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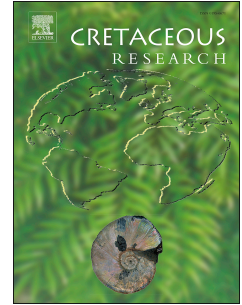


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1           **A new Mesozoic record of the pseudoscorpion family Garypinidae from Upper**  
2                           **Cretaceous (Santonian) Ajkaite amber, Ajka area, Hungary**

3 János Novák <sup>a\*</sup>, Mark S. Harvey <sup>b</sup>, Márton Szabó <sup>c,d</sup>, Jörg U. Hammel <sup>e</sup>, Danilo Harms <sup>f</sup>,

4 Ulrich Kotthoff <sup>g</sup>, Christoph Hörweg<sup>h</sup>, Manuel Brazidec<sup>i</sup>, Attila Ósi <sup>d</sup>

5  
6 <sup>a</sup> Eötvös Loránd University, Department of Systematic Zoology and Ecology, Pázámány Péter  
7 Sétány 1/C, Budapest 1117, Hungary.

8 <sup>b</sup> Collections & Research, Western Australian Museum, 49 Kew Street, Welshpool, Western  
9 Australia 6986, Australia; School of Biological Sciences, University of Western Australia,  
10 Crawley, Western Australia 6009, Australia.

11 <sup>c</sup> Hungarian Natural History Museum, Department of Paleontology and Geology, Ludovika tér  
12 2-6., Budapest 1083, Hungary

13 <sup>d</sup> ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of  
14 Palaeontology, Pázmány Péter sétány 1/C, Budapest 1117, Hungary.

15 <sup>e</sup> Helmholtz-Zentrum Hereon, Institute of Materials Physics, Max-Planck-Str. 1 Geesthacht,  
16 21502, Germany.

17 <sup>f</sup> Leibniz-Institute for the Analysis of Biodiversity Change (LIB), Martin-Luther-King-Platz 3  
18 Hamburg, 20146, Germany; Honorary Research Fellow: Harry Butler Centre, Murdoch  
19 University, Murdoch, Western Australia; Australian Museum Research Institute, Australian  
20 Museum, Sydney, Australia; SARChI Chair on Biodiversity Value and Change, Centre for  
21 Invasion Biology, University of Venda, Thohoyandou, South Africa.

22 <sup>g</sup> Leibniz-Institute for the Analysis of Biodiversity Change (LIB), Martin-Luther-King-Platz 3  
23 Hamburg, 20146, Germany; Institute for Geology, Universität Hamburg, Bundesstraße 55,  
24 20146 Hamburg, Germany.

25 <sup>h</sup> Natural History Museum Vienna, 3. Zoology (Invertebrates), Burgring 7, 1010 Vienna,  
26 Austria.

27 <sup>i</sup>University of Rennes, CNRS, Géosciences Rennes, UMR 6118, 35000 Rennes, France.

28

29 \* novakjanos01@gmail.com

30

31 **Abstract.** Pseudoscorpions have a sparse fossil record although they are among the oldest  
32 terrestrial lineages with origins extending to the Devonian (ca. 390 Ma). Amongst the 25 extant  
33 families of pseudoscorpions, only 14 are known from fossils, most of which are preserved in  
34 European ambers from the Eocene. Fossil pseudoscorpions from the Cretaceous of Europe have  
35 only been reported from three localities, Archingeay amber (France), from the Rhenish Massif  
36 (Germany), and from Álava and Teruel amber (Spain), but only one of these has ever been  
37 formally described. Here we add a new fossil pseudoscorpion genus and species, *Ajkagarypinus*  
38 *stephani* gen. et sp. nov., from an Upper Cretaceous (Santonian, ca. 86.3–83.6 Ma) amber  
39 deposit in the Ajka Coal Formation (Ajka area, Hungary), the so-called Ajkaite. This fossil  
40 extends the spatial range of the pseudoscorpion family Garypinidae and suggests that they  
41 might have been widespread in the whole Eurasian landmasses under humid, subtropical  
42 climatic conditions.

43

44 **Keywords:** Santonian, *Ajkagarypinus*, Pseudoscorpiones, amber inclusion, Late Cretaceous.

45

## 46 1. Introduction

47 Pseudoscorpions are small predatory arachnids, with more than 3900 species in 25 recent and  
48 one fossil families (World Pseudoscorpiones Catalog, 2023 – as WPC, 2023 in the followings).

49 The earliest known species, *Dracochela deprehendor* Schawaller et al. 1991, was found in the

50 Gilboa mudstones, New York, United States and is of Middle Devonian (ca. 390 Ma) age  
51 (Schawaller et al., 1991; Judson, 2012). The next oldest fossil species, *Archaeofeaella*  
52 *henderickxi* Kolesnikov et al. 2022, was recently described as a claystone fossil from the  
53 Ukraine, originating from the Late Triassic (Carnian – Norian) (Kolesnikov et al., 2022). These  
54 older records aside, fossil pseudoscorpions are comparatively rare, and due to their small size  
55 and relatively soft bodies, almost all of them are preserved as amber inclusions rather than  
56 compression fossils. Moreover, most of the fossil specimens are restricted to Cretaceous and  
57 Cenozoic ambers (Harms and Dunlop, 2017).

58 Even though each pseudoscorpion family most likely originated in the Palaeozoic or  
59 Mesozoic (Benavides et al., 2019), only eight pseudoscorpion families have been recorded from  
60 the Mesozoic, including Chthoniidae, Feaellidae, Pseudogarypidae, Ideoroncidae, Cheiridiidae,  
61 Garypinidae, Cheliferidae, and Chernetidae (Fig. 1; Harms and Dunlop, 2017; Geißler et al.,  
62 2022). The majority of Mesozoic pseudoscorpions have been reported from Burmese amber  
63 (Cenomanian, Cretaceous, ca. 99 Ma) (e.g., Harms and Dunlop, 2017; Harvey et al., 2018; Porta  
64 et al. 2020; Wriedt et al., 2021; Geißler et al., 2022). In contrast, only a handful of Mesozoic  
65 pseudoscorpions have been reported in Europe. *Heurtaulia rossiorum* Judson, 2009 was  
66 described from upper Albian Archingeay amber (ca. 100 Ma) from south-western France  
67 (Perrichot, 2004; Judson, 2009). Furthermore, a carbonised fossil chela of a pseudogarypid  
68 pseudoscorpion was found in the mid-Cretaceous infills of the Rhenish Massif (Judson, 2017),  
69 which basically consists of upper Devonian limestone and middle Cretaceous karst fillings  
70 (upper Albian – lower Cenomanian) (Viehofen et al., 2008). Two unidentified pseudoscorpions  
71 have also been reported from the Álava amber deposit from Spain (Albian, Cretaceous, ca. 100–  
72 113 Ma) by Delclòs et al. (2007) but not formally described. Sánchez-García et al. (2023)  
73 reported a third Spanish specimen consisting of an isolated pedipalp from Albian Teruel amber,  
74 identified as a Pseudogarypidae.

75           The pseudoscorpion family Garypinidae Daday, 1889 belongs to the superfamily  
76 Garypinoidea Daday, 1889, with Larcidae Chamberlin, 1930 as its sister group (Benavides et  
77 al., 2019), although two independent molecular studies failed to find evidence for a  
78 monophyletic Garypinidae (Murienne et al., 2008; Benavides et al., 2019). The family was  
79 originally created by Daday (1889) and subsequently regarded as a subfamily of Olpiidae  
80 Banks, 1895 (Chamberlin 1930), but returned to family level by Judson (1993, 2005).  
81 Garypinidae currently consists of 21 genera and 81 species (WPC, 2023). Modern  
82 representatives of the family are present in all continents with the exception of Antarctica. They  
83 reach their highest diversity in tropical and subtropical areas of the world occurring  
84 predominantly in leaf litter, under bark, and under stones (Beier, 1963). Phoresy, a passive  
85 method of dispersal, has been suggested for the fossil species *Garypinus electri* Beier, 1937  
86 (Judson 2005), found in Eocene Baltic amber (Beier 1937). The oldest formal fossil member of  
87 the family is *Amblyolpium burmiticum* (Cockerell, 1920) which was reported from Burmese  
88 amber (Cockerell, 1920). Lately, Sánchez-García et al. (2023) restudied the Álava material  
89 (Albian, Cretaceous, 100–113 Ma) and ascribed the two specimens to the family, pending  
90 description. A further specimen of the family was also reported from Oise (Le Quesnoy) amber  
91 (Ypresian, Eocene, 53 Ma), but lacks a species description (Nel et al. 1999; Judson 2009).

92           The Ajka amber (so-called *ajkaite*) is a recently re-discovered Upper Cretaceous  
93 (Santonian) amber from Hungary, found to be very rich in arthropod inclusions. In this  
94 assemblage, spiders, cockroaches, dipterans, hymenopterans and coleopterans have been  
95 described so far (Borkent, 1997; Szabó et al., 2022a,b,c,d), and further inclusions are still  
96 awaiting detailed study. The present paper describes the oldest currently known European  
97 representative of Garypinidae, discovered in ajkaite, together with its taxonomic and faunistic  
98 implications.

99

100

101 **2. Geological background**

102         Ajkaite, a type of often heavily oxidized amber containing organic inclusions, occurs in  
103 the layers of the Upper Cretaceous Ajka Coal Formation (Fig. 2A). The first outcrops of the  
104 formation were discovered in the Csinger Valley (Figs 2B; C), four kilometres southeast of the  
105 city of Ajka in the 1860's, where the earliest researchers noticed the fossil resin content of the  
106 coal-bearing layers (Hantken, 1878; Szabó, 1871) (Fig. 2A). The Ajka Coal Formation occurs  
107 in the Bakony Mountains (Transdanubian Range), deposited in three different sub-basins (Ajka,  
108 Magyarpolány-Devecser, and Gyepükaján) (see Császár and Góczán, 1988; Siegl-Farkas,  
109 1988).

110         Upper Triassic (or, more rarely, Jurassic or Lower Cretaceous) limestones form the  
111 geological base of the Ajka Coal Formation. Ajka coal is overlain by either the marine Jákó  
112 Marl Formation (Haas et al., 1992), or the Eocene shallow marine deposits of the Szőc  
113 Limestone Formation. The Ajka Coal Formation is built up by an alternation of coal or clayey  
114 coal beds, marls, sands and sandstone beds, as well as light grey to brownish carbonaceous to  
115 argillaceous pelitic rocks with interbedded molluscan lumachelles (Haas, 1983). The thickness  
116 of the formation sometimes reaches 100 metres. The depositional process of the formation  
117 resulted in at least seven main coal beds (from the oldest coal bed nr. 6 to the youngest coal bed  
118 nr. 0). The thickness of the coal beds ranges from 80 to 360 cm (Kozma, 1991). Based on  
119 palynological and nannoplankton investigations, the formation has been dated as Santonian,  
120 86–83 Ma (Bodor and Baranyi, 2012; Bodrogi et al., 1998; Ósi et al., 2016; Siegl-Farkas and  
121 Wagreich, 1996). Ajkaite is known to occur (in varying amounts) across all coal-bearing layers  
122 of the formation.

123

124

### 125 3. Material and methods

126 Coal mining in the Ajka area commenced in 1865 (Kozma, 1991) and ceased in 2004.  
127 Amber-bearing coal seams are no longer available, and ajkaites are no longer collectible. In the  
128 last years of the operation of the Ajka coal mines, coal wastes (e.g. Jókai coal refuse) were a  
129 popular destination for amateur fossil collectors. The pseudoscorpion described below is  
130 located in a piece of reddish ajkaite, provided by the amateur collector István Szabó, who found  
131 it most probably on the Jókai coal refuse on 27 March 1997. The specimen is now housed in  
132 the invertebrate paleontological collection of the Department of Paleontology and Geology of  
133 the Hungarian Natural History Museum (NHMUS; Budapest).

134 The amber stone was originally fused to a piece of the original embedding coal matrix  
135 (Fig. 3A), which was removed during the preparation of the inclusion-bearing part of the amber.  
136 The piece was then carefully cut into a near-cubic shape, the coal was removed, and polished  
137 using thin silicon carbid sanding papers on a grinder polisher (Buehler MetaServ 3000) in order  
138 to facilitate better observations of the specimen using light microscopes (Fig. 3B).

139 Line drawings were made with the use of Photoshop CS5 software. Photographs and  
140 measurements were taken partly by a Nikon SMZ25 stereomicroscope and a Nikon DS-Ri2  
141 camera unit, using Nikon NIS-Elements BR v.5.02.00 camera analysis software (all Nikon  
142 Instruments Inc., New York, NY, USA) at the Natural History Museum of Vienna, and partly  
143 with a Leica DMC4500 camera attached to a Leica M205C stereomicroscope (University of  
144 Rennes) (the origin of the images are marked in Figure 3A–F). Additionally, a Zeiss Axioskop  
145 2 was used for detailed examination (Eötvös Loránd University).

146 To achieve 3D details, the amber piece containing the pseudoscorpion was examined  
147 further at the Deutsches Elektronen Synchrotron (Hamburg, Germany) where it was studied  
148 using synchrotron radiation based micro-computed tomography (SR $\mu$ CT) (Figs 4A–F).  
149 Imaging was performed at the Imaging Beamline P05 (IBL) (Greving et al., 2014; Haibel et al.,

2010; Wilde et al., 2016) operated by the Helmholtz-Zentrum Hereon at the storage ring  
PETRA III (Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany). Imaging was  
done at a photon energy of 32.6 keV and a sample to detector distance of 80 mm. Projections  
were recorded using a custom developed 20 MP CMOS camera system (Lytaev et al., 2014)  
with an effective pixel size of 1.28  $\mu\text{m}$ . For each tomographic scan 2401 projections at equal  
intervals between 0 and  $\pi$  have been recorded. Tomographic reconstruction has been done by  
applying a transport of intensity phase retrieval approach and using the filtered back projection  
algorithm (FBP) implemented in a custom reconstruction pipeline (Moosmann et al., 2014)  
using Matlab (Math-Works) and the Astra Toolbox (van Aarle et al., 2015, 2016; Palenstijn et  
al., 2011). For the processing, raw projections were binned for further processing two times,  
resulting in an effective pixel size of the reconstructed volume of 2.56  $\mu\text{m}$ . Subfamily level  
classification follows Harvey's work (Harvey, in press).

162

163

#### 164 **4. Systematic paleontology**

165 Order: Pseudoscorpiones de Geer, 1778

166 Family: Garypinidae Daday, 1889

167 Subfamily: Garypininae Daday, 1889

168 Remarks: the new taxon can be clearly attributed to the family Garypinidae by the combination  
169 of the following characteristics: venom apparatus present in both chelal fingers; movable  
170 cheliceral finger with just 1–2 subapical teeth; *gs* subdistal on movable cheliceral finger;  
171 carapace sub-rectangular; pseudosternum absent; surface of pedipalps and carapace smooth;  
172 tergites divided; rallum with four blades; basal concentration of the trichobothria of the internal  
173 series on fixed chelal finger; legs I and II diplotarsate; arolia divided.

174

175 Genus *Ajkagarypinus* gen. nov.

176 urn:lsid:zoobank.org:act:031AF2D1-ADDC-4721-B62A-17AAAE948126

177 *Etymology.* The genus is named after the settlement of Ajka (Hungary), the locality of Ajkaite.

178 *Type species.* *Ajkagarypinus stephani* sp. nov.

179 *Diagnosis.* *Ajkagarypinus* gen. nov. differs from all other genera of the family Garypinidae by  
180 the setation of the cheliceral hand, in which *es* is duplicated, and the combination of the  
181 following characteristics: legs I and II with patella about same size as femur; cheliceral setae *ls*  
182 and *is* situated apart from each other; fixed chelal finger with 8, movable with 4 trichobothria;  
183 trichobothrium *est* situated approximately midway between *et* and *esb*; trichobothrium *st* dorsal  
184 to *b*; pedipalpal femur without trichobothria.

185 *Remarks.* There is one character that requires further discussion, which is the position of the  
186 trichobothria on the movable chelal finger. In most garypinids, they are situated in a straight  
187 line with *st* situated between *sb* and *t*, whereas in species of *Serianus*, *Protogarypinus* and  
188 *Teratolpium*, trichobothrium *st* is situated directly dorsal to *sb* (e.g. Beier, 1954, 1959; Hoff,  
189 1956, 1964; Mahnert 1988; Muchmore, 1968; Piedra-Jiménez, et al., 2019). It is difficult to  
190 ascertain the homology of the trichobothria in *Ajkagarypinus*, but it is not inconceivable that  
191 the dorsalmost trichobothrium is *st*, and its position dorsal to *b* represents a very unique  
192 morphological modification.

193

194 *Ajkagarypinus stephani* sp. nov.

195 urn:lsid:zoobank.org:act:C7FEB2F3-F3DB-4A6D-B8E4-74DF49CCDAC2

196 Figs 3–5.

197

198 *Etymology.* This species is named in honour of the amateur fossil collector István Szabó  
199 (Stephan is the Latin translation of the Hungarian name István), who provided the amber piece  
200 for study and donated it to the collection of the Hungarian Natural History Museum.

201 *Holotype.* NHMUS PAL 2022.91.1., adult, sex unknown.

202 *Locality and horizon.* Ajka Coal Formation (Santonian, Upper Cretaceous), unknown shaft of  
203 the Ajka coal mine; Ajka (Hungary).

204 *Diagnosis.* See the diagnosis of the genus.

205 *Description.* Colour: body and pedipalps reddish brown; carapace slightly darker than the  
206 pedipalps; legs lighter yellowish brown; opisthosoma partly missing (Figs 3C, D, E, F).

207 Carapace (Figs 3F, 4A, 5A). Conical and 1.55× longer than wide, reaching its maximal width  
208 at the base. Two pairs of corneate eyes present near the anterior margin. Vestitural setae  
209 acuminate. Lyrifissures of carapace not visible. Surface smooth.

210 Chelicera (Fig. 5B). Hand with 6 acuminate setae, two of which situated at the externolateral  
211 side of the hand: *es* duplicated; *ls* and *is* situated apart from each other; movable finger with 1  
212 acuminate subdistal seta. Rallum with four blades. Serrula exterior: ca. 15 blades; lamina  
213 exterior not visible. Galea long and simple, probably broken on left chelicera.

214 Coxal region and genitalia not visible due to a crack on the surface of the amber piece.

215 Pedipalps (Fig. 5C). Robust. Vestitural setae acuminate, surface smooth. Femur broadening  
216 gradually from the pedicel, widest at its middle part. Femur 2.95, patella 1.53, chela (with  
217 pedicel) 3.09, hand 1.58 × longer than broad, movable finger 0.79 times longer than hand  
218 (without pedicel). Chelal fingers slightly shorter than the hand (without pedicel) (Fig. 5D).

219 Fixed chelal finger with 8, movable with 4 trichobothria. Trichobothria *eb* and *esb* grouped  
220 basally; *est* medially, halfway between *et* and *esb*; *et* subterminally; *ib*, *isb*, *ist*, and *it* grouped  
221 near the base of finger; trichobothria *b*, *sb*, and *st* forming a group near to base; *t* distad to them,  
222 approximately halfway between *sb* and the finger's tip. Venom glands and venom ducts present

223 in both fingers, exact length of venom ducts not determinable due to the preservation of the  
224 fossil. Chelal teeth small, triangular, slightly retrose, and closely spaced; equal in form and size  
225 although the exact number cannot be determined due to bubbles partly covering them.  
226 Accessory teeth absent.

227 Legs. Junction between femora and patellae I and II oblique. Leg I and II diplotarsate; arolia  
228 long and divided; claws not visible; vestitural setae acuminate. Left legs III, IV, and right IV  
229 missing, but right leg III visible only on synchrotron model.

230 Abdomen: tergites divided. First three not clearly visible, remaining ones missing.

231 Measurements (in mm). Body length (without the missing abdominal segments) 0.682.  
232 Carapace  $0.39 \times 0.31$ . Chelicerae  $0.13 \times 0.07$ ; movable finger length 0.08. Pedipalp: femur  $0.39$   
233  $\times 0.13$ ; patella:  $0.27 \times 0.18$ ; chela  $0.57 \times 0.19$ ; hand length (without pedicel) 0.29; movable  
234 finger length 0.23.

235 *Remarks.* The specimen preserved muscle filaments as imprints in the pedipalps that are clearly  
236 visible in both trochanters, femora, patellae and chelae (Figs 3E-F). Muscle imprints are not  
237 rare in amber (e.g., Henwood, 1992; van de Kamp et al., 2014; Li et al., 2021) but this is the  
238 first time that such an exceptional preservation is recorded in Ajkaite.

239

240

## 241 **5. Discussion**

242 Pseudoscorpion fossils are very rare in the Carpathian Basin. Sziráki and Dulai (2002)  
243 reported a poorly preserved compression fossil pseudoscorpion specimen from the upper  
244 Miocene (Sarmatian) of the Tokaj Mts. (Hungary). *Ajkagarypinus stephani* gen. et sp. nov.  
245 represents the second fossil pseudoscorpion from the Carpathian Basin, further highlighting the  
246 importance of the present discovery (not counting that Mesozoic pseudoscorpions are overall  
247 rare in the European fossil record, see above).

248           The new garypinid fossil from the Santonian of Hungary is the second described species  
249 of this family from the Mesozoic following *Amblyolpium burmiticum* (Cockerell, 1920) and the  
250 third described Mesozoic pseudoscorpion species from Europe following *Heurtaulia*  
251 *rossiorum* Judson, 2009 and *Archaeofeabella henderickxi* Kolesnikov, Turbanov, Eskov,  
252 Propistsova et Bashkuev, 2022. It is also one of the oldest fossil pseudoscorpions in amber.

253

#### 254 *Palaeoecology*

255           The discovery of *Ajkagarypinus stephani* gen. et sp. nov. is an interesting addition to  
256 our knowledge on the Ajkaite paleofauna, and also the Ajka coal paleobiota. The depositional  
257 area of the Ajka Coal likely reflects an arboreous-swampy and lacustrine environment. The  
258 climate has been estimated to be a tropical monsoon climate with presumably seasonal, high  
259 precipitation (2000–2500 mm per year) (L. Rákosi, pers. comm.; Siegl-Farkas, 1988). This  
260 conforms with the ecological needs of the closest living relatives of the fossil plant forms  
261 documented from the Ajka Coal, so the palaeoclimate must have been tropical to subtropical  
262 (Bodor et al., 2012). Based on palynological and palaeocarpological studies, Normapolles-  
263 related forests are suggested with a fern-dominated understorey (Bodor and Baranyi, 2012).

264           The arthropod fauna studied in detail so far conforms with this environment. Among the  
265 spider fossils, a hersiliid spider, *Hungarosilia verdesi* Szabó et al., 2022a, has been described  
266 (Szabó et al., 2022a). Modern members of this family generally live in warm, tropical,  
267 subtropical climates where many of these are associated with tree bark habitats. The  
268 ceratopogonid dipterans *Adelohelea magyarica* Borkent, 1997 and *Leptoconops clava* Borkent,  
269 1997, the hymenopterans *Ajkanesia harmincipsiloni* Szabó et al., 2022b, *Amissodigitus belai*  
270 Szabó et al., 2022b and *Spathiopteryx soosi* Szabó et al., 2022b, the click-beetle *Ajkaelater*  
271 *merkli* Szabó et al. 2022c and the cockroach *Alienopterix santonicus* Szabó et al. 2022d also fit  
272 well into the climatic conditions mentioned above (Borkent, 1997; Szabó et al., 2022b, c, d).

273 The occurrence of a garypinid pseudoscorpion further enriches this diverse arthropod world and  
274 help to reconstruct the former environment more accurately. Extant representatives of the  
275 family Garypinidae have been found in diverse habitats, such as in rainforests (Harvey, 1988;  
276 Dashdamirov, 2008), temperate forests (Hoff, 1961; Benedict and Malcolm, 1978; Harvey and  
277 Štáhlavský, 2010; Piedra-Jiménez et al. 2019), woodlands (Gardini and Gavalas, 2021; Hoff,  
278 1959), semi-arid deserts (Chamberlin, 1923; Heurtault, 1970; Nassirkhani and Doustaresharaf,  
279 2019) and sea-shore habitats (Lee, 1979; Mahnert 2014). Habitat types include moist leaf litter,  
280 tree bark and rocks. In the light of occurrences in rainforests and other mesic habitats, the  
281 occurrence of Garypinidae fits well into the ecosystem of the Ajka Coal paleohabitat.

282 Phoresy as a means of passive dispersal might occur in the Garypinidae and was  
283 suggested for *Garypinus electri*, an Eocene fossil member of the family Garypinidae (Judson,  
284 2005) from Baltic amber. Phoresy would be an ideal form of dispersal in a system of islands,  
285 just like the western Tethyan archipelago had been during the Late Cretaceous (Csiki-Sava et  
286 al. 2015). *Ajkagarypinus stephani* might have been living under or near tree bark, using phoresy  
287 on insects as a means of passive dispersal similar to many modern pseudoscorpions. That said,  
288 the Garypinidae are ecologically diverse and also occur in leaf litter habitats whereas their  
289 morphology seems quite conserved both over time and between recent genera. The suggestion  
290 of phoresy is therefore hypothetical and can only be tested if additional specimens become  
291 available.

292

## 293 **6. Conclusions**

294 A new fossil pseudoscorpion genus and species, *Ajkagarypinus stephani* gen. et sp. nov., is  
295 described from an Upper Cretaceous (Santonian, ca. 86.3–83.6 Ma) amber deposit in the Ajka  
296 Coal Formation (Ajka area, Hungary), the so-called Ajkaite. *Ajkagarypinus stephani* gen. et sp.  
297 nov., is the third described Mesozoic pseudoscorpion species from Europe following

298 *Heurtaulia rossiorum* Judson, 2009 and *Archaeofeaella henderickxi* Kolesnikov, Turbanov,  
299 Eskov, Propistsova et Bashkuev, 2022. This fossil extends the spatial range of the family  
300 Garypinidae and suggests that they might have been widespread in the whole Eurasian  
301 landmasses under humid, subtropical climatic conditions.

302

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318

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550 Figure 1. The phylogenetic tree of pseudoscorpions according to Benavides et al. (2019) with  
551 known fossils added according to Harms and Dunlop (2017), to Schwarze et al.  
552 (2021), and to Geißler et al. (2022). The record of *Ajkagarypinus* is indicated by a red  
553 star. Vertical colour bands reflect the fossiliferous localities containing fossil Pseudoscorpions, blue  
554 (sedimentary): Devonian Gilboa mudstones, Triassic Ukrainian claystone; yellow (amber):  
555 Cretaceous Myanmar amber, Eocene succinite (Bitterfeld, Baltic amber), Miocene Mexican and  
556 Dominican Republic amber. (COLOURED PICTURE)

557 Figure 2. A: Locality map of Ajka. B: Location of Ajka-Csinger valley and the Ajka Coal area.  
558 C: Simplified geological section of the Ajka Subbasin (modified after Szabó et al., 2022c)  
559 (COLOURED PICTURE)

560 Figure 3. *Ajkagarypinus stephani* gen. et sp. nov. holotype (NHMUS PAL 2022.91.1) images.  
561 A: the Ajkaite piece before polishing (Leica DMC4500; scale bar: 20mm); B: the Ajkaite  
562 piece with the holotype in itself, after polishing, positioned by a plasticine piece (Nikon  
563 SMZ25; scale bar: 1mm); C: the holotype from lateral view (Nikon SMZ25; scale bar:  
564 0.5mm); D: holotype, dorsal view (Leica DMC4500; scale bar: 0.5mm); E: dorsal view  
565 (Leica DMC4500; scale bar: 0.25mm); F: dorsal view (Leica DMC4500; scale bar: 0.1mm).  
566 (COLOURED PICTURE)

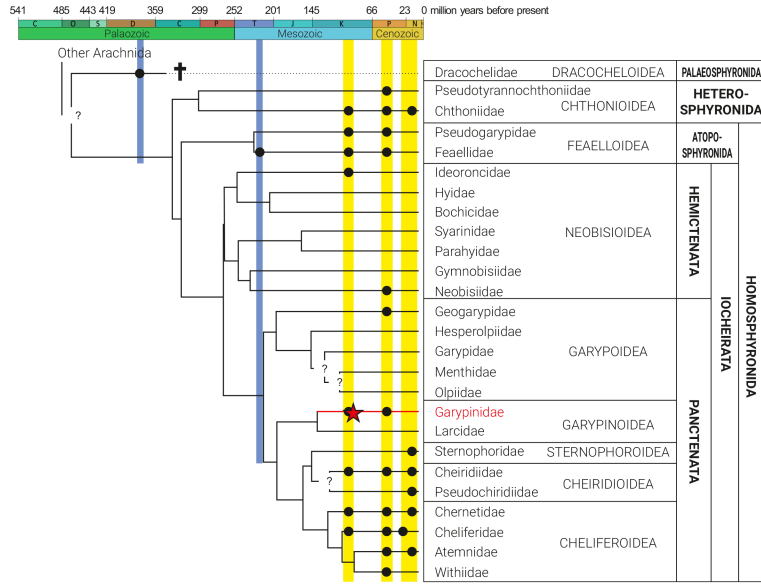
567 Figure 4. *Ajkagarypinus stephani* gen. et sp. nov. holotype (NHMUS PAL 2022.91.1),  
568 screenshots of the synchrotron model (scalebar: 0.5mm). A: dorsal view; B: ventral view; C:  
569 frontal view; D: right lateral view; E: left lateral view; G: ventrolateral view.

570 Figure 5. *Ajkagarypinus stephani* gen. et sp. nov. holotype (NHMUS PAL 2022.91.1). A: body,  
571 dorsal view (scale bar: 0.5mm); B: right chelicera, dorsal view (scale bar: 0.1mm); C: left  
572 pedipalp, dorsal view (scale bar: 0.25mm); D: right chela, lateral view (scale bar: 0.25mm).

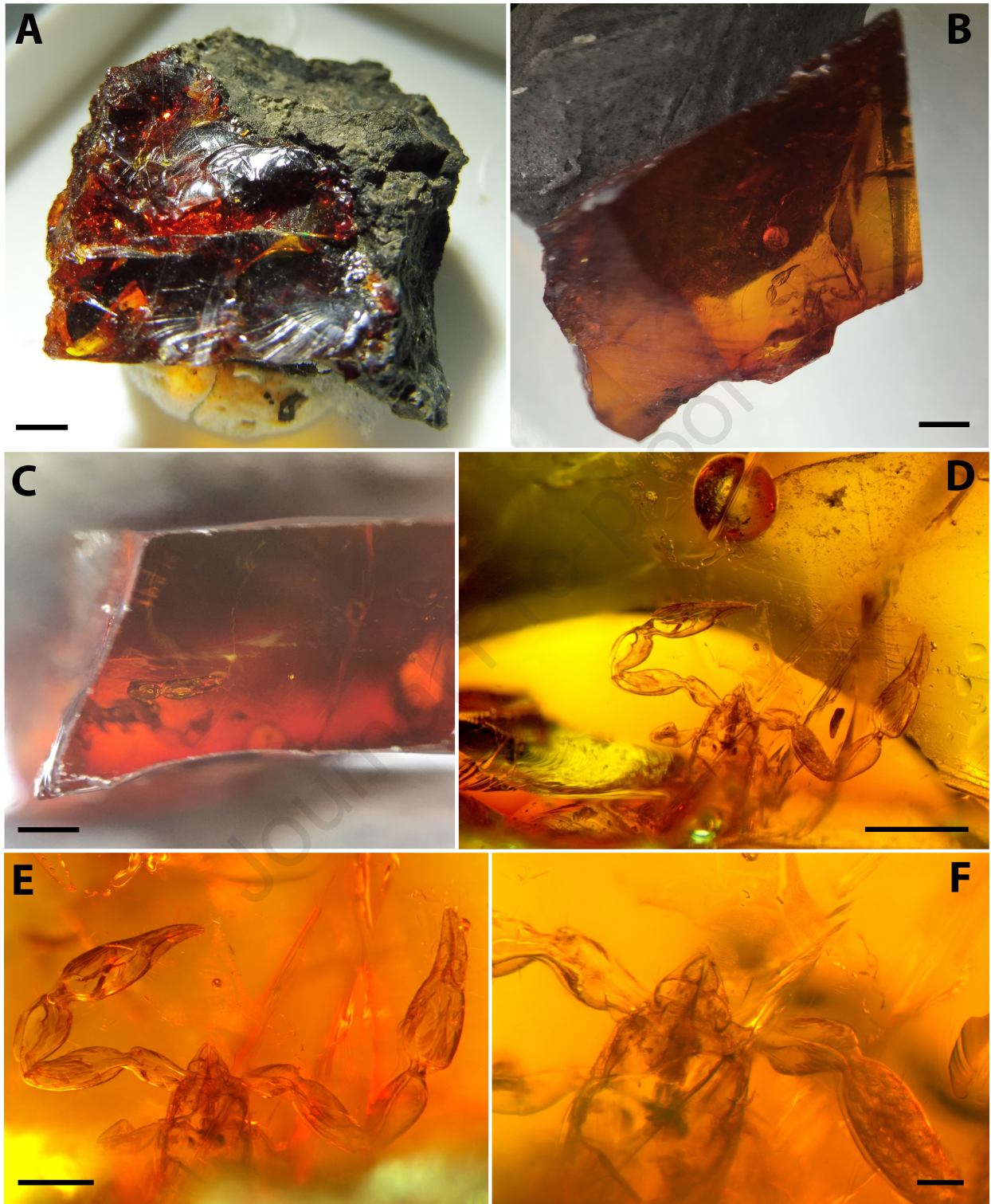
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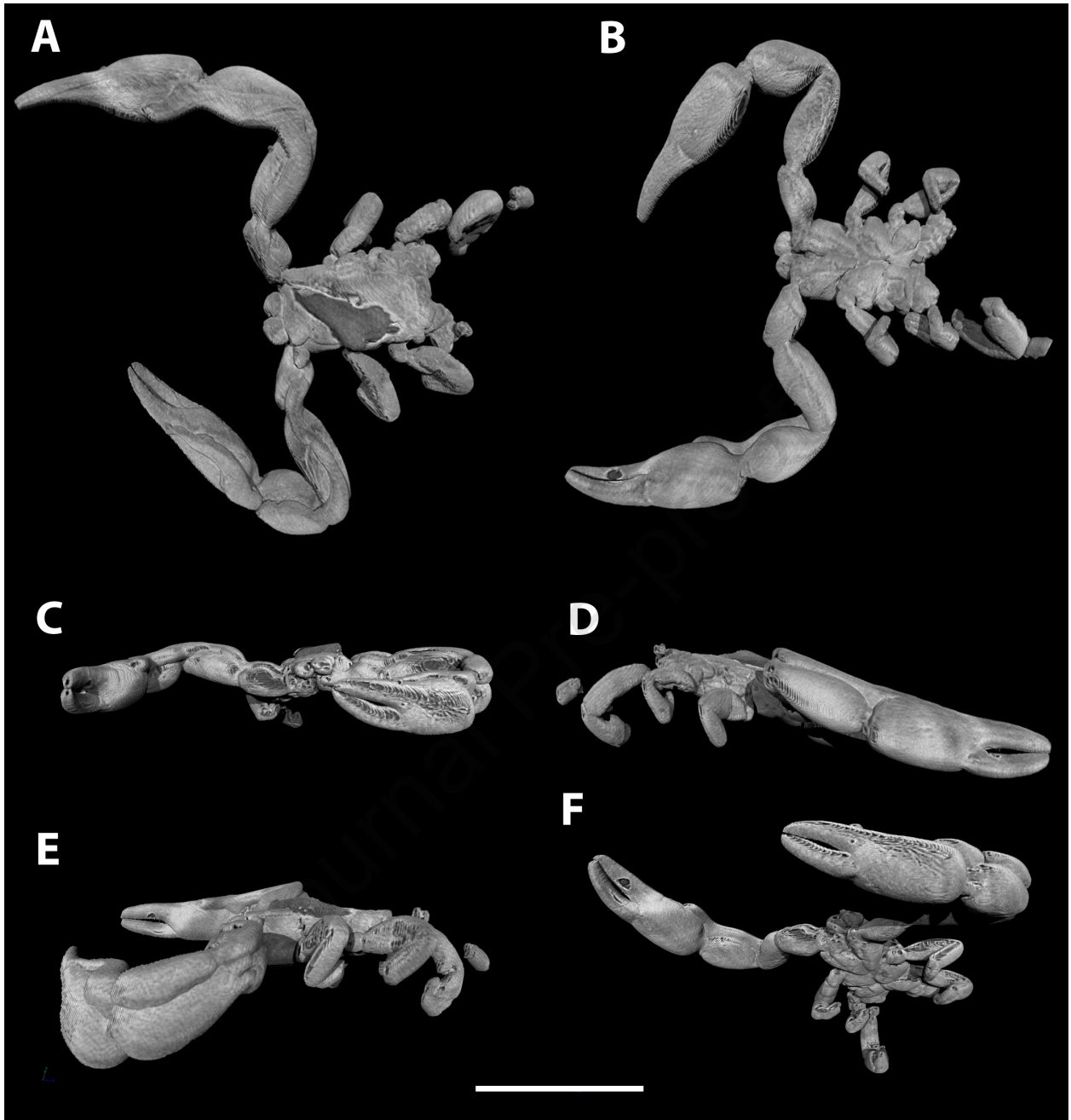
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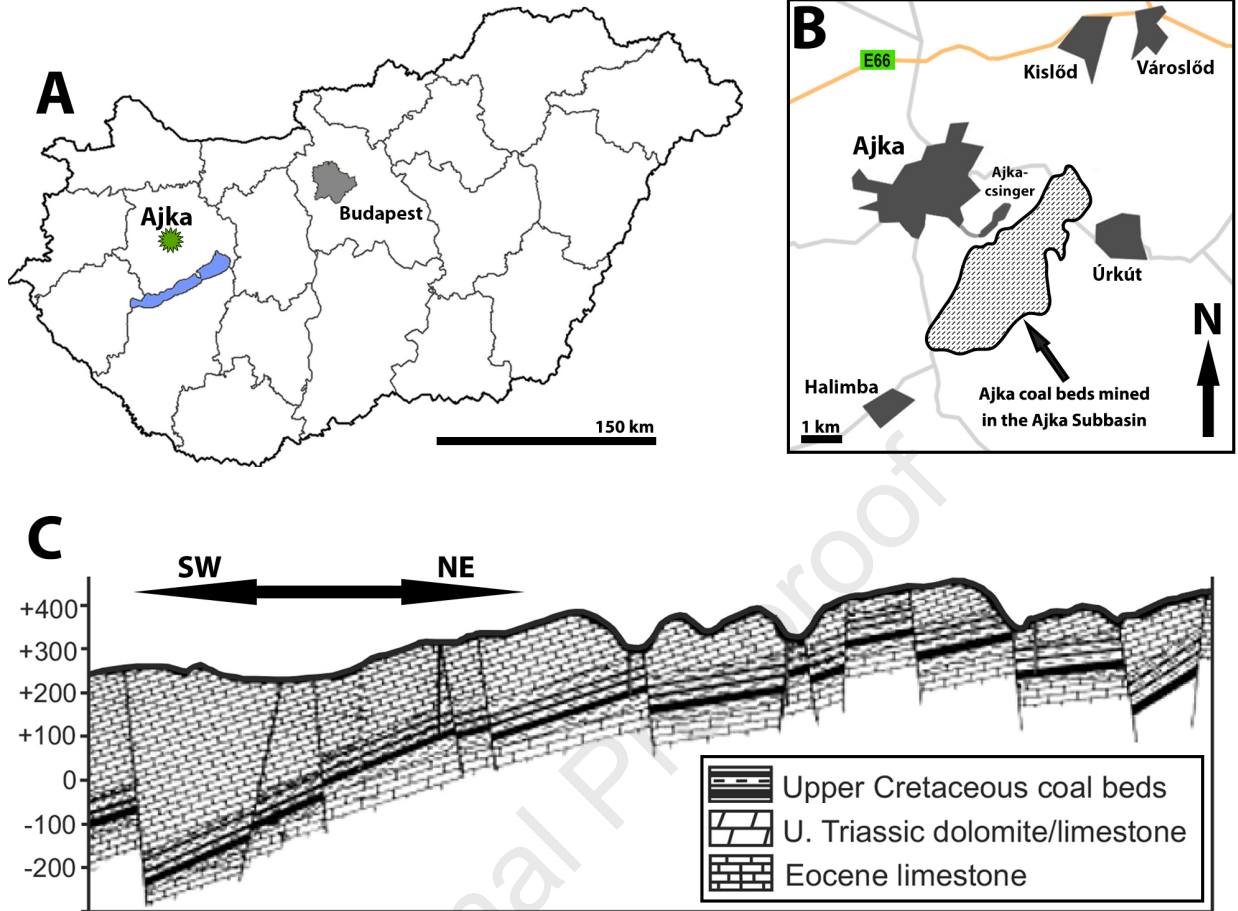
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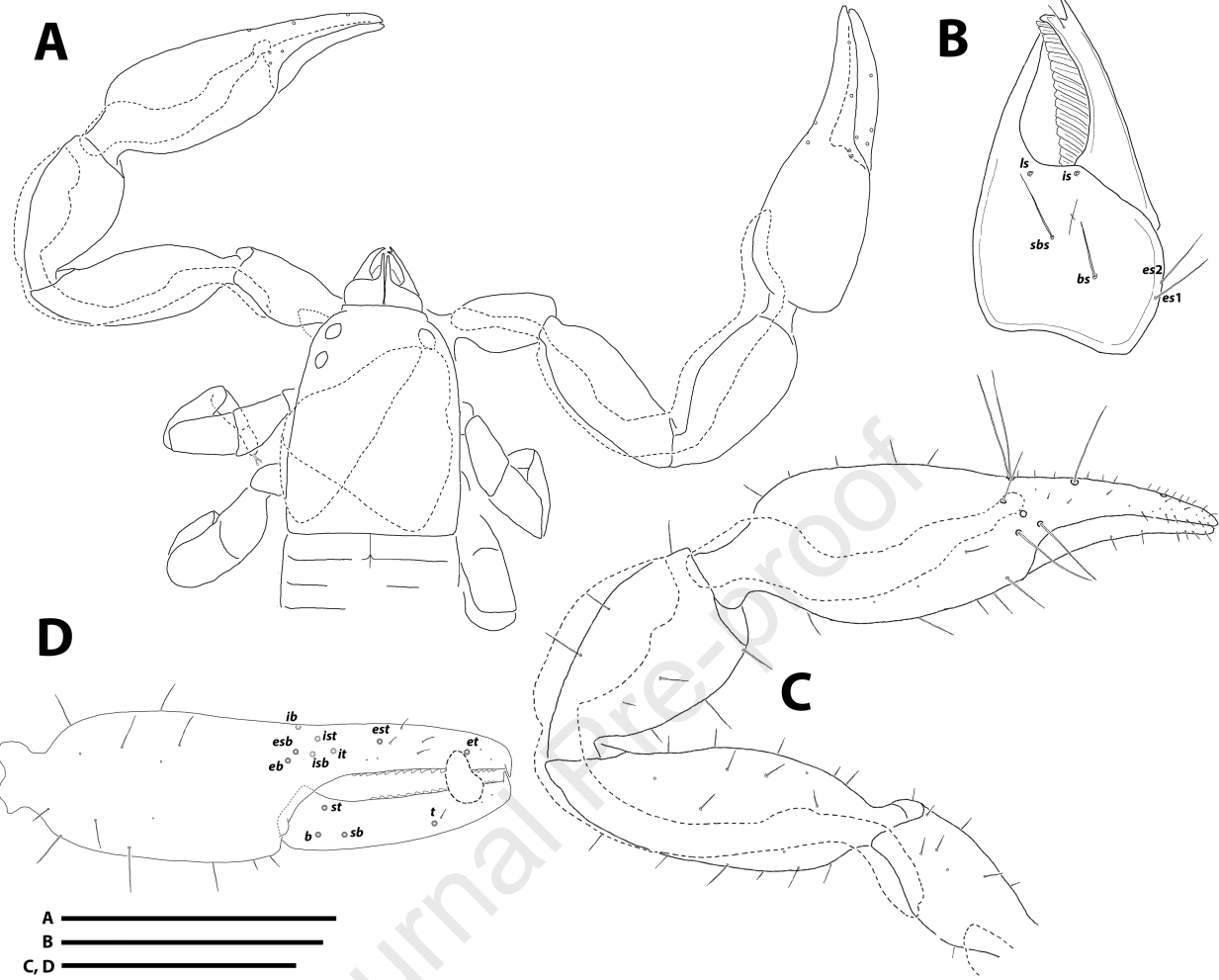


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*Ajkagarypinus stephani* gen. et sp. nov. from Santonian is described

*Ajkagarypinus stephani* is the second fossil pseudoscorpion from the Carpathian Basin

*Ajkagarypinus stephani* is the second species of Garypinidae from the Mesozoic

This fossil greatly contributes to Mesozoic pseudoscorpion biogeography

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**Author contribution**

JN conducted the taxonomical investigation of the specimen and elaborated the first version of the manuscript. MH provided advice regarding the accurate taxonomic placement of the new taxon. AÓ and MS elaborated the first draft of geological and palaeoecological parts of the manuscript. JH, DH and UK organized to the synchrotron model with support of a student contributor. MB conducted the polishing of the amber piece. CH, MB, and JN captured photographs on the specimen. AÓ, MS, UK, and DH provided insight to the paleontological dimensions of the finding. All authors read, finetuned and approved the final version of the manuscript.

**Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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