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A new species of Cyrtophyllitinae (Insecta: Ensifera) from the Cretaceous China

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ABSTRACT

A new fossil species of Cyrtophyllitinae, *Vitimoilus ovatus* sp. nov., is described from the Dabeigou Formation and Yixian Formation of the Lower Cretaceous of China. It is clearly placed in *Vitimoilus* Gorochov, 1996 according to the following characters: R forking into RA and RP distally, M forking into MA and MP distally; CuA fused with CuPaα distal of the middle of the wing length; cross-veins in basal part of CuPb–CuPaβ area non-strongly curved.

1. Introduction

The family Haglidae, a major constituent of the Hagloidea, existed from the Triassic to Cretaceous but flourished from the Triassic to the Middle Jurassic (Gorochov, 1986); (Rasnitsyn and Quicke, 2002). Species of this extinct family were plentiful and diverse, which classified into 8 subfamilies: Haglopterinae Gorochov 1986, Haglinae Handlirsch 1906, Isfaropterinae Martynov 1937, Triassaginae Gorochov & Maehr 2008, Voliopinae Gorochov 1986, Bachariinae Gorochov 1988, Angarohaglinae Gorochov 1995 and Cyrtophyllitinae Zeuner 1935 (Gorochov, 1995); (Gorochov and Maehr, 2008). However, the family Haglidae seems to be a paraphyletic group in a cladistic analysis by Béthoux and Nel (2002). In contrast to their record elsewhere, haglid insects are not very diverse in the Mesozoic of China. Historically, there are only 12 species have been ascribed to the Haglidae (Haglinae) from China (Lin, 1965; Hong, 1982a, 1982b, 1983; Ren et al., 1995; Wang and Liu, 1996; Gu et al., 2012a; Gu et al., 2012b). Among them, the species *Hebeihagla songyingziensis* Hong, 1982b has been considered as a synonym of *Parahagla sibirica* Sharov, 1968 within the subfamily Chifengiinae; all the species of *Alloma* Hong, 1982a has been transferred to Chifengiinae of Prophalangosidae (Gu et al., 2010). Only three species, *Isfaroptera*? *yujiagouensis* Hong, 1983, *Liassophyllum caii* Gu, Qiao et Ren, 2012, *Archaboilus musicus* Gu, Engel et Ren, 2012, described from the Middle Jurassic of China show clearly diagnostic characters of Haglidae. Most of the rest probably belong to the family Prophalangopsidae due to their wing venation patterns, but they need further study to settle questions of their familial status.

Currently, there are five genera assigned to the subfamily Cyrtophyllitinae, including *Archaboilus* Martynov, 1937; *Protohagla* Zeuner 1962; *Cyrtophyllites* Oppenheim, 1888; *Tasgorosailus* Gorochov, 1990 and *Vitimoilus* Gorochov, 1996, (Zeuner, 1939; Gorochov, 1988, 1990, 1995, 1996). In this contribution, a new species of Cyrtophyllitinae is described. They were collected from the Dabeigou Formation and Yixian Formation of the Lower Cretaceous.

2. Materials and methods

All collections described in this contribution were examined with a Leica MZ12.5 dissecting microscope. The photographs were taken using a Canon EOS 550D digital camera coupled to a Canon 50 mm macro lens. Line drawings and figures were prepared with

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Adobe Illustrator 6 and Photoshop CS5 software. The specimens are housed at the Key Lab of Insect Evolution & Environmental Changes, Capital Normal University (CNU), Beijing, China.

The wing venation nomenclature used in this paper is based on the interpretation of Bèthoux & Nel (Béthoux and Nel, 2001, 2002). Corresponding abbreviations are: ScA, anterior subcosta; ScP, posterior subcosta; RA, anterior radius; RP, posterior radius; MA, anterior media; MP, posterior media; CuA, anterior cubitus; CuP, posterior cubitus; CuPaα, the anterior branch of first posterior cubitus; CuPaβ, the posterior branch of first posterior cubitus; CuPb, the second posterior cubitus. The term 'handle' describes a strong cross-vein appearing as a main vein.

3. Systematic palaeontology

Order Orthoptera Olivier, 1789
Suborder Ensifera Chopard, 1920
Superfamily Hagloidea Handlirsch, 1906
Family Haglidae Handlirsch, 1906
Subfamily Cyrtophyllitinae Zeuner, 1935

Genus *Vitimoilus* Gorochov, 1996

Revised diagnosis. Forewing broad oval and large size; area between anterior margin and ScA with numerous weak veinlets; ScP undulated with numerous branches; R forking distally; M forking into MA and MP distally, at the level of the mid-length of wing; CuA fused with CuPaα distal of the middle of the wing length (main diagnostic trait); cross-veins in basal part of CuPb–CuPaβ area non-strongly curved (main diagnostic trait).
Species included. *V. captiosus* Gorochov, 1996 (the type species), *V. ovatus* sp. nov.

Vitimoilus ovatus sp. nov.
Figs. 1–3

Materials. Holotype: male, CNU-ORT-HF2010004PC
Paratype: male, CNU-ORT-LJ2011045PC
Etymology. From the Latin *ovatus*, refers to its oval wing shape.
Horizon and locality. Holotype: The Dabeigou Formation, Lower Cretaceous, Fengning county, Hebei province, China. Paratype: The Yixian Formation, Lower Cretaceous, Jianchang County, Liaoning province, China.
Diagnosis. Large size; forewing broad and oval shape; R forking relatively early and at the level of the divergence of M; RP obviously curved towards anterior wing margin basally; free M extremely short; basal part of MP strongly directed towards posterior margin, then bends to wing apex.
Description.

General description: Forewing broad oval and large size, length 55–73.7 mm, width 26.1–36.4 mm. Area between ScA and anterior wing margin with numerous weak veinlets which connected by a lot of small and dense cells; ScA long and curved, very closed to anterior margin; area between ScA and ScP distinctly broad; ScP long and slightly undulate, its branches numerous and with a secondary vein between them, formed by two rows of regular cells; ScP reaching anterior margin at about 3/4 length of wing; stem of R long and slightly curved, forking into RA and RP at the level of the divergence of M; RA and RP pectinately branching, RP branching late, area between RA branches with a series of simple and straight cross-veins; stem of RP obviously curved towards anterior margin, first branch of RP curved towards posterior margin; a row of straight cross-veins regularly arranged between ScP and R, and also between RA and RP; M + CuA separate into M and CuA slightly basal of divergence of R; area between radius and medial slightly expanding to the distal portion; area between base of RP and base of MA with long and oblique cross-veins closely arranged; free M extremely short, only about one-fifth the length of free CuA; M forking into MA and MP distally, at the mid-length of wing; MA slightly undulate, basal part of MP strongly directed towards posterior margin, then bends to wing apex and running parallel with MA; free CuA gently curved; area between M + CuA and CuPaα broad, with most straight and simple cross-veins and several forked cross-veins close to free CuA; free CuPaα extremely long, at least two times long than free CuA and fused with CuA distal of the divergence of M; CuA + CuPaα with 5–6 branches, area between branches with irregular reticulate cross-veins; 'handle' straight, reaching the fusion of CuA and CuPaα; area between CuPaβ and the last posterior branch of CuA + CuPaα broad, filled with a series of

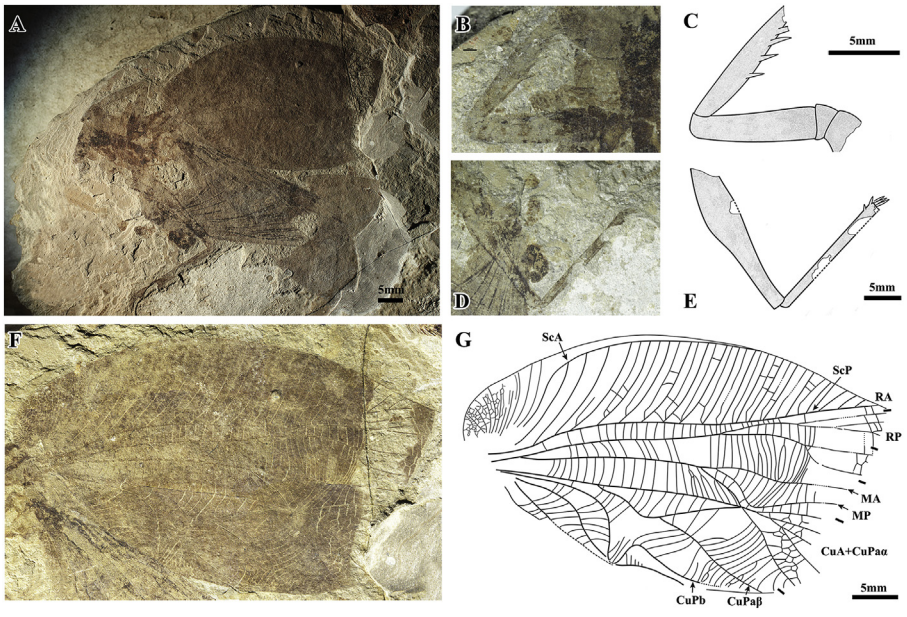

Fig. 1. The holotype of *Vitimoilus ovatus* sp. nov., CNU-ORT-HF2010004PC: A, Photo of habitus; B–C, Foreleg; D–E, Hindleg; F–G, Forewing.

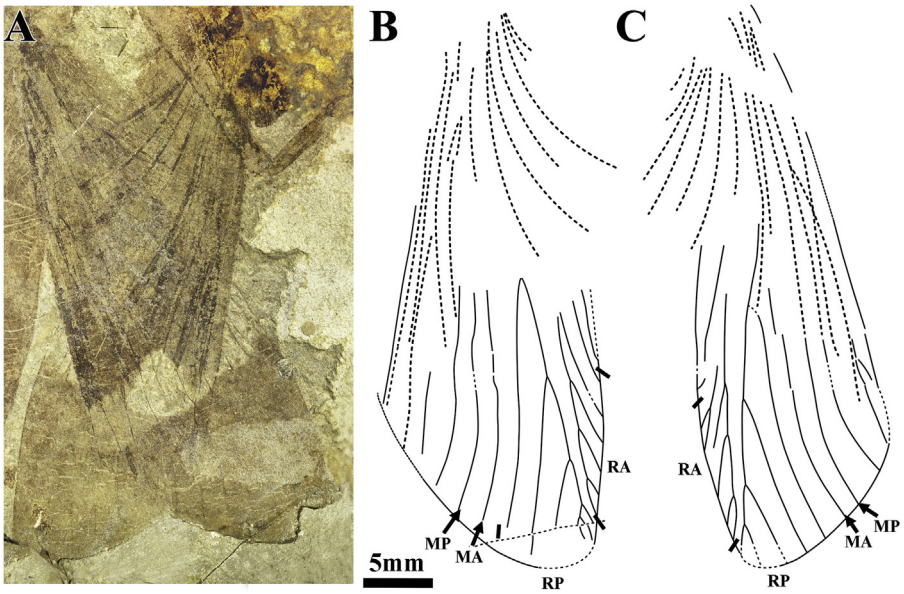

Fig. 2. A–C, Hindwings of the holotype of *V. ovatus* sp. nov.

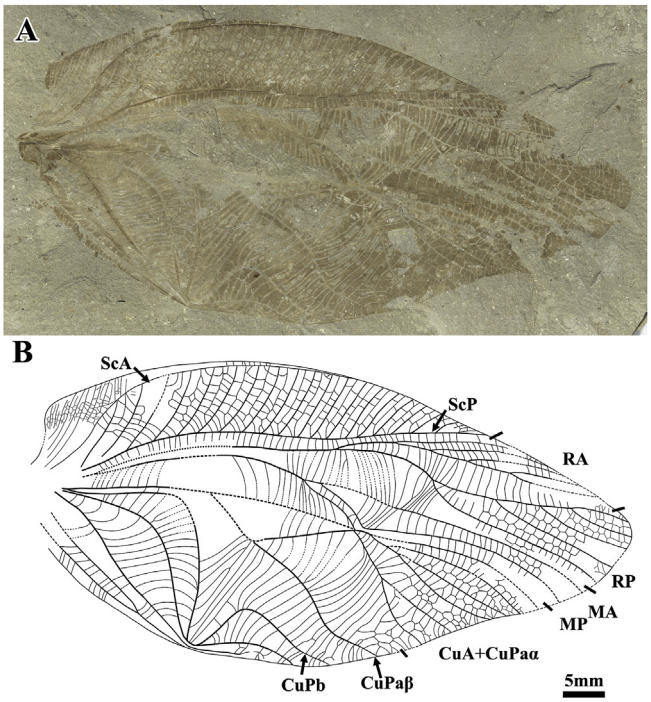

Fig. 3. The paratype of *V. ovatus* sp. nov., CNU-ORT-LJ2011045PC.

slightly curved cross-veins; CuPb long and steeply curved at stridulatory part, bends towards anterior margin after its fusion with anal veins, cross-veins between CuPaβ and CuPb mostly straight.

Specimen CNU-ORT-HF2010004PC (Figs. 1–2): the holotype, well-preserved, negative and positive imprints. **Forewing** preserved length 46.8 mm (the estimated length about 55 mm) and 26.1 mm in width (ScA reaching anterior margin to the opposite); R simple for 25.9 mm long, RA pectinate with 4 branches preserved, RP with 2 branches preserved, RA and RP branching nearly at the same level; M + CuA emits from R basally, and simple for about 20.4 mm long; free M 1.7 mm long; M forking into MA and MP at about 28.0 mm from the wing base; CuA + CuPaα with 5 branches preserved; CuPaβ broken by a long 'handle' vein. **Hind wings** strongly overlapped, about 41 mm long. The venation of hind wing resembles forewing, both RA and RP probably with 6 pectinate branches; MA and MP parallel; cubitus veins not clear by the folding and overlapping, several anal and jugal veins (inferred line) preserved. **Legs:** left foreleg: fore-coxa nearly trapezoid, trochanter slightly triangle, femur 8.9 mm long, tibia preserved with 4 spines ventrally; right hind leg: femur 19.8 mm long in preserved length and 4.6 mm wide (best width), tibia 18.7 mm long with 4 spurs preserved distally, hind tarsus invisible.

Specimen CNU-ORT-LJ2011045PC (Fig. 3), the paratype, a nearly complete single forewing with negative and positive imprints, 73.7 mm long and 36.4 mm wide (ScA reaching anterior margin to the opposite), ratio of length to width about 2; R simple for 37.9 mm, RA pectinate with 5 branches reaching anterior wing margin; RP pectinate with 5 branches, three of them reaching apex and the rest reaching posterior margin, first branch of RP emitting at the level of second branch of RA originating; most area between RP branches covered by regular reticulate cross-veins; stem of M + CuA arched; free M 2.0 mm long; M forking into MA and MP at about 35.7 mm from the wing base; CuA + CuPaα ramified with 6 branches; most area between branches of CuA + CuPaα filled with irregular cells; CuPaβ broken by 'handle' vein and visible part of CuPaβ undulated.

4. Discussion

This new species can be assigned Cyrtophyllitinae by its developed ScA which curved and very close to anterior margin, R forking into RA and RP distally. It can be assigned to *Vitimoilus* Gorochov, 1996 by following combination of characters: forewing oval, basal area between ScA and anterior margin filled by numerous weak and reticular cross-veins, M forking into MA and MP distally, CuA fused with CuPaα distal of the middle of the wing length, cross-veins between CuPaβ and proximal portion of CuPb almost straight. Compared with the type species *V. captious* Gorochov, 1996, the new species *V. ovatus* can be identified by the following characters: large size of forewing, R forking relatively early and close to the divergence of M; RP obviously curved towards anterior

margin basally; area between ScP and RA broad. It also differs from another Chinese cyrtophyllitin species *Archaboilus musicus* by its late divergence of M, broad stridulatory area, non-curved cross-veins between the area of CuPb and CuPaβ.

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