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ScienceDirect

Palaeoworld xxx (2016) xxx–xxx

Palaeoworld

www.elsevier.com/locate/palwor

Taxonomical and biostratigraphical remarks on the rhynchonellide "*Paurorhyncha*" (Brachiopoda) in the Yidade Formation of eastern Yunnan, China

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Received 18 March 2016; received in revised form 24 June 2016; accepted 5 July 2016

Abstract

Additional specimens of rhynchonellide brachiopods from the marly limestones in the Yidade Formation at the Panxi section in eastern Yunnan have been ascribed to the species "*Paurorhyncha*" *squamosa* Wang, 1956 and "*P.*" *depressa* Wang, 1956. The two species have been used frequently as index fossils for the Frasnian (Upper Devonian), but their taxonomic assignments are problematic because their internal structures remain unknown. In this study, detailed systematical examinations on both external characters and internal structures revealed by serial sections suggest that the two species are more appropriately assigned to the genus *Hadrotatorhynchus* Sartenaer, 1986. Based on the stratigraphical distributions of *Hadrotatorhynchus* and the conodonts in the upper unit of the Yidade Formation, the *Hadrotatorhynchus*-bearing horizons are re-considered as the uppermost Givetian (Middle Devonian) rather than Frasnian stage, although the precise position of the Middle/Upper Devonian boundary still depends on further investigations of high-resolution biostratigraphy.

Keywords: Yidade Formation; Panxi section; *Hadrotatorhynchus*; Rhynchonellide brachiopods; Devonian

1. Introduction

The Yidade Formation overlying the well-known "Nanpanjiang Limestone" at the Panxi section in eastern Yunnan of southwest China has been known for decades (Sun, 1945; Ku, 1949; Wang and Yu, 1962; Fang, 1963; Hou and Xian, 1964; Liao, 1974; Wang et al., 1974, 1982; Xian et al., 1988), but the problems about chronostratigraphic correlation and biostratigraphic distribution of fossil groups occurring in this formation remain unsolved. The formation was assigned primarily to the Frasnian of Upper Devonian, based on the absence of *Stringocephalus*, together with the occurrences of the Upper Devonian brachiopods *Yunnanellina* and *Tenticospirifer* in the upper part of the Yidade Formation (Sun, 1945). However, the characteristic Upper Devonian brachiopods such as *Yunnanellina* and *Tenticospirifer* have rarely been found in the Yidade Formation after Sun (1945). Instead, abundant other rhynchonellide and atrypide brachiopods were reported, but have never been systematically described or figured so far. The Yidade Formation thus became problematic in age determination because neither the Middle nor Upper Devonian characteristic fossils have been formally described by previous workers.

Using two specimens collected from the Yidade Formation, Wang (1956) erected two new brachiopod species ("*Paurorhyncha*" *squamosa* and "*P.*" *depressa*) on the basis of their external morphology, and considered them to be of the Frasnian age. These two species then were extensively used as index fossils for Frasnian in the eastern Yunnan and adjacent areas (Fang, 1963, 2000; Yunnan Compiling Group for Regional Stratigraphic Chart, 1978; Wang et al., 1982; Yunnan Bureau of Geology and Mineral Resources, 1982; Wan, 1983; Xian et al., 1988). Recently, the two species were moved to the genus *Phlogoiderhynchus* by Ma et al. (2006), based on external morphology of other two specimens from the middle part

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http://dx.doi.org/10.1016/j.palwor.2016.07.002
1871-174X/

of the Panxi section, and were ascribed to early Frasnian. Lately, Zhang et al. (2015) suggested the occurrence of the *Phlogoiderhynchus* as the Givetian/Frasnian boundary at the Panxi section, in light of systematic revision work on some leiorhynchid brachiopods in South China.

In spite of the significant biostratigraphical value of the rhynchonellide brachiopods in the Yidade Formation, with the two species of "*Paurorhyncha*" in particular, their systematic status remains unclear. In this paper we aim to present the first detailed taxonomical studies (both external and internal morphology) and attempt to assess the biostratigraphical significance on the basis of our newly collected rhynchonellide brachiopods by the first author from the Yidade Formation at the Panxi section in eastern Yunnan, southwestern China.

2. Geological background and material

Marine sequences of the Middle and Upper Devonian were developed at the Panxi section with great thickness, yielding diverse fossils, including flora, fishes, and abundant corals and brachiopods. The Yidade (or Itate) Formation, referred primarily as the lower member of the Upper Devonian, is exposed near Yutade Village, which is about 7 km away from the Panxi Town (Fig. 1). The formation rests conformably on the Middle Devonian nodular-like limestones and is overlain conformably by the dolomites of Zaijie Formation. The Yidade Formation is distributed in south–north trend and dominated by shales and marls. According to Liao (1974), the Yidade Formation near the Yutade Village is about 432 m thick. Lithologically it can be subdivided into three units. The lower unit, about 129.6 m thick, is composed of grey shales and marls, occasionally interbedded with marly limestones. Shales are gradually reduced upward in the middle unit, and became dominated by limestones in the upper unit. The middle unit is about 93 m thick, and fossils are predominated by rhynchonellide brachiopods. The upper unit is 209.8 m thick and composed mainly of thick-bedded limestones and marly limestones containing abundant atrypide brachiopods.

The rhynchonellide materials reported in this paper were collected from two horizons of the middle unit of Yidade Formation at about 1.2 km northeast of the Yutade Village. The samples contain over hundreds of specimens, in association with a few specimens of *Athyris*, *Emanuella*, and ?*Dielasma*. Most of the rhynchonellides can be ascribed to Camaroechioidea, e.g., *Hypothyridina* sp., *Leiorhynchus* sp., "*Leiorhynchus*" *deprati*, as well as "*Paurorhyncha*" *squamosa* and "*P.*" *depressa*. Considerable specimens assigned to the genus "*Paurorhyncha*" possess well-preserved thick shells, although some of them are partly exfoliated or recrystallized. These thick-shelled forms are commonly well articulated and can be used for studying their detailed external and internal characters and intraspecific variations. Otherwise, less than about one-third of the material consists of relatively poorly-preserved, often fragmentary, thin-shelled specimens.

3. Remarks on the biostratigraphical distribution

Discussions on the age correlation of the Yidade Formation have persisted over a long period, since some Givetian brachiopods, e.g., *Ambocoelia sinensis*, *Atrypa desquamata*, *Hypothyridina parallelepipeda*, have been argued by Wang and Yu (1962) in the lower members of the formation. Although the Yidade Formation has been assigned to the Frasnian in many previous studies and its basal lithological boundary was regarded as the Middle/Upper Devonian boundary (Fang, 2000), there have

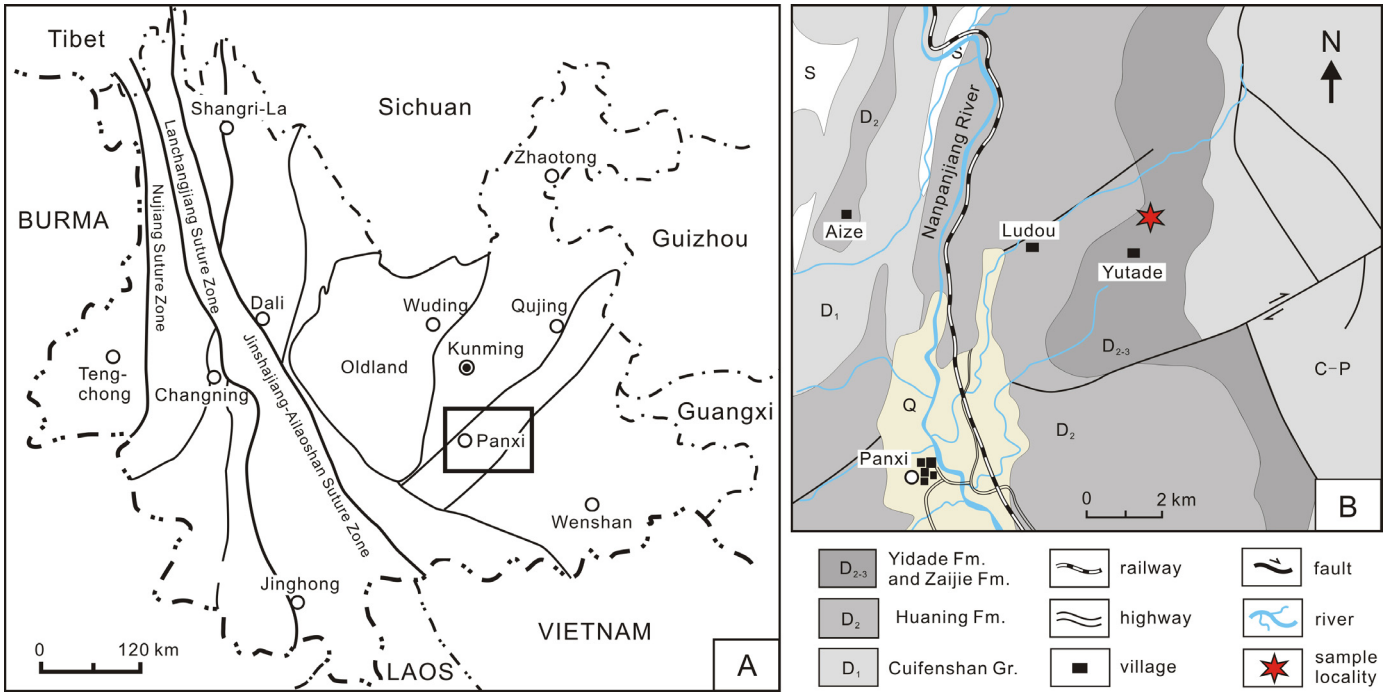

Fig. 1. (A) Geological framework and location of the study area in Yunnan Province (modified from Yunnan Bureau of Geology and Mineral Resources, 1995). (B) Sedimentary distribution in the Panxi area and locality of the fossils.

Please cite this article in press as: Qiao, L., Shen, S.Z., Taxonomical and biostratigraphical remarks on the rhynchonellide "*Paurorhyncha*" (Brachiopoda) in the Yidade Formation of eastern Yunnan, China. Palaeoworld (2016), http://dx.doi.org/10.1016/j.palwor.2016.07.002