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A new species of middle Rhuddanian *Halysites* (Tabulata) from Meitan, northern Guizhou, Southwest China

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Abstract. A new halysitid species, *Halysites gaojiangensis*, is systematically described from the middle Rhuddanian (Llandovery, Silurian) Wulipo Bed at Gaojiang, Meitan County, northern Guizhou Province, Southwest China. It provides new data for further investigation of the tabulate faunal change across the Ordovician–Silurian transition. *Halysites* across the Ordovician–Silurian transition is reviewed and briefly discussed.

Key words: halysitids, middle Rhuddanian, Silurian, Southwest China.

INTRODUCTION

It is known that tabulate corals underwent a significant faunal change across the Ordovician–Silurian transition (Scrutton 1988; Kaljo 1996). However, lack of sufficient material from some key regions (e.g., South China) hinders further investigation of the process and mechanism of this major faunal replacement. Until very recently, Wang et al. (2014) first reviewed the tabulate occurrences in South China through this critical interval and briefly summarized its general macroevolutionary pattern across the Ordovician–Silurian boundary. Nevertheless, systematic descriptions of those tabulates are urgently needed for some further relevant investigations.

The present paper, which is part of such an effort, is to describe a new halysitid species from the middle Rhuddanian Wulipo Bed at Gaojiang, Meitan County, northern Guizhou Province, Southwest China (Fig. 1). The age determination for this bed is based on several lines of evidence (see discussion in Wang et al. 2014). It is worthy of mention that this new species, together with other associated tabulates (e.g., *Propora* and *Paleofavosites*), represents a tabulate fauna of the survival interval after the second pulse of the end-Ordovician mass extinction. Hence, for the first time, it provides a key link to bridge the gap between the coral faunas of the latest Ordovician and early Silurian in South China and enables us to further investigate the survival of corals after the major biotic event.

Biometric methods used in this paper largely follow Young & Elias (1995). The specimens illustrated and discussed here are deposited at Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences.

HALYSITES ACROSS THE ORDOVICIAN–SILURIAN TRANSITION

On the basis of new data from Southwest China and other published data from other regions, *Halysites* across the Ordovician–Silurian transition at species level is summarized and briefly discussed here.

The earliest known definite member of *Halysites* is *H. praecedens* Webby & Semeniuk, 1969 from the lower Katian of New South Wales, Australia (Webby & Semeniuk 1969), which is followed by *Halysites* sp. recorded from the stratigraphically much higher Uralba Beds of New South Wales (Hall 1975). Since then, however, there are very few fossil records of this genus in the latest Ordovician and the earliest Silurian rocks globally until the middle Llandovery. Apart from the middle Rhuddanian *H. gaojiangensis* sp. nov. described here, other reliable records also include (1) another indeterminate species *Halysites* sp. from the upper Hirnantian unnamed limestone in Shiqian County, northeastern Guizhou, Southwest China, which shows great similarity with *H. gaojiangensis* sp. nov. (Wang et al. 2014 and our unpublished data); (2) *H. alexandricus* reported from the late Hirnantian Edgewood coral assemblage of North America (Young & Elias 1995; note that such an age assignment is based on biostratigraphy of many fossil groups, and see Wang (2014) for more detailed discussion); (3) *H. priscus*

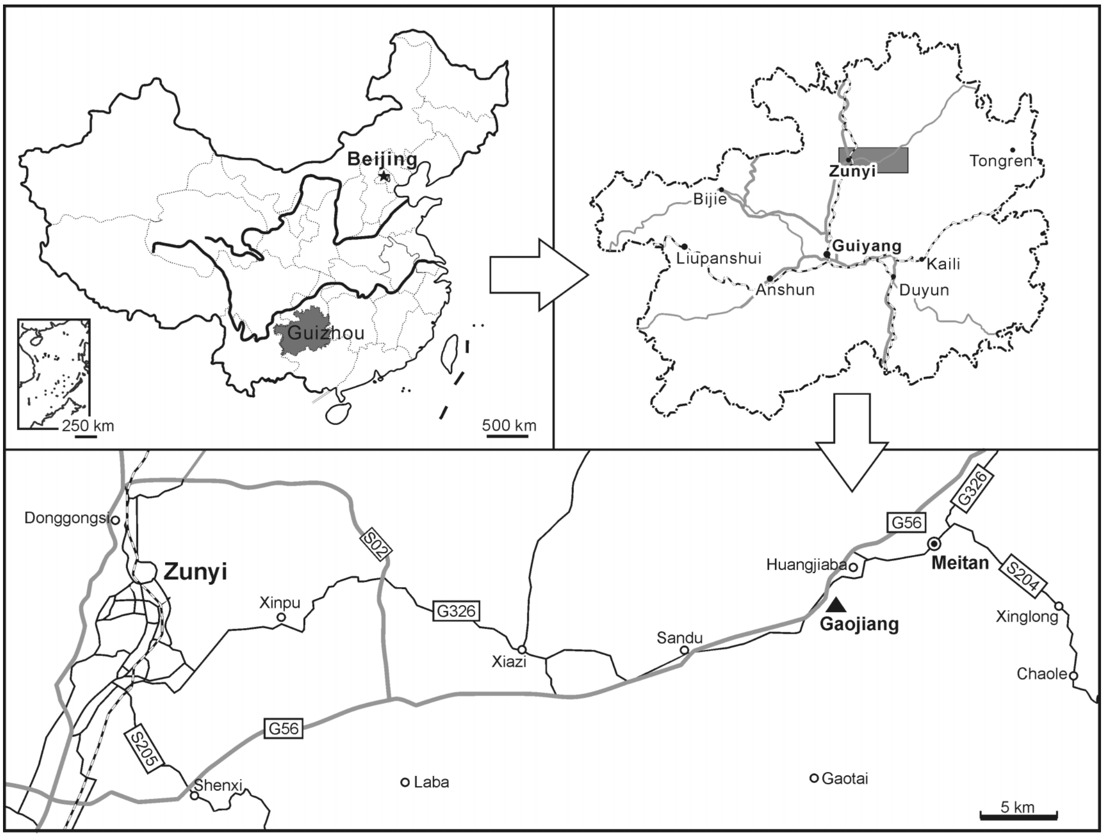

Fig. 1. Locality map of *Halysites gaojiangensis* sp. nov. described in this paper.

Klaamann, 1966 from the Juuru Stage (lower Llandovery) of Estonia.

It should be noted that the age of all but two Katian *Halysites* records from Australia is late Hirnantian or much younger. Thus, the reappearance of *Halysites* in the late Hirnantian is probably related to the improvement of the marine environment after the early–middle Hirnantian glaciation.

SYSTEMATIC PALAEONTOLOGY

Subclass TABULATA Milne-Edwards & Haime, 1850
Order HALYSITIDA Sokolov, 1947
Family HALYSITIDAE Milne-Edwards & Haime, 1849
Genus *Halysites* Fischer von Waldheim, 1828

Type species. *Tubipora catenularia* Linnaeus, 1767; Silurian of Gotland (by monotypy).

Remarks. The present concept of *Halysites* follows Laub (1979), who considered *Schedohalysites* as a junior synonym of *Halysites*.

Halysites gaojiangensis sp. nov.
Figure 2A–R, Tables 1, 2

Derivation of name. After Gaojiang village, Meitan County, northern Guizhou Province where the type locality is situated.

Holotype. NIGP160711, Wulipo Bed (middle Rhuddanian), Gaojiang, Meitan County, Guizhou.

Paratypes. NIGP160712–NIGP160714 (three specimens), all of which were collected from the same locality and horizon as the holotype.

Diagnosis. *Halysites* with extremely long ranks without any junctions or lacunae observed. Corallites commonly 1.29–2.16 mm long and 1.02–1.85 mm wide. Tubules do not occur between every pair of adjacent corallites. Septal spines rare to absent. Tabulae complete, widely spaced, averaging about 6 tabulae in 5 mm.

Description. (See measurements in Table 1 and Table 2). Coralla 56.22–98.19 mm wide and 30.78–47.78 mm high, growth form of coralla tabular or high domical. Corallites arranged in ranks. Ranks extremely long, somewhat parallel, highly curved to gather together, but never to form any junctions or lacunae.

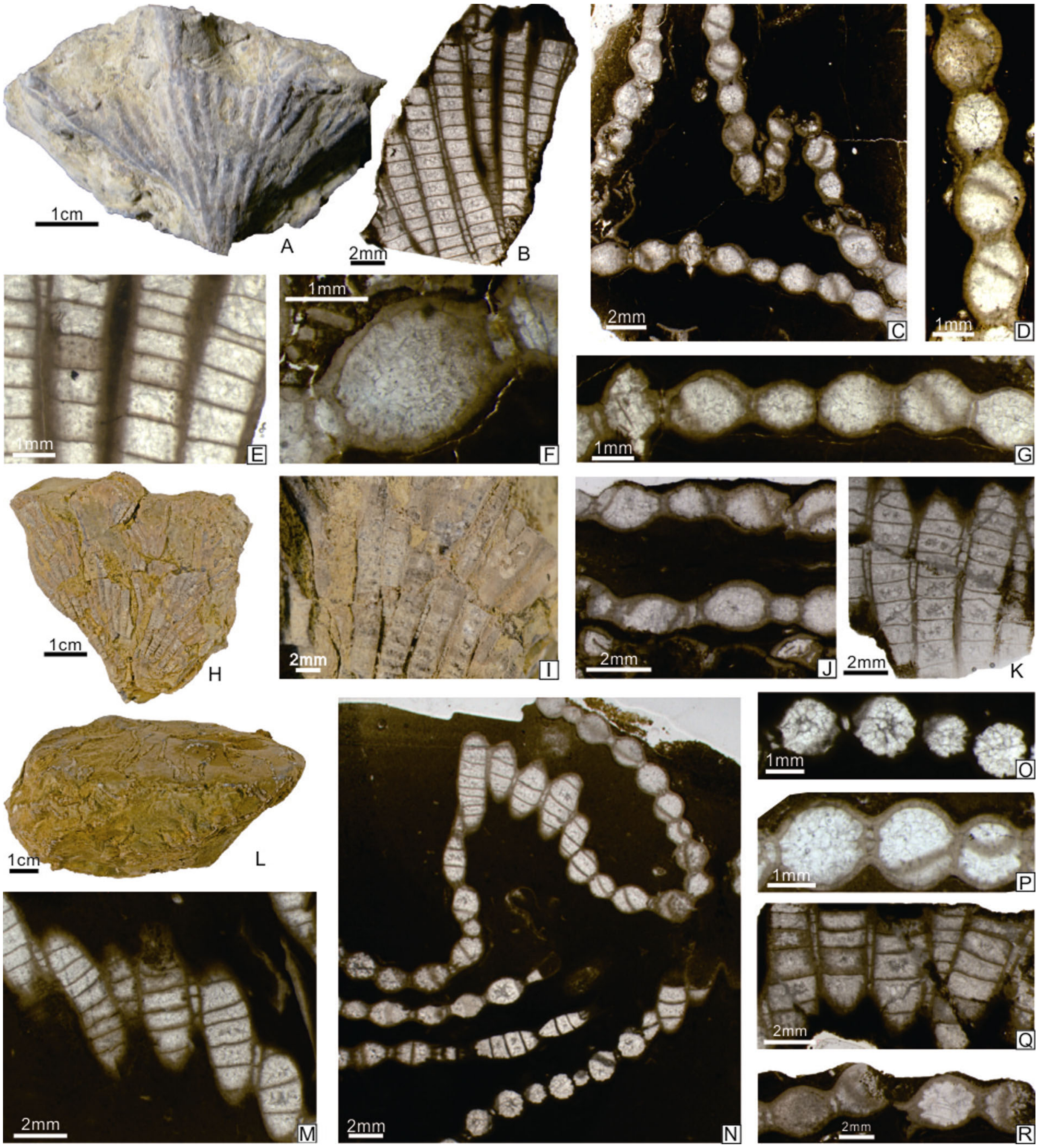

Fig. 2. A–R, *Halysites gaojiangensis* sp. nov. from the Wulipo Bed at Gaojiang, Meitan, Southwest China. A–G, NIGP160711, holotype: A, exterior lateral view of corallum; B, E, transverse section and its local enlargement; C, D, F, G, longitudinal section and its three local enlargements; H–K, NIGP160712, paratype: H, I, exterior lateral view of corallum and its local enlargement; J, K, transverse and longitudinal sections. L–P, NIGP160713, paratype: L, exterior lateral view of corallum; M, longitudinal section; N, O, P, transverse section and its two local enlargements. Q, R, NIGP160714, paratype: transverse and longitudinal sections.

Table 1. Corallum size and shape of *Halysites gaojiangensis* sp. nov. W = corallum width (mm), H = corallum height (mm), M = height to the colony's widest point (mm)

Specimen	W	H	M	Growth form
NIGP160711	70.08	43.73	32.15	High domical
NIGP160712	56.22	47.78	47.78	High domical
NIGP160713	98.19	30.78	–	Tabular

In transverse sections, corallites commonly subovate or subelliptical, generally 1.29–2.16 mm long and 1.02–1.85 mm wide. Corallite walls fibrous, consisting of one layer, thick, ranging from 0.09 to 0.25 mm, average at 0.19 mm. Septal spines horn-like, fibrous, embedded in the corallite wall, rare or absent. Septal length variable, with maximum length 0.17 mm. Tubules do not occur between every pair of adjacent corallites, commonly subrectangular, rarely subquadrate; commonly 0.31–0.65 mm long and 0.08–0.29 mm wide.

In longitudinal sections, tabulae dark in colour, commonly thin and complete, flat or rarely convex, widely spaced, averaging about 5.6 in 5 mm. Tabulae structure indistinct. Tubule tabulae commonly seen, complete, flat or slightly convex, moderately spaced, averaging about 8.8–11.6 in 5 mm. The microstructure of tubule tabulae not distinguishable.

Corallites increase interstitial (between adult corallites in a rank) or lateral (at the end of a rank). Interstitial increase occurs through the expansion of an existing tubule, and new tubules are inserted on either side of each new corallite at a higher level. Lateral increase occurs along the bottom of the new rank, and new tubule is inserted above the base.

Discussion. The new species belongs to the *Halysites* species group whose tubules do not occur between every pair of adjacent corallites, all of which are transitional between *Catenipora* and *Halysites*. It remarkably differs from all other species of this group in having extremely long ranks without any junctions and lacunae observed.

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Table 2. Numerical data on *Halysites gaojiangensis* sp. nov. TaL = tabularium length (mm), TaW = tabularium width (mm), TaA = tabularium area (mm^2), TuL = tubule length (mm), TuW = tubule width (mm), WT = wall thickness (mm), LS = length of septa (mm), Ta5 = number of tabulae in 5 mm

	TaL	TaW	TaA	TuL	TuW	WT	LS	Ta5
Minimum value	1.29	1.02	1.2	0.31	0.08	0.09	0	5
Maximum value	2.16	1.85	2.26	0.65	0.29	0.25	0.17	7
Range of means	1.65–1.74	1.37–1.33	1.72–1.74	0.46–0.53	0.16–0.22	0.16–0.17		5.2–6.8
Mean value	1.68	1.31	1.73	0.50	0.19	0.166		5.8
Measurements	54	54	54	28	28	56		19
Specimens	4	4	4	4	4	4	4	4

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