

## SEM morphological study of clam shrimp *Ganestheria* (spinicaudatan) from Upper Cretaceous of Jiangxi, southeastern China

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### Abstract

Morphological re-examination of the specimen of *Ganestheria longnanensis* Bi and Xie from the Upper Cretaceous Zhoutian Formation in Chenglong Village, Longnan County, Jiangxi Province, southeastern China under a scanning electron microscope (SEM) revealed morphological features on the carapace that had not been recognized previously: widely spaced radial lirae on growth bands intercalate large-sized polygonal reticulation, within which small-sized reticulation also occurs.

*Key words:* fossil clam shrimp, taxonomy, Upper Cretaceous, Zhoutian Formation, China.

### Introduction

Bi and Xie (in Chen and Shen, 1982) described the clam shrimp (spinicaudatan) *Ganestheria* from the Ganzhou Formation, which was uplifted to the Ganzhou Group by the Jiangxi Geological Survey in 1994, and containing two formations, i.e. the lower Maodian Formation and the upper Zhoutian Formation. The Zhoutian Formation is composed mainly of variegated siltstone and claystone, intercalated with thin-bedded sandstone, gypsum, salt and conglomerate. The holotype specimen of the type species *Ganestheria longnanensis* Bi and Xie was collected from the Zhoutian Formation in Chenglong Village, Longnan County, Jiangxi Province of southeastern China. Then later *Ganestheria* became an index genus to correlate the Zhoutian Formation with the upper Huizhou Formation in Shexian County of

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Anhui Province because of the occurrence of the genus in both sequences. In this paper a re-examination of a specimen of *Ganestheira longnanensis* under an SEM revealed important morphological features not previously seen, as recorded below.

### Material and methods

The studied specimen is deposited in the collection of the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPCAS). It is an external mould of a left valve, and was originally collected from the Upper Cretaceous Zhoutian Formation in Chenglong Village, Longnan County, Jiangxi Province.

Most of the previous studies on the palaeontology of fossil clam shrimps have used a light microscope. This means that some potential characters of taxonomic value were difficult to see clearly (Li, 2004; Li and Batten 2004, 2005; Li et al., 2004, 2006, 2007a, b, 2009, 2010, 2014, 2015; Li and Matsuoka, 2013). Here the authors have relied on examination of the specimen using a LEO 1530 VP SEM and a Zeiss V20 Stereomicroscope.

### Systematic palaeontology

Class: Branchiopoda Latreille, 1817

Subclass: Phyllopoda Preuss, 1951

Order: Diplostraca Gerstaecker, 1866

Suborder: Spinicaudata Linder, 1945

Superfamily: Lioestheriacea Raymond, 1946

Family: Sinoestheriidea Chen and Shen, 1982

Genus *Ganestheria* Bi and Xie, in Chen and Shen, 1982, emend.

1982 *Ganestheria* Bi and Xie gen. nov., in Chen and Shen, p. 41.

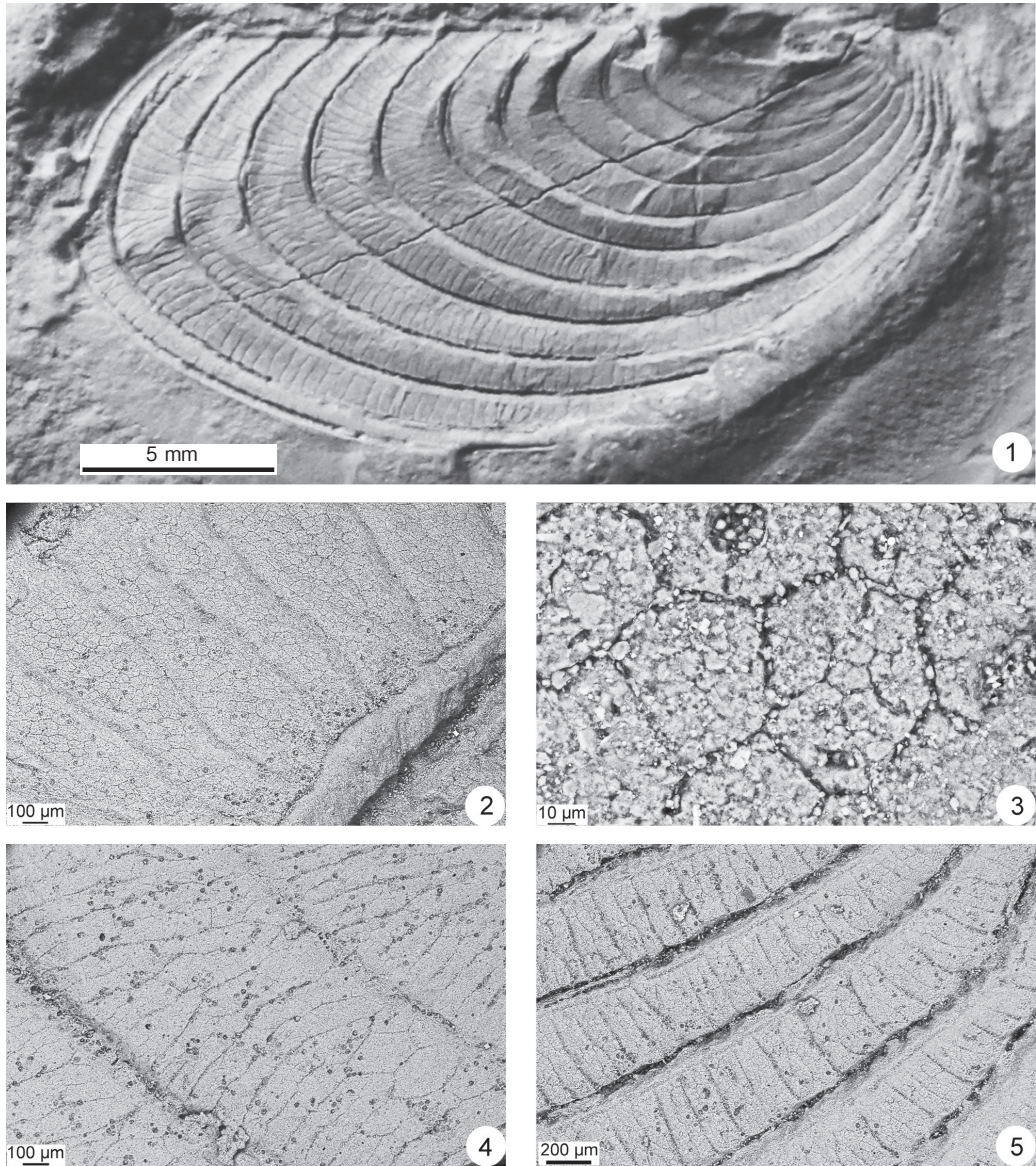
1985 *Ganestheria* Bi and Xie (in Chen and Shen, 1982), Chen and Shen, p. 81.

2014 *Ganestheria* Bi and Xie (in Chen and Shen, 1982), emend., Chen and Shen, p. 445.

*Type species.* *Ganestheria longnanensis* Bi and Xie, in Chen and Shen, 1982

*Occurrence.* Upper Cretaceous Zhoutian Formation, Longnan County, Jiangxi Province; Upper Cretaceous Huizhou Formation, Shexian County, Anhui Province, China.

*Emended diagnosis.* Carapace very large, elliptical in outline; dorsal margin ridge-like and markedly serrated, with spinous apophyses; umbo located between the anterior and median points of the dorsal margin; growth lines stout and convex, posterodorsal part slightly



**Fig. 1.** 1-5, *Ganestheria longnanensis* Bi and Xie, in Chen and Shen, 1982, emend., all, except Fig. 1.1 (a light microscope image), are SEM images of an external mould of a left valve from the Upper Cretaceous Zhoutian Formation, Longnan County, Jiangxi Province. **1**, NIGPCAS 160162. **2**, large-sized reticulation intercalated between widely spaced radial lirae on growth band in the postero-dorsal part of the carapace. **3**, secondary small-sized reticulation occurs within the large-sized polygonal reticulation. **4**, irregular radial lirae on growth bands in the middle part of the specimen. **5**, widely spaced regular radial lirae on growth bands in the antero-ventral part of the specimen.

recurved, with a row of rounded nodes; growth band broad, flattened and few in number, ornamented with widely spaced and regular radial lirae, large-sized polygonal reticulation occurs between radial lirae, secondary small-sized reticulation also occurs within the large-sized reticulation.

*Discussion.* *Ganestheria* was originally described with radial lirae ornamentation only (Bi and Xie in Chen and Shen, 1982). Chen and Shen (2014) described another specimen and recognized that it has markedly serrated ridge-like dorsal margin with spinous apophyses. Now through an SEM re-examination, we have revealed that reticulation occurs between the widely spaced radial lirae.

*Ganestheria longnanensis* Bi and Xie, in Chen and Shen, 1982, emend.

Fig. 1.

1982 *Ganestheria longnanensis* Bi and Xie gen. and sp. nov., Chen and Shen, p. 42, pl. 3, fig. 2.  
2014 *Ganestheria longnanensis* Bi and Xie in Chen and Shen, 1982, emend., Chen and Shen, p. 449, pl. 1, figs. 6–8.

*Material.* External mould of a left valve, NIGPCAS 160162, Chenglong, Longnan County, Jiangxi Province, southeastern China.

*Emended diagnosis.* As the genus.

*Description.* Carapace very large, elliptical in outline, 22.9 mm long, 11.1 mm high; dorsal margin long and straight, ridge-like and markedly serrated, with spinous apophyses; umbo located between the anterior and median points of dorsal margin; anterior height less than the posterior, the greatest height near the median part of the carapace; growth lines stout and convex, slightly recurved at postero-dorsal margin, with a distinct row of rounded nodes, more than 14 in number; growth band broad and flattened, widely spaced radial lirae intercalate large-sized polygonal reticulation, within which small-sized reticulation also occurs.

*Discussion.* Another species of *Ganestheria* has been described from the Upper Cretaceous Huizhou Formation in Anhui Province, i.e. *G. shexianensis* (Zhang, in Zhang et al., 1976) Chen and Shen, 1982. Although it is very similar in outline with *G. longnanensis*, the rounded nodes on growth lines are not visible because of the poor preservation. It is only possible to make a detailed comparison when better preserved specimens are recovered in the future.

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### References

- Chen, P. J. and Shen, Y. B., 1982, Late Mesozoic conchostracans from Zhejiang, Anhui and Jiangsu provinces. *Palaeontol. Sin. New. Ser. B*, **17**, 1-117 (in Chinese with English summary).
- Chen, P. J. and Shen, Y. B., 1985, *Fossil Conchostracans*. Science Press, Beijing, 1-241, 26 pls. (in Chinese).
- Chen, P. J. and Shen, Y. B., 2014, On the family Sinoestheriidae (Crustacea: Diplostraca: Spinicaudata). *Acta Palaeont. Sinica*, **54**, 443-451 (in Chinese with English summary).
- Gerstaecker, A., 1866, Crustacea (Erste Halfe). In Bronn, H. G. ed., Die Klassen und Ordnungen der Thier-Reichs, **5** (Part 1: Arthropoda), 1-1320.
- Latreille, P. A., 1817, *Le Règne Animal, Tome III, Contenant les Crustacés, les Arachnides et les Insectes*. A. Bedin, Paris, 1-653.
- Li, G., 2004, Discovery of *Qinghaiestheria* from the Upper Jurassic Penglaizhen Formation in Sichuan, southwestern China. *Jour. Asian Earth Sci.*, **24**, 361-365.
- Li, G., Ando, H., Hasegawa, H., Yamamoto, M., Hasegawa, T., Ohta, T., Hasebe, N. and Ichinnorov, N., 2014, Confirmation of a Middle Jurassic age for the Eedemt Formation in Dundgobi Province, southeast Mongolia: constraints from the discovery of new spinicaudatans (clam shrimps). *Alcheringa*, **38**, 305-316.
- Li, G. and Batten, D. J., 2004, Revision of the conchostracan genera *Cratostracus* and *Porostracus* from Cretaceous deposits in north-east China. *Cret. Res.*, **25**, 919-926.
- Li, G. and Batten, D. J., 2005, Revision of the conchostracan genus *Estherites* from the Upper Cretaceous Nenjiang Formation of the Songliao Basin and its biogeographic significance in China. *Cret. Res.*, **26**, 920-929.
- Li, G., Hirano, H., Batten, D. J., Wan, X. Q., Willems, H. and Zhang, X. Q., 2010, Biostratigraphic significance of spinicaudatans from the Upper Cretaceous Nanxiong Group in Guangdong, South China. *Cret. Res.*, **31**, 387-395.
- Li, G., Huang, Q. H., Chen, C. R. and Jin, X. X., 2004, Restudy of *Cratostracus songhuajiangensis* from the Upper Cretaceous Qingshankou Formation of Heilongjiang, China. *Acta Palaeont. Sinica*, **43**, 108-111 (in Chinese).
- Li, G. and Matsuoka, A., 2013, Revision of clam shrimp ("conchostracan") genus *Tylestheria* from Late Cretaceous deposits of China. *Sci. Rep., Niigata Univ. (Geol.)*, no. 28, 51-63.
- Li, G., Matsuoka, A. and Willems, H., 2015, SEM morphological study of the clam shrimp type specimens of *Eosestheria sihetunensis* from the Lower Cretaceous Yixian Formation in western Liaoning, northeastern China. *Sci. Rep., Niigata Univ. (Geology)*, no. 30, 27-37.
- Li, G., Shen, Y. B. and Batten, D. J., 2007a, *Yanjiestheria*, *Yanshania* and the development of the *Eosestheria* conchostracan fauna of the Jehol Biota in China. *Cret. Res.*, **28**, 225-234.
- Li, G., Shen, Y. B., Liu, Y. Q., Bengtson, P., Willems, H. and Hirano, H., 2009, Revision of the clam shrimp genus *Magumbonia* from the Upper Jurassic of the Luanping Basin, Hebei, Northern China. *Acta Geol. Sinica*, **83**, 46-51.
- Li, G., Wan, X. Q., Willems, H. and Batten, D. J., 2007b, Revision of the Conchostracan Genus *Tenuestheria* from the Upper Cretaceous Lanxi Formation in Zhejiang and Its Biostratigraphic Significance in Southeast China. *Acta Geol. Sinica*, **81**, 925-930.
- Li, G., Wang, S. E. and Shen, Y. B., 2006, Revision of the genus *Abrestheria* (Crustacea: Conchostraca) from the

- Dabeigou Formation of northern Hebei, China. *Progress in Natural Science*, **16** (Special Issue), 284–291.
- Linder, F., 1945, Affinities within the Branchiopoda with notes on some dubious fossils. *Arkiv för Zoologi*, **37A**, 1–28.
- Preuss, G., 1951, Die Verwandtschaft der Anostraca und Phyllopoda. *Zool. Anzeiger*, **147**, 50–63.
- Raymond, P. E., 1946, The genera of fossil Conchostraca: an Order of bivalved Crustacea. *Bull. Mus. Comparative Zool., Harvard College*, **96**, 218–307.
- Zhang, W. T., Chen, P. J. and Shen, Y. B., 1976, *Fossil Conchostraca of China*. Science Press, Beijing, 1–325 (in Chinese).