

# Discovery of sponge body fossils from the late Meishucunian (Cambrian) at Jinsha, Guizhou, south China<sup>\*</sup>

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**Abstract** Here we report discovery of a sponge body fossil *Triticispongia* sp. from the base of lower Cambrian Niutitang Formation at Jinsha, Guizhou. Stratigraphically, the fossil horizon is located below Ni-Mo ore layer with the Niutitang Biota above, and is equivalent to the late Meishucunian. The species is global in shape with skeletons composed of stauractins and monaxons. *Triticispongia* sp. reported here may be the earliest sponge body fossils of Cambrian, which provides new information for understanding early evolution and radiation of sponge animals.

**Keywords:** sponges, Cambrian, Niutitang Formation, Guizhou, China.

Since abundant sponges and large bivalved arthropods from the lower Cambrian Niutitang Formation at Sancha, Dayong, Hunan Province were discovered<sup>[1, 2]</sup>, much attention has been paid to why there are so many fossils preserved in the early Cambrian black shale in this oxygen-deficient environment. During recent years, many well preserved multi-phyla fossils were reported from the early Cambrian black shale not only in Guizhou Province<sup>[3-5]</sup>, but also in western Zhejiang and southern Anhui<sup>[6, 7]</sup>, south China.

Previous studies of systematic description and classification of these fossils from the Niutitang Formation<sup>[1-3, 8-10]</sup>, and from the Hetang Formation<sup>[6, 7]</sup> demonstrated that fossil assemblages in these black shales are characterized by abundant sponge fossils. The well-documented Niutitang Biota from Zunyi area, Guizhou consists of 26 genera, including sponges, coelenterates, mollusks, arthropods, and algae. Sponges in the Niutitang Formation are abundant not only in numbers but also in diversity, numbers of 13 sponge genera make up 70% of the whole biota. According to previous comparisons, many scholars considered that the age of lower limit of Niutitang Biota is earlier than that of the Chengjiang Biota<sup>[3, 5, 8, 11]</sup>. Therefore, Zhao once proposed that the

first radiation of sponges should happen in the Niutitang time interval<sup>[8]</sup>.

Here we report the earliest sponge body fossils located below Ni-Mo ore layer from the late Meishucunian pelitic silicalite, siliceous mudstone at the base of the Niutitang Formation in Jinsha, Guizhou (Fig. 1). Energy-dispersive X-ray (EDX) analysis revealed that the sponge spicules are composed of SiO<sub>2</sub> (Fig. 2).

## 1 Geologic setting

Jinsha is located in the southwest of the Yangtze platform and belongs to Zunyi-Zhijin stratigraphic sub-district<sup>[12]</sup>. The fossils described here are from the lower Cambrian Niutitang Formation at Zhangyangou Village, which is 13km northwest from Yankong Town, Jinsha County, Guizhou Province (Fig. 1). In the ascending order, the section consists of the Dengying, Niutitang and Mingxinsi formations. There is a parallel unconformity between the Niutitang and Dengying formations, but the Niutitang Formation and Mingxinsi Formation is conformably contacted. The section is well exposed and has been regarded as the type section of the Niutitang Formation by Zhang et al. since 1970<sup>[12, 13]</sup>.

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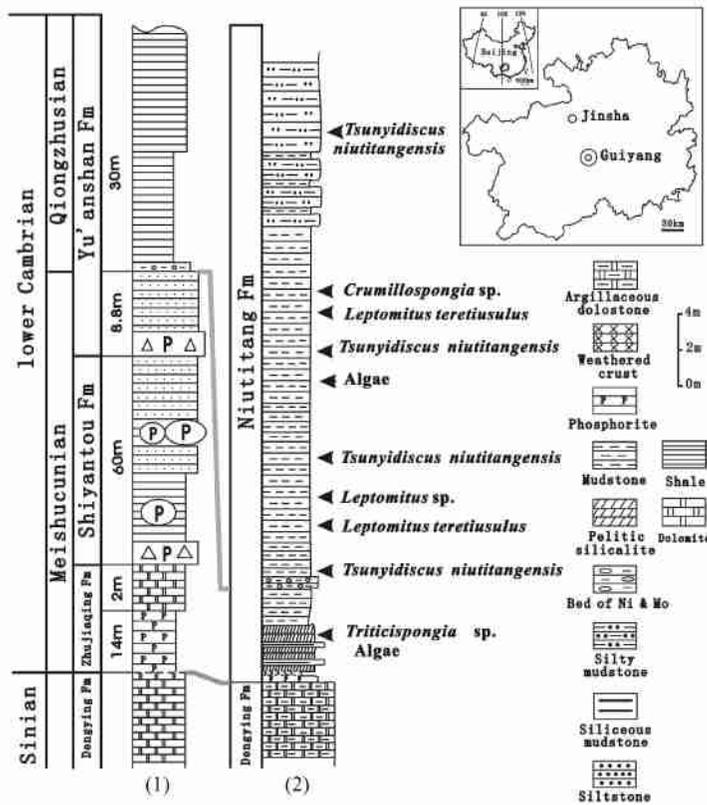


Fig. 1. Generalized stratigraphic log and fossil distribution of the Yankong section in comparison to the well investigated shallow water section of Yunnan. (1) Meishucun section, Jinning County, Yunnan (after Zhu et al.<sup>[14]</sup>); (2) Yankong section, Jinsha County, Guizhou.

Mass original sponge body fossils have been found for the first time in the pelitic silicalite at 2.2 m above the boundary between the Dengying and Niutitang formations (Fig. 1). The fossil horizon is 3 m below the Ni-Mo ore layer and 3.3 m below the lowest horizon of Niutitang Biota. The Niutitang Biota in this section contains abundant *Tsunyidiscus* (Fig. 3) bradoriids, large bivalved arthropods, sponges, and trace fossils.

## 2 Age

The Niutitang Formation is characterized by a diachronous transgressive black shale succession. *Tsunyidiscus* first appeared in the lower part of the Niutitang Formation and becomes abundant in the middle and upper parts of the Niutitang Formation<sup>[13, 15, 16]</sup>. The Chengjiang Biota is known from middle and upper parts of *Eoredlichia* Zone at the middle and upper parts of Qiongzhusian Stage. *Parabadiella* Chang, 1966 and *Mianxiandiscus* (*Tsunyidiscus*) Zhang and Zhu, 1980 were worldwide considered as the oldest one by Zhang<sup>[17]</sup> and collected in the subjacent sediments. Thus the hori-

zon of these trilobites should be the early Qiongzhusian<sup>[11]</sup>. According to correlation of strata, Zhao et al.<sup>[3, 8]</sup>, Yuan et al.<sup>[11]</sup>, Steiner et al.<sup>[5]</sup> and Peng et al.<sup>[16]</sup> considered the age of the lower limit of Niutitang Biota as early Qiongzhusian (*Parabadiella* zone). Therefore the base of the Niutitang Formation is lower than that of the Qiongzhusian Formation in Yunnan<sup>[15, 18]</sup>.

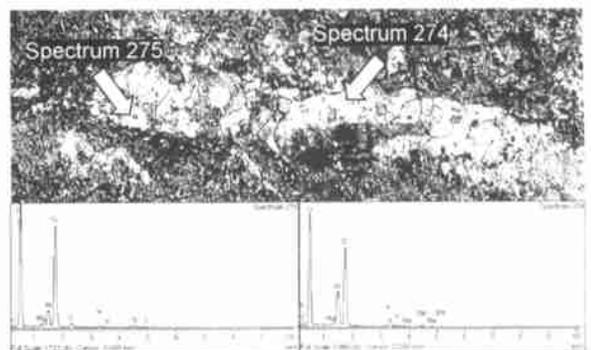


Fig. 2. EDX spectrum of the sponge spicules.

The multi-metal layer rich in Ni and Mo is a stable datum horizon from the lower Cambrian Niutitang Formation in Guizhou Province and neighboring re-

gion. The multi-metal layer (Ni-Mo ore layer) is an event bed and considered as an equivalent time horizon widespread in Yangtze Platform. So it is used as a stratigraphic marker for defining the base of the Qiongzhusian<sup>[14]</sup>, and the marker of the lower limit of the Niutitang Biota, too.

According to the correlations above, phosphates, dark silicalite, siliceous shale with the sponges which are less than 2 m in thickness below Ni-Mo ore bed at the base of the Niutitang Formation represent the sediments of late Meishucunian age.

Only isolate spicules had been reported at the lowermost Cambrian<sup>[19-22]</sup> until abundant sponges

### 3 Systematic paleontology

**Class Hexactinellida Schmidt, 1870**

**Subclass Amphidiscophora Schulze, 1887**

**Order Reticulosa Reid, 1958**

**Superfamily Protospongia Finks, 1960**

**Family Protospongiidae Hinde, 1887**

**Genus *Triticispongia* Mehl et Reitner, in Steiner et al., 1993**

***Triticispongia* sp.**

(Fig. 3, 1, 2, 3, 4, 6; Fig. 4)

**Material:** 50 compressed specimens available for the present study. All are kept at the Museum of Paleontology, Guizhou University.

**Locality and horizon:** Zhangyangou Village, Yankong Town, Jinsha, Guizhou; the base of the lower Cambrian Niutitang Formation.

**Diagnosis:** Global sponges with stauractins and monaxons in various sizes, generally 5 to 10 mm in diameter. The spicules are very fine and range in oblique.

**Description:** The global sponge with skeleton composed of stauractins and scale monaxons in different sizes. Two moderately well-organized spicule series present with rectangular patterns. One series with prominent spicule axes arranged parallel and normal to principal sponge axis and the second somewhat obliquely. Stauractins present two types with different intersected degree. One is 90°, the other is diaxon with 70° (Fig. 4). The larger spicules are 0.02–0.05 mm in width and up to 2 mm in length, mainly distributed on the surface of sponges. The small spicules are 0.003–0.005 mm in diameter and 0.2–0.5 mm in length. Except for stauractins we can find scale monaxons nearly 2–3 mm long.

which were ever regarded as the earliest sponge body remains<sup>[1,23]</sup> from the lower Cambrian Niutitang Formation at Sancha, Dayong, Hunan Province were discovered by Steiner et al. in 1993. But these sponges from Hunan collected above Ni-Mo ore bed directly overlies the dark cherts, and the horizon of them coincides with the horizon of the Niutitang Biota from Songlin, Zunyi and Yankong, Jinsha of Guizhou Province, indicating that previously reported sponge body fossils are not older than Qiongzhusian. So the late Meishucunian sponge body fossils reported here from the base of Niutitang Formation at Yankong, Jinsha may be the earliest sponge body fossils of Cambrian found so far.

**Comparison:** *Triticispongia* sp. is similar to the type species *Triticispongia diagonata*<sup>[1]</sup> of Hunan and specimens of Yunnan<sup>[24]</sup>, because their shape is global and their bodies and spicules are very small. However, the former can be distinguished from the both latter by denser stauractins and presence of scale monaxons.

### 4 Conclusions

(1) The original sponge body fossils from the base of Niutitang Formation, Yankong, Jinsha may be the earliest sponge body fossils of Cambrian so far.

(2) Through analysis of EDX to reveal their composition, and the sponge body fossils are composed generally of SiO<sub>2</sub>.

(3) Most people believed that sponges appeared in late Neoproterozoic<sup>[1,25-30]</sup> and more diverse sponges have been reported in Atdabanian age<sup>[31-33]</sup> or in early Qiongzhusian age<sup>[8]</sup>. The sponge body fossils from the base of Niutitang Formation, Yankong, Jinsha may be a forerunner before the first radiation of sponge, and their discovery provides lots of important information and materials for understanding the early evolution of sponge animals.

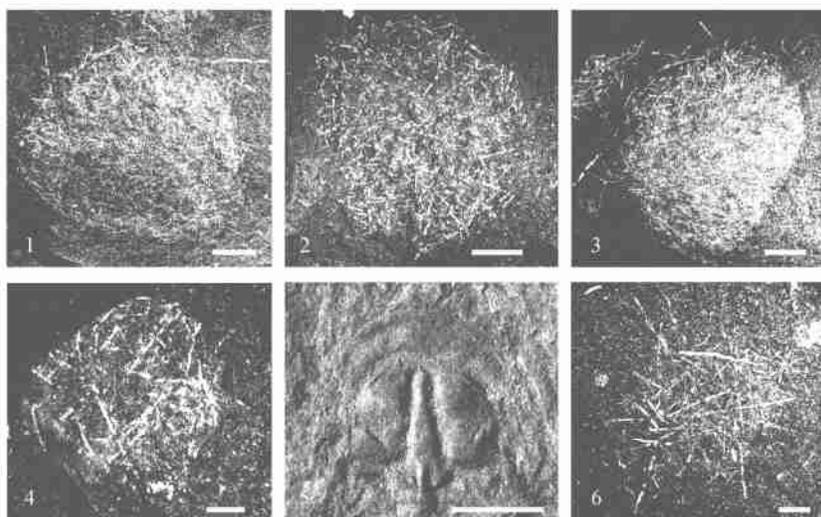


Fig. 3. 1, *Triticispongia* sp., JS-5-67, scale bar = 2 mm; 2, *Triticispongia* sp., JS-2.5-3a, scale bar = 2 mm; 3, *Triticispongia* sp., JS-5-118-1, scale bar = 2 mm; 4, *Triticispongia* sp., JS-2.5-4, scale bar = 2 mm; 5, *Tsunyiidiscus niutitangensis*, JS-5.5-15a, scale bar = 1 mm; 6, *Triticispongia* sp., JS-5-100, scale bar = 1 mm.

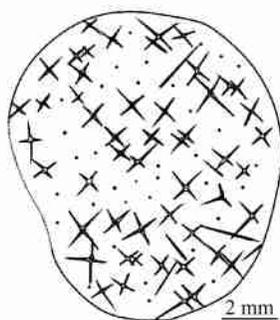


Fig. 4. The sketch of *Triticispongia* sp. (JS-2.5-3a).

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