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Late Jurassic radiolarians from the Zhongba melange in the Yarlung–Tsangpo suture zone, southern Tibet

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Abstract

The Zhongba melange along the Yarlung–Tsangpo suture zone, southern Tibet, is composed mainly of red bedded chert and sandstone in addition to subordinate mudstone with blocks of augite peridotite, gabbro, basalt, limestone, and chert. The chert from the mélangé yields well-preserved radiolarian fossils that can be assigned to the *Hsuum maxwelli* zone (JR 7) of Kimmeridgian (Late Jurassic) age. This evidence enables the biostratigraphic age determination of this melange. The radiolarian assemblage is older than microfossils previously reported from this melange.

Key words: Radiolaria, melange, Kimmeridgian, Jurassic, Tibet.

Introduction

The Yarlung–Tsangpo suture zone in southern Tibet, which separates Eurasian and Indian continents, has been interpreted as marking the history of the Neo-Tethys Ocean. The former >4000-km-wide Tethys Ocean was closed along the Indus–Yarlung–Tsangpo suture zone during the Cenozoic collision between the two continents (Fig. 1). Much of this oceanic crust was lost or destroyed during its collision and subduction. The application of radiolarian biostratigraphy along this suture zone sheds light on the evolution of the Neo-Tethys Ocean.

Much data about radiolarians from the remnants of the Neo-Tethys Ocean have been reported in many studies: Zedong (Wang et al., 2002; McDermid et al., 2002; Aitchison et al.,

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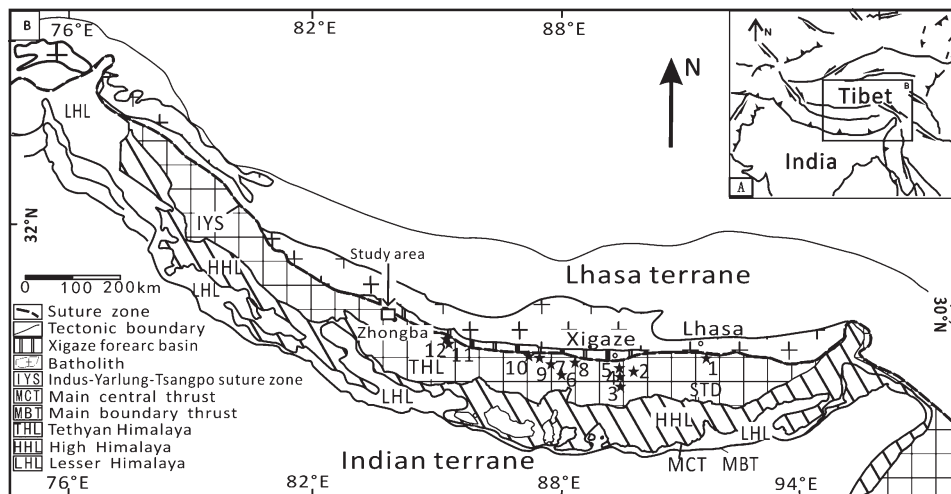


Fig. 1. A map of the Himalayan region showing the location of the Indus, Yarlung–Tsangpo suture zone, and the radiolarian localities.

1. Zedong (Wang et al., 2002; McDermid et al., 2002; Aitchison et al., 2007); 2. Congdu (Wu et al., 1984); 3. Sa'gya (Li et al., 2003); 4. Xialu (Wu, 1993; Matsuoka et al., 2001, 2002, 2005; Ziabrev et al., 2004); 5. Dazhuqu (Ziabrev et al., 2003); 6–10. Zhongbei, Pomunong, Jiding, Tangga and Angren (Zhu et al., 2005); 11. Sangdanlin (Ding, 2003; Ding et al., 2005); 12. Saga (Li et al., 2007).

2007); Congdu (Wu et al., 1984); Sa'gya (Li et al., 2003); Xialu (Wu, 1993; Matsuoka et al., 2001, 2002, 2005; Ziabrev et al., 2004); Dazhuqu (Ziabrev et al., 2003); Zhongbei, Pomunong, Jiding, Tangga and Angren (Zhu et al., 2005); Sangdanlin (Ding, 2003; Ding et al., 2005); Saga (Li et al., 2007) (Fig. 1). Most data are from the middle and eastern part of the Yarlung–Tsangpo suture zone. However, geological and paleontological data from the western part of the suture zone are still scarce. To know the evolution of the Neo-Tethys clearly, we need detailed geological and paleontological data along the whole suture zone.

This paper presents well-preserved and clearly imaged radiolarians from the Zhongba melange, which lies on the western part of the Yarlung–Tsangpo suture zone. This is the first report of Late Jurassic radiolarians from the Zhongba mélangé.

Geological Setting

The Yarlung–Tsangpo suture zone lies between the Xigaze forearc basin to the north and the Tethyan Himalaya to the south (Fig. 1). For a section from the Xigaze forearc basin 30 km north of Zhongba, Wan et al. (2001) reported the upper Cretaceous to lower Eocene sequence, which is the youngest shallow marine sedimentary sequence, according to studies conducted on foraminifers. The Tethyan Himalaya is a thick succession of Cretaceous–Paleogene marine sediments (Garzanti, 1999). Ding (2003) and Ding et al. (2005) reported a

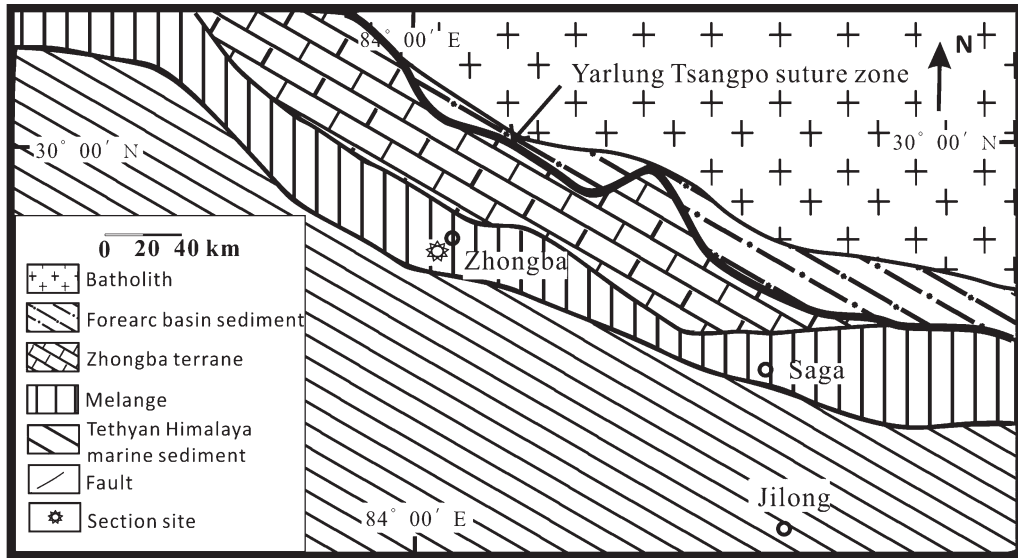


Fig. 2. A geological map showing the region around Zhongba County.

Paleocene deep-marine sedimentary section in Saga County, on the north of the Tethyan Himalaya. All of these features indicate the closure of the Yarlung–Tsangpo suture zone.

The Yarlung–Tsangpo suture zone is divided into two branches from Saga to the west. Our investigations focused on the southern branch of the suture zone near Zhongba, which has been little studied. In our study area, the Zhongba terrane, which is composed of Permian to Triassic mudstone, sandstone, and limestone sequences, lies between the Xigaze forearc basin and the Tethyan Himalaya. The Xigaze forearc basin, Zhongba terrane and Tethyan Himalaya are in fault contact with each other (Fig. 2). A complete ophiolite succession has been found by both a previous study (Sun et al., 2002) and our field investigations. The melange is composed of chert, sandstone, and subordinate mudstone with blocks of augite peridotite, gabbro, basalt, limestone, and chert. Sun et al. (2002) reported Late Cretaceous radiolarians from the ophiolitic melange.

The section in this report is located ca. 9 km southwest of Zhongba County (Fig. 2). In this section (Fig. 3), dominant strata are red bedded chert and medium-grained sandstone. Many blocks of basalt, limestone and chert can be found together with thick chert, sandstone and mudstone sequences. The limestone is recrystallized. No fossils can be found in the limestone. Two faults—a north-dipping fault and a south-dipping inferred fault—are recognized in this section. Folds are observed in the red chert that lies to the south of the inferred fault (Fig. 3).

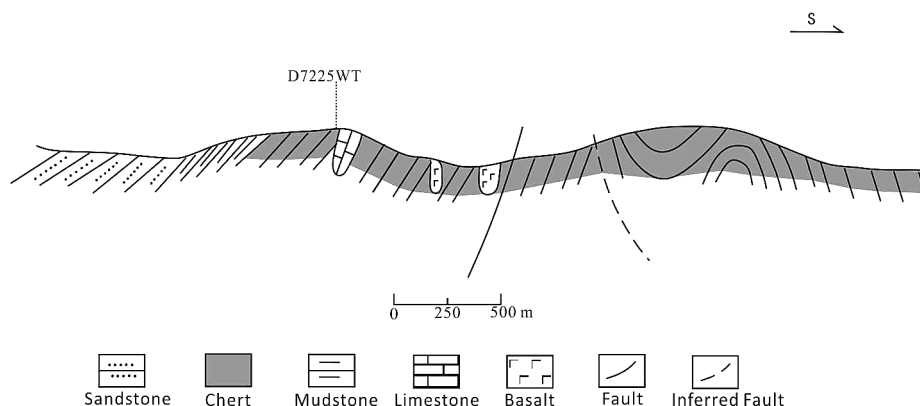


Fig. 3. The cross section of the sampling site.

Samples

Sample D7225WT was collected from the red chert bed, which is tectonically connected with the limestone block in the section (Fig. 3). The sample yielded well-preserved radiolarian shells.

Rock samples were disaggregated by 4% hydrofluoric acid for 20–24 h. The 61–380 μm fractions were used for micropaleontological research. Radiolarian shells are mounted on a stub with synthetic medium for scanning electron microscope observation. The fossil specimens reported in this paper have been deposited in the China University of Geosciences (Beijing).

Radiolarian assemblage and its age assignment

Age assignments of Jurassic radiolarians are based mainly on the zonal scheme established in Japan and the western Pacific (Matsuoka, 1995).

The radiolarians obtained in this report are as follows (Fig. 4): *Hsuum brevicostatum* gr. *Ozoldova*, *Stichocapsa* sp., *Eucyrtidiellum* sp. cf. *E. unumaense* (Yao), *Pseudoeucyrtis* sp., *Archaeodictyomitra* sp., *Parahsuum* sp., *Lactorum*(?) sp., *Podobursa* sp., and *Trirabs* sp.

Hsuum brevicostatum gr. *Ozoldova* is a typical Late Jurassic radiolarian species that exists from the *Striatojaponocapsa conexa* zone through the *Kilinora spiralis* zone to the *Hsuum maxwelli* zone (Matsuoka, 1995). *Stichocapsa* sp., *Eucyrtidiellum* sp., *Pseudoeucyrtis* sp., and *Podobursa* sp. are also the dominant taxa in these zones. The absence of *Striatojaponocapsa conexa* (Matsuoka) and *Kilinora spiralis* (Matsuoka) gives a clue that our sample is younger than the *Kilinora spiralis* zone. The faunal composition of our sample

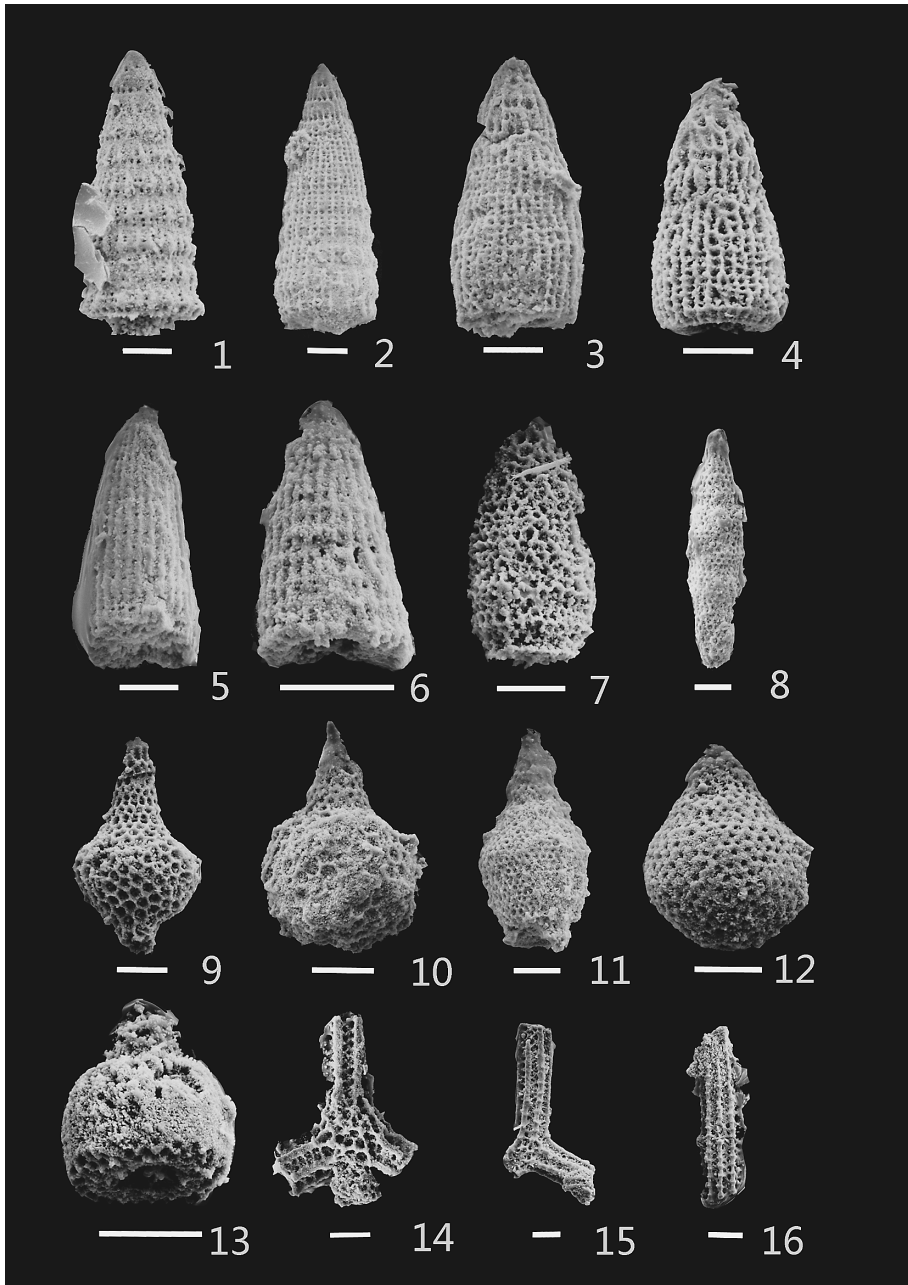


Fig. 4. Radiolarian fossils from sample D7225WT. All the scale bars are 50 μm .

1: *Hsuum brevicostatum* gr. Ozvoldova, 2: *Hsuum* sp., 3-4: *Parahsumm* sp., 5-6: *Archaeodictyomitra* sp., 7: *Laxtorum*(?) sp., 8: *Pseudoeucyrtis* sp., 9: *Podobursa* sp., 10: *Podobursa* sp., 11: *Pseudoeucyrtis* sp., 12: *Stichocapsa* sp., 13: *Eucyrtidiellum* sp. cf. *E. unumaense* (Yao), 14-16: *Tritrabs* sp.

from Tibet matches very well with sample 32R-CC, Leg 129, Site 801, western Pacific Ocean (Matsuoka, 1992). These indicate that the radiolarians from this sample are restricted to the *Hsuum maxwelli* zone (JR 7), which suggests a Kimmeridgian age.

Discussion

The melange in southwestern Zhongba is mainly red bedded chert and sandstone which contains basalt, limestone and chert blocks. Radiolarians from the chert are the first robust indication of a Kimmeridgian age. This finding significantly extends the age range of this region, from the Late Jurassic to the Late Cretaceous (Sun et al., 2002). Furthermore, although radiolarian-bearing strata along the Yarlung–Tsangpo suture zone range in age from Middle Triassic (Anisian) or earlier through to Late Cretaceous (Turonian) (Yang et al., 2002), Jurassic radiolarian data have only been reported from Xialu (Matsuoka et al., 2001, 2002, 2005; Ziabrev et al., 2004). Radiolarian taxa from the Zhongba melange are chronologically consistent with those from the Xialu chert and Naga ophiolite (Baxter et al., 2011), indicating that the Zhongba melange, Xialu chert and Naga ophiolite were once part of the same Neo-Tethys Ocean. Given the fact that this sedimentary melange is in fault contact with both the northern ophiolite sequence and southern normal marine sediments, more detailed stratigraphic and paleontological investigations of radiolarian in this region are needed.

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