

# The Discovery of Eocene Radiolarian Fauna from Tūna, Yadong, Southern Tibet, China



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Citation: Li et al., 2019. The Discovery of Eocene Radiolarian Fauna from Tūna, Yadong, Southern Tibet, China. *Acta Geologica Sinica* (English Edition), 93(supp.2): 265–267.

## 1 Introduction

The collision of India with Eurasia is one of the most spectacular geological events in the Cenozoic. It has profoundly influenced the evolution of the Himalayan orogen and the oceanographic evolution of the Earth (Butler, 1995; Rowley, 1996; Li and Wan, 2003a and b; Wang et al., 2003; Aitchison et al., 2007). However, timing of the initiation of continental collision is still controversial. Existing estimates range from 70 Ma to 25 Ma (Beck, et al., 1995; Rowley, 1996; Hodges, 2000; Ding, 2003; Li and Wan, 2003a; Xu et al., 2015). Yadong area in southern Tibet was once located in the Tethyan residence sea and developed the youngest marine strata, which can provide very important evidence for interpreting the evolution of the Tethys and constraining the time of the India-Eurasia collision (Li et al., 2005; Jiang et al., 2016; Niu et al., 2016; Zhang and Li, 2017). In this work, Eocene radiolarian assemblages were firstly discovered from the Sandy-shale Member of Zhepure Formation in the Gulupu section, Tūna, Yadong, Southern Tibet, which can provide direct constraint on the closing time of the Neo-Tethyan Ocean.

## 2 Materials and methods

The Gulupu section is in the Southern Tethyan Himalaya Sub-belt, about 2 km west to Tūna town of Yadong of 28°03'55"N and 89°11'29"E, where outcrops a Paleocene stratigraphic sequence. 154 Samples for micropalaeontology study were collected from the Zhepure Formation of the Gulupu section (of which sample 64 to 154 from the Sandy-shale Member, which yields many Eocene radiolarians). The microfossils processing and identification were accomplished in the Micropalaeontology Laboratory of China University of Geosciences (Beijing). Each sample were broken into pieces of 0.5–1 cm, and then soaked in 10% Na<sub>2</sub>SO<sub>4</sub> solution in beakers; this mixture is stirred every three days. After about 15 days the mixture is washed, and screened through a 40-mesh and a 250-mesh stainless sieve, and the two residues separated into two different beakers to dry. The well-preserved fossils were cleaned by ultrasonic cleaner, mounted on stubs, and imaged using a Scanning Electron Microscope (SEM).

## 3 Planktic foraminiferal biostratigraphy

Based on the comparison with the Paleogene radiolarian data available in southern Tibet (Liu and Aitchison, 2002; Ding, 2003; Li et al., 2007; Liang et al., 2011; Liang, 2012; Wang et al., 2016; Wang et al., 2016) and other areas in the world (Foreman, 1973; Riedel and Sanfilippo, 1978; Strong et al., 1995; Hollis, 1998; Sanfilippo and Hull, 1999; Sanfilippo et al., 2003; Bak and Barwicz-Piskorz, 2005; Barwicz-Piskorz and Rajchel, 2012), 12 species of 11 radiolarian genera were identified from the Sandy-shale Member of the Zhepure Formation of the Gulupu section, which provides an age of early to middle Eocene. The important elements (Fig.1) of which include *Calocyclus ampulla*, *Buryella clinata*, *Pseudostaurosphaera perelegans*, *Theocotyle venezuelensis*, *Lamptonium fabaeforme constrictum*, *Stylosphaera minor*, *Lychnocanium bellum*, *Cenosphaera* sp., *Buryella granulate*, *Periphaena? duplus*, *Amphibrachium paleogenicum*, *Heliodiscus pentasteriscus*. Among them, *C. ampulla* is rare to common in the lower and middle Eocene of the Skole series (*B. bidartensis*-*T. mongolfieri* Zone) and the lower Eocene of Subsilesian series. *B. clinata* is a representative elements of the *B. clinata*-*T. ampla* Zone and has been found in late Early and earliest middle Eocene radiolarian assemblages from Cyprus, Mexico Gulf, Skole series, and DSDP Site 248. *T. venezuelensis* was reported in the lower Eocene of the Subsilesian series. *P. perelegans* and *L. fabaeforme constrictum* have been found in lower to early middle Eocene of Carpathian Tethys. *L. bellum* is common in the lower and middle Eocene of the Skole series (*P. striata striata* Zone). *C. sp.* has been found in the later Paleocene to Eocene of Mexico Gulf, later Paleocene in southern Tibet, and early Eocene in the Subsilesian series. *H. pentasteriscus* is common in middle Eocene in Carpathian Tethys.

## 4 Conclusions

The radiolarian assemblage from the Sandy-shale Member of the Zhepure Formation gives an early to middle Eocene age, which indicates that the final closure of the Tethys seaway should occur after middle Eocene in Tūna area.

**Key words:** Eocene, Radiolaria, Zhepure Formation, Yadong, Tethyan Oceana

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**Acknowledgments:** This work is granted by the National

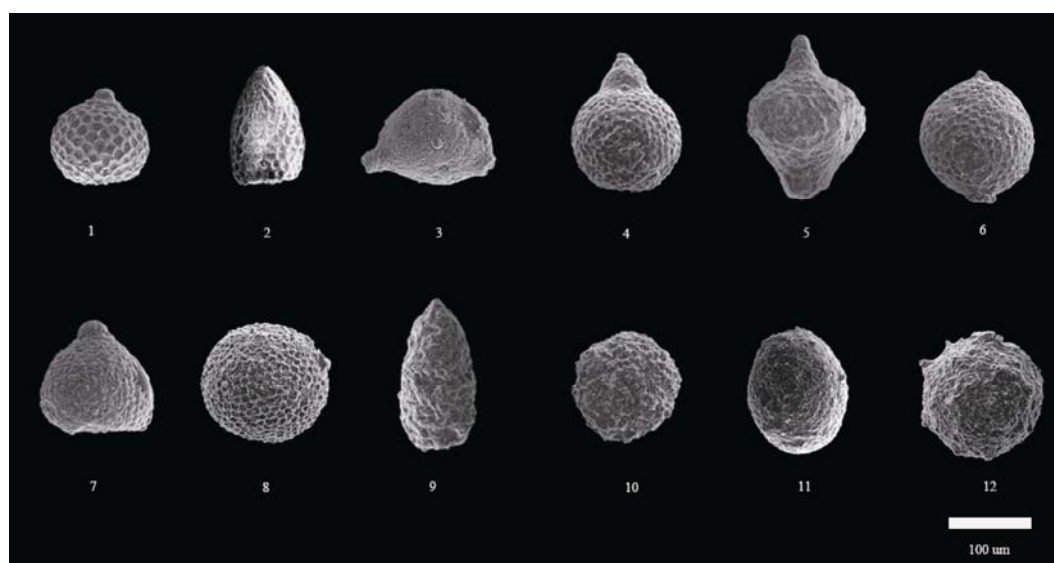


Fig. 1. SEM photographs of the Eocene radiolarians from the Gulupu section.

1. *Calocyclus ampulla* Ehrenberg; 2. *Buryella clinata* Foreman; 3. *Pseudostaurosphaera perelegans* Krasheninnikov; 4. *Theocotyle venezuelensis* Riedel & Sanfilippo; 5. *Laptonium fabaeforme constrictum* Riedel & Sanfilippo; 6. *Stylosphaera minor* Clark & Campbell; 7. *Lychnocanium bellum* Clark & Campbell; 8. *Cenosphaera* sp. Sanfilippo & Riedel; 9. *Buryella granulate* Petrushevskaya; 10. *Periphaena? duplus* Kozlova; 11. *Amphibrachium paleogenicum* Gorbunov; 12. *Heliodiscus pentasteriscus* Clark & Campbell.

Natural Science Foundation of China (Grant No. 41272030), the IGCP679, and the National Basic Research Program of China (Grant No. 2012CB822001).

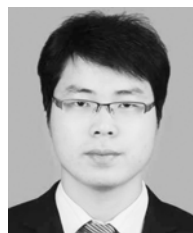
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