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A new species of *Baikuris* (Hymenoptera: Formicidae: Sphecomyrminae) in mid-Cretaceous amber from France

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Abstract

A new species of the extinct ant genus *Baikuris* Dlussky, 1987 (Formicidae: Sphecomyrminae) is described and figured from a male preserved in a piece of <100 Myr amber from Charentes, in southwestern France. *Baikuris maximus* sp. nov., is distinguished from other species notably by its larger size, its forewing with vein 2M+Cu absent and vein 3Cu tubular, and the presence of a subpetiolar process. The diagnosis of the genus is emended, and its distribution during the Cretaceous is briefly discussed.

Keywords: Insecta; ant; Sphecomyrmini; amber; Albian–Cenomanian; France

1. Introduction

Sphecomyrminae were among the first ants to colonize the Earth, and they existed for at least 22 million years in the Cretaceous, from the latest Albian (100 Ma) to the middle Campanian (78 Ma). Since the first description of a sphecomyrmine in the late 60's (Wilson et al., 1967), the group's diversity has reached 18 species in 9 genera, yet it remains one of the most puzzling of all ant subfamilies. The female castes exhibit a variety of 'standard' (e.g., *Sphecomyrma* Wilson and Brown, 1967, *Sphecomyrmodes* Engel and Grimaldi, 2005) and highly specialized (e.g., *Haidomyrmex* Dlussky, 1996, *Zigrasimecia* Barden and Grimaldi, 2013) head morphologies, and of the ant synapomorphies, sphecomyrmines lack only the elongated scapes. The only tentative placement of the group within a phylogenetic framework, conducted by Grimaldi et al. (1997), is now largely outdated given the substantial recomposition of the ant subfamilies (Bolton, 2003, Rabeling et al., 2008) and the progress in the understanding of their relationships based on morphological and molecular studies (Brady et al., 2006, Moreau et al., 2006, Keller, 2011, Moreau and Bell, 2013).

Sphecomyrmines had a wide distribution although apparently restricted to Laurasia. They are known exclusively in amber, however, so this evident bias of preservation likely gives us a wrong picture of their actual diversity and distribution through the Cretaceous. Fossils of Sphecomyrminae have been unearthed from mid-Cretaceous ambers of France and Myanmar, and Late Cretaceous ambers of the U.S. Atlantic Coastal Plain, Siberia, and Canada (see LaPolla et al., 2013: tab. 1, with additions of Barden and Grimaldi, 2013, McKellar et al., 2013, Krynicki, 2013, Perrichot, 2014). Among these, the genus *Baikuris* is known exclusively from males and was first described from late Cretaceous (Campanian?) Taimyr amber of Baikura by Dlussky (1987), with the two species *B. mandibularis* Dlussky, 1987 and *B. mirabilis* Dlussky, 1987. A

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4 third species, *B. casei* Grimaldi, Agosti, and Carpenter, 1997, was later described from Turonian
5 New Jersey amber (Grimaldi et al., 1997).

6 A fourth species of *Baikuris* is described herein, based on a male from latest Albian –
7 earliest Cenomanian (approximately 100 Myr) amber of southwestern France, known as
8 Charentese amber.
9

10 11 **2. Material and methods** 12 13

14 The material comprises a single specimen, a nearly complete male missing only the right antenna
15 with a small frontal area and apical part of the right foreleg, and preserved in a cylindrical piece
16 of dark amber which was collected in 2000 by the author from the Font-de-Benon quarry near
17 Archingeay, in the Charentes region (Fig. 1A). The amber comes from the lowermost of two
18 amber-bearing strata present in this quarry (Fig. 1B), i.e. the latest Albian – earliest Cenomanian
19 level A1s1-A sensu Perrichot et al. (2010), also named A1s11 sensu Néraudeau et al. (2002). It is
20 the same outcrop and geological stratum that yielded the holotypes of *Gerontofornica cretacica*
21 and *Haidomyrmodes mammuthus*, two other fossil ants described earlier by Nel et al. (2004) and
22 Perrichot et al. (2008), respectively. Details on the geology, paleobiota, and paleoenvironment of
23 this fossil deposit were provided by Perrichot et al. (2010).
24

25 The amber piece was so turbid that the ant and three other fossil inclusions (two Diptera
26 and one Hymenoptera: Platygasteridae) were hardly discernable. The piece was cut in three parts
27 and a razor blade was used to remove the maximum of amber surrounding the fossils for an
28 optimal observation of each inclusion. The ant could not be separated from a crane fly (Diptera:
29 Limoniidae, assignable to *Antodicranomyia azari* Perrichot, Nel, and Krzeminski, 2007) that
30 contacted its left antenna. The head was still poorly visible so black ink was injected through the
31 missing part of frons for enabling better visibility. Then a small drop of epoxy was placed to
32 close the hole, and the amber fragment was placed between cover slips and embedded in Canada
33 balsam following established techniques (Azar et al., 2003). The material is deposited in the
34 Geological Department and Museum of the University Rennes 1, France.
35

36 The specimen was examined under incident and transmitted light using a Leica MZ APO
37 stereomicroscope, and imaged with the aid of a Canon 5D Mark II camera attached to it. Stacks
38 of photographs taken at different depths of field were merged using HeliconFocus software
39 (HeliconSoft Ltd.). All photographs will be made freely available on AntWeb (www.antweb.org)
40 upon publication of this article. Line drawings were made with a camera lucida and digitally
41 processed using Illustrator CS4 software. Measurements were made using the ocular graticule of
42 the stereomicroscope. The wing vein nomenclature follows Perfilieva (2011).
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48 **3. Systematic palaeontology**

49 Family: Formicidae Latreille, 1802

50 Subfamily: Sphecomyrminae Wilson & Brown, 1967

51 Tribe Sphecomyrmini Wilson & Brown, 1967

52 Genus *Baikuris* Dlussky, 1987
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55 *Type species.* *Baikuris mandibularis* Dlussky, 1987: 134, fig. 2. See also Perfilieva, 2011: figs.
56 3a–c, pl. 6.6–6.8.
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58 *Diagnosis* (from Dlussky, 1987; Grimaldi et al., 1997, with emended characters in italics). Males
59 having large eyes *oval* to reniform; mandibles narrow, with margins virtually parallel,
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4 masticatory margin without teeth; base of outer surface with oval area and ridge (opening of
5 mandibular gland?); maxillary palps long, 6-segmented; labial palps *4-segmented* (visible in *B.*
6 *casei*); scutum with distinct parapsidal grooves; forewing venation complete (class I in
7 Perfilieva's (2011) terminology), with cell 1+2r six-angled, cross-vein 1r-rs absent or tubular for
8 a short distance, *vein 2M+Cu short or absent, distal portion of Cu (3Cu) spectral and not*
9 *reaching wing margin, or tubular and almost reaching wing margin*; mid and hind legs with
10 trochantellus; fore tibia with *one apical spur* (two spurs incorrectly mentioned in Grimaldi et al.,
11 1997), mid and hind tibiae with two apical spurs; tarsal claws with small preapical tooth; petiole
12 nodiform, low and elongate; *a more or less distinct* constriction between first and second gastral
13 segments; genitalia small and retracted into gastral segments; cerci well developed.

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17 ***Baikuris maximus*** Perrichot, sp. nov.

18 Figs. 2–3
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21 *Diagnosis.* Differs from other *Baikuris* species by its larger size (11.5 mm for the body length, as
22 opposed to a maximum of 8 mm for other species), the presence of a subpetiolar process, and the
23 forewing with crossvein 1r-rs complete although largely spectral, its tubular portion not
24 exceeding 0.33× total length, with vein 3Cu tubular, almost touching wing margin, with 2M+Cu
25 absent. These and other characteristics of the different species are summarized in table 1.

26 *Derivation of name.* The specific epithet is taken directly from the Latin adjective meaning
27 "biggest", and refers to the large size of the specimen.

28 *Holotype.* IGR.ARC-112.1, male; deposited in the Geological Institute and Museum of the
29 University Rennes 1, France.

30 *Type locality and horizon.* Font-de-Benon quarry, ca. 1 km east of Archingeay, Charente-
31 Maritime, France; Cretaceous, Latest Albian – Earliest Cenomanian (ca. 100 Ma), lithological
32 level A1s1-A.

33 *Description.* Male large, body length 11.5 mm. Head length 1.80 mm (excluding mandibles),
34 width 1.05 mm (excluding eyes). Compound eyes large, maximal length 1.05 mm, reniform,
35 strongly convex, in full-face view situated beyond the outlines of the sides of head. Ocelli large,
36 prominent. Frons and right antenna not preserved. Antenna long and filiform, total length 10.4
37 mm; scape short, about 0.4× length of flagellomere I; pedicel very short, as long as broad, 0.45×
38 length of scape; flagellomere I (fI) longest antennomere, fIII slightly longer than fII, following
39 segments increasingly shorter except apical flagellomere only slightly longer than preceding
40 segment, narrowly tapered at apex; length of antennomeres (in mm): scape 0.40, pedicel 0.18,
41 flagellomeres fI 1.30, fII 1.03, fIII 1.05, fIV 1.00, fV 0.95, fVI 0.90, fVII 0.82, fVIII 0.75, fIX
42 0.70, fX 0.64, fXI 0.66. Clypeus and mouthparts largely obscured by preservation; anterior
43 clypeal margin distinctly convex; mandibles small, with sides parallel, apparently with a small
44 preapical tooth; maxillary palps long, five segments visible; labial palps not visible. Occipital
45 carina present.

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52 Mesosoma. Propleuron somewhat elongate, forming a neck dorsally. Scutellum with deep
53 parapsidal grooves widely separated posteriorly, distinctly diverging anteriorly. Legs long and
54 slender; trochantellus visible on hind leg only, possibly present on mid leg but obscured; fore
55 tibia apically with one pectinate spur (strigil); mid tibia with two simple spurs subequal in
56 length; hind tibia with one short, simple spur, and one long, pectinate spur; tarsomere I of all legs
57 with longitudinal row of short erect setae on inner surface; inner surface of tarsomeres I-IV
58 apically with pair of spinelike setae (visible on left mid and hind legs); pretarsal claws with a
59 distinct preapical tooth. Forewing length 6.8 mm; distal portion of M (4M) and Cu (3Cu) tubular,
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4 almost reaching wing margin; cell [rm] long, crossvein rs-m situated beyond apex of
5 pterostigma; crossvein cu-a aligned with 1M (2M+Cu absent). Hind wings largely hidden
6 underneath forewings, only median anterior third visible; anterior margin with four basal and
7 seven distal hamuli; R, 1R1, 1Rs, 2Rs, rs-m, 1M, and 2M apparently all tubular.
8

9 Metasoma. Petiole with short anterior peduncle and distinct node, its length (1.20 mm)
10 twice greatest height; an acute, triangular subpetiolar process situated on ventral surface just
11 posterior to peduncle; attachment of petiole on propodeum low, not particularly thick. First
12 gastral segment (abdominal segment III) bell-shaped, approximately 0.9× length of petiole; a
13 distinct constriction between gastral segments I and II and a slight constriction between gastral
14 segments III and IV; apical portion of gaster not visible, retracted inside preceding segment
15 (abdominal segment VI).
16

17 *Remarks.* The new fossil exhibits the main synapomorphies of the genus *Baikuris*, which are the
18 eyes reniform, the mandibles narrow and rectangular, without conspicuous tooth, the
19 scape/pediceal ratio, the presence of deep parapsidal grooves, the forewing with cell 1+2r partly
20 divided by a rudimentary cross-vein 1r-rs, and the petiole nodiform, low and elongate.
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23 **4. Discussion**

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26 The new specimen is the oldest known record of the genus *Baikuris*, which is now known by
27 four species ranging from the Albian–Cenomanian boundary to the Campanian (100 Ma to 80
28 Ma approximately). As for all sphecomyrmine ants, the genus is known exclusively from amber
29 fossils and its apparent distribution is restricted to the mid and high latitudes of the Northern
30 Hemisphere, more precisely to continents that formed Laurasia during the Cretaceous (Fig. 4). It
31 is still difficult to associate *Baikuris* with any of the known female castes of Sphecomyrminae: in
32 Charentese amber, female ants belong to the genera *Sphecomyrmodes* and *Haidomyrmodes*
33 Perrichot et al., 2008 (also *Gerontofornica* Nel and Perrault, 2004, which was described as
34 uncertain in subfamily but may belong to Sphecomyrminae as well); in New Jersey amber,
35 females are assignable to *Sphecomyrma* and another male morphotype was tentatively assigned
36 to *Sphecomyrma* already; and no female caste is known from Baikura amber (Fig. 4). So there is
37 no recurrent association of *Baikuris* with another genus known from females which could
38 indicate congeneric castes.
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42 **5. Conclusion**

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45 The middle of the Cretaceous has been a key period in the early evolution of ants, yet our
46 understanding of the diversity, paleoecology, and paleobiogeography of ant lineages that existed
47 at the time is scant. Fossil discoveries have greatly increased in the past two decades, which
48 progressively fill the gap, and the new species described here adds to the knowledge of the most
49 basal of these lineages, the Sphecomyrminae. The family is most diversified in the earliest
50 Cenomanian of Myanmar, but specimens found in amber from the Albian–Cenomanian of
51 France, Turonian of New Jersey, Santonian to Campanian of Siberia, and Campanian of Canada,
52 demonstrate a broad distribution across Laurasia.
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57
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Table 1. Comparison of *Baikuris* species.

	<i>B. mandibularis</i>	<i>B. mirabilis</i>	<i>B. casei</i>	<i>B. maximus</i> sp. nov.
body length	4-5 mm	8 mm	7.5 mm	11.5 mm
eyes	reniform	reniform	oval	reniform
antennomeres I-IV ratio	1/0.5/2.9/2.0	?	1/0.45/2/?	1/0.46/2.8/2.66
forewing r-rs	incomplete, tubular for 1/2 distance to pterostigma	nearly complete, spectral	absent	nearly complete, tubular for 1/3 distance to pterostigma, then spectral
forewing 2M+Cu	short	short	short	absent
forewing 3Cu	spectral	spectral	absent	tubular, almost reaching wing margin
subpetiolar process	absent	absent	absent	present
gastral constriction between segments I-II	slight	slight	slight	deep

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4 **Figure captions**
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7 **Fig. 1.** Geographical and geological setting of the Cretaceous ant-bearing amber deposits from
8 the Charentes region. **A** – Location of the sites with indication of all known fossil ant taxa,
9 including *Baikuris maximus* sp. nov. **B** – Regional stratigraphic section with indication of the
10 two amber levels with fossil ants (numbers of sites correlate with Fig. 1A).
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13 **Fig. 2.** *Baikuris maximus* sp. nov., holotype IGR.ARC-112.1, from Charentese amber. **A.**
14 Dorsolateral habitus. **B.** Head in full-face view. **C.** Left meso- and metathoracic legs. **D.**
15 Forewings. **E.** Metasoma in profile view.
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18 **Fig. 3.** Line drawings of *Baikuris maximus* sp. nov. **A.** Lateral habitus; the arrows indicate the
19 subpetiolar process and the gastral constriction. **B.** Head in full face view. **C.** Left forewing, with
20 indication of veins mentioned in the description; tubular veins in black, spectral vein in grey.
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23 **Fig. 4.** Palaeogeographical distribution of the genus *Baikuris*, with other sphecomyrmine genera
24 and their castes (m: male; w: worker; q: gyne) known from the same amber deposits; early Late
25 Cretaceous map (~ 90 Ma) modified from Blakey (2011).
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Figure 1
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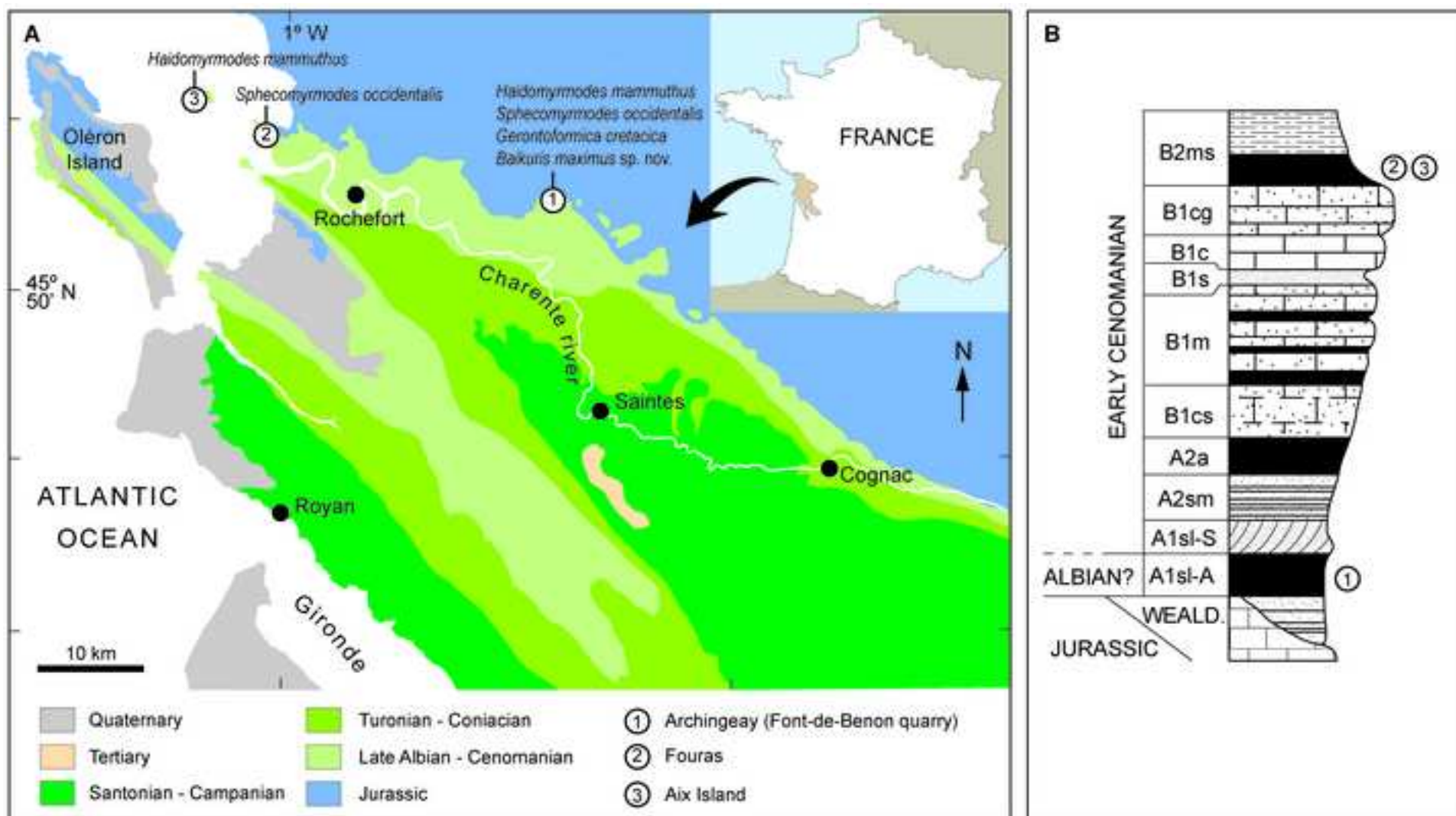


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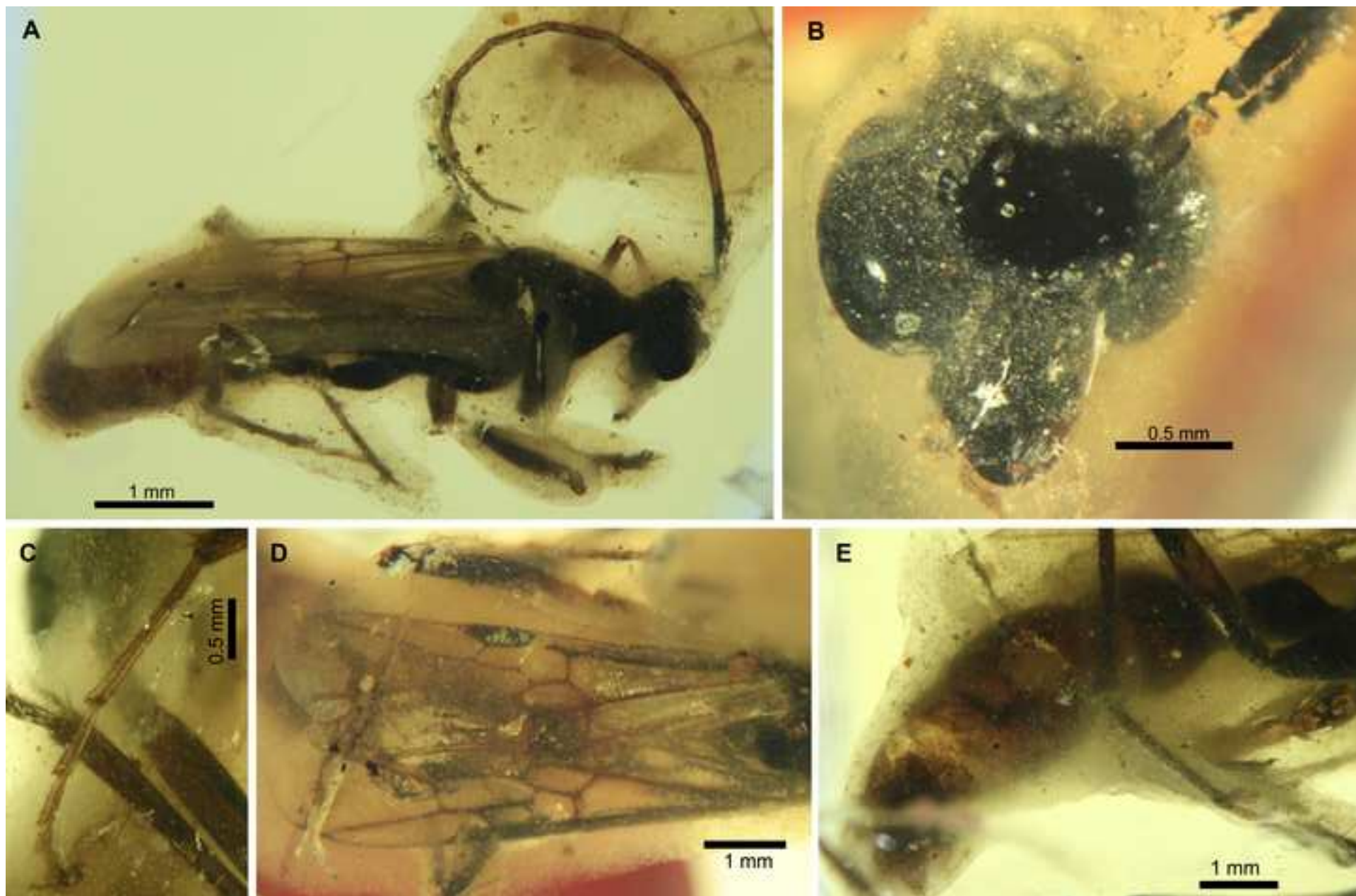


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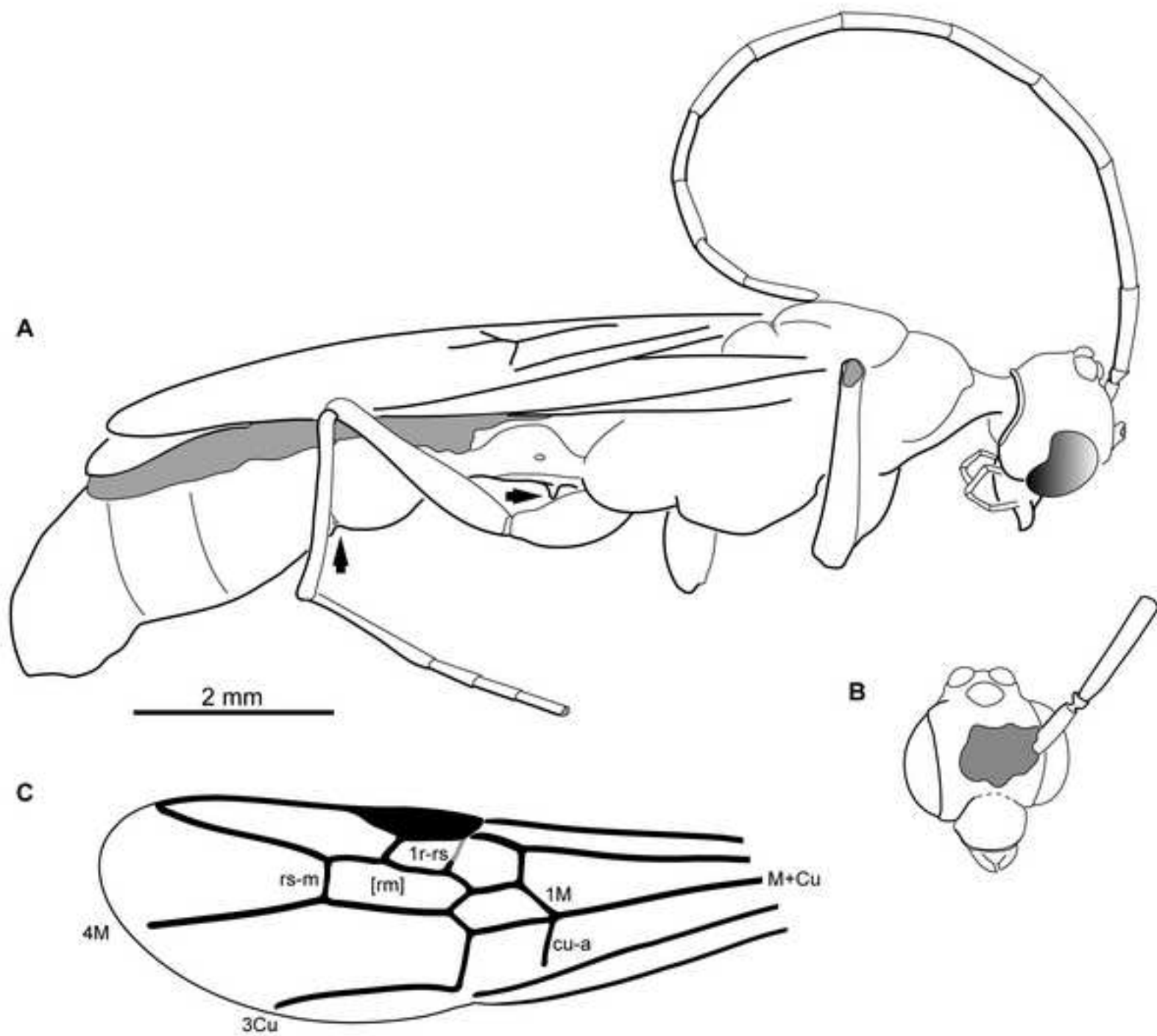
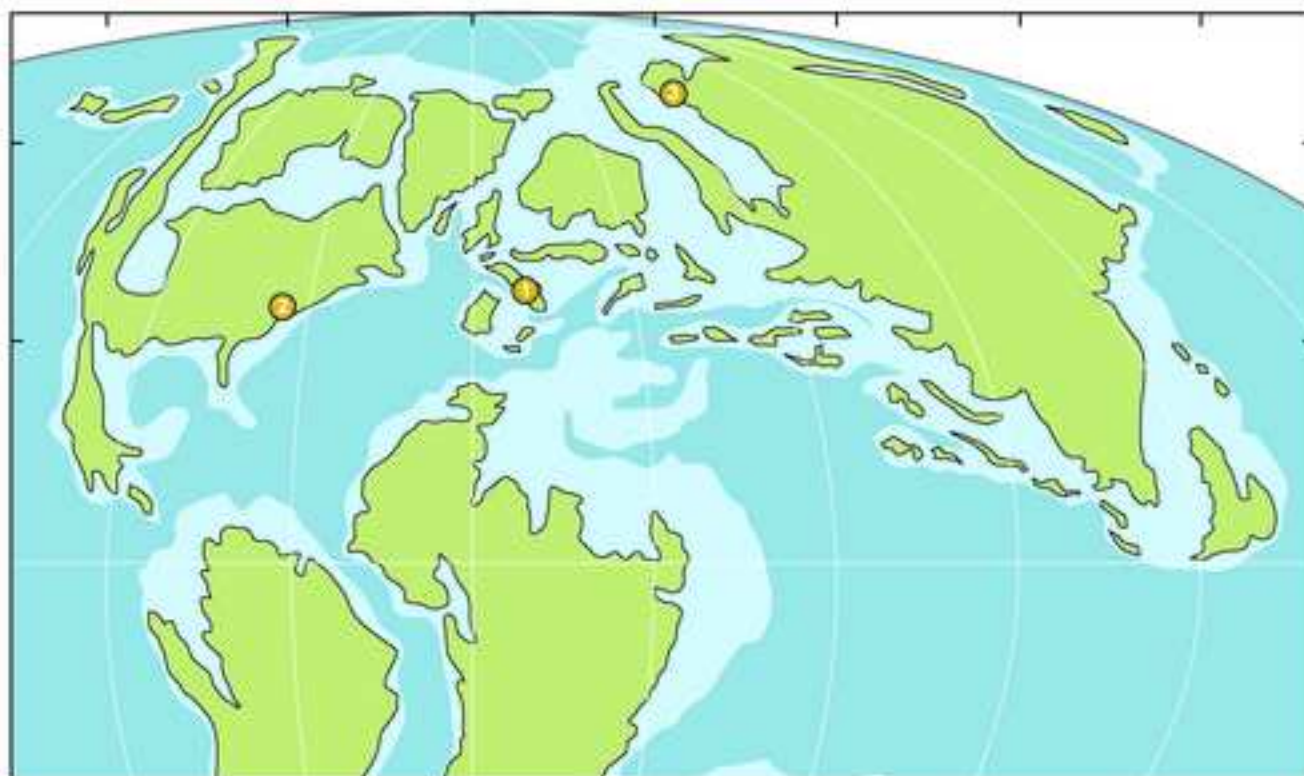


Figure 4

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- Charentese amber (100 Ma):
Baikuris (m), *Haidomyrmodes* (q, w),
Sphecomyrmodes (w), *Gerontoformica* (w)
- New Jersey amber (92 Ma):
Baikuris (m), *Haidomyrmodes* (q, w),
Sphecomyrma (w, m?)
- Taimyr (Baikura) amber (80 Ma):
Baikuris (m)