## Eocene Dinoflagellate Biostratigraphy in Tüna, Yadong, Tibet



YAO Youjia<sup>1, 2</sup>, LI Guobiao<sup>1, 2, \*</sup>, ZHANG Wenyuan<sup>1, 2</sup>, LI Yuewei<sup>1, 2, 3</sup>, LV Beibei<sup>2</sup>, Han Dandan<sup>2</sup>, LI Qi<sup>2</sup>, XIU Di<sup>2, 4</sup> and GUO Baojie<sup>2</sup>

<sup>1</sup> State Key Laboratory of Environmental Geology and Biogeology, China University of Geosciences, Beijing 100083, China

<sup>2</sup> School of Earth Sciences and Resources, China University of Geosciences, Beijing 100083, China

<sup>3</sup> Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing 100044, China

<sup>4</sup> Hebei Regional Institute of Geology and Mineral Resources Investigation, Lanfang 065000, China

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**Abstract:** The extinction of the Tethys Ocean and the formation of the Qinghai-Tibet Plateau have long been the concerning focus of the global geologists (Wang et al., 2003; Aitchison et al., 2007). It not only greatly changed the global paleotectonics and paleogeography, but also led to profound changes in the global climate pattern. At present, the timing of the onset of collision, especially the final extinction of intercontinental marine deposits, is still uncertain. The study of the late evolution history of the Tibetan Tethys and the determination of its closure time can provide a very important and direct basis for the study of the collision process between India and Asia (Li and Wan, 2003a). A successive Cretaceous-Paleogene marine stratigraphic sequence developed in southern Tibet (Wan, 1990; Ding, 2003; Li and Wan, 2003a, 2003b; Li et al., 2003, 2005a, 2005b, 2007, 2009, 2011; Niu et al., 2016; Zhang and Li, 2017).

Terrestrial strata dominate the Paleogene in China and marine strata are only developed in such areas as Tibet, Xinjiang and Taiwan. The Paleogene marine strata are well outcropped in southern Tibet, which yielded abundant microfossils (Ding, 2003; Li and Wan, 2003a, 2003b; Li et al., 2003, 2005a, 2005b).

The Tüna Reservoir section is located in ~2.5 km west of the town of Tűna, Yadong, southern Tibet. The Zhepure Formation of this section is mainly composed of microfossils-bearing shale and limestone (Niu et al., 2016; Zhang et al., 2017), which represented the southern Tethyan passive margin succession. The detailed study was carried out on the dinoflagellate biostratigraphy of the Sandy-shale Member of the Zhepure Formation in the Tüna Reservoir section and 88 species of 63 dinoflagellate genera were identified. The identification of dinoflagellate was mainly based on such data as He (1991), He et al. (2009), etc. The main elements of the dinoflagellate assemblage from the Zhepure Formation include Apteodinium donghaiense, A. rohmbiforme, Chalesdowniea rhombiodalis, Cleistosphaeridium shandongense, Hystrichokolpoma salacia, Membranilarnacia variata, Wetzeliella xinjian, Luxadinium elongatum, etc.

Four dinoflagellate assemblage zones were recognized as follows (from bottom to top):

1. Apteodinium donghaiense-Apteodinium rohmbiforme assemblage zone. The representative elements of this assemblage zone are A. donghaiense and A. rohmbiforme. Other important elements include Areoligera medusttiformis, Araneosphaera araneosa, Cribroperidinium kashiense, Chiropteridium glalea, Chytroeisphaeridia microgranulata, Codosphaeridium (C.) furcans, Cleistosphaeridium bulbum, Distatodinium ellipticum, Glaphyrocysta intricata, Membranilarnacia variata, Operculodinium brevibaculatum, Parabohaidina (P.) laevigata ovata,Spiniferites bentorii truncatus, Thalassiphora chinensis and Wetzeliella degenerata etc. The age of this assemblage zone is roughly early Eocene.

2. Chalesdowniea rhombiodalis-Hystrichokolpoma salacia assemblage zone. The representative elements of this assemblage zone are Chalesdowniea rhombiodalis and Hystrichokolpoma salacia. Other important elements include Apteodinium Binzhoudinium helicoides. longispinosum, Bohaidina (Bohaidina) granulata biconica, B. (B.) retirugosa retirugosa, Chiropteridium glalea, Chytroeisphaeridia microgranulata, Cleistosphaeridium digitale, C. baculatum, Cryptachaeodinium Cordosphaeridium longispinum, (C.)taeniforme Charlesdowniea tenuivirgula, C. rhombiodalis, Distatodinium ellipticum, Escharspaeridia explanata, and F. donghaiensis etc. Less important elements include Distatodinium ellipticum and Echinocysta echinoides etc. The age of this assemblage zone is roughly Early-Middle Eocene.

3. Membranilarnacia variata-Wetzeliella xinjian assemblage zone. The representative elements of this assemblage zone are Membranilarnacia variata and Wetzeliella xinjiangensis. Other important elements include Apteodinium helicoides, Chytroeisphaeridia microgranulata, Cleistosphaeridium shandongense, Fibrocysta dongyingensis, Impletosphaeridium luxurium, Spiniferites monilis and Pyxidinopsis composita etc. The age of this assemblage zone is roughly middle Eocene.

4. Cleistosphaeridium shandongense-Luxadinium elongatum assemblage zone. The representative elements of this assemblage zone are Cleistosphaeridium shandongense and Luxadinium elongatum. Other important elements include Apteodinium helicoides, Areoligera longispinata, Chytroeisphaeridia baetica, Distatodinium ellipticum, Echinocysta multispinata, Hystrichosphaeridium tubiferum, Homotryblium plectilum, Sepispinula huguoniotii, Sentusidinium biornatum crissum etc. The age of this assemblage zone is roughly late Eocene.

Based on the dinoflagellate data in the study area, it is suggested that the age of the Sandy-shale Member of the Zhepure Formation in Tüna should be middle to late Eocene, which indicates that the time of the final extinction of the Neo-Tethys Ocean in the study area should be in the late Eocene or

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<sup>\*</sup> Corresponding author. E-mail: liguobiao@cugb.edu.cn

later.

Key words: Eocene, Tethys, dinoflagellate, biostratigraphy, Tüna, Yadong

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## About the first author



YAO Youjia, female, born in 1990 in Daqing City, Helongjiang Province; master; graduated from China University of Geosciences (Beijing). She is now interested in the study on Mesozoic and Cenozoic palaeontology and stratigraphy. Email: 290780191@qq.com; phone: +86 15645989991.

## About the corresponding author



LI Guobiao, male, born in 1968 in Wugang City, Hunan Province; PhD; graduated from China University of Geosciences; professor at the school of Earth Sciences and Resources, China University of Geosciences (Beijing). He is now interested in the study on palaeontology and stratigraphy. Email: liguobiao@cugb.edu.cn.; phone: +86 13552818921.