

CORRESPONDENCE

A new species of ice crawlers from Burmese amber (Insecta: Grylloblattodea)

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Abstract Modern grylloblattids are one of the least diverse insect orders. The single extant family is contrasted with 46 families described from the fossil records, which extend to the Late Carboniferous. The most ancient grylloblattid nymphs are known from the Lower Permian. Till now, there is no report on grylloblattid from Burmese amber, which is a very old amber locality. Herein, we describe *Sylvalitoralis cheni* Zhang, Bai & Yang, **sp. nov.** from Grylloblattina based on a nymph specimen from the mid-Cretaceous Myanmar (Burmese) amber.

Key words Grylloblattodea, nymph, Burmese amber, *Sylvalitoralis cheni*, new species.

1 Introduction

Modern grylloblattids (also known as ice bugs, ice crawlers and rock crawlers), all occur northward of about 35° latitude in cool-temperate areas of the United States, Canada, Russia, Japan, Korea and China, and they are restricted to cold and extreme habitats that are difficult to access. They are one of the least diverse modern insect orders. All of the known extant species, which belong to the family Grylloblattidae and five genera, *Galloisiana*, *Grylloblattina*, *Grylloblattella*, *Namkungia* and *Grylloblatta* (Bai *et al.*, 2010; Marshall & Lytle, 2015). The single extant family is contrasted with 46 families described from the fossil records, which extend to the Late Carboniferous (Storozhenko, 1992, 1997; Huang *et al.*, 2008; Aristov & Zessin, 2009; Prokop *et al.*, 2015). The morphology of grylloblattodeans was almost stable with only minor changes during the evolution over 300 million years, in addition to the most significant differences of thorax between extant and extinct members (Bai *et al.*, 2010).

The most ancient grylloblattid nymphs are known from the Lower Permian. Carpenter (1935) recognized three groups of nymphs on the basis of extensive fossil materials from the Artinskian locality of Elmo in the United States (over 80 specimens, comprising 10% of all grylloblattids in this locality). The richest collection of nymphs comes from the Kungurian locality of Tsherkarda, the Middle Urals. Over 250 specimens (approximately 15% of grylloblattids) with the majority belonging to *Kirkorella mira* (family Atactophlebiidae) were reviewed by Aristov *et al.* (2006).

Till now, there is no report on grylloblattid from any amber locality in the world. Herein, we describe *Sylvalitoralis cheni* Zhang, Bai & Yang **sp. nov.** from Grylloblattina based on a nymph specimen from the mid-Cretaceous Myanmar (Burmese) amber.

2 Material and methods

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Received 5 June 2016, accepted 18 July 2016

Executive editor: Fuqiang Chen

2.1 Material and photography

The specimen was obtained from an amber deposit in the Hukawng Valley of Myanmar. The age has been estimated as ca. 99 Ma (98.8 ± 0.6 ; earliest Cenomanian) based on U-Pb dating of zircons from the volcanoclastic matrix of the amber (Shi *et al.*, 2012). The mining locality is at Noiye Bum, near Tanai Village ($26^{\circ}21'33.41''\text{N}$, $96^{\circ}43'11.88''\text{E}$) where many important materials were found including vertebrates and invertebrates (Cruikshank & Ko, 2003; Grimaldi *et al.*, 2002; Bai *et al.*, 2016a, b, c; Boucher *et al.*, 2016; Beutel *et al.*, 2016; Xing *et al.*, 2016). The deposit has been investigated and dated in detail by Cruikshank & Ko (2003) and Shi *et al.* (2012).

The piece of amber containing the specimen was ground and polished to a $20.5 \times 17.1 \times 2.5$ mm cube (0.85 g) and examined with a LEICA MZ 12.5 dissecting microscope with a drawing tube attachment. Photographs were taken using a Nikon D610 digital camera fitted to a Zeiss Stemi 2000-C stereomicroscope and processed in Helicon Focus 5.1 software and lastly Adobe Photoshop CS5® to deal with the images. By merging several photographs of one series, at different focal planes, a single final photograph was created in which the entire sample was in focus.

2.2 Micro-CT scanning and 3D reconstruction

The amber specimen was scanned with an MicroXCT 400 (Carl Zeiss X-ray Microscopy, Inc., Pleasanton, USA) at the Institute of Zoology, Chinese Academy of Sciences. The scan of the entire animal (Figs 2–4) was done with a beam strength of 60 KV, absorption contrast and a spatial resolution of $5.4732 \mu\text{m}$. Based on the obtained image stacks, structures of the specimen were reconstructed and separated with Amira 5.4 (Visage Imaging, San Diego, USA). The subsequent volume rendering and animation were performed with VG Studiomax 2.1 (Volume Graphics, Heidelberg, Germany). Final figures were prepared with Photoshop CS5® (Adobe, San Jose, USA) and Illustrator CS5® (Adobe, San Jose, USA). Resolution was not sufficient for showing setae or spines.

3 Taxonomy

Order Grylloblattodea Walker, 1914

Suborder Grylloblattina Walker, 1914

Family *incertae sedis*

Genus *Sylvalitoralis* Aristov, Novokshonov & Pan'kov, 2006

Sylvalitoralis cheni Zhang, Bai & Yang, sp. nov. (Figs 1–4)

Material examined. Holotype. Currently only one nearly complete specimen is known (No. BU-001678). This nymph male is designated as the holotype of the new species. It is currently housed in the Institute of Zoology, Chinese Academy of Sciences (IZCAS), and will be eventually deposited in the Three Gorges Entomological Museum, Chongqing (specimen available for study by contacting MB or WWZ).

Etymology. This species is named in honor of the late Prof. Sicien Chen (Shixiang Chen), fellow of Chinese Academy of Sciences, former PI for the Group of Morphology and Evolution of Coleoptera, IZCAS. Prof. Chen was the founder and former director of IZCAS, and he made great contributions to entomological research of China.

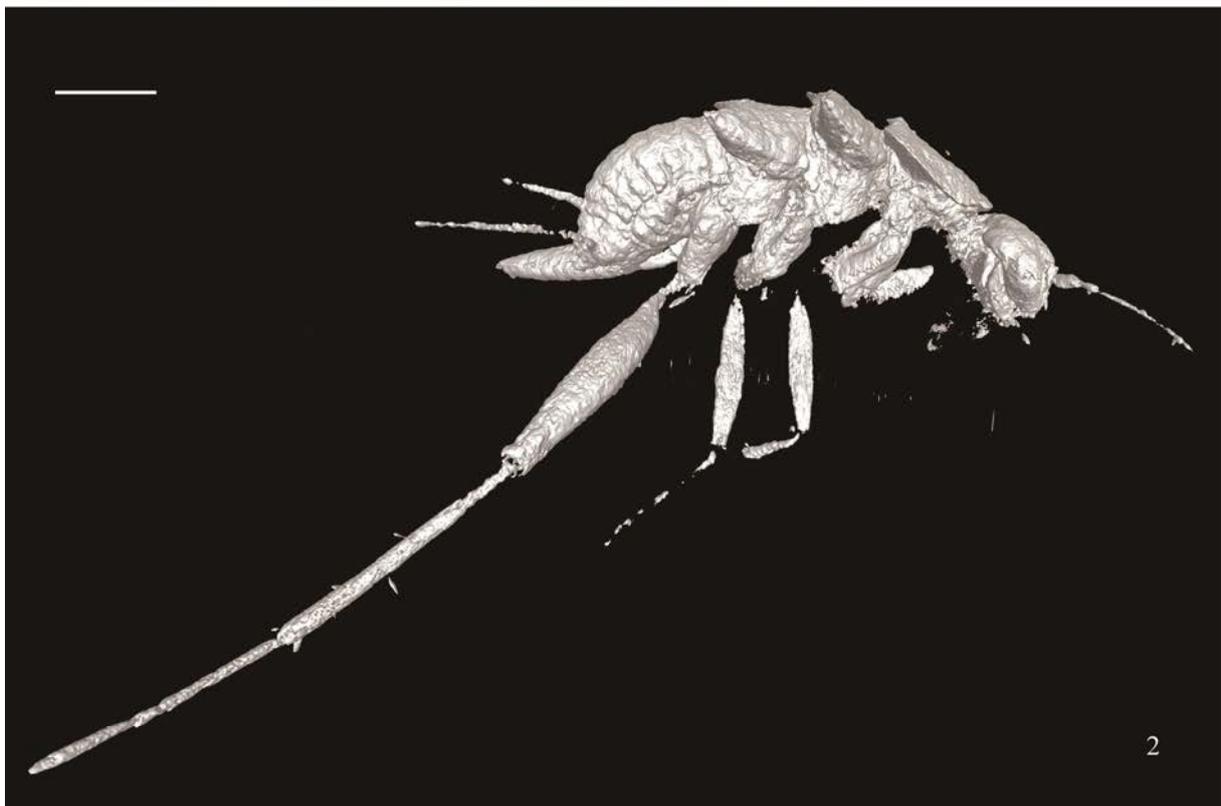
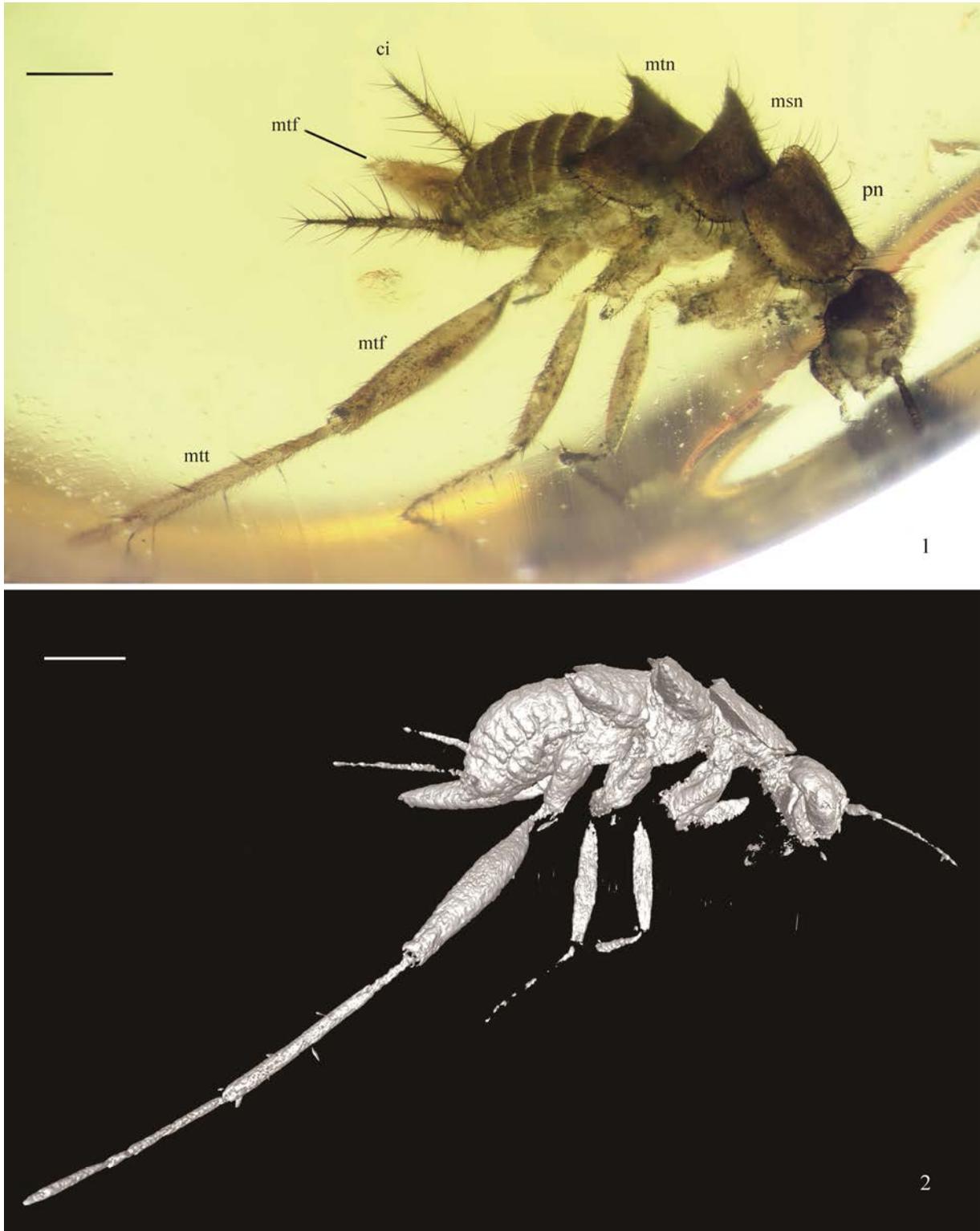
Diagnosis. This new species can be attributed to *Sylvalitoralis* as follows: head large, with thick antennae; pronotum with weak paranota narrowing backward, less than twice as broad as head and as broad as mesonotum; middle and hind tibiae unarmed, directed backward; first tarsomere as long as third; abdominal tergites without paranota. It differs from the known species *Sylvalitoralis* by the shorter antennae, pronotum 0.75 times as long as wide, long legs and stronger metafemur.

Description. Male (holotype). Total body length 4.9 mm (measured from anterior margin of labrum to posterior margin of tenth abdominal segment). Body colored heavy orange-brown on head and thorax, lighter in color on abdominal segments, and covered with numerous short hairs (Fig. 1).

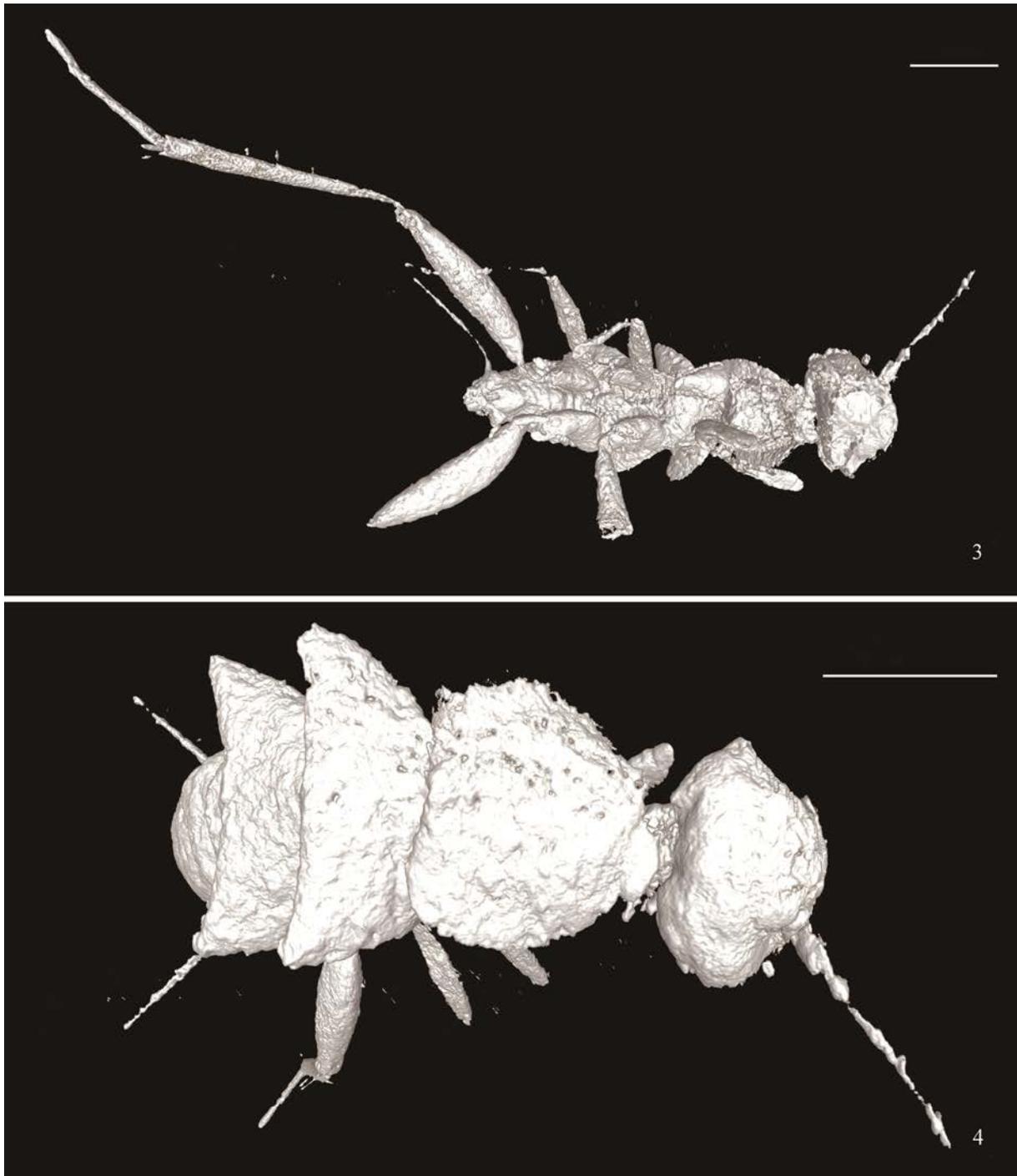
Head attached obliquely to pronotum (Figs 1–4). Cranium wider than long, with short setae on each lateral margin, longer setae around the antennal socket and near eye; epicranial suture partly preserved, not reaching the circumantennal suture. Eyes white, oval in shape (Fig. 1). Antennae shorter than twice of head length, filiform, composed of at least 20 antennomeres, first segment about three times in length of second segment and two times in width.

Pronotum 0.75 times as long as wide, slightly concave in the posterior part, with long setae on the margins. Mesonotum and metanotum obviously concave in the posterior part, with long setae on the margins.

Legs elongate, with many scattered setae. Coxa with scattered setae and distinct ribs on the ventral part. Pro- and mesofemur with two rows of weak setae on the margins of ventral side; metafemur with two rows of long setae on the



Figures 1–2. *Sylvalitoralis cheni* Zhang, Bai & Yang, **sp. nov.**, holotype (No. BU-001678). 1. Habitus photograph, lateral view. 2. 3D reconstructions based on μ -CT data. Abbreviations: ci—cerci; msn—mesonotum; mtf—metafemur; mtn—metanotum; mtt—metatibia; pn—pronotum. Scale bar = 1 mm.



Figures 3–4. 3D reconstructions of *Sylvalitoralis cheni* Zhang, Bai & Yang, **sp. nov.**, holotype (No. BU-001678) based on μ -CT data. 3. Ventral view. 2. Head and thorax, dorsal view. Scale bar = 1 mm.

margins of ventral side. Protibia with dense and thin setae on ventral side; meso- and metatibia covered with many scattered setae, with long setae on outside; two large spines on the apical part of all tibiae. Only right metatarsi (first to third) preserved in the amber, with many long hairs, but the tarsal claws not preserved.

Abdominal tergites with lateral margin flexed to the posterior, 10-segmented, with long setae on the first to eighth tergites. Abdominal sternites with lateral margin flexed to the posterior, without setae. Cercomeres nine, cylindrical, with one ring pattern of setae on the distal part of all cercomeres except the 7th. Male genitalia badly preserved, obviously shrinking and in black color, probably carbonization.

Funding This research was supported by the National Science Fund for Fostering Talents in Basic Research (Special Subjects in Animal Taxonomy, NSFC-J1210002), the Special Fiscal Funds of Shaanxi Province (2013-19), Research Equipment Development Project of Chinese Academy of Sciences (YZ201509), and by a Humboldt Fellowship (M.B.) from the Alexander von Humboldt Foundation.

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