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A new Cretaceous age for the Saiqu "mélange," southern Tibet: evidence from Radiolaria

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ABSTRACT

This study concerns the mélange that crops out in the north of Saiqu, Sagya County, southern Tibet. The age of the mélange has been debated for years, because the ages of fossils from various blocks conflicted with each other, and no macrofossils had been discovered from the matrix. Furthermore, no one had looked at the matrix for microfossils, mainly because of their mistaking this suite of mélange as straightforward sedimentary strata. However, abundant microfossils *are* present in the matrix of the mélange, and four radiolarian assemblages have been recognized: (1) *Holocryptocanium* aff. *barbui-Dictyomitra turris*; (2) *Acanthocircus dicrancanthos-Thanarla pulchra*; (3) *Thanarla veneta-Pseudodictyomitra pseudomacrocephala*; and (4) *Dictyomitra magnifica-Dictyomitra turritum*. The matrix-derived radiolarian assemblages indicate a Late Cretaceous age. The mélange in Saiqu can be correlated with the Zongzhuo Formation of neighbouring regions by either lithological associations or fossil assemblages. Consequently, the mélange has been referred to the Upper Cretaceous Zongzhuo Formation, instead of the Triassic Xiukang Group, with which it was previously associated. The mélange of the Zongzhuo Formation resulted from the subduction of the Indian Plate beneath the Asian Plate during the Late Cretaceous.

1. Introduction

A mélange aggregation, which is composed of two parts (exotic blocks of various ages and the matrix strata), occurs along the south side of the Indus-Yarlung Zangbo Suture Zone, also known as the Indus-Yarlung Suture Zone (IYSZ), which for years has been studied by geologists from China and abroad. The age and stratigraphic correlation of this mélange in Saiqu, Sagya, southern Tibet are still strongly debated, however (Gansser, 1974; Chen, 1980; Qian, 1982; TBGMR, 1983, 1993; Wang et al., 1983). Some regard it as part of the Upper Cretaceous Zongzhuo Formation (TBGMR, 1983), simply based on similar distributional positions; some incorporate it into the general Triassic (TBGMR, 1993), based on macrofossil evidence (mainly bivalves and ammonites) from some of the mélange blocks; and others interpret it as part of the Upper Triassic 'Xiukang Group', based on some similarities in their lithological characteristics. However, these interpretations have lacked fossil evidence from the *matrix* of the mélange. No one has previously looked at the matrix for microfossils, mainly because they have regarded this suite of strata as non-mélange deposits, not recognising that it is part of a mélange aggregation.

Considering the regional tectonics, the mélange of the Zongzhuo Formation in both Saiqu and Gyangtze is situated in the Subduction-collapsed Mélange Belt of Chen et al. (1984), closely related to the subductional activity near the IYSZ. It is regarded as one of the main lines of evidence for the subduction-collision activity between the Indian and Asian Plates, and plays a key role in our understanding of that, and also of the evolutionary history of the Tethys Sea. It is necessary, therefore, to study in detail the lithology, deformation-metamorphism and formational mechanics, and especially to determine the age, of the mélange complex, which will allow us to determine the way in which it developed.

Based on detailed mapping of the Saiqu area, preliminary indications were that the suite of strata cropping out here should represent part of the mélange. We targeted the matrix, rather than the non-age-diagnostic blocks, in order to try to determine the age of the mélange complex.

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2. Material and methods

Twenty-three samples were collected from the mélange, represented by a 2482-m-thick, well-exposed section, located at Saiqu (88°53′28″E, 28°52′56″N), Sagya county, southern Tibet (Fig. 1). Processing and identification of the radiolarians were carried out in the laboratory of the Institute of Geology and Geophysics, Chinese Academy of Sciences (Beijing, China). One kilogram, dry-weight, was processed per sample. Liberation of the radiolarians was accomplished using the following procedures: (1) samples were mechanically crushed into small (centimetre-sized) pieces; (2) the sediment was dissolved using dilute hydrofluoric acid (the strength of the acid and time of treatment varied from lithology to lithology), and each sample was rinsed in fresh water and examined frequently to ensure optimum results; (3) encrusting iron oxides were removed by washing the samples in a solution of 1% oxalic acid.

The radiolarians were mounted on 22 × 40 mm glass slides in glycerine jelly and sealed for examination under a transmitted-light microscope. Representatives of each species were measured and photographed (Figs. 2, 3) using a scanning electron microscope (SEM). All radiolarian specimens are deposited in the Institute of Geology and Geophysics, Chinese Academy of Sciences in Beijing.

3. The radiolarian assemblages

Abundant radiolarians were recovered from five of the 23 samples from the Saiqu section, with four assemblages being recognized (oldest to youngest): (1) *Holocryptocanium* aff. *barbui-Dictyomitra turris*; (2) *Acanthocircus dicrancanthos-Thanarla pulchra*; (3) *Thanarla veneta-Pseudodictyomitra pseudomacrocephala* and (4) *Dictyomitra magnifica-Dictyomitra turritum* (Fig. 4). These have been calibrated against the radiolarian zones of Sanfilippo and Riedel (1985), which are the zones referred to below, and provide a broad indication of age.

3.1. Holocryptocanium *aff.* barbui-Dictyomitra turris *assemblage*

These taxa occur in Samples Wg5 and Wg3, respectively. *Holocryptocanium barbui* is stratigraphically restricted to the Albian-earliest Cenomanian (upper part of the *Acaeniotyle umbilicata* Zone to lower part of the *Obesacapsula somphedia* Zone). *Dictyomitra* is confined to the Late Cretaceous, first appearing around the mid-Turonian. *Pseudodictyomitra* (found in Sample Wg3) and *Cryptamphorella* (occurring in Sample Wg5) are frequent in the Upper Cretaceous. We conclude that these samples/beds are, thus, approximately Cenomanian in age. *Hsuum*, *Praeconocaryomma*, *Xitus* and *Zhamoidellum* have been reported from blocks of the Upper Cretaceous Zongzhuo Formation (Nagarze area, southern Tibet) by Zhen (1980); these taxa occur in these samples, but may have been reworked from the Jurassic (J. Gregory, pers. comm., 2006).

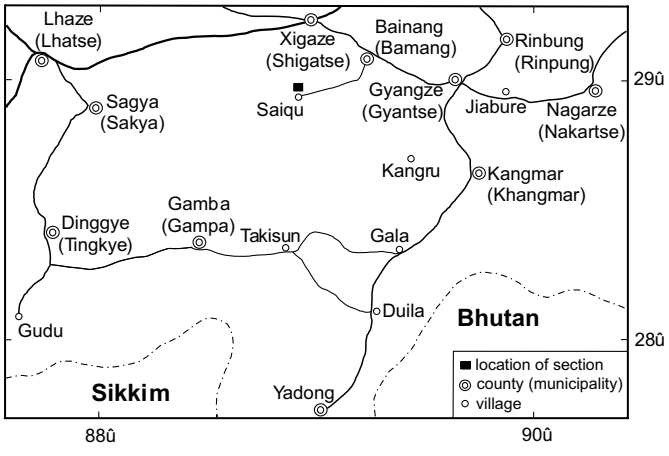

Fig. 1. Schematic map showing location of the section.

3.2. Acanthocircus dicrancanthos-Thanarla pulchra *assemblage*

This assemblage occurs in Sample Wg6, which was taken from one of the silica-rich blocks of mélange in the section. *Acanthocircus dicrancanthos* ranges from the upper Tithonian to Hauterivian (upper pre-*Sphaerostylus septemporatus* Zone to top *Dibolachars tytthopora* Zone). *Thanarla pulchra* is stratigraphically limited to the upper Tithonian to lower Barremian (upper pre-*Sphaerostylus septemporatus* Zone to lower *Dibolachars tytthopora* Zone). *Acaeniotyle* is frequent in Lower Cretaceous sediments. *Archaeodictyomitra*, *A. dicrancanthos* and *Thanarla conica* have also been reported from blocks of the Zhongzhuo Formation of the Nagarze area (Zhen, 1980). *Pseudodictyomitra pachicostata* has been reported from silica-rich lenses of the Zhongzhuo Formation of the Beishan section near Qiongdui village in the Nagarze area (Zhen, 1980). Therefore, this assemblage is interpreted as Early Cretaceous in age, which suggests that the blocks containing this assemblage most probably originate from the older Gyabula Formation.

3.3. Thanarla veneta-Pseudodictyomitra pseudomacrocephala *assemblage*

This assemblage was found in Sample Wg12. *Pseudodictyomitra pseudomacrocephala* ranges from the late Albian to the middle Turonian, and is frequent in the Cenomanian to middle Turonian. It has been reported from the lentoid silica-rich deposits of the Zongzhuo Formation of the Beishan section (Zhen, 1980). *Thanarla veneta* is limited to the latest Albian to earliest Turonian (top *Acaeniotyple umbilicata* Zone to middle *Obesacapsula somphedia* Zone). *Alievium* is frequent in the Late Cretaceous. *Novixitus* has been reported to occur in the Cenomanian and Turonian of North America. Therefore, this assemblage is interpreted as Cenomanian-earliest Turonian in age.

3.4. Dictyomitra magnifica-Dictyomitra turritum *assemblage*

This assemblage occurs in Sample Wg14. *Dictyomitra* is stratigraphically limited to the Late Cretaceous and is frequent in the middle-late Turonian to early Maastrichtian. *Obesacapsula* is frequent in the Late Cretaceous. This sample is thus Turonian to Maastrichtian in age.

4. Conclusions

The radiolarians retrieved from the matrix of the mélange of the Saiqu section (Sagya county, southern Tibet) indicate that this mélange is Cretaceous in age. A lithological and microfaunal comparison of the mélange of Saiqu with formations in neighbouring regions of southern Tibet further suggests that it is part of the Cretaceous Zongzhuo Formation, rather than belonging to the Triassic Xiukang Group, as had been previously concluded. Consequently, the formation of this mélange is probably related to the subduction-collision between the Indian and Asian Plates.