A new species of Mesochrysopidae (Neuroptera) from the Lower Cretaceous Crato Formation of Brazil

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A new species of Mesochrysopidae (Neuroptera) from the Lower Cretaceous Crato Formation of Brazil

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Abstract

A new extinct species, *Karenina cuneiformis* sp. nov. (Neuroptera: Mesochrysopidae) is described from the Lower Cretaceous Crato Formation of northeastern Brazil. This new species is similar to *K. borschukewitzi* (Nel et al., 2005) and *K. longicollis* Makarkin & Menon, 2005, but differs from those by wing venation and possesses an apparently stout, cuneiform humeral veinlet in the forewing.

Keywords: Mesochrysopidae, new species, Lower Cretaceous, Crato Formation, Araripe Basin, Brazil.

1. Introduction

Mesochrysopidae Handlirsch, 1906 is an extinct Mesozoic family of Neuroptera, heretofore comprising 28 species in 16 genera and occurring from the Lower Jurassic to the Upper Cretaceous of Eurasia and South America (Makarkin & Menon 2005; Makarkin et al. 2012; Yang et al. 2012; Liu et al. 2016). This family has sometimes been treated as a subfamily (Mesochrysopinae) of Chrysopidae (e.g., Adams 1967; Schlüter 1984; Séméria & Nel 1990; Martins-Neto 2003; Engel et al. 2018); here, I follow the familial status of Mesochrysopidae based on taxonomic studies (Makarkin & Menon 2005; Nel et al. 2005; Ren et al. 2010; Yang et al. 2012; Liu et al. 2016). The genus *Karenina* Martins-Neto, 1997 was originally placed in Ascalaphidae, but Nel et al. (2005) transferred it to Allopteridae and Makarkin & Menon (2005) later synonymized the Allopteridae with the Mesochrysopidae based on wing venation. The genus *Karenina* comprises five species from the Lower Cretaceous Crato Formation of Brazil: *K. breviptera* Martins-Neto, 1997, *K. borschukewitzi* (Nel et al., 2005), *K. cuneiformis* sp. nov. (herein), *K. leilana* Makarkin & Menon, 2005, and *K. longicollis* Makarkin & Menon, 2005.

This paper describes a new species from the Lower Cretaceous of the Crato Formation. This new species is the first one within the genus *Karenina* with an apparently stout, cuneiform humeral veinlet in the forewing.

2. Material and methods

The holotype is deposited in the Osaka Museum of Natural History (OMNH), Osaka City, Osaka, Japan, under the collection number of OMNH TI 530. The Crato Formation is considered to be late Aptian to late Albian in age (Makarkin & Menon 2005; Martins-Neto & Rodrigues 2009).

The specimen was examined under a SMZ 800 stereomicroscope (Nikon Corporation, Tokyo, Japan), and photographed with a Canon EOS 80D (Canon, Tokyo, Japan) with an EF–S 60mm F2.8 Macro USM (Canon) plus Kenko Extension Tubes (KenkoTokina, Tokyo, Japan). All figures were prepared by using Adobe Photoshop 2021 and Adobe Illustrator 2021 (Adobe, San Jose, CA, USA).

Wing venation terminology generally follows Breitkreuz et al. (2017). Venational abbreviations: A – Anal vein; A1 – first anal vein; Cu – Cubitus; CuA – Cubitus Anterior; CuP – Cubitus Posterior; hv – humeral veinlet; im – first intramedian cell; M – Media; MA – Media Anterior; MP – Media Posterior; R – Radius; RA – Radius Anterior; RP – Radius Posterior; Sc – Subcosta Posterior.

3. Systematic palaeontology

Order Neuroptera Linnaeus, 1758

Family Mesochrysopidae Handlirsch, 1906

Genus *Karenina* Martins-Neto, 1997

Type species: *Karenina breviptera* Martins-Neto, 1997: 74.

Species included: *K. breviptera* Martins-Neto, 1997, *K. borschukewitzi* (Nel et al., 2005), *K. cuneiformis* sp. nov. (herein), *K. leilana* Makarkin & Menon, 2005, and *K. longicollis* Makarkin & Menon, 2005, all from the Lower Cretaceous of the Crato Formation, Brazil.

Remarks: The genus *Karenina* is most similar to the genus *Kareninoides* Yang, Makarkin & Ren, 2012. However, it can be distinguished from the following morphological characters: forewing nearly oval with hind margin strongly curved (forewing elongate with hind margin smoothly slightly curved in *Kareninoides*); hind wing length 0.6–0.8 of forewing (hind wing length 0.9 of forewing in *Kareninoides*); in hind wing, both Banksian lines not developed (well developed, long in *Kareninoides*) (Yang et al. 2012).

Karenina cuneiformis sp. nov.
Figs. 1–3

LSID: urn:lsid:zoobank.org:act:5C651F5E-EE7C-46D0-96BB-BBEE3182EF6B

Etymology: From Latin '*cuneiformis*' meaning 'cuneiform', in reference to the wedge-shaped humeral veinlet in the forewing.

Holotype: OMNH TI 530 (part only), Osaka Museum of Natural History (OMNH), Osaka City, Osaka, Japan. A nearly completely preserved specimen in dorsal aspect.

Locality and age: Nova Olinda Member, Crato Formation; Araripe Basin, Ceará State, northeastern Brazil. Late Aptian, Early Cretaceous.

Diagnosis: Pronotum elongate, three times longer than wide. Forewing elongate, length/width ratio 3.3; humeral veinlet apparently stout and cuneiform; RP divided into nine branches. Hind wing long, 0.7 of forewing length; A1 with once branche.

Differential diagnosis: The new species differs from *K. breviptera* by length of pronotum (6.2 mm in *K. cuneiformis* vs ca. 3 mm in *K. breviptera* Martins-Neto, 1997: pl. 2.E). *K. cuneiformis* can be distinguished from *K. borschukewitzi* by the number of branches of A1 and the number of cross veins between CuA and A1 of hind wing (onece and one crossvein in *K. cuneiformis*, twice and two crossveins in *K. borschukewitzi*). *K. cuneiformis* can be separated from *K. leilana* by length/width ratio of forewing (3.3 in *K. cuneiformis*, while 2.8 in *K. leilana*). Finally, *K. cuneiformis* can be distinguished from *K. longicollis* by numbers of RP branches of forewing (nine in *K. cuneiformis* whereas 12–13 in *K. longicollis*).

Description: Sex unknown. Body, length 26 mm as preserved (measured from vertex to apex of abdomen). Head incompletely preserved. Antennae lost or unvisible. Pronotum elongate, slightly widened at posterior portion, length 6.2 mm, 3.1 times longer than width. Mesothorax poorly preserved, large and rounded, 3 mm long and 3.8 mm wide. Metathorax poorly preserved, short, 1.4 mm long and 3 mm wide. Legs not entirely preserved. Foreleg with long femur and tibia, slender; both about 5 mm as preserved. Mid/hind leg with long tibia; 8 mm as preserved, claws distinct.

Forewing elongate-oval, rounded apex, 28 mm long, 8.4 mm wide (length/width ratio 3.3). Costal space narrow, composed of 35 cells, humeral veinlet stout and apparently cuneiform in shape with slightly semi cylindrical (Fig. 3b), all subcostal veinlets simple, pterostigma preserved. Sc fused with RA distad, veinlets of Sc + RA simple, three veinlets connected by crossveins. Subcostal space very narrow, crossvein not detected. Stem of RP straight, origin inclined at acute angle to RA. RA space (between RA and RP) broadest at proximal third, narrowed distad, with 20 (right wing) and 17 (left wing) cells. RP divided into nine zigzagged branches, forked only marginal forks. Radial crossveins numerous, forming irregular gradate series, partly reticulate. No crossvein between stem of RP and M. M basally fused with R nearly humeral veinlet, divided into MA and MP; MA arched, slightly zigzagged distally; MP slightly zigzagged. Basal crossvein m-cu located slightly distal to origin of M. Cu originated at wing base, divided into CuA and CuP at basal crossvein m-cu; CuA straight proximally, connecting stem of MP and first intramedian cell (im), strongly zigzagged distally with terminal branches; CuP relatively short, with terminal fork; two crossveins between CuA and CuP. Anal vein poorly preserved, two crossveins between CuP and A1.

Fig. 1. *Karenina cuneiformis* sp. nov., holotype, OMNH TI 530 (part). – Scale: 10 mm.

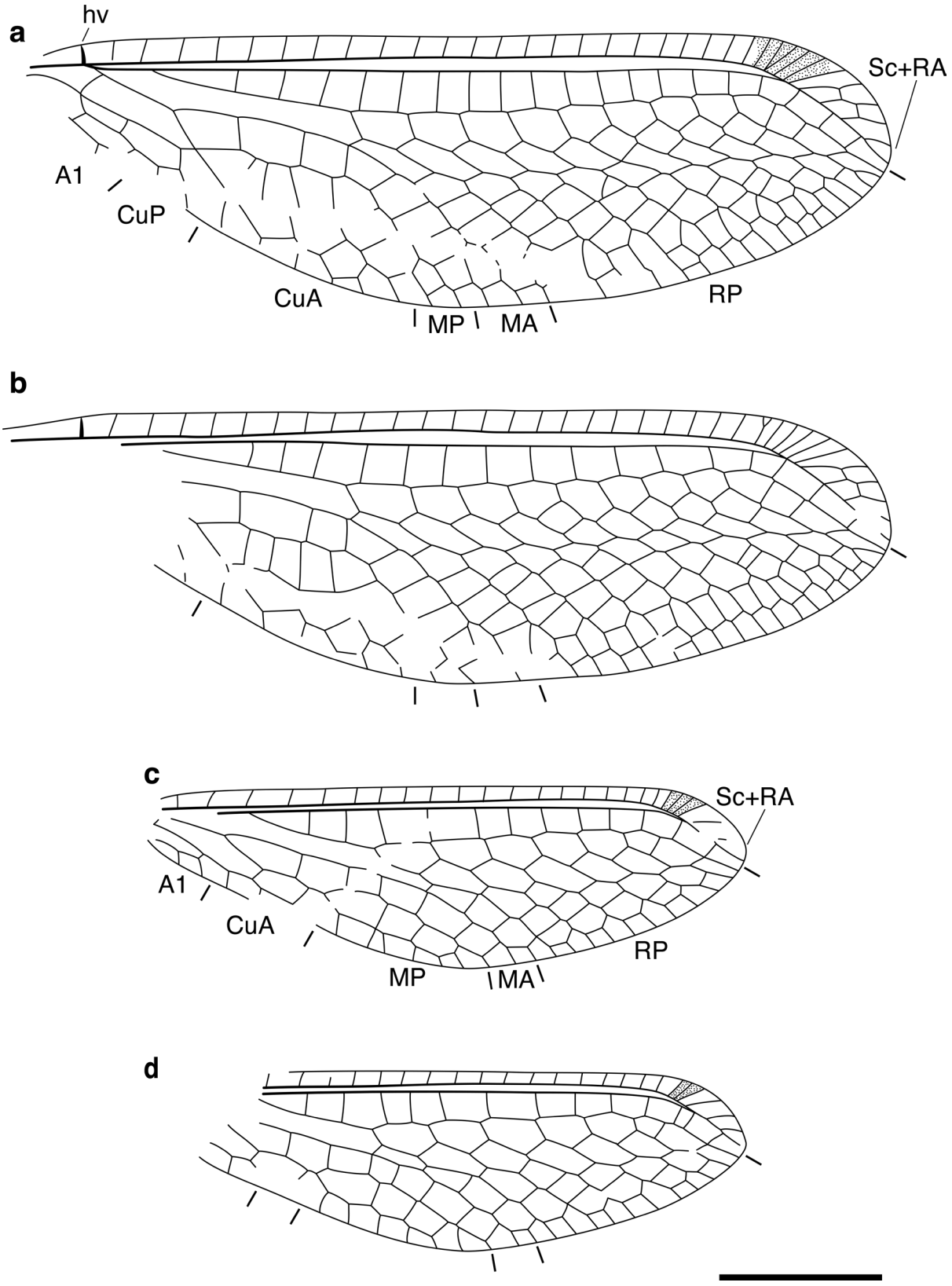

Fig. 2. *Karenina cuneiformis* sp. nov., wing venation of the holotype OMNH TI 530; **a**: right forewing; **b**: left forewing; **c**: right hind wing; **d**: left hind wing. – Scale: 5 mm, all wings to the same scale.

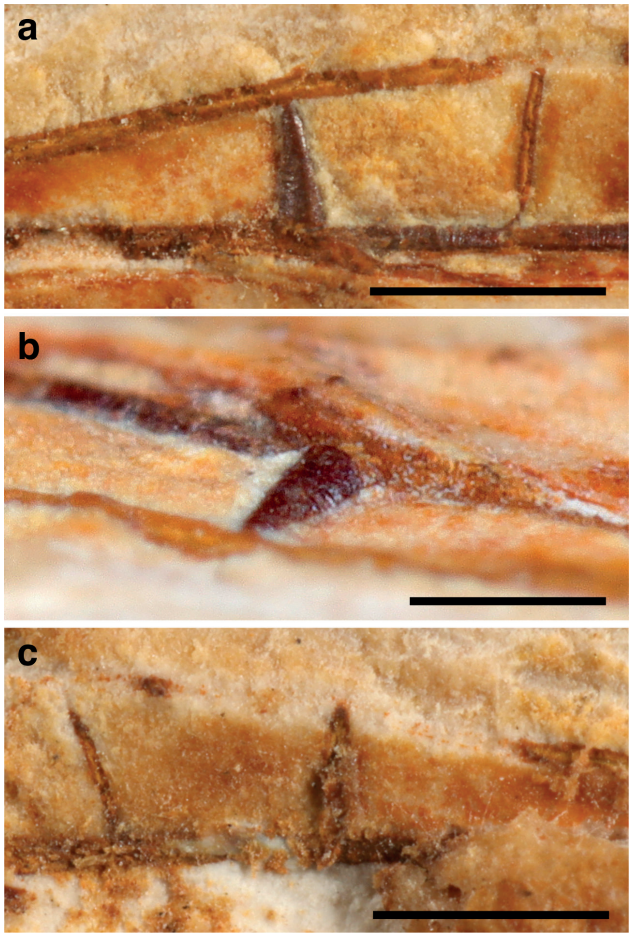

Fig. 3. *Karenina cuneiformis* sp. nov., humeral veinlet of the holotype OMNH TI 530; **a**: right forewing; **b**: anterodorsal view of right forewing; **c**: left forewing. – Scales: (a, c) 1.0 mm; (b) 0.5 mm.

Hind wing elongate-oval, sub-acute apex, 20 mm long, 5.7 mm wide (length/width ratio 3.5). Costal space narrowed, composed of 24 cells, all subcostal veilets simple, pterostigma preserved. Sc fused with RA distad, veinlets of Sc + RA simple. Subcostal space very narrow, crossvein not detected. Stem of RP straight, origin inclined at acute angle to RA. RA space broadest at proximal third, narrowed distad, with 13 (right wing) and 14 (left wing) cells. RP divided into six zigzagged branches. Radial crossveins forming two regular gradate series in anterior area, whereas forming irregular gradate series in posterior area. No crossvein between stem of RP and M. M originated at wing base, divided into MA and MP; MA arched, slightly zigzagged distally; MP deeply forked, slightly zigzagged. Area between M and Cu with at least three crossveins, basal crossvein poorly preserved. CuA originated at wing base, almost straight. CuP absent. Only A1 preserved, forked terminally, at least one crossvein between CuA and A1.

4. Discussion

The most peculiar morphological character in *Karenina cuneiformis* sp. nov. is the apparently stout, cuneiform humeral veinlet of the forewing. All described Mesochrysopidae have simple (i.e., non-recurrent, unbranched) humeral veinlets (Makarkin et al. 2013: fig. 7), most of which are thin and crossvein-like. In all species of the genus *Karenina* except *K. cuneiformis* sp. nov. the humeral veinlet has been depicted as either thin and simple or the base of the forewing is not or poorly preserved and it cannot be detected. However, in a personal communication, Dr. Makarkin states: "The humeral veinlet in the holotype of *K. longicollis* is also stouter, but this fact was not mentioned in the paper of Makarkin & Menon (2005). However, this thickening of the humeral veinlet in *K. longicollis* appears to be slightly less developed than that in *K. cuneiformis* sp. nov." Although the evolutionary background and the functional significance – if any – of a thick, wedge-shaped humeral veinlet such as that allegedly present in *K. cuneiformis* sp. nov. are unknown, the discovery of further diversity of the Mesochrysopidae might shed light on this matter.

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