

Short communication

The first plumalexiid wasp (Hymenoptera: Chrysidoidea, Plumalexiidae) from the mid-Cretaceous Burmese amber

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ABSTRACT

A new species of plumalexiid wasp, *Plumalexiidae ohmkuhnlei* sp. nov., is described from the mid-Cretaceous Myanmar (Burmese) amber, based on a single male specimen. It is compared with the only other known plumalexiid, *Plumalexiidae rasnitsyni* Brothers, from the Turonian New-Jersey amber, and provides additional information confirming the relatively basal status of the family within Chrysidoidea.

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1. Introduction

The family Plumalexiidae was previously known only from a single fossil species. It was described and based on two conspecific males from Turonian Raritan amber (New Jersey, USA) and interpreted as a sister-group of Plumariidae in a clade basal in Chrysidoidea, although it could also be interpreted as sister to the remaining chrysidoidea or even to the chrysidoidea as a whole (Brothers, 2011). The family is relatively plesiomorphic in most of its characters compared to the Plumariidae and hence is important in understanding the ancestry of the enigmatic plumariids (*op. cit.*).

Plumalexiidae differ from all Chrysidoidea other than Plumariidae in having the hind wing with rich venation including two closed cells (vs. few simple veins and no closed cells). Plumalexiidae differ from Plumariidae primarily in their less modified wing venation: fore wing lacking secondary veins and with the 2rm cell only slightly or not at all smaller than the 1mcu cell. Herein, we describe a second species of Plumalexiidae based on a unique fossil discovered recently in the mid-Cretaceous Burmese amber that confirms and broadens our knowledge of the family and adds significantly to its diversity and distribution in space and time.

2. Material and methods

The specimen described herein was collected in amber mines in the Hukawng Valley of Kachin State, Myanmar (locality in Li et al., 2018: fig. 1). The rocks containing the Burmese amber are radiometrically dated at 98.79 ± 0.62 Ma (Shi et al., 2012). However, since it is well known that amber easily becomes redeposited, we prefer to refer to the amber informally as being of mid-Cretaceous age. Morphological terminology is the same as in Brothers (2011) except for the wing venation shown on Fig. 1C.

The material is deposited at the A.A. Borissiak Palaeontological Institute, Russian Academy of Sciences, Moscow, as a part of collection donated by Dr. Christoph Öhm-Kühnle (Herrenberg, Germany). The amber was studied using a Leica M165C stereomicroscope with a Leica DFC 420 camera at the A.A. Borissiak Palaeontological Institute. For imaging of the specimen, a compound microscope Nikon E-800 with dry (4x, 10x, 20x) and water dip optics (40x and 60x) was used. The specimen was imaged with the combination of brightfield and incident illumination. Stacks of images, comprising multiple focal planes, were obtained with Olympus OM-D E-M10II camera. Helicon Focus Pro $\times 64$ was used to stack photos for better depth of field. Line drawings were done using image-editing software (CorelDraw, 2019 and Adobe Photoshop CS2) on the basis of digital photographs. All taxonomic acts

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Fig. 1. *Plumalexius ohmkuhnlei* sp. nov., holotype, general view: A, ventral, B, dorsal.

established in the present work have been registered in ZooBank (see below), together with the electronic publication LSID: urn:lsid:zoobank.org:pub:9F2F0814-856B-40F3-8DFC-F6E43F68B56A

3. Systematic paleontology

Order Hymenoptera Linnaeus, 1758
Superfamily Chrysidoidea Latreille, 1802
Family Plumalexiidae Brothers, 2011

Genus *Plumalexius* Brothers, 2011

***Plumalexius ohmkuhnlei* sp. nov.**

Figs 1-3.

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Diagnosis. Body slender (vs. robust in *P. rasnitsyni*), scape and pedicel long (scape about as long as eye width) and each bearing long setae (vs. shorter and with long setae only on pedicel), maxillary palp with 3 apical segments as long as eye width (vs. much shorter), flagellomere 1 longer than flagellomere 2 (vs. shorter), propleura forming long neck (vs. short neck), fore wing with 1-RS and 1-M parallel (vs. forming a distinct angle) and 2-RS+M absent (vs. 2-RS+M distinctly present), coxae elongate (vs. subglobose).

Description. Male. Head dark and mesosoma whitish above, otherwise originally possibly fuscous (actually variegate: fuscous or pale

depending on inner tissues touching surface or not), metasoma light brown, antenna yellow except scape dark apically, legs dark with tarsi and femoral and tibial bases yellow, pterostigma and tubular veins fuscous. Head and body length as preserved (in dorsal view, from tip of left mandible to apex of metasomal tergum 7) 2.72 mm; head length, as visible in dorsal view (from visible fore margin of frons to occipital margin) 0.30 mm, head width 0.62; mesosoma length 0.79 mm; metasoma length 1.51 mm; fore wing length 1.71 mm; approximate hind wing length 1.42 mm. Head and mesosoma with weak microsculpture, pro- and mesonotum with scattered small setae. All antennal segments with dense, long and very thin (difficult to see) radially arranged setae. Metasoma smooth, shining, laterally and ventrally toward apex with distinct erect setae.

Head. Orthognathous; much wider than high; vertex evenly rounded. Eye ovate, bulging, apparently glabrous, ommatidia distinct. Ocelli ovate, large. Occipital carina complete. Interpostgenal bridge almost as long as pedicel. Frons somewhat deformed, unknown if convex or not, with distinct midfrontal sulcus from anterior ocellus forward; clypeus transverse, with thin, more or less straight fore margin. Temple short, convex. Gena simple. Antennal sockets with elongate inner rim, almost reaching eye, distant from each other, close to posterior/dorsal margin of clypeus; scape about twice as long as wide, broadened towards oblique apex; pedicel slightly shorter and much thinner than scape, slightly broadening apically; flagellomeres distinctly broadening apically (except apical segment), very gradually becoming shorter

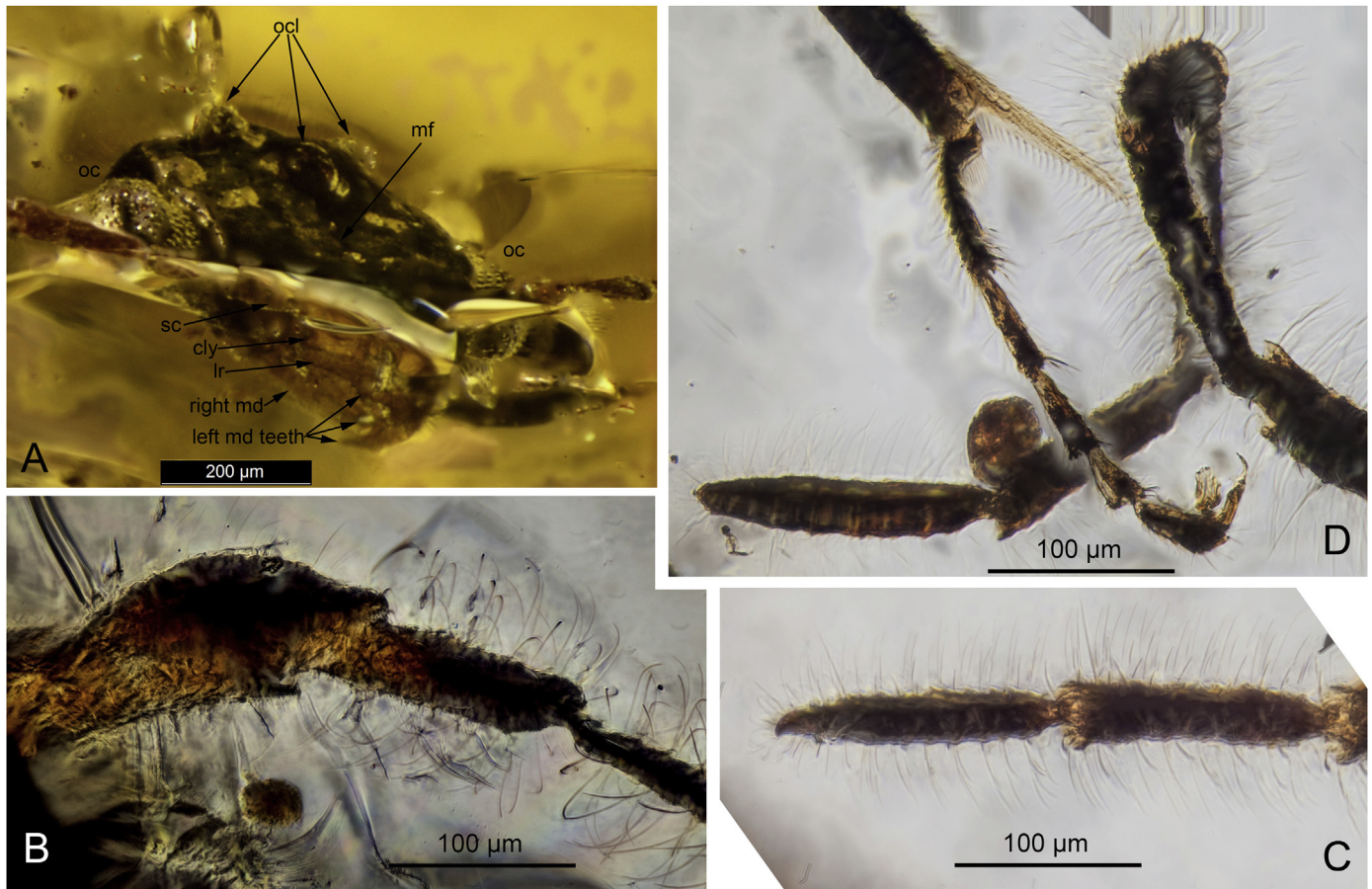


Fig. 2. *Plumalexius ohmkuhnlei* sp. nov., holotype: A, head, anterior view, B, scape and pedicel, showing vestiture, C, apical flagellomeres, same; D, fore tarsus, calcar, and apical flagellomeres. Symbols: cly, clypeus; lr, labrum; md, mandible; mf, midfrontal line; oc, eye; ocl, ocellus; sc, scape.

toward apex (except for slightly longer apical segment). Labrum short, probably wide. Mandible with two large teeth and one smaller tooth in-between, otherwise teeth not visible. Maxillary palp with 4 segments visible, the three apical ones long and narrow, the other long but thick.

Mesosoma ovate, about twice as long as high. Pronotum forming a curved oblique ribbon anterolateral to mesoscutum, anteroventrally with collar (flange) about as long as pronotum behind it, leaving propleura exposed anteriorly; reaching tegula posteriorly. Propleura contacting each other along midline dorsally; anteriorly produced as a rather long neck; swollen posteriorly; posterior ventral margin indented medially, with medium-size diamond-shaped prosternum there; fore coxae approximated. Mesoscutum shorter than wide, moderately convex; notaulus distinct and apparently not complete posteriorly, weakly diverging anteriorly; transverse mesoscutal line thin; mesoscutellum not reaching line, distinctly shorter than scutum, weakly convex. Mesoventropleuron lacking visible sculpture, posteromedially produced but not forming distinct (delineated) lamellae. Mesocoxae moderately separated with small hearth-like metasternum. Metanotum a long, simple plate (no metascutellum defined), metapostnotum not visible. Metacoxae slightly separated. Propodeum comparatively short, tapering behind, not clearly visible but apparently mainly smooth, without any defined posterior declivity; incision between mesosoma and metasoma pronounced.

Fore wing broad, about $2.3 \times$ as long as wide, about $2.2 \times$ as long as mesosoma, with seven closed cells, veins approaching but not reaching margin. Costal cell well developed, not broad.

Pterostigma large, about $0.20 \times$ as long and $0.19 \times$ as wide as wing, entirely sclerotised. Marginal cell (3r) about $2.19 \times$ as long as wide, $1.59 \times$ as long as pterostigma, apex acute. First submarginal cell (1+2r) about $1.2 \times$ as long as wide, $0.62 \times$ as long as marginal cell. Second submarginal cell (2rm) slightly shorter and narrower than pterostigma, pointed basally (RS+M ending at 1m-cu), about $0.85 \times$ as long as first submarginal cell. Veins tubular except for nebulous free apical sections of M, Cu and A. No trace of any accessory vein(s) in apical membrane. Prestigmal vein (R between RS base and pterostigma) scarcely swollen, about $0.86 \times$ as long as vein 1-Rs. Crossvein cu-a distinctly postfurcal, about $2.2 \times$ as long as 1-Cu. Vein Cu2 absent, first subdiscal cell (2cu-a) broadly open apically.

Hind wing about $0.8 \times$ as long as fore wing. Basal (1rm) and subbasal (cua) cells closed by tubular veins; costal cell open anteriorly, vein C present only basally. Veins tubular except for nebulous free apical sections of Rs, M, Cu and A. Crossvein r-m long, about $4.1 \times$ as long as 1-Rs. Vein 1M absent (free M and Cu starting from one point). Crossvein cu-a distantly antefurcal, 2M+Cu about $0.60 \times$ as long as 1M+Cu. Anal lobe long, rather narrow, briefly incised apically. Jugal lobe absent. Hamuli apparently 4 or 5.

Legs well developed, slender, moderate in size (components mostly flattened and deformed); coxae small, elongate; trochanters well developed and cylindrical; no trochantelli; fore and mid femora slender, hind femur moderately wide ($4.5 \times$ as long as wide as compared with $3.2 \times$ in type species); tibiae with spurs (1-2-2) only (without spines or strong setae); basitarsomeres long, about as long as next three tarsomeres combined; arolia shorter than claws; claws simple ventrally. Fore coxa with trochanter inserted

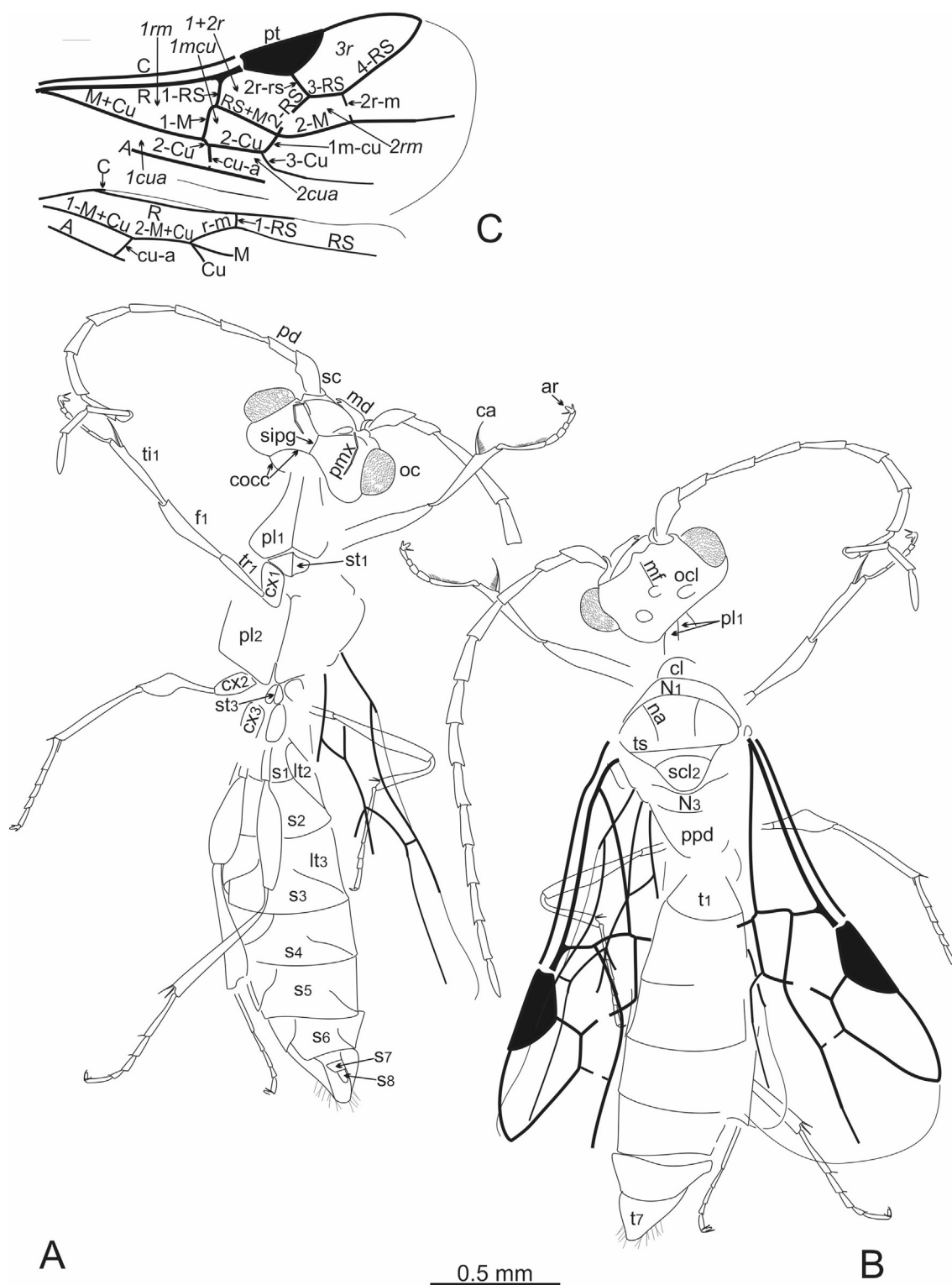


Fig. 3. *Plumalexius ohmkuhnlei* sp. nov., holotype, interpretation (setae omitted): A, ventral, B, dorsal, C, wing venation. Symbols: ar, arolium; ca, calcar (preening fore tibial spur); cl, collar; cocc, occipital carina; cx1, cx2, cx3, fore, mid and hind coxae; f1, fore femur; mf, midfrontal sulcus; lt2, lt3, lateroterga of 2nd and 3rd metasomal terga; md, mandible; N1, N3, pro- and metanota; na, notaulus; oc, eye; ocl, ocellus; pd, pedicel; pl1, pl2, pro- and mesopleura; pmx, maxillary palp; ppd, propodeum; s1 – s7, metasomal sterna; s8, hypopygium; sc, scape; scl2, mesoscutellum; st1, st3, pro- and metasterna; t1, t7, first and last metasomal terga; ti1, fore tibia; tr1, fore trochanter; ts, transverse mesonotal suture; venational symbols standard except that cell symbols shown in italics, and 1-RS, 2-RS etc. denote successive sections of respective veins.

subapically; fore tibia subapically with curved, bladelike calcar bearing adaxial row of setae, long basally and shorter apically; fore basitarsus also with adaxial brush of setae. Mid- and hind tibiae each with two straight simple apical spurs, inner spur somewhat longer than outer; tarsomeres slightly widened apically, their lower surfaces with setae, particularly toward apices.

Metasoma elongate ovate, about $3 \times$ as long as wide; terga subequal in length except that tergum 2 slightly longer and terga 6–7 slightly shorter than others. First tergum rounded posteriorly and not overlapping fore margin of tergum 2, apparently more sclerotised than others. Seventh tergum triangular, narrowly rounded apically, with sides broadly bent ventrally. Lateroterga wide, oblique. First sternum apparently simple and evenly overlapping second sternum, base of sternum 2 roundly excised. Seventh sternum small, trapezoidal, transverse. Hypopygium small, tongue-like. Male genitalia not apparent.

Female. Unknown.

Material examined. Type. Holotype PIN no. 5620/46a: specimen in mid-Cretaceous Burmese amber obtained from a mine situated in Northern Myanmar, Kachin State, Tanai Township, Hukawng Valley, SW of Tanai City, donated by Dr. Ch. Öhm-Kühnle. Syninclusions: Diptera: Psychodidae, Homoptera: Aleyrodidae.

Etymology. The species is named in honor of Dr. Christoph Öhm-Kühnle, in appreciation of his skill in selecting the most interesting hymenopteran inclusions in Burmese amber that are donated subsequently to the Paleontological Institute RAS, as for the present specimen.

4. Discussion

The current specimen shows several differences from the type species of *Plumalexius*, *P. rasnitsyni*, as given above, some of which could possibly be considered as of generic value in other families. Without additional representatives of the family, however, comparison of intrageneric as opposed to intergeneric variation is not feasible. The similarities between the specimens are very striking, and at least some of the apparent differences may result from the differences in preservation and aspects of the three specimens involved, and so may turn out to be less significant than initially thought when further specimens from the same or even other sources become available. Consequently, we have preferred to describe the new specimen as a second species of *Plumalexius*, emphasizing the similarities rather than the differences, despite their considerable geographical separation.

The new species renders new and important information about Plumalexiidae as a basal branch of chrysidoid wasps (Brothers, 2011), that confirms the plesiomorphic nature of many characters of Plumalexiidae and adds to the family's temporal and geographical ranges. It has a minimum mid-Cretaceous age. Its distribution is very wide, from eastern North America to an isolated island of the West Burma block in the midst of the Tethys ocean far northward of its mother Gondwana continent (Zhang et al., 2018; Westerweel et al., 2019). Plumalexiidae have a putatively plesiomorphic rich wing venation, little modified as compared with Plumariidae and much less modified than in other chrysidoids. The new species even adds a few more

putative plesiomorphies compared with the type species, although these differences may be more apparent than real since the type specimens of *P. rasnitsyni* have the bodies largely covered by milky deposits which obscure many details: a comparatively large, flat prosternum; long, flat metanotum; and not fully depressed metasternum, which confirm phylogenetically the basal, archaic nature of Plumalexiidae. However, this concerns only the male morphology: in contrast, the very limited information about the female sex of the extant probable sister family Plumariidae (Evans, 1967; Brothers, 1984), coupled with the absence of possible female fossils of Plumalexiidae, suggests that the latter could be equally wingless and specialized for a cryptic existence.

5. Concluding remarks

The original description and establishment of a new family of Chrysoidea based on a single species known only from two specimens in Turonian New-Jersey amber (Brothers, 2011) was somewhat tentative, given the paucity of material and inability to determine various potentially important characters. The discovery of a second fossil species of Plumalexiidae, from a locality extremely remote from eastern North America and a significantly older deposit, has strengthened the validity of the family by providing additional information on many characters and variation within the family, although many questions remain.

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