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The early cretaceous orthopteran *Parahagla sibirica* Sharov, 1968 (Prophalangopsidae) from the Jiuquan Basin of China and its palaeogeographic significance

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ABSTRACT

The orthopteran *Parahagla sibirica* Sharov, 1968 is reported based on a male forewing for the first time from the Lower Cretaceous Chijinbao Formation of the Jiuquan Basin, Gansu Province, Northwest China. The diagnosis of the species is revised based on the new specimen. Its palaeogeographic and stratigraphic distributions are discussed, based on which two possible migration paths of the species are indicated as follows: (1) This species initially appeared in northern Hebei and western Liaoning, China at latest in the earliest Aptian, and further migrated northwestwards to Transbaikalia and westwards to Gansu Province soon later (early-middle Aptian). (2) Or alternatively, it originally occurred in Transbaikalia earlier than the Aptian and further migrated southwards to northern China during the Aptian.

1. Introduction

The Jiuquan Basin, one of the major Mesozoic terrestrial basins in Northwest China, is located in northwestern Gansu Province. In the basin, the Lower Cretaceous Xinminbao (Xinminpu) Group consists of the Chijinbao (Chijinpu), the Xiagou and the Zhonggou formations in ascending order (Fig. 1). Since the giant mayfly *Ephemeropsis trisetalis* Eichwald was discovered in the Jiuquan Basin in 1947, numerous fossil insects have been reported from the Lower Cretaceous of this region. Chen and Tan (1973) reported a new coleopteran family, Umenocoleidae, from the Lower Cretaceous of Yumen, Gansu Province, and it was later transferred to the Blattaria (Vršanský, 1999). Hong (1982) described about 50 species of insects in 8 orders from the Lower Cretaceous of the Jiuquan Basin. Ma, Lin, and Shen (1984) and Niu (1987) also reported some typical components of the Jehol Biota from this basin including *E. trisetalis* and the aquatic beetle *Coptoclava longipoda* Ping. Zheng et al. (2015) discovered the dragonfly *Hemeroscopus baissicus* Pritykina from the Zhonggou Formation. However, some of these insects are taxonomically incorrect or their stratigraphic position is uncertain (Zheng et al., 2015). Generally, the Chijinbao Formation is characterized by *E. trisetalis* and *C. longipoda*, the Xiagou Formation by *Coptoclava* sp., and the Zhonggou Formation by *H. baissicus*.

Recently, the authors investigated these strata in Jiuquan and recovered insect fossils from the Chijinbao Formation including caddisfly cases, mayfly and dragonfly nymphs, backswimmers, non-biting mosquitoes and an orthopteran forewing (Fig. 1). The

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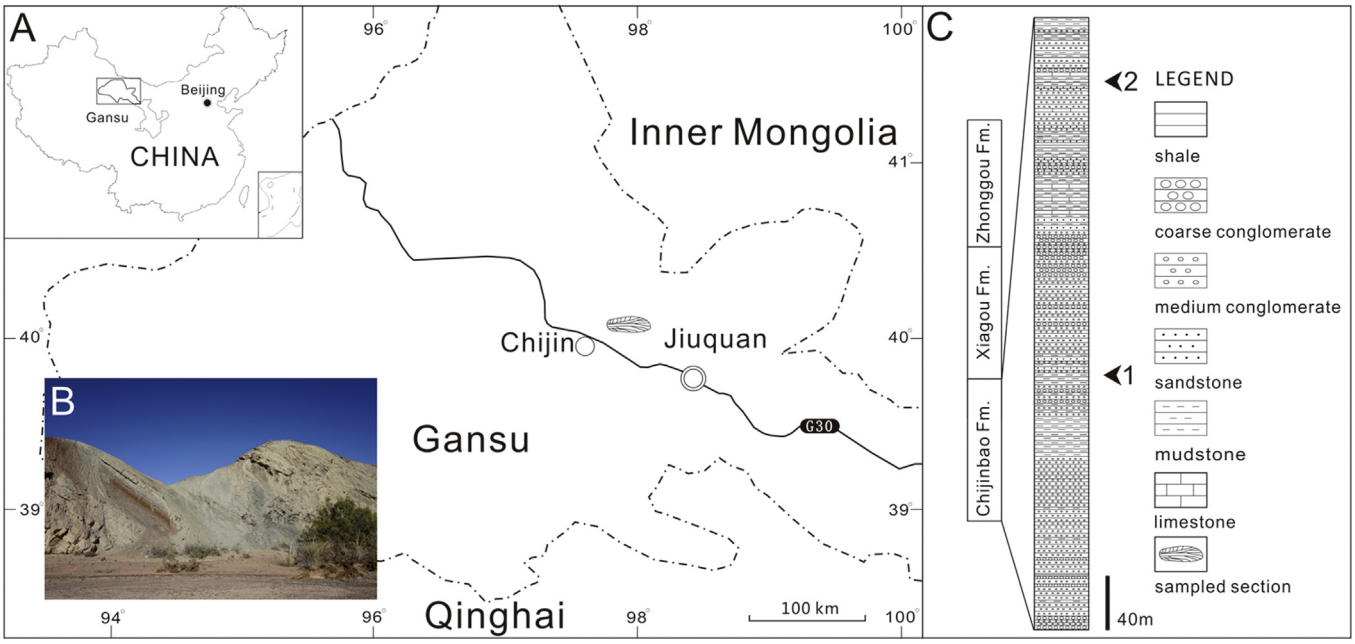

Fig. 1. Geographic and stratigraphic details of the orthoperan *Parahagla sibirica* Sharov. A. Geographic sketch map of Jiuquan City, Gansu Province, China, showing the locality of the Qingquan Section. B. Photo showing the Qingquan Section. C. Stratigraphic column showing the lithology of the Chijinbao Formation and the position (arrows) of the material collected in the Qingquan outcrop. Arrow 1: the position of mayfly nymphs, backswimmers and mosquitos; Arrow 2: the position of *Parahagla sibirica* Sharov, dragonfly nymphs and caddisfly cases.

orthopteran (Figs. 2 and 3) is assigned to *Parahagla sibirica* Sharov, 1968 (Prophalangopsidae) which has a widespread distribution having been previously reported from the Lower Cretaceous of Transbaikalia (Russia) and western Liaoning and northern Hebei (China) (Gu, Qiao, & Ren, 2010; Hong, 1982; Meng & Ren, 2006; Meng, Ren, & Li, 2006; Ren, 1995; Sharov, 1968). The new record of *P. sibirica* in the Jiuquan Basin not only expands its distribution but also provides the opportunity to discuss its migration.

2. Material and methods

The specimen described here was collected from the upper part of the Lower Cretaceous Chijinbao Formation near the village of Qingquan (39°57′ N, 97°39′ E), Yumen City, Gansu Province, China (Fig. 1A). The fossil is preserved as a compression on the surface of grey clayish shales. The Chijinbao Formation unconformably overlies the Jurassic Longfengshan Group and conformably underlies the Xiagou Formation. The lower part of the Chijinbao Formation is composed of darkish-grey, brownish-grey and grey medium conglomerates, intercalated with grey and red coarse conglomerates, grey mudstones and shales. The middle part consists mainly of grey and red coarse and medium conglomerates, intercalated with grey sandstones, greyish-green shales and mudstone lenses. The upper part is made up of greyish-black and grey medium conglomerates and grey mudstones, intercalated with grey sandstones and black carbonaceous shales. The Chijinbao Formation has a total thickness of about 460 m and yields fossil bivalves, gastropods, insects, conchostracans, ostracods, vertebrates, plants and charophytes.

There is no consensus on the interpretation of wing-venation nomenclature of Orthoptera; here we follow that proposed by Zeuner (1939), Sharov (1968, 1971), and amended by Gorochov (1986, 1995). The venational terms used by Béthoux and Nel (2001, 2002) are listed here following the corresponding ones in Gorochov (1995) in parenthesis if any differences are present between the two terminologies: C (ScA), costa; Sc (ScP), subcosta; RA, radius anterior; RS (RP), radial sector; M (M + CuA), media; MA (M), media anterior; MP (CuA), media posterior; Cu (CuPa), cubitus; CuA (CuPaα), cubitus anterior; CuP (CuPb), cubitus posterior; A, analis; 1A, first anal vein; 2A, second anal vein; “handle vein”, special crossvein between CuA_1 and CuA_2.

The specimen was examined dry using a Nikon SMZ1000 stereomicroscope. The photographs were taken using a NIKON D800 digital camera, and the line drawings were compiled by tracing the photographs using the image-editing software CorelDraw X5 and Adobe Photoshop CS. The specimen is deposited at the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences, Nanjing, China.

3. Systematic palaeontology

Order: Orthoptera Olivier, 1789.
Family: Prophalangopsidae Kirby, 1906.
Subfamily: Chifengiinae Hong, 1982.
Genus: *Parahagla* Sharov, 1968.
Type species. *Parahagla sibirica* Sharov, 1968.
Included species. Only the type species.
Parahagla sibirica Sharov, 1968 (Figs. 2 and 3).
1968 *Parahagla sibirica*: Sharov, p.64, Fig. 25 A.
1982 *Hebeihagla songyingziensis*: Hong, pp. 1121–1122, pl.III, Fig. 3, text-Fig. 1.
1995 *Habrohagla curtivenata*: Ren, pp. 63–64, pl.5, Fig. 5, text-Fig. 3–20.
2006 *Chifengia amans*: Meng and Ren, pp. 285–287, Figs. 7 and 8.
2006 *Chifengia angustata*: Meng et al., pp. 753–754, Figs. 3 and 6.
2006 *Chifengia lata*: Meng et al., p. 753, Figs. 2 and 5.
2006 *Grammohagla latibasis*: Meng et al., pp. 754–756, Figs. 7 and 8.
2006 *Grammohagla striata*: Meng and Ren, p. 283, Figs. 1–4.
2006 *Trachohagla jeholia*: Meng et al., p. 752–753, Figs. 1 and 4.