dortokid

<sup>7</sup> The basic stratigraphic log kindly provided by Emilian Săsăran (UBBG).

<sup>8</sup> Specimens collected by the UBBG Palaeotheriological Laboratory field team (V. Codrea, P. Dica, E. Săsăran, and M. Vremir) during August-November 1999 and by M. Vremir in May 2006.

(cf. *Ronella*); a small-sized early testudinoid (“*Palaeochelys* - *Mauremys*” group, aff. *Borkenia* sp.); and a medium-to-large sized carettochelyid trionychoid (*Allaeochelys* sp.).

Ordo: TESTUDINES (Batsch 1788)

Infraordo: PLEURODIRA (Cope 1864)

Familia: Podocnemididae (Cope 1868)

Subfamilia: *Erymnochelyinae* (de Broin 1988, sensu de Broin 1991)

(= Magnatribus: *Erymnochelyda*, Gaffney *et alii* 2011)<sup>9</sup>

Genus: *Neochelys* (Bergounioux 1954)

Type species: *Emys capellinii* (Zigno 1889): middle Eocene (MP 10-11), Purga di Bolca, Italy.

Distribution: Europe only, MP 7-20 (Portugal, Spain, Italy, Belgium, France, Germany).

### ***Neochelys* sp.**

Referred specimens - 19 exoskeletal elements (MNI=4).<sup>10</sup> GT1: Distal fragment of a costal plate; GT2: Peripheral plate; GT3: Incomplete second right costal plate; GT4: Peripheral fragment; GT5: Posterior peripheral plate; GT6: 3<sup>rd</sup> left peripheral plate; GT7: Fragmentary costal plate; GT8: 7<sup>th</sup> left costal plate; GT12: Hyoplastral fragment; GT 13: Xiphplastra fragment (sub-site 2); GT19: Unsituated hyo-hypoplastral fragment; GT20: Proximal fragment of 4<sup>th</sup> left costal plate; GT9–11 and 17: Unidentified exoskeletal fragments found associated in sub-site 1, most likely belonging to the same individual (see taphonomy section below); GT15: 10<sup>th</sup> left peripheral plate (sub-site 3); GT21: Incomplete right hypoplastron (sub-site 4b). GT23: Fragmentary left xiphplastra (sub-site 3).

GT21: Nearly complete right hypoplastron (fig 3A; pl. 1/1 a-c). Part of the medio-cranial side is missing, while the inguinal process and distal margin are fragmented. The shape of the element is quadrilateral because it is enlarged axially. The cranial edge has a sinuous outline marginally showing the small mesoplastral insertion which is apparently short, and relatively rounded and wide. The preserved medial suture, as well as the caudal suture are straight. The inguinal process is large and robust, oriented close to vertical. The external margin (behind the inguinal process) has a rounded lip, especially on the visceral side, showing the parallel insertion of the dermal scutes. The ventral side of the plate is relatively smooth, with a very fine and shallow ornamentation. The abdomino-femoral sulcus follows a sinuous line, starting from the caudal third of the axial side, oriented slightly anteriorly across the plate, and ending below the inguinal process. Dimensions: length = 68 mm; axial length = 34\* (~70) mm; width of the cranial margin = 70\* (~90 = restored) mm; width of the caudal margin = 63 mm;

<sup>9</sup> Gaffney *et alii* 2011.

<sup>10</sup> MNI = minimum number of individuals.

preserved width of the mesoplastron = 30 mm; distal thickness = 5 mm; axial thickness = 10 mm.

*Remarks* on GT21: This plate belongs to a medium-sized mature individual. The estimated size of the whole plastron is 25 x 22 cm, corresponding to a 30 x 25 cm sized carapace (allometric calculation based mainly on French specimens).<sup>11</sup> The most salient features of the specimen are: The presence of a relatively short, but rounded, mesoplastron (based on the hypoplastral suture); the large and robust inguinal process, the configuration of the abdomino-femoral sulcus, the shape and thickness of the plate, as well as its size and robustness. Morphological and biometric data indicate close similarity with the genus *Neochelys*; however, the short but wide mesoplastron of this specimen is often considered to represent a less evolved grade compared to the rounded-polygonal shape characteristic for the middle-upper Eocene species.<sup>12</sup>

GT15: The 10<sup>th</sup> left peripheral plate (**fig. 3E-F; pl. 1/2 a-d**) has a relatively wide quadrangular shape. The proximal sutural margin is not preserved, although only a very small part (few mm) are missing. The external edge is sharp, presenting a sinuous line, interrupted by the wide intermarginal sulcus. In cross-section the bone is lenticular, enlarged proximally. The dorsal side of the plate is slightly concave and smooth, but the ventral one is convex, suggesting a posteriorly recurved border of the shell. The sulci of the marginal scutes are well-preserved, wide and deep dorsally, less developed ventrally. The pleuro-marginal sulcus is straight, running parallel to the margin, but the intermarginal sulcus is slightly forward oriented.

*Dimensions:* length = 34 mm; cranial width = 28\* mm (~ 33); caudal width = 29\* mm (~ 34); proximal thickness = 12.5 mm.

*Remarks* on GT15: Based on the dimensions of the peripheral plate, the size of the carapace is approximated to be of maximum of 30 x 25 cm. The main distinctive features are the relatively large size; wide posterior peripheral, with elongated, sharp-lenticular profile; smooth surface; and relatively wide sulci. The size of this specimen, as well as its morphological features, suggest referral to the genus *Neochelys*, the most common taxon identified within the assemblage. The morphology of the marginally recurved peripheral suggests a relatively elevated carapace.

GT20: A 24 x 22 mm proximal fragment of the 4<sup>th</sup> left costal plate (**fig. 3C; pl. 2/3 a-b**) preserving the proximal sutural margin and parts of the cranial and caudal sides. This plate is rather thick (7 mm), showing an obvious profile curvature. The outlines of the 4<sup>th</sup> and 5<sup>th</sup> neurals are well-preserved, indicating slightly enlarged hexagonal neural plates.

GT3: The 2<sup>nd</sup> right costal plate (**fig. 3C; pl. 2/4 a-c**) is partially preserved (length = 62 mm). The distal parts of the cranial margin are missing, and the mold

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<sup>11</sup> Broin de 1977.

<sup>12</sup> Lapparent de Broin 2003.

of the neural file suggests more elongated anterior neural plates. “Y” shaped sulci open axially and present a wide angle, indicating quadrilateral vertebral scutes (roughly 50 x 60 mm at mid-section). The bone is quite robust (thickness of 6 to 8 mm) and shows moderate arching. The original length of the whole plate was approximately 90 mm.

GT8: Almost complete 7<sup>th</sup> left costal plate with a fragmented distal end (**fig. 3C; pl. 2/5**) and a pentagonal shape, enlarged distally (length = 50 mm; proximal width = 14 mm; distal width = 22 mm). The cranial, as well as caudal edges of this plate are curved backwards. The proximal margin shows two sides: The anterior one molds the last (7<sup>th</sup>) widened neural plate while the posterior one represents the axial intercostal suture. Wide angled “Y” shape sulci are opened proximally, positioned on the caudal half. The arching of the plate is less pronounced, although somewhat more marked in the proximal section.

*Discussion:* All fossil specimens found at sub-site 1 belong to the same individual. With the exception of a few costal and peripheral plates, one plastral and several other fragmentary or indeterminate exoskeletal remains were collected, most too incomplete to be of any further use in specimen determination. The allometrically estimated dimensions of the shell are 26 x 21 cm, suggesting a small-to-medium sized individual. Some of the characteristic features observed on this specimen are: Relatively elongated anterior, and wider medio-posterior neutrals; small and curved posterior costals; quadrilateral and slightly enlarged vertebral scutes; short anterior peripherals with small marginal scutes (overlapped by the pleurals to a large degree), and moderate carapacial doming. According to the available morphological and biometrical data, this specimen can be allocated to the genus *Neochelys*. Due to the lack of more complete and better preserved remains, the present fossil material does not allow for more specific identification.

This exclusively European genus is known from the Ypresian-early Priabonian interval (MP7-20) in the Franco-Belgian Basin, as well as from Germany, Italy, and the Iberian Peninsula. The earliest known European record is from the base of the MP7 zone in Belgium (Dormaal), France (Rains), and, most notably, Portugal (Silveirinha).<sup>13</sup> During the MP9-14 interval, this genus became both very abundant and more diversified. The dimensional range of the shell is quite variable during the Paleogene, with progressive size increases being possibly controlled mainly by climatic and environmental changes.<sup>14</sup> Small-to-medium sized specimens are characteristic for the early Eocene, while large sized species are known from the middle to late Eocene (up to cca. MP20), when the genus progressively went extinct (along a north-to-south gradient) following the Bartonian crisis.

Besides the type species (*N. capellinii* Zigno - MP10/11),<sup>15</sup> a few other species have been described from the MP7-12 interval, in particular from France

<sup>13</sup> Lapparent de Broin 2001; Lapparent de Broin 2003.

<sup>14</sup> Broin de 1977; Lapparent de Broin 2001; Lapparent de Broin 2003.

<sup>15</sup> Bergounioux 1954; Kotsakis 1978.

and Italy: *N. arenarum* (Broin de 1977) - MP7; *N. (Papoulemys) laurenti* (Tong 1998) - MP9; and *N. eocaenica* (De Stefano 1902)<sup>16</sup> - MP12. In addition, other species are known from Germany (*N. franzensi*, Schleich 1993) and Spain (*N. zamorensis*, Jiminez-Fuentes 1992).

The geographically closest early Eocene freshwater turtle locality to Giurtelecu Şimleului is Messel in Germany (MP11). From this site, the cheloniofaunal list<sup>17</sup> includes podocnemydids (*Neochelys franzensi*, Schleich 1993), carettochelyids (*Allaeochelys* sp.), trionychids ("*Trionyx*" *messelianus*, Reinach 1900) and geoemydids (*Francellia messeliana* (Staesche 1928), *Euroemys kehreri* (Staesche 1928) and *Juvemys* sp., out of which three families are also present at the Giurtelecu Şimleului locality. However, the Romanian record of the genus *Neochelys* is probably not the earliest one, despite the fact that several of its characters suggest a more basal morphotype.

Given that the origins and phylogenetic relationship of the genus *Neochelys* are linked to North Africa,<sup>18</sup> the main question that this fossil material raises is the timing of the diversification of the lineage. It remains unclear whether the bulk of this radiation took place in North Africa or in Europe;<sup>19</sup> this new Romanian discovery raises the possibility that other continental immigration routes may have also existed during this time interval besides southwestern Europe (S to N expansion in Iberia during MP7). Indeed, the Balkano-Anatolian and Zagros landmasses (**fig. 7**) may have presented a possible link to northern Africa (Egypt), from where some of the closely allied taxa, such as the stereogenyinins *Stereogenys libya*, *S. cromeri* and *Shweboemys antique* (marine or near-shore forms), and respectively *Dacquemys fajumensis*, etc.<sup>20</sup> are known.

Discovery of more complete fossil material from Transylvania will definitely help to answer some of these questions.

Familia: *Dortokidae* (Lapparent de Broin, Murelaga 1996)

Type genus and species: *Dortoka vasconica* Lapparent de Broin, Murelaga 1996: Late Campanian, Laño, Trevino County, Spain.

Distribution of family: late Barremian, Spain; Cenomanian, SW France; Santonian, Hungary; early Campanian, Austria; late Campanian-Maastrichtian, N Spain and S France; early Maastrichtian and latest Paleocene, Romania.

Genus: ?*Ronella* (Lapparent de Broin 2000)

Type species: *Ronella botanica* (Lapparent de Broin 2000): upper Paleocene-latest Thanetian (MP 5/6), Jibou-botanical garden, Sălaj County, Romania.

Distribution: Romania only, latest Thanetian (Jibou and Rona, Sălaj County).

<sup>16</sup> Kotsakis 1978.

<sup>17</sup> Marlo *et alii* 2004.

<sup>18</sup> Lapparent de Broin 2001.

<sup>19</sup> Lapparent de Broin 2003.

<sup>20</sup> Gaffney *et alii* 2011.

**cf. *Ronella* sp.**

*Referred specimen* - GT 24: small unsituated costal plate fragment with a well-preserved external decoration (site 5).

GT 24: A small unsituated costal bone fragment (**pl. 2/6**), exhibiting a particular and very characteristic dortokid-type decoration on the external surface, characterised by fine, closely spaced and parallel crests, and a wide and deep sulcus, identical to those seen on the paratype specimen of *Ronella botanica* (UBBG-Cluj). The specimen probably belongs to a medium-sized individual.

*Remarks* on GT24: The specimen from Giurtelecu Șimleului is comparable in size with the Late Cretaceous dortokids from SW Europe and Transylvania. Although the material is very poor, the (apomorphic) external decoration indicates the presence of a dortokid, most likely the genus *Ronella*, characterized by less well developed linear decoration on the costal plates than seen in the Cretaceous forms known from Spain,<sup>21</sup> southern France,<sup>22</sup> Hungary, Austria and Romania.<sup>23</sup>

*Discussion:* The presence of this taxon in the lower Eocene of northern Transylvania is not surprising, since the group is well-represented in the uppermost Paleocene of the Jibou region, an occurrence relatively close both stratigraphically and geographically to that from Giurtelecu Șimleului. The eastern European lineage of the dortokids,<sup>24</sup> definitely became extinct soon after the arrival of the more specialized freshwater turtle faunas of African and Asiatic origin, and very likely Giurtelecu Șimleului marks their latest occurrence, further supporting an early Eocene age for this locality.

The family Dortokidae represents a strictly European endemic group of pleurodires, characterised by a mixture of primitive and more derived morphological features.<sup>25</sup> Two genera are described: *Dortoka* (type species: *D. vasconica*, Lapparent de Broin, Murelaga 1996) from the Upper Cretaceous of Spain and France, respectively *Ronella* (type species: *R. botanica*, Lapparent de Broin 2000) from the uppermost Paleocene of Romania. The family also includes two particular, more primitive *Dortoka*-related forms from the upper Barremian of northern Spain<sup>26</sup> and the lower Cenomanian of southwestern France.<sup>27</sup> A new taxon ("*Muehlbachia nopsca*" - considered a *nomen nudum*)<sup>28</sup> was recently identified in the upper Cretaceous (Maastrichtian) of the Transylvanian and Hațeg basins in Romania.<sup>29</sup> This particular small-sized Late Cretaceous taxon shows morphological features indicating a combination of intermediate and more primitive characters

<sup>21</sup> Perez-Garcia *et alii* 2012.

<sup>22</sup> Lapparent de Broin *et alii* 2004.

<sup>23</sup> Vremir, Rabi 2011; Rabi *et alii* 2013.

<sup>24</sup> Ibid.

<sup>25</sup> Lapparent de Broin, Murelaga 1999; Lapparent de Broin *et alii* 2004; Vremir, Rabi 2011; Perez-Garcia *et alii* 2012; Rabi *et alii* 2013.

<sup>26</sup> Murelaga 1998.

<sup>27</sup> Vullo, Néraudeau 2008.

<sup>28</sup> Vremir, Rabi 2011; Rabi *et alii* 2013.

<sup>29</sup> Vremir 2004; Vremir, Codrea 2009; Vremir 2010; Vremir, Rabi 2011; Rabi *et alii* 2013.

between the Late Cretaceous *Dortoka* and in certain aspects, more advanced than in the late Palaeocene *Ronella*. Other poorly preserved dortokids were recently identified in the Santonian of Hungary and the lower Campanian of Austria,<sup>30</sup> and at least some of them show more derived shell characters than documented in late Campanian-Maastrichtian *Dortoka*, further suggesting the presence of at least two different lineages in the late Cretaceous.

One of the main autapomorphic characters of the family is represented by the strong medial ornamentation of tubercles, crests, ridges on neurals and costals (*Dortoka* and the Transylvanian taxon “*Muelbachia*”); these are less well developed on the costals of *Ronella*, in a manner similar to that recorded in specimen GT24.

Infraordo: CRYPTODIR<sub>A</sub> (Cope 1868)

Suprafamilia: Testudinoidea (Batsch 1788)

Familia: Geoemydidae (Theobald 1868)

Group: “*Palaeochelys* s.l. – *Mauremys*” (Hervet 2003).

This group of primitive testudinoids (originating from the Asiatic Lindholmemydidae),<sup>31</sup> was recently defined<sup>32</sup> as a phylogenetic entity, gathering a number of Paleogene and Neogene European freshwater testudinoids, including the polyphyletic ‘*Palaeochelys*’ (s. l.) genus and the *Mauremys* lineage. “*Palaeochelys*” is an artificial genus which comprises several newly defined Palaeogene (MP 7-MN 6?) taxa, differing from the *Palaeochelys* (s. s.) species (upper Oligocene-Miocene). Species of this group were previously referred to various genera, including *Palaeochelys* (s. s.), *Borkenia*, *Palaeoemys*, *Ocadia*, *Emys*, and *Clemmys*.<sup>33</sup> The early Eocene European radiation of Testudinoidea produced a number of species and genera which were insufficiently known and defined until recently.<sup>34</sup> Their stratigraphic distribution and phylogenetic relationships are widely discussed by several authors,<sup>35</sup> with divergent opinions in certain aspects.

Genus: ?*Borkenia* (Schleich 1994) = ?*Geiseltelmys* (Khosatski, Mlynarski 1966)

Type species: *Borkenia oschkinisi* Schleich, 1994: middle Eocene - Lutetian (MP11-13), Stolzenbach bei Borken, Hessen, Germany.

Distribution: Germany, MP11-14 (including Geiseltal oberkohle, Halle).

#### **aff. *Borkenia* sp.**

Referred specimens - Three exoskeletal elements (belonging probably to different individuals): GT 14: incomplete 4<sup>th</sup> right costal plate (sub-site 2); GT 18: fragmented hypoplastron (sub-site 5); GT 22: fragment of costal plate (sub-site 2).

<sup>30</sup> Ibid.

<sup>31</sup> Claude, Tong 2004.

<sup>32</sup> Hervet 2003a; Hervet 2004a.

<sup>33</sup> Hervet, Lapparent de Broin 2000; Lapparent de Broin 2001; Hervet 2003b.

<sup>34</sup> Broin de 1977; Lapparent de Broin 2001.

<sup>35</sup> Hervet, Lapparent de Broin 2000; Hervet 2003a; Hervet 2003b; Hervet 2004a; Hervet 2004b; Claude, Tong 2004.

In previous works these undescribed specimens were listed as “Testudinoidea indet.”<sup>36</sup> and “*Palaeochelys* sp. (s. l.)”, respectively.<sup>37</sup>

GT 14: The 4<sup>th</sup> right costal plate, with missing distal end, represents approximately two-thirds of the complete bone (**pl. 3/7 a-b**). It presents an elongated quadrilateral shape, distally slightly widened. On the dorsal surface, the “Y” shaped sulcus is well-developed, being opened at an axial angle on the middle section of the preserved fragment, suggesting the presence of rather widened vertebral scutes. A pronounced areolar sculpture (anulii), as well as a very fine vermicular decoration on the external surface, is present. The absence of any longitudinal carina can be noticed.

*Dimensions:* Length = 21 (30\*) mm; Proximal width = 11 mm; Distal width = 12 mm; Thickness = 3 mm.

*Remarks* on GT14: This specimen possibly belongs to a subadult individual with a shell size of 11 x 9 cm. The thickness of the bone, the degree of ossification, as well as the aspect of mature areolar sculpture, could also indicate a small sized species (a common feature in early Eocene testudinoids). However, the count of scute anulii is not a very accurate method for individual age estimate. Important features of the specimen are represented by the straight proximal edge suggesting relatively elongated quadrilateral, or posteriorly elongated hexagonal neurals and the relatively wide vertebral scutes (both primitive characters), meanwhile the curvature of the plate indicates a moderately arched, dorso-laterally not carinated carapace. Carinate or keeled shells are commonly found in the early representatives of the *Paleochelys-Mauremys* group, and in other primitive testudinoids, but in the former, these appear only at their early ontogenetic stage. A referral of this material to the genus *Borkenia* is based on its small size (as nearly mature individual), wide vertebral scutes, and the lack of the dorso-lateral carina/keel.

GT 18: Near complete left hypoplastron, presenting an incomplete external margin and only half of the caudal margin (**fig. 4; pl. 3/8 a-c**). It has a pentagonal shape, slightly enlarged distally. The axial suture, as well as the cranial edge, are straight. The caudal side is oblique, being oriented at 20° axially. The inguinal process is relatively strong (although partially broken), the preserved fragment showing a cylindrical shape, oriented backward. The external surface presents a very fine vermicular decoration, identical to that seen on GT 14. The sinuous abdomino-femoral sulcus is oriented parallel to the anterior margin, situated slightly anterior to the middle of the plate, and with the external termination slightly curved posteriorly.

*Dimensions:* Length = 25 (28\*) mm; Anterior width = 20 mm; Medial length = 22 mm; Posterior width = 21 mm; Thickness = 4 to 5.5 mm.

*Remarks* on GT18: The bone is well ossified (fontanelae closed, but sutures not firmly ossified), suggesting a small sized subadult individual. The approximate dimensions of the shell were 9 x 7 cm. The most important features of the

<sup>36</sup> Lapparent de Broin *et alii* 2004.

<sup>37</sup> Vremir 2004.

specimen include the lack of mesoplastron, the orientation of the hypo-xiphiplastral suture, the backward oriented, rather strong cylindrical inguinal process, as well as the configuration and anteriorly positioned abdomino-femoral sulcus. Because of the fragmentary state and isolated nature of the specimen, several other primitive features (the presence of the inguinal scute or relic inframarginals; large bridge in comparison with the plastral length, and femoral scute longer than the abdominal one), characterizing the early testudinoids, are not preserved in GT18. The tentative referral to the genus *Borkenia* is based on its relatively small size (even being a subadult), and the oblique-inward orientation of the the hypo-xiphiplastral suture.

*Discussion:* The early-middle Eocene representatives of the *Palaeochelys-Mauremys* group include morphologically primitive testudinoids (*Palaeoemys*, Schleich 1994; *Francellia*, Hervet 2004; *Juvemys*, Hervet 2003; *Owenemys*, Hervet 2004; *Euroemys*, Hervet 2004; and *Borkenia*, Schleich 1994) known from many western European localities, mainly from England, France, and Germany. The sudden taxonomic “inflation” is not necessarily surprising since a large number of new specimens from different localities have been described, and the majority of the older material was reviewed as a whole,<sup>38</sup> documenting a massive European radiation. On the other hand, divergent opinions have been raised,<sup>39</sup> especially regarding the affiliation of certain newly defined genera (*Francellia*, *Juvemys*, *Owenemys*, *Euroemys*). According to this later opinion, the early-middle Eocene genus *Palaeoemys* (type species *P. hessiaca*, Schleich 1994) includes, besides the genus *Ocadia* (p. p.), specimens referred to *Francellia* (*F. salonagmirei* = *Palaeoemys testudiniformis*; *F. messeliana* = *Palaeoemys hessiaca*), *Owenemys* (*O. testudiniformis* and *O. corroyi* = *Palaeoemys testudiniformis*), *Euroemys* (*E. kebreri* = *Palaeoemys hessiaca*), and *Juvemys* (*J. labarrerei* = *Palaeoemys testudiniformis*) as well. The synonymies are augmented by the nondiagnostic characters used for their definition, respectively the pronounced intrageneric and/or intraspecific variations observed on *Palaeoemys*. The above mentioned authors also include in this group the new ptychogasterid *Hummelemys ambigua*, Hervet 2004b, as a junior synonym of *Borkenia germanica*, Schleich 1994 (= *Geiselemys*, Khosatski, Mlynarski 1966),<sup>40</sup> the later taxon closely related to *Palaeoemys*. Thus, according to this opinion the early-middle Eocene “*Palaeochelys*” (s. l.) group is restricted to *Borkenia* = *Geiselemys* (including *Hummelemys* and *Ocadia* p.p. = “*O. germanica*”, Hummel 1935) and *Palaeoemys* (including *Ocadia* p.p., *Francellia*, *Owenemys*, *Juvemys* and *Euroemys*). The subgenus *Geiselemys* was defined<sup>41</sup> from the middle Eocene of Germany (Geiseltal coal mine, Halle), based on rather ambiguous and mostly variable plastral features. The available characters observed on the specimens GT 14 and GT 18, suggest a close relationship to the genus *Borkenia*, especially because its small-size, the presence of

<sup>38</sup> Hervet 2003a; Hervet 2004a.

<sup>39</sup> Claude, Tong 2004; Claude *et alii* 2012.

<sup>40</sup> Ibid.

<sup>41</sup> Khosatsky, Mlynarski 1966.

the strong inguinal buttress, the inward orientation of the hypo-xiphiplastral suture and the lack of lateral keels on the carapace.

Suprafamilia: Trionychoidea (Gray 1825)  
Familia: Carettochelyidae (Boulanger 1887)

Genus: *Allaeochelys* (Noulet 1867)

Type species: *Allaeochelys parayeri* (Noulet 1867): Bartonian (MP15), Castrais, France. Europe only, MP7 - 15 (England, Spain, France, Belgium, Germany).

***Allaeochelys* sp.**

*Referred specimen:* GT 16 - incomplete right hypoplastron (site 4a).

GT16: The medial fragment of the right hypoplastron (**fig. 5; pl. 3/9 a-c**) elongated in shape, represents one-third of the whole plate, having a very robust aspect. The complete axial and part of the cranial sutural margins are preserved. The internal (visceral) surface is smooth, but the external (ventral) one shows a peculiar decoration. This is composed by more or less regularly arranged, relatively large (4 to 8 mm), elongated vermicular or polygonal elements, presenting an apparent radial orientation, mainly into distal and caudal directions. The abdomino-femoral sulcus is absent. The plate is relatively thick, becoming thinner distally. The cranial and axial sutural margins (the caudal side is not preserved) on the mid-section of the profile show a continuous elevated crest or double articulation, which was indented in the neighbouring plates and suggests a limited kinesis, further characterizing this group.<sup>42</sup> The cranial margin (hyo-hypoplastral suture) has an oblique (20°) orientation backward. In the medial corner it shows a concavity which apparently represents the indentation of the medio-caudal point of the hypoplastron, also with a kinetic function.

*Dimensions:* Length = 83 mm; Maximum width = 43 mm; Axial length = 72 mm; Width of the cranial suture = 29 mm; Medio-cranial thickness = 12 mm.

*Remarks* on GT16: It is a quite robust plate, belonging to a large-sized specimen. The allometrically estimated dimensions of the plastron are 28 x 22 cm, corresponding to an approximately 40 x 35 cm carapace. The most important features supporting the carettochelyid affinities of the specimen include: the lack of abdomino-femoral sulcus (apomorphic); the typical carettochelyid decoration; the backward orientation of the cranial edge; the presence of the double kinetic articulation on the medial and cranial sutural margins. The relatively large size of the specimen is in accordance with the dimensions of the Eocene specimens described from western Europe.<sup>43</sup>

*Discussion:* The genus *Allaeochelys* has been known from the Ypresian - Bartonian interval from England, the Franco-Belgian Basin and Germany (MP7-

<sup>42</sup> Hutchinson *et alii* 2004.

<sup>43</sup> Broin de 1977.

15), respectively from southern France and Spain (MP8-15).<sup>44</sup> The youngest European occurrence of carettochelyids (possibly accounted for by a second colonization event) is from the upper Oligocene and middle Miocene of Germany.<sup>45</sup> This strictly aquatic form arrived to western Europe from Asia during the early Eocene (MP7/8), slightly later than the first testudinoids. They reached southern France and Spain during MP8/9, which indicates a north-to-south direction of the invasion,<sup>46</sup> possibly following a high latitude route during the Paleocene/Eocene Boundary climatic optimum. As their ecological requirements are more restrictive (large and interconnected water bodies), their migration was more restricted than those of the testudinoids and podocnemidids, further suggesting a north-eastern European invasion route (**fig. 7**). The specimen is too fragmentary to offer any possibility of comparison with other European and Middle Asiatic taxa; nonetheless, its geographic and stratigraphic occurrence is of outmost importance for future palaeobiogeographic interpretations.

## Disscussions and Conclusions

**Taphonomy and paleoecology:** Without exceptions, the specimens presented here were found disarticulated, some of them showing abrasion marks and syndepositional breaks. The well-preserved bony elements, some of them exhibiting very fine vermicular or linear decorations (GT 15 and 18), were collected *ex-situ* from the weathered surface, coming from a bluish-gray claystone unit, as isolated and less transported skeletal parts, most likely disarticulated in an aquatic environment (autochthonous status). In the siliciclastic microconglomerate level (site 4a), the carettochelyid plastral element (GT16) underwent a long hydrodynamical transport by saltation, being broken and buried in a coarse channel-lag deposit (para-autochthonous status).

The most complete picture is emerging from site 1 from where 15 exoskeletal elements, belonging to the same individual, were collected (**fig. 6**). Facial analysis of the hosting sediments, a dark red-bluish spotted silty claystone sequence containing carbonate nodules, rhysocretions, and bioturbations, suggests these can be interpreted as moderately-well drained floodplain deposits, undergoing subsequent pedogenic transformations.

Based on results of neotaphonomic experiments on the timing and nature of taphonomic processes affecting turtles in different environments (different subtropical aquatic and terrestrial settings),<sup>47</sup> it was concluded that the carcass could float up to 10 weeks before sinking, while the flesh gradually decays, and the skeleton rapidly disarticulates in aquatic environments. Under all experimental conditions, the axial and appendicular elements separated early in the process, followed by the carapace, and finally by the plastron. In terrestrial settings, insect larvae rapidly consumed the soft tissue, and within 3-4 weeks only the dessicated

<sup>44</sup> Bergounioux 1931; Broin de 1977; Broin de 1987; Santiago, Andres 2005.

<sup>45</sup> Karl *et alii* 2006; Joyce *et alii* 2004.

<sup>46</sup> Lapparent de Broin 2003.

<sup>47</sup> Brand *et alii* 2003.

appendages attached to the shell remained, until subsequently these were detached during the following 3 to 8 weeks. Disarticulation of the shell is longest in dry terrestrial environments. The process could take up to 2 years, starting with the peripherals and the separation of the plastron. The plastral disarticulation sequence starts posteriorly and progresses anteriorly, being more pronounced at ground contact. The weathering under terrestrial conditions is weak, and it could take one or even two years for some of the elements (particularly the plastral bones) to reach weathering stage (ws) 1, or eventually ws 2.<sup>48</sup> The outer surface of the shell could be protected by the epidermal scutes until disarticulation, which leads to a more evident weathering on the internal surface of the exoskeletal elements. As ws 2 progresses, cracking and/or flaking appears in a smaller scale when compared with large mammalian/reptilian bones. In aquatic environments, no weathering signs can be observed even after 3 years of exposure (ws 0).

The partial skeleton found in sub-site 1 (**fig. 6**), was exposed and weathered a relatively long period of time, being disarticulated and partially destroyed before burial. The degree of disturbance, as well as the lack of any endoskeletal elements, suggest a primary transport and decomposition in aquatic environment, followed by the disarticulation of the exoskeleton. The preserved skeletal components (mainly costals and plastral plates, a few peripherals), alongside the breakage pattern and the weathering stage of the bones (ws 2-3), suggest a final multiannual subaerial exposure without any, or at most slight, hydrodynamic reworking, the occurrence of the latter eventually supported by the lack of any neural plates (which, due to the presence of vertebral corpuses attached to the plate, present a higher grade of transportability).

Particularly the extant carettochelyines prefer clear, shallow and continuous flowing waters, with a sandy-gravel substrate and densely vegetated/forested riverbanks. In the late Maastrichtian and Palaeocene Transylvanian deposits the small and medium-sized dortokids are most frequently found in proximal overbank and lacustrine environments, whereas the small testudinoids are linked to aquatic-semiaquatic environments, preferring more standing water bodies with rich food resources. In contrast, the podocnemidids occur in various environments, ranging from marine-costal to lagoonal and riverine habitats.

At least for the studied stratigraphic section, we can conclude a rather stable environment of partially pedogenised, moderately-well drained floodplains, with occasional water-pools and minor channels, alongside with the proximity of a low to medium-energy meandering river, inhabited by various freshwater turtles. Up to date, no other invertebrate or vertebrate macrofossils were found in the Giurtelecu Șimleului outcrop.

**Palaeobiogeography:** The Giurtelecu Șimleului assemblage is dominated by the genus *Neochelys*, and is typical for the lower-middle Eocene of western Europe, which in most of the known localities from Iberia, southern France, the Franco-Belgian Basin and Germany also contain cryptodiran carettochelyds (*Allaeochelys*), trionychids (*Trionyx* s. l.) and early testudinoids (members of the *Palaeochelys*-

<sup>48</sup> Behrensmeyer 1978.

*Mauremys* group and ptychogasterids). The age of this new locality is slightly younger than the well-known Rona and Jibou localities (Sălaj County, NW Romania) of late Paleocene (Thanetian - MP5/6) age,<sup>49</sup> being separated (at least from paleocheloniological point of view) by a major early Eocene palaeobiogeographic event, marked by the first arrival and expansion of African and Asiatic immigrant taxa, closely linked to global sea-level changes and climatic warming.

The absence of the above mentioned immigrant taxa from the late Thanetian vertebrate assemblage identified within the lacustrine deposits of the Rona member (RL) from Jibou region,<sup>50</sup> which contain only one endemic dortokid species (*Ronella botanica*), could indicate the arrival and expansion of some north African (*Neochelys*) and Asiatic (*Alleochelys* and *aff. Borkenia*) immigrant species at the very beginning of the Eocene. On the other hand, the dortokids are already missing from other similar, early Eocene (or even Paleocene; MP7-8) European freshwater turtle assemblages (apparently since the end of the Late Cretaceous).<sup>51</sup> The first mention of *Palaeochelys* (s. l.) from the late Paleocene from Jibou area<sup>52</sup> relies on poorly preserved and fragmentary material. Later studies indicated that this material belongs to the subsequently erected Dortokidae, respectively to *Ronella botanica*, described on the basis of more complete specimens.

Because only freshwater immigrant species are concerned, the east- and southward expansion of the European emergent areas (through the Balkano-Anatolian and Zagros region), linked by rivers and/or wetlands can be considered as a possible migration route from North Africa as well as Asia (fig. 7). Since the Maastrichtian time, such periodic land-connections between southern Europe and the far East through the Zagros land-mas, was demonstrated on limnic ostracoda faunas.<sup>53</sup> Unfortunately, only very scarce or no information is available regarding the early Paleogene cheloniofauna of Bulgaria, and particularly those of Asiatic Turkey and the Middle East.

**Stratigraphy:** The siliciclastic continental Jibou Formation (JF) of late(?) Maastrichtian - middle Lutetian age, is exposed on the northwestern parts of Transylvanian Basin (Gilău, Meseș and Preluca areas), as well as in the Șimleu Basin, unconformably overlapping the Carpathian folded structures. From a faciesal point-of-view, this unit is characterised by dominantly red coloured alluvial to evaporitic deposits, particularly detrital sequences with alluvial fans and fan-deltas.<sup>54</sup> In certain areas, intercalations of lacustrine beds/units also occur, represented by the Rona Member, the Horlacea Limestone and the Agârbiciu Dolostone.

<sup>49</sup> Gheerbrant *et alii* 1999; Codrea *et alii* 2003.

<sup>50</sup> Ibid.; Lapparent de Broin, Murelaga 2003; Lapparent de Broin *et alii* 2004.

<sup>51</sup> Ibid.

<sup>52</sup> Vremir, Codrea 1996.

<sup>53</sup> Colin *et alii* 2012.

<sup>54</sup> Hosu 1999.

The thickness of the whole JF could reach 1300 m in north (Meseș area), being built up from three distinct informal members: the lower member (JF1-late(?)) Maastrichtian - late Palaeocene), up to 800 m thick; the middle member, represented by the lacustrine Rona Limestone (RL), about 200-250 m thick; and the upper siliciclastic member (JF2), 250-300 m in thickness.

Since the late XIX<sup>th</sup> century, several vertebrate fossils were identified in the lower section of the JF1, including a crocodylimorph tooth, a well-preserved dinosaur rib referred to “*Mochlodon*” = *Zalmoxes* (actually most likely belonging to an ankylosaurian dinosaur, based on the characteristic „T”-shaped cross section of the rib)<sup>55</sup> and unidentified turtles, all collected in the Someș Odorhei area.<sup>56</sup> Much later, other autochthonous dinosaur remains (associated vertebrae and scapula) were discovered in the Bârza Valley by field-geologist Paul Dica, and later identified as most likely belonging to the basal euornithopod *Zalmoxes shqiperorum*.<sup>57</sup>

In the Gilău and Huedin areas, the thickness of JF is restricted to 100 m, being dominated by lateritic palaeosol units (presumably Palaeocene-lower Eocene), with some local lacustrine interbeds in the upper section (Horlacea Limestone - Lutetian).

In the Iara Basin (south of Gilău area), the JF is better represented, with a thickness of over 200 m, representing the upper Maastrichtian-Lutetian interval. The sequence, well exposed in the Fizeșu Ierii quarry, is more detrital, being dominated by arenites and orthoconglomerates with thin red claystone-siltstone interbeddings, and show numerous disconformities. The only (probably late? Maastrichtian) vertebrate fossil identified so far from the Iara basin is a large femoral shaft of a titanosaur (cf. *Magyarosaurus*) collected from the base of the continental sequence,<sup>58</sup> until recently deposited in the UBBG paleontological collection, and which presently is lost.<sup>59</sup>

In the Preluca area, the JF occurs in the Glod anticline, with a composition reminiscent of that from the Gilău-Huedin area, however lacking any lacustrine intercalations.

In Șimleu basin, especially at Giurtelecu Șimleului locality, the JF has a thickness of cca. 80 m, being unconformably bounded by the metamorphic basement, respectively a transgrading Pliocene marine sequence (**fig. 2**). The only Maastrichtian vertebrate fossil identified so far in the Șimleu Basin is a well preserved ornithopod vertebra, most likely belonging to the genus *Zalmoxes* (as yet unpublished). In the central region of the Șimleu basin, the JF was encountered only through drillings, the total thickness being even less than in the northwestern part, up to 46 m in Șimleu Silvaniei.<sup>60</sup>

The age of this continental unit was disputed for a long time, being considered as representign the lower Eocene,<sup>61</sup> the middle Eocene,<sup>62</sup> or the Upper

<sup>55</sup> Specimen deposited in MAFI Ob 1954 (Budapest); reidentification made by M. Vremir (2000).

<sup>56</sup> Nopcsa 1905.

<sup>57</sup> Codrea, Godefroit 2008.

<sup>58</sup> M. Mészáros (UBBG Cluj) personal communication 1998; Codrea *et alii* 2010.

<sup>59</sup> Apparently sold to a private fossil dealer (P. Dica, personal communication 2008).

<sup>60</sup> Clichici 1973.

<sup>61</sup> Hofmann 1887.

Cretaceous-Paleocene.<sup>63</sup> Based on the calcareous nannoplankton assemblage, a Lutetian (NP 14) age was considered for the upper part of the Rona Member,<sup>64</sup> and a Paleocene-Ypresian-Lutetian age for the whole Rona Member.<sup>65</sup> Based on charophyte assemblages, the lower section of Rona Member was dated as latest Thanetian, while the upper section is doubtfully considered as Ypresian.<sup>66</sup> Even now, there are doubts regarding the precise age of certain units, although the autochthonous vertebrate assemblages with euornithopod and ankylosaur dinosaurs indicate the presence of the uppermost Cretaceous (upper? Maastrichtian) in the lower section of the JF1. A late Paleocene (Thanetian) age is given for the lower-middle section of the RL (at Jibou), and an early Eocene (Ypresian) age for the lower section of the JF2. The top of the JF2 is overlain by the lower evaporitic sequence of the Foidaş Formation within the Rakotzi Group (upper Lutetian).

In particular, the red continental deposits from the Crasna Valley, in the Giurtelecu Şimleului area, were considered to be of Pliocene,<sup>67</sup> Cretaceous-Paleocene,<sup>68</sup> or even Triassic<sup>69</sup> in age. The continental deposits from Coasta lui Damian Hill, as well as the Izvorului, Zmeilor and Mălădia valleys, were studied more recently,<sup>70</sup> and on the base of their calcareous nannoplankton and ostracod assemblages a middle Eocene (middle to late Lutetian) age was established for the middle and upper sections of the sequence. From a faciesal point of view, they were considered of lacustrine origin, with some oligohaline marine (or lagoonal) ingressions, particularly in the upper section of the profile, immediately below the Pliocene erosional unconformity. On the other hand, the presence of a well preserved ornithopod vertebra in the base of the JF in the Şimleu Silvaniei area, might indicate a larger temporal extent of the unit, similar to the situation recorded in the Jibou area.

In this respect, and according to the newest available information, the Giurtelecu Şimleului section must be regarded as synchronous with the lower section of the JF2 in the Meseş area, being slightly younger than the lacustrine Rona Member. On the basis of the present study, at least the lower-middle section of the profile is considered to represent the Ypresian, possibly up to the (?) lower Lutetian (MP 8-12?).

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<sup>62</sup> Koch 1894.

<sup>63</sup> Nopcsa 1905.

<sup>64</sup> Mészáros 1995.

<sup>65</sup> Rusu 1995.

<sup>66</sup> Codrea *et alii* 2003.

<sup>67</sup> Mátyásovski 1879.

<sup>68</sup> Mateescu 1927; Clichici 1973.

<sup>69</sup> Paucă 1964.

<sup>70</sup> Mészáros, Dioszegi 1988.

Odorhei and Șimleu Silvaniei areas; to Vlad Codrea (UBBG Cluj) for acces to some of the described specimens; to Zoltán Csiki-Sava (University of Bucharest) and Márton Rabi (University of Tübingen) for reviewing the manuscript; to Gareth Dyke (University of Southampton) for revising the English text; and to Călin Șuteu (University of Alba Iulia) for preparing some of the images and photographic plates.

## O asociație de țestoase fosile Eocen timpurie din Bazinul Șimleului (Nord-Vestul României): semnificația paleobiogeografică

(rezumat)

Un set restrâns de fosile de țestoase sunt descrise din depozitele continentale siliciclastice aparținând Formațiunii de Jibou (JF2) din apropierea localității Giurtelecu Șimleului (Bazinul Șimleului, județul Sălaj, România). Asociația este compusă din patru taxoni de apă dulce, inclusiv un podocnemidid pleurodiran de talie mică-medie (subfamilia Erymnochelyinae: *Neochelys* sp.), un pleurodiran bazal (familia Dertokidae: cf. *Ronella* sp.), un testudinoid timpuriu de talie mică (grupul „Palaeochelys-Mauremys”: aff. *Borkenia* sp.) și un trionychoïd de talie mare (familia Carettochelyidae: *Allaeochelys* sp.). Vîrstă Ypresian-Lutetian inferioară (MP8-12?) a sedimentelor, este în acord cu apariția și coexistența spațio-temporală a trei taxoni (podocnemidide, carettochelyide și testudinoide), în conformitate cu datele paleochelonilogice europene. O vîrstă Eocen timpurie este, de asemenea, indicată de talia mică spre medie (lungimea reconstituată a carapacei este de 20-30 cm) și gradul morfologic mai puțin evoluat al specimenelor de *Neochelys* identificate.

Pe lângă importanța stratigrafică a acestei descoperiri, este de notat semnificația paleobiogeografică. Reprezintă cea mai timpurie apariție de vîrstă Tertiäră în arealul central-est european al unor imigranți de apă dulce de origine Asiatică și Nord-Africană, cât și cea mai tîrzie semnalare a dertokidelor primitive, endemice Europei. Până în prezent, asociații similar de țestoase de apă dulce Eocen inferioare-mediile, conținând testudinoide timpurii, podocnemidide (*Neochelys*), carettochelyide (*Allaeochelys*) - în mod frecvent asociate cu trionychide (*Trionyx* s.l.), dar fără prezența dertokidelor -, au fost descrise doar din Vestul Europei.

### Explicația figurilor

- Fig. 1.** Harta geologică a zonei Șimleu Silvaniei-Giurtelecu Șimleului (Bazinul Șimleului; Nord-Vestul României); situl fosilifer este marcat cu „F” (după Clichici 1973 - modificat).
- Fig. 2.** Coloana stratigrafică simplificată în situl Coasta lui Damian (Giurtelecu Șimleului).
- Fig. 3.** *Neochelys* sp. din situl Coasta lui Damian: A - GT21, hypoplastron stâng; B - GT3, a două placă costală dreapta în vedere dorsală; C - poziționarea diferitelor plăci costale (GT3, GT8, GT20) pe conturul reconstituit al carapacei; D - GT12, fragment de hyoplastron drept; E, F - GT 15, a cezea placă periferală stângă în vedere dorsală (E) și caudală (F).
- Fig. 4.** aff. *Borkenia* sp. din situl Coasta lui Damian: GT18, hypoplastron stâng prezentând procesul inguinul și sutura abdomino-femorală suprapus conturului reconstituit al carapacei.
- Fig. 5.** *Allaeochelys* sp. din situl Coasta lui Damian: GT16, hypoplastron drept fragmentar în vedere ventrală (externă), cu reconstituirea punții articulare și lobului plastral posterior.
- Fig. 6.** Plan de săpătură prezentând asocierea elementelor exoscheletice de *Neochelys* sp. descoperite în situl Coasta lui Damian (sub-sit 1).
- Fig. 7.** Harta paleogeografică a provinciei mediteraneene, Europa și Nordul Africii, prezentând posibilele rute de migrație Eocen timpurie ale podocnemididelor (Po), testudinoidelor timpurii (Te) și carettochelyidelor (Ca). Bazinul Șimleu (România) este marcat cu un punct.
- Pl. 1.** 1 - *Neochelys* sp. GT21 - hypoplastron drept în vedere ventrală/externă (a), dorsală/internă (b) și caudală (c); 2 - *Neochelys* sp. GT15 – a 10-a placă periferală stângă în vedere ventrală (a), dorsală (b), anteroiară/cranială (c) și posterioară/caudală (d).

- Pl. 2.** 3 - *Neochelys* sp. GT20 - fragment proximal a celei de a patra plăci costale stângi în vedere dorsală (a) și ventrală (b); 4 - *Neochelys* sp. GT3 - a doua placă costală dreaptă incompletă în vedere dorsală (a), ventrală (b) și cranială (c); 5 - *Neochelys* sp. GT8 - a șaptea placă costală stângă în vedere dorsală (păstrată în argilă siltică roșieică cu pete cenușii-albastrui); 6 - cf. *Ronella* sp. GT24 - fragment de placă costală nesituată, în vedere dorsală, prezentând ornamentația lineară și linia adâncă de sutură a plăcilor cornoase.
- Pl. 3.** 7 - aff. *Borkenia* sp. GT14 - porțiunea medio-proximală a celei de a patra plăci costale drepte în vedere dorsală (a) și ventrală (b); 8 - aff. *Borkenia* sp. GT 18 - hypoplastron stâng în vedere ventrală/externă (a), dorsală/internă (b) și laterală (c); 9 - *Allochelys* sp. GT16 - hypoplastron drept fragmentar în vedere ventrală/externă (a), dorsală/internă (b) și axială (c).
- Pl. 4.** 10 - *Neochelys* sp. GT13 - fragment de xiphiplastron stâng juvenil în vedere ventrală/externă (a) și dorsală/internă (b, c), cu sutura pubiană bine individualizată; 11 - *Neochelys* sp. GT23 - fragment de xiphiplastron stâng adult în vedere ventrală/externă (a) și dorsală/internă (b).

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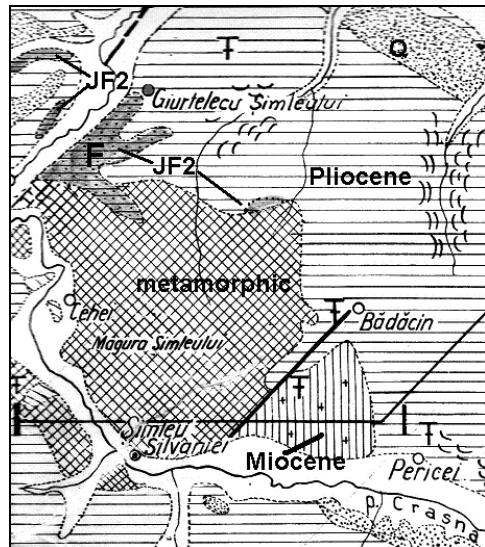
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An Early Eocene Freshwater Turtle Assemblage from the Șimleu Basin (NW Romania)

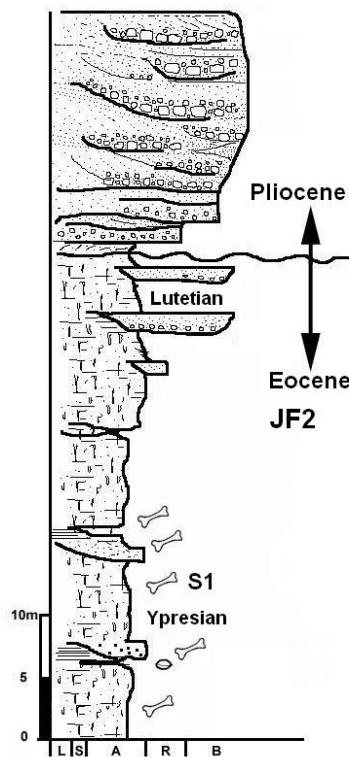
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**Keywords:** Vertebrate paleontology, Testudines, *Neochelys*, cf. *Ronella*, aff. *Borkenia*, *Allaeochelys*, Ypresian, Transylvania, Romania.

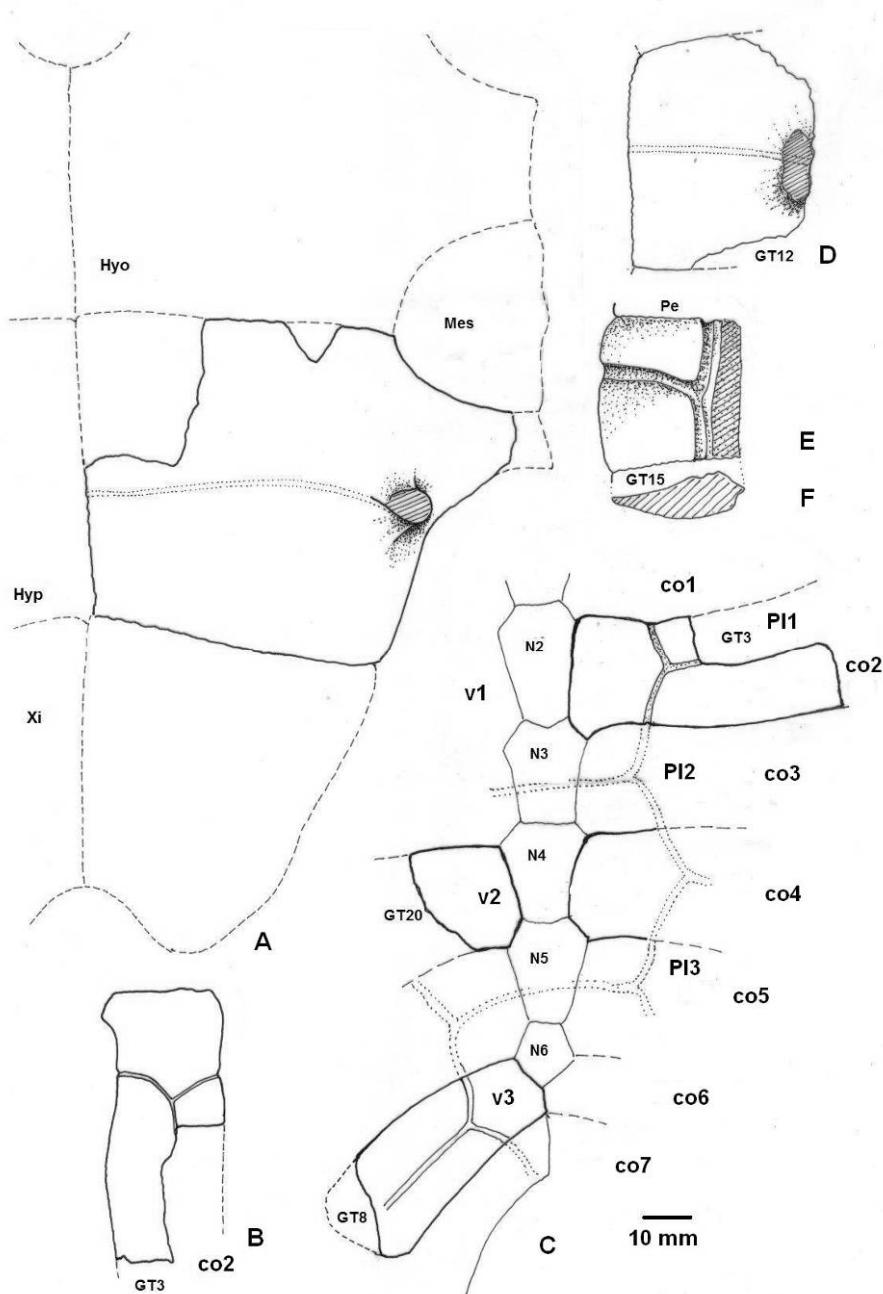
**Cuvinte-cheie:** paleontologia vertebratelor, Testudines, *Neochelys*, cf. *Ronella*, aff. *Borkenia*, *Allaeochelys*, Ypresian, Transilvania, România.



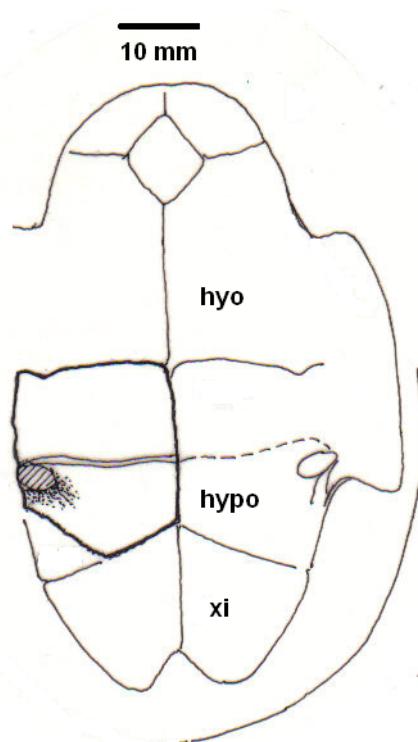
**Fig. 1.** Geological map of Șimleu Silvaniei-Giurtelecu Șimleului area (Simleu Basin; NW Romania); the fossiliferous site is marked with „F” (after Clichici 1973-modified)



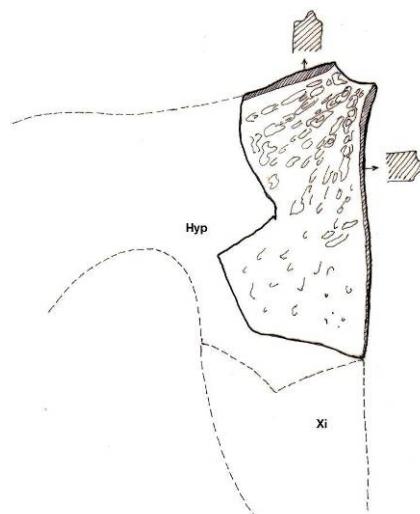
**Fig. 2.** Simplified stratigraphic log at Coasta lui Damian Hill (Giurtelecu Șimleului)



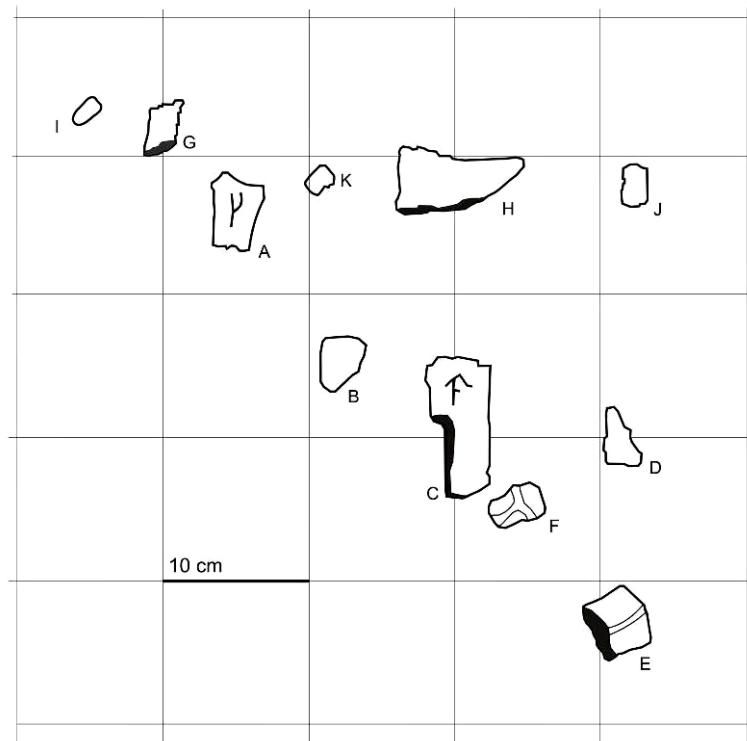
**Fig. 3.** *Neochelys* sp. from Coasta lui Damian Hill: A - GT21, left hypoplastron; B - GT3, the 2nd right costal plate in dorsal view; C - position of various costal plates (GT3, GT8, GT20) on the reconstructed contour of the carapace; D - GT12, fragment of the right hypoplastron; E, F - GT 15, the 10th left peripheral plate in dorsal (E) and caudal (F) view



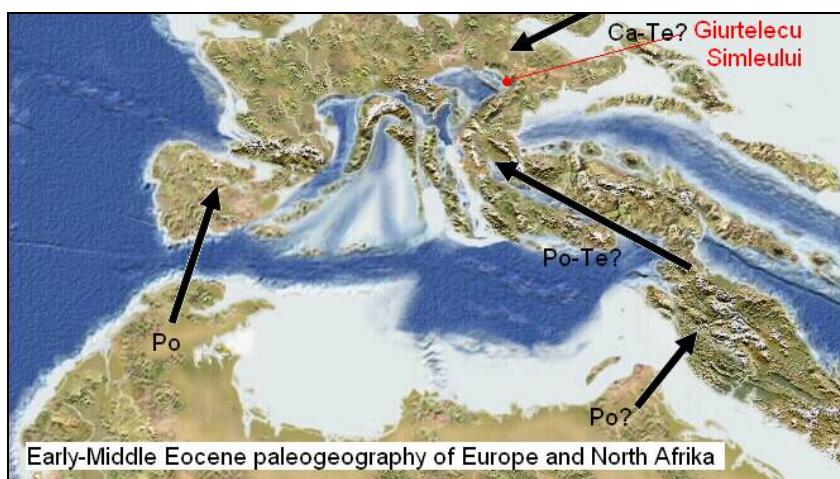
**Fig. 4.** *aff. Borkenia* sp. from Coasta lui Damian Hill: GT18, left hypoplastron depicting both the inguinal process and the abdomino-femoral sulcus, and the reconstructed contour of the shell



**Fig. 5.** *Allaeochelys* sp. from Coasta lui Damian Hill: GT16, fragmentary right hypoplastron in ventral (external) view, and the reconstructed contour of the bridge and posterior plastral lobe



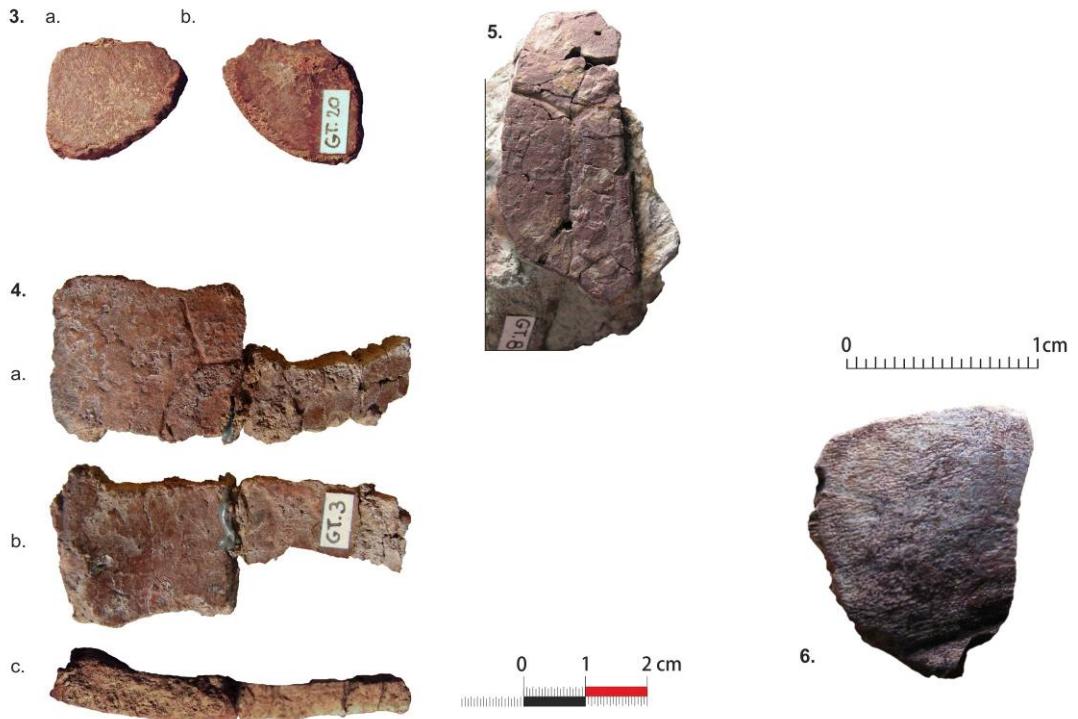
**Fig. 6.** Bone-map of the associated *Neochelys* sp. exoskeletal elements as found in Coasta lui Damian sub-site 1



**Fig. 7.** Palaeogeographic map of the Mediterranean region of North Africa and Europe, showing the possible early Eocene migration routes of Podocnemididae (Po), Testudinoidea (Te) and Carettochelyidae (Ca). The Șimleu Basin (NW Romania) is marked with a dot



**Pl. 1.** 1 - *Neochelys* sp. GT21 - right hypoplastron in ventral/external (a), dorsal/internal (b) and caudal (c) views; 2 - *Neochelys* sp. GT15 - 10<sup>th</sup> left peripheral plate in ventral (a), dorsal (b), anterior (c) and posterior (d) views



**Pl. 2.** 3 - *Neochelys* sp. GT20 - the proximal fragment of the 4<sup>th</sup> left costal plate in dorsal (a) and ventral (b) views; 4 - *Neochelys* sp. GT3 - incomplete second right costal plate in dorsal (a), ventral (b) and cranial (c) views; 5 - *Neochelys* sp. GT8- the 7<sup>th</sup> left costal plate in dorsal view (in red-bluish spotted silty claystone); 6 - cf. *Ronella* sp. GT24 - unsituated costal plate fragment in dorsal view, showing the linear decoration and deep sulcus



**Pl. 3.** 7 - aff. *Borkenia* sp. GT14 - the medio-proximal part of the 4<sup>th</sup> right costal plate in dorsal (a) and ventral (b) views; 8 - aff. *Borkenia* sp. GT 18 - the left hypoplastron in ventral/external (a), dorsal/internal (b) and lateral (c) views; 9 - *Allochelys* sp. GT16 - fragmentary right hypoplastron in ventral/external (a), dorsal/internal (b) and axial (c) views

10. a.



c.



b.



11. a.



b.



**Pl. 4.** 10 - *Neochelys* sp. GT13 - fragment of a juvenile left xiphiplastron in ventral/external (a) and dorsal/internal (b, c) views, with a well marked pubic scar; 11 - *Neochelys* sp. GT23 - fragment of an adult left xiphiplastron in ventral/external (a) and dorsal/internal (b) views

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- AAR-SI** - Analele Academiei Române. Memoriile Secțiunii Istorice. București (s. III, 1922-1947).
- Academica** - Academica. Academia Română. București.
- ACG** - Anuarul Comitetului Geologic. Institutul Geologic al României. București.
- ACMI** - Anuarul Comisiunii Monumentelor Istorice. București.
- ActaArchHung** - Acta Archaeologica. Academiae Scientiarum Hungaricae. Budapest.
- ActaBC** Acta Bacoviensia. Serviciul Județean Bacău al Arhivelor Naționale. Bacău.
- ActaMN** - Acta Musei Napocensis. Muzeul Național de Istorie a Transilvaniei. Cluj-Napoca.
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- Acta Siculica** - Acta Siculica. Analele Muzeului Național Secuiesc. Sfântu Gheorghe.
- ActaZC** - Acta Zoologica Cracoviensia. Institute of Systematics and Evolution of Animals. Kraków.
- ADIU** - АРХЕОЛОГІЯ І ДАВНЯ ИСТОРИЯ УКРАЇНИ. Kiev.
- AÉ** - Archaeologai Értesítő a Magyar régészeti, művészeti-történeti és éremtani társulat tudományos folyóirata. Budapest.
- AHR** - Asiatic Herpetological Research. Chengdu Institute of Biology. Chengdu.
- AIIA** - Anuarul Institutului de Istorie și Arheologie Cluj. Cluj-Napoca (din 1990 Anuarul Institutului de Istorie „George Bariț”).
- AIIAI/AIIX** - Anuarul Institutului de Istorie și Arheologie „A. D. Xenopol” Iași. Iași (din 1990 Anuarul Institutului de Istorie „A. D. Xenopol” Iași).
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- AIIN** - Anuarul Institutului de Istorie Națională. Cluj-Sibiu.
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| <b>Buridava</b>                | - Buridava. Studii și materiale. Muzeul Județean „Aurelian Sacerdoteanu” Vâlcea. Râmniciu Vâlcea                         |
| <b>BV</b>                      | - Bayerische Vorgeschichtblätter. München.   |
| <b>CA</b>                      | - Cercetări arheologice. Muzeul Național de Istorie a României. București.   |
| <b>CAANT</b>                   | - Cercetări arheologice în aria nord-tracă. București.   |
| <b>CAn</b>                     | - Current Anthropology. Chicago.   |
| <b>Carnets de Géologie</b>     | - Carnets de Géologie. Brest.  |
| <b>CCA</b>                     | - Cronica cercetărilor arheologice. București.   |
| <b>CCGG</b>                    | - Cahiers du Centre Gustave Glotz. Sorbonne (Paris).   |
| <b>CFS</b>                     | - Courier Forschungsinstitut Senckenberg. Senckenberg Forschungsinstitut und Naturmuseum. Frankfurt am Main.             |
| <b>Ciências da Terra (UNL)</b> | - Ciências da Terra (UNL). Earth Sciences Journal. Caparica.   |
| <b>ClausthalerGeo</b>          | - Clausthaler Geowissenschaften. Institut für Geologie und Paläontologie. Clausthal-Zellerfeld.                          |

Lista abrevierilor

- CMPUMichigan** - Contributions from the Museum Paleontology. The University of Michigan. Michigan.
- Codrul Cosminului** - Codrul Cosminului, Seria Nouă. Analele Științifice de Istorie, Universitatea „Ștefan cel Mare” Suceava. Suceava
- CommArchHung** - Communicationes Archaeologicae Hungariae, Magyar Népművészeti Múzeum. Budapest.
- Communications** - Communications. École Des Hautes Étude en Science Sociales – Centre D’Études Transdisciplinaires (Sociologie, Anthropologie, Politiques), Paris.
- Copeia** - Copeia. American Society of Ichthyologists and Herpetologists. New York.
- Corviniana** - Corviniana. Acta Musei Corvinensis. Hunedoara.
- CRAcadSciParis** - Comptes Rendus De L’Academie Des Sciences. Serie II, Fascicule A - sciences de la Terre et des Planètes. Paris.
- CretaceousRes** - Cretaceous Research. Published by Elsevier.
- Crisia** - Crisia. Culegere de materiale și studii. Muzeul Țării Crișurilor. Oradea.
- Cultura creștină** - Cultura creștină. Publicație apărută sub egida Mitropoliei Române Unite cu Roma Greco-Catolică și a Facultății de Teologie Greco-Catolică din Universitatea „Babeș-Bolyai” Cluj-Napoca, Departamentul Blaj. Blaj.
- Cumania** - Báks - kiskun Megyei Múzeumok Közleményei. Kecskemét.
- Dacia** - Dacia. Recherches et découvertes archéologiques en Roumanie. București, I, (1924) - XII (1948). Nouvelle série: Revue d’archéologie et d’histoire ancienne. București.
- Danubius** - Danubius. Muzeul de Istorie Galați. Galați.
- DMÉ** - A Debreceni déri Múzeum Évkönyve. Debrecen.
- Dolgozatok** - Dolgozatok az Erdély Nemzeti Múzeum Érem - és Régiségtárából. Kolosvár (Cluj).
- DolgSzeged** - Dolgozatok. A. M. Kir. Ferencz József Tudományegyetem Archaeologiai Intézetéből. Szeged.
- DP** - Documenta Praehistorica. Poročilo o raziskovanju paleolitika, neolitika in eneolitika v sloveniji. Ljubljana.
- Drobeta** - Drobeta. Muzeul Regiunii Portilor de Fier. Drobeta Turnu-Severin.
- Dumerilia** - Dumerilia. Association des amis du laboratoire des reptiles et amphibiens du Muséum = AALRAM. Paris.
- Eclogae** - Eclogae Geologicae Helvetiae. Swiss Journal of Geosciences. Swiss Geological Society. Zürich.
- EHR** - The English Historical Review. Oxford University Press (UK).
- Environment & Progress** - Environment & Progress. Universitatea „Babeș-Bolyai” Cluj-Napoca. Facultatea de Știință și Ingineria Mediului. Cluj-Napoca.
- EphNap** - Ephemeris Napoccensis. Institutul de Arheologie și Istoria Artei, Cluj-Napoca. Cluj-Napoca.
- ErdMúzÉvk** - Erdélyi Múzeum Egyesület Évkönyve. Kolosvár (Cluj).
- EstudiosAlava** - Estudios del Museo de Ciencias Naturales de Alava. Vitoria.
- Eurasia Antiqua** - Eurasia Antiqua. Zeitschrift für Archäologie Eurasiens. Mainz am Rhein.

Lista abrevierilor

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|----------------------------|--|
| <b>FbÖst</b>               | - Fundberichte aus Österreich. Wien.   |
| <b>FK</b>                  | - Földtani közlöny. Magyarhoni foldtani tarsulat folyóirata. Budapest.   |
| <b>FöldrKözl</b>           | - Földrajzi Közlemények. Budapest.   |
| <b>FoliaArch</b>           | - Folia Archaeologica. Magyar Történeti Múzeum. Budapest.  |
| <b>Gemina</b>              | - Gemina. Timișoara.   |
| <b>Geodiversitas</b>       | - Geodiversitas. Museum National d'Histoire Naturelle Paris. Paris.  |
| <b>Gerión</b>              | - Gerión. Revista de historia antigua, Universidad Complutense de Madrid. Madrid.  |
| <b>Germania</b>            | - Germania. Römisch-Germanischen Kommission des Deutschen Archäologischen Instituts. Frankfurt am Main.                              |
| <b>Godišnjak</b>           | - Godišnjak. Jahrbuch Knjiga. Sarajevo-Heidelberg.   |
| <b>HAC</b>                 | - Historiae Augustae Colloquia Nova Series. Bari.  |
| <b>Hantkeniana</b>         | - Hantkeniana. Periodical of the Department of Palaeontology, Eötvös University. Budapest.   |
| <b>Hermes</b>              | - Hermes. Zeitschrift für klassische Philologie. Stuttgart.  |
| <b>Hesperia</b>            | - Hesperia. Journal of American School of Classical Studies at Athens. Athens.   |
| <b>Hierasus</b>            | - Hierasus. Muzeul Județean Botoșani. Botoșani.  |
| <b>HJ</b>                  | - The Historical Journal. University of Cambridge (UK).  |
| <b>Hrisovul</b>            | - Hrisovul. Academia de Poliție „Alexandru Ioan Cuza”. Facultatea de Arhivistică. București.   |
| <b>HTRTÉ</b>               | - A Hunyadmegyei Történelmi és Régészeti Társulat Évkönyvei (1880-1913). Deva.   |
| <b>HU</b>                  | - Historia Urbana. Institutul de Cercetări Socio-Umane. Sibiu.   |
| <b>IA</b>                  | - International Affairs. Royal Institute of International Affairs. London.   |
| <b>Instrumentum</b>        | - Instrumentum (Bulletin du Groupe de travail europeen sur l'artisanat et les productions manufacturees dans l'Antiquite. Montagnac. |
| <b>Ioan Neculce</b>        | - Ioan Neculce. Buletinul Muzeului de Istorie a Moldovei. Iași.  |
| <b>Iranica Antiqua</b>     | - Iranica Antiqua. Leiden.   |
| <b>Iistros</b>             | - Iistros. Muzeul Brăilei. Brăila.   |
| <b>Îndrumător pastoral</b> | - Îndrumător pastoral. Episcopia Ortodoxă Română de Alba Iulia. Alba Iulia   |
| <b>JAMÉ</b>                | - A Nyíregyhzái Jósa András Múzeum Évkönyve. Nyíregyháza.  |
| <b>JAMT</b>                | - Journal of Archaeological Method and Theory. New York.   |
| <b>JCH</b>                 | - Journal of Contemporary History. University of Cambridge (UK), University of Wisconsin at Madison (USA).                           |
| <b>JMH</b>                 | - The Journal of Modern History. University of Chicago.  |
| <b>JMV</b>                 | - Jahresschrift für mitteldeutsche Vorgeschichte. Halle (Saale).   |
| <b>JRGZM</b>               | - Jahrbuch des Römisch-Germanischen Zentralmuseums zu Mainz. Mainz.  |
| <b>JRS</b>                 | - The Journal of Roman Studies. London.  |
| <b>JSP</b>                 | - Journal of Systematic Palaeontology. British Natural History Museum. London.   |

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- JTa** - Journal of Taphonomy. Paleontological Network Foundation.
- Klio** - Klio. Beiträge zur Alten Geschichte. Berlin.
- Korunk** - Korunk. Kolozsvár. Cluj-Napoca.
- KözlDebrecon** - Közlemények a Debreceni M. Kir. Tisza István-Tudományegyetem Régészeti Intézetéből. Debrecen.
- Latomus** - Latomus. Revue d'études latines. Bruxelles.
- MA** - Mitropolia Ardealului. Revista oficială a Arhiepiscopiei Sibiului, Arhiepiscopiei Vadului, Feleacului și Clujului, Episcopiei Alba Iuliei și Episcopiei Oradei. Sibiu (1956-1991). A continuat *Rerista Teologică*, (1907-1947) și este continuată de aceeași revistă.
- MAGW** - Mitteilungen der anthropologischen Gesellschaft in Wien. Wien (1912-1941).
- Marburger Studien** - Marburger Studien. Marburg.
- Marisia** - Marisia. Studii și Materiale. Târgu Mureș.
- Marmatia** - Marmatia. Baia Mare.
- Mas de las Matas** - Mas de las Matas. Grupo de Estudios Mastnos. Mas de las Matas.
- Materiale** - Materiale și cercetări arheologice. București.
- MBGAEU** - Mitteilungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte. Berlin.
- MedTrans** - Mediaevalia Transilvanica. Satu-Mare.
- MÉFRA** - Mélanges de l'École française de Rome. Antiquité. Roma.
- Mehedinți** - Mehedinți - Istorie și cultură. Drobeta Turnu Severin.
- MemAntiq** - Memoria Antiquitatis. Complexul Muzeal Județean Neamț. Piatra Neamț.
- MemMNHistNat** - Memoires du Museum National d'Histoire Naturelle - Serie C: Sciences de la Terre. Paris.
- MemPadova** - Memorie degli Istituti di Geologia e Mineralogia dell' Università di Padova. Padova.
- MES** - Middle Eastern Studies. The University of Texas at Austin.
- MFMÉ StudArch** - A Móra Ferenc Múzeum Évkönyve. Studia Archaeologica. Szeged.
- MIAK** - Materialy i issledovaniya po archeologii Kubani. Krasnodar.
- MittUngGeo** - Mitteilungen aus den Jahrbuch der Kön. Ungarische Geologischen Anstalt. Budapest.
- MKÉ** - Múzeumi és Könyvtári Értesítő. Budapest.
- MKFIE** - A Magyar Királyi Földtani Intézet Évkönyve. Mitteilungen aus dem Jahrbuch der Kgl. ungar. Geolog. Anstalt. Annales Instituti Regii Hungarici Geologici. Budapest.
- MN** - Muzeul Național de Istorie a României. București.
- MÖSTA** - Mitteilungen des Österreichischen Staatsarchivs. Österreichischen Staatsarchiv. Wien.
- Natl Geogr Res** - National Geographic Research Journal. Washington, D.C.
- NeuesJahrGP** - Neues Jahrbuch für Geologie und Paläontologie Monatschafte. Stuttgart.
- NTS** - The Nordic Textile Journal. University College of Borås. The Swedish School of Textiles.
- OJA** - Oxford Journal of Archaeology, Blackwell Publishing Inc.

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- ÓL** - Ősrégészeti Levelek. Prehistoric newsletter. Budapest.
- Oltenia** - Oltenia. Studii și comunicări. Arheologie – Istorie. Craiova.
- OpuscArchaeol** - Opuscula Archaeologica Radovi Arheološkog zavoda. Zagreb.
- Oryctos** - Oryctos. Musée des Dinosaures d'Espéraza.
- PA** - Patrimonium Apulense. Alba Iulia.
- PalaeoAfricana** - Palaeontologia Africana. Annals of the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand. Witwatersrand. Johannesburg.
- Paleobiology** - Paleobiology. The Paleontological Society. Gainsville.
- Palevol** - Palevol. Comptes Rendus de l'Académie des sciences. Issy-les-Moulineaux.
- Pallas** - Pallas. Revue d'études antiques. Université du Mirail. Toulouse.
- PamArch** - Památky archeologické. Praha.
- PAS** - Prähistorische Archäologie in Südosteuropa. Berlin.
- PBF** - Prähistorische Bronzefunde. München.
- Peuce** - Peuce. Studii și comunicări de istorie veche, arheologie și numismatică. Tulcea.
- PLoS ONE** - PLoS ONE. International, peer-reviewed, open-access, online publication.
- PNAS** - Proceedings of the National Academy of Sciences of the United States of America. Washington.
- Pontica** - Pontica. Muzeul de Istorie Națională și Arheologie Constanța. Constanța.
- PPP** - Palaeogeography, Palaeoclimatology, Palaeoecology ("Palaeo3"). An International Journal for the Geo-Sciences.
- PPS** - Proceedings of the Prehistoric Society. Cambridge-Londra.
- Programm Mühlbach** - Programm des evagelischen Untergymnasium in Mühlbach und der damit verbundenen Lehranstalten. Mühlbach (Sebeș).
- PZ** - Prähistorische Zeitschrift. Deutsche Gesellschaft fuer Anthropologie, Ethnologie und Urgeschichte, Institut für Prähistorische Archäologie. Berlin.
- RA** - Revista Arheologică. Institutul de Arheologie și Istorie Veche. Chișinău.
- Renașterea** - Renașterea. Cluj-Napoca.
- RÉV** - Revue des études latines. Paris.
- RevAquitania** - Revue Aquitania. Revue interrégionale d'archéologie. Aquitaine.
- RHSEE/RESEE** - Revue Historique du Sud-Est Européen. Academia Română. București și Paris (din 1963 Revue des Études Sud-Est Européennes).
- RI** - Revista de Istorie (din 1990 Revista istorică). București.
- RJTRG** - Romanian Journal of Tectonics and Regional Geology. București.
- RM** - Revista Muzeelor. București.
- RMGM** - Revista Muzeului de Geologie și Mineralogie. Cluj-Napoca.
- RMM** - Revista Muzeelor și Monumentelor. București.
- RMM-MIA** - Revista Muzeelor și Monumentelor. Monuments Istorice și de Artă. București.

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| <b>RRH</b>                    | - Revue Roumaine d'Histoire. Academia Română. Bucureşti.  |
| <b>RRL</b>                    | - Revue Roumaine de Linguistique. Academia Română - Institutul de Lingvistică „Iorgu Iordan - Al. Rosetti”. Bucureşti |
| <b>RT</b>                     | - Revista Teologică. Sibiu.   |
| <b>RVM</b>                    | - Rad Vojvodanskih muzeja. Novi Sad.  |
| <b>SAA</b>                    | - Studia Antiqua et Archaeologica. Iaşi.  |
| <b>SAHIR</b>                  | - Studia et Acta Historiae Iudaeorum Romaniae. Institutul de Istorie „A. D. Xenopol” Iaşi. Iaşi.                      |
| <b>SAI</b>                    | - Studii și articole de istorie. Bucureşti.   |
| <b>Sargetia Naturae</b>       | - Sargetia. Acta Musei Devensis. Series Scientia Naturae. Deva.   |
| <b>Sargetia</b>               | - Sargetia. Buletinul Muzeului judeţului Hunedoara (Acta Musei Devensis). Deva.                                       |
| <b>SASTUMA</b>                | - Saarbrücker Studien und Materialien zur Altertumskunde. Bonn.   |
| <b>SB</b>                     | - Studia Bibliologica. Bucureşti.   |
| <b>SBV</b>                    | - Studia bibliologica Valachica. Târgovişte.  |
| <b>SC (Ştiințele Naturii)</b> | - Studii și Cercetări (Ştiințele Naturii). Complexul Muzeal Bistrița-Năsăud. Bistrița.                                |
| <b>SCB</b>                    | - Studii și cercetări de bibliologie. Bucureşti (1955-1963).  |
| <b>SCIM</b>                   | - Studii și cercetări de istorie medie. Bucureşti.  |
| <b>SCIV(A)</b>                | - Studii și cercetări de istoria veche. Bucureşti (din 1974, Studii și cercetări de istorie veche și arheologie).     |
| <b>SCN</b>                    | - Studii și cercetări numismatice. Bucureşti.   |
| <b>SEER</b>                   | - The Slavonic and East European Review. University College London.   |
| <b>SlovArch</b>               | - Slovenská Archeológia. Nitra.   |
| <b>SMICont</b>                | - Studii și materiale de istorie contemporană. Institutul de Istorie „Nicolae Iorga” Bucureşti. Bucureşti.            |
| <b>SMIMod</b>                 | - Studii și materiale de istorie modernă. Institutul de Istorie „Nicolae Iorga” Bucureşti. Bucureşti.                 |
| <b>SMK</b>                    | - Somogyi Muzeumok Kozlemenyei. Somogyi Megyei Muzeumok. Kaposvar.  |
| <b>Starinar</b>               | - Starinar, Treća Serija. Arheološki Institut. Beograd.   |
| <b>StComSM</b>                | - Studii și comunicări. Muzeul județean Satu Mare. Satu Mare.   |
| <b>StudArch</b>               | - Studia Archaeologica. Budapest.   |
| <b>StudGeolSalmanticensis</b> | - Studia Geologica. Salmanticensia. Universidad de Salamanca. Departamento de Geología. Salamanca.                    |
| <b>StudiaTGCV</b>             | - Studia. Theologia Graeco-Catholica Varadiensis. Oradea.   |
| <b>StudiaUBBG</b>             | - Studia Universitatis „Babeş-Bolyai”. Series Geologia. Cluj-Napoca.  |
| <b>StudiaUBBH</b>             | - Studia Universitatis „Babeş-Bolyai”. Series Historia. Cluj-Napoca.  |
| <b>Študijné Zvesti AUSAV</b>  | - Študijné Zvesti. Archeologickeho Ustavu Slovenskei Akademie Vied. Nitra.  |
| <b>Suceava</b>                | - Anuarul Muzeului Județean. Suceava.   |
| <b>SympThrac</b>              | - Symposia Thracologica. Institutul Român de Tracologie.  |
| <b>Terra Sebus</b>            | - Terra Sebus. Acta Musei Sabesiensis. Sebeș.   |
| <b>Thraco-Dacica</b>          | - Thraco-Dacica. Institutul Român de Tracologie. Bucureşti.   |

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- Tibiscum** - Tibiscum. Studii și Comunicări de Istorie și Etnografie. Caransebeș.
- Tibiscus** - Tibiscus. Muzeul Banatului Timișoara. Timișoara (1971-1979).
- Tisicum** - Tisicum. A Jász-Nagykun-Szolnok megyei múzeumok évkönye. Szolnok.
- Transilvania** - Transilvania. Foaia Asociației Transilvane pentru Literatura Română și Cultura Poporului Român. Brașov.
- Tyragetia** - Tyragetia. Muzeul Național de Arheologie și Istorie a Moldovei. Chișinău.
- UPA** - Universitätsforschungen zur Prähistorischen Archäologie. Berlin.
- Vjesnik** - Arheološkog muzeja u Zagrebu. Vjesnik Arheološkog muzeja u Zagrebu. Zagreb.
- VZBGW** - Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien. Wien.
- WPZ** - Wiener Prahistorische Zeitschrift. Selbstverlag der Wiener Prahistorischen Gesellschaft. Wien.
- Zalai Múzeum** - Zalai Múzeum. Zalaegerszeg.
- ZfA** - Zeitschrift für Archäologie. Berlin.
- Ziridava** - Ziridava. Muzeul Județean Arad. Arad.