Gondwana Research xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Gondwana Research

journal homepage: www.elsevier.com/locate/gr

The youngest marine deposits preserved in southern Tibet and disappearance of the Tethyan Ocean

Tian Jiang [a,b], Jonathan C. Aitchison [b,c,*], Xiaoqiao Wan [a]

[a] State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences, Xueyuan Lu 29, Beijing 100083, China
[b] School of Geosciences, The University of Sydney, Sydney, NSW 2006, Australia
[c] School of Geography, Planning and Environmental Management, The University of Queensland, Brisbane, QLD 4072, Australia

ARTICLE INFO

Article history:
Received 31 October 2014
Received in revised form 15 January 2015
Accepted 30 January 2015
Available online xxxx

Handling Editor: A.S. Collins

Keywords:
Southern Tibet
Marine sediment
Late Eocene
Tethyan Ocean
India–Asia collision

ABSTRACT

Fossil ages as young as Priabonian (38–34 Ma) are reported for the last marine sedimentary rocks in southern Tibet. Correlation is based on examination of foraminifers and nannofossil biostratigraphy of youngest preserved sediments in sections at Gamba (Zongpu), Tingri (Qumiba) as well as a previously unreported section at Yadong. Our results demonstrate that a marine seaway remained in existence south of the Yarlung Tsangpo suture zone until at least Priabonian time. Notably this remains a maximum age estimate in this area as all sections are truncated by erosion or faulting. We compare our results with sections throughout the Himalaya region to demonstrate that shallow marine conditions existed widely during the Eocene period. In fact, it seems likely that the marine conditions in the Tethyan Himalaya did not entirely disappear by the end of Priabonian, especially in the eastern Himalaya. The data presented in this study place direct constraints on the elimination of the Tethyan Ocean and thus have important implications for timing of the India–Eurasia collision.

1. Introduction

The collision of India with Eurasia, which has profoundly influenced the geological, geochemical, climatic and oceanographic evolution of the Earth, is one of the most significant tectonic events during the Cenozoic (Butler, 1995). In the last few decades, many researchers have attempted to reconstruct the evolution of the Himalayan orogen and Tibetan uplift. However, timing of the initiation of continental collision, key to all reconstruction models, is still strongly disputed, and the estimated time ranges from 70 Ma to 25 Ma (Searle et al., 1987; Beck et al., 1995; Yin and Harrison, 2000; Zhu et al., 2005; Aitchison et al., 2007, 2011; Aitchison and Ali, 2012; van Hinsbergen et al., 2012; Wang et al., 2012; Singh, 2013; Xu et al., 2014).

Many approaches are used to date the timing of the collision including the relative position of the Indian plate, the commencement of the influx of sedimentary detritus onto the Indian passive plate margin along the Indus Yarlung Tsangpo Suture Zone (IYTSZ), initiation of major collision related thrust systems in the Himalaya Ranges, and the end of calc-alkaline magmatism along the Trans-Himalayan batholith, etc. (Searle et al., 1988; Aitchison et al., 2007; Najman et al., 2010). The cessation of marine sedimentation on the Indian margin, which is closely related to the elimination of the Tethyan Ocean, is widely regarded as placing a direct constraint on timing of the initiation of continent–continent collision and has long been investigated in different Himalayan regions (Rowley, 1996; Green et al., 2008).

In the Lesser Himalaya, the final marine deposits are commonly preserved as part of a nappe or klippe. They commonly underlie regional hiatus and are themselves thrust over Oligocene to Miocene continental clastic sediments. The age of the final marine deposits varies from west to east. In the frontal region of the Kashmir syntaxis, the marine Patala Formation has been dated at 55–50 Ma where it underlies the continental Balakot Formation (Najman et al., 2001, 2002). Southeast of the Kashmir syntaxis, the Subathu Formation outcrops widely in locations from Simla to Tansen (Fig. 1a), and preserves the Eocene final marine deposits of 44 Ma (Bhatia and Bhargava, 2006). South of the eastern Himalayan syntaxis, the collision-related final marine sediments outcrop as the lower Eocene Rengging Formation and the upper lower Eocene to Middle Eocene Yinkiong Formation in the Siang window region of Assam–Arakan Basin (Tripathi et al., 1978, 1981; Tripathi and Mamgain, 1986; Tripathi et al., 1988; Acharyya, 2007; Acharyya and Saha, 2008). Even younger final marine deposits occur in the Bengal basin, where the Sylhet limestone and overlying Kopili Formation are of Middle to upper Eocene age (Samanta, 1965, 1968, 1969; Singh and Pratap, 1983; Alam et al., 2003).

In the western Tethyan Himalaya, limestone of the Kong Formation (48.6 Ma) in the Zanskar Basin and nummulitic limestone (50.8–49.4 Ma) that outcrop near the Indus Suture Zone are regarded as the

* Corresponding author at: School of Geography, Planning and Environmental Management, The University of Queensland, Brisbane, QLD 4072, Australia. Tel.: +61 7 3346 7010.
E-mail address: jona@uq.edu.au (J.C. Aitchison).

http://dx.doi.org/10.1016/j.gr.2015.01.015
1342-937X/

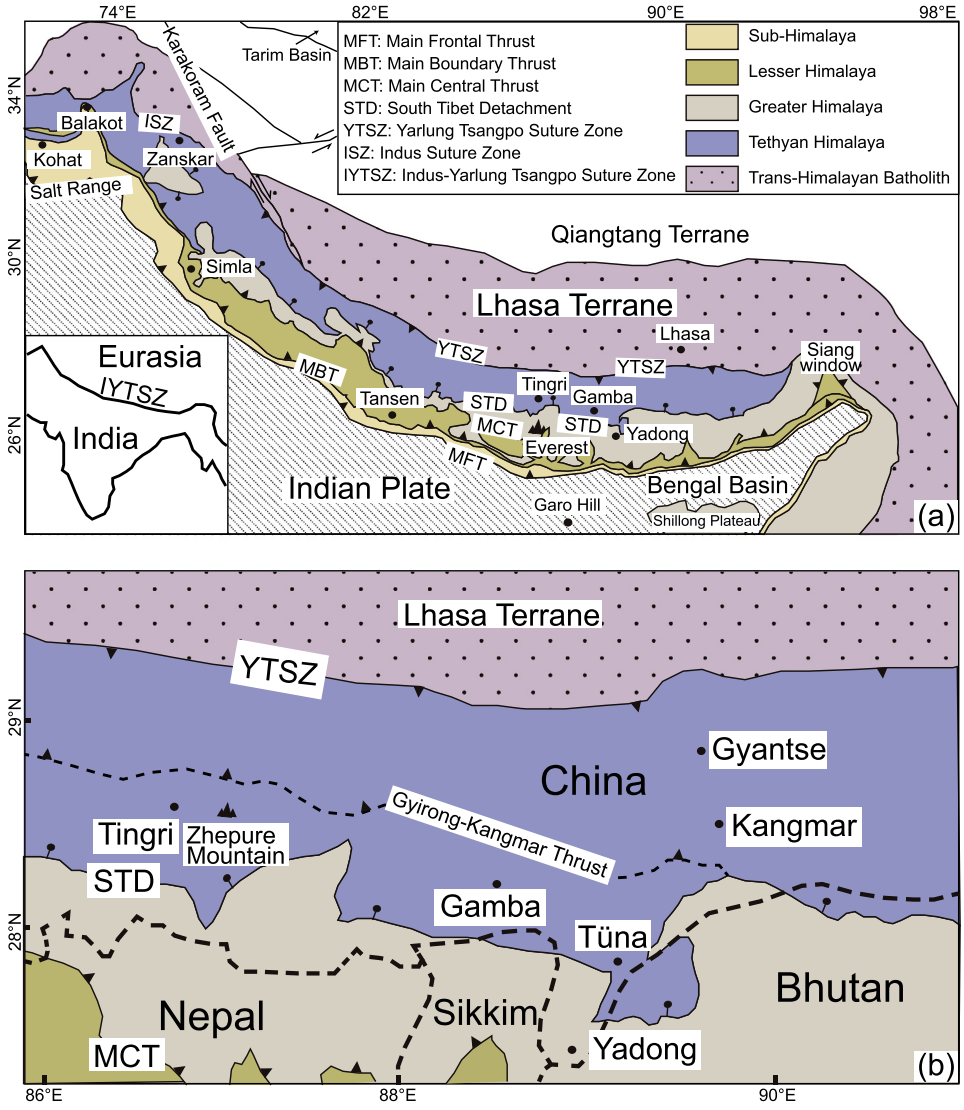

Fig. 1. (a) Simplified map of the Himalaya orogen showing the main regional tectonic elements and locations discussed in the text, (b) Simplified map of Gamba–Tingri region. Modified from Aitchison et al. (2007), Yin (2006).

youngest record of the Tethyan Sea (Searle et al., 1988; Green et al., 2008; Mathur et al., 2009). However, it must be noted that nummulitic limestones in the Zanskar valley are overlain by unfossiliferous mass flow deposit (turbidites and deep marine conglomerates) that nevertheless indicate ongoing marine conditions. In southern Tibet, several sedimentary successions containing final marine sediments have been reported, including the Tingri (Qumiba) section (Li et al., 2000; Xu, 2000; Wang et al., 2002; Zhu et al., 2005) and the Gamba (Zongpu) section (Wan, 1987; Willems, 1993; Li and Wan, 2003; Wan et al., 2006, 2010). However, documentation of these sections is commonly incomplete or important questions remain regarding stratigraphic continuity, the reliability of fossil identifications and their depositional setting. In this study, we critically assess existing data of the youngest marine strata in Gamba–Tingri region in order to correlate and compare between sections in southern Tibet. This also includes the Yadong section, a previously unreported succession 70 km east of Gamba, from which we recorded planktonic foraminifers and nannofossils. We endeavor to establish the precise timing of final marine sedimentation in the eastern Tethyan Himalaya, so that we can correlate it with the results from other regions throughout the Himalaya to reconstruct the elimination of the Tethyan Ocean.

2. Geological setting

From south to north, the Himalaya is divided into four zones: the Outer or Sub-Himalaya, the lesser or lower Himalaya, the Greater or Higher Himalaya, and the Tethyan or Tibetan Himalaya. Farther north lies the Indus Yarlung Tsangpo Suture Zone beyond which is the Trans-Himalayan (Gangdese) batholith, or Lhasa Terrane, which represents the original southern margin of Asia prior to Indus collision (Thakur, 1992; Yin, 2006). The Sub-Himalaya, mainly consist of the Neogene Siwalik molasse, bounded by the Main Boundary Thrust (MBT) to the north and the Main Frontal Thrust (MFT) to the south. The Lesser Himalaya consists of low-grade metasedimentary rocks, with discontinuous exposures of Paleogene sediments (Yin, 2006; Acharyya, 2007). The Greater Himalaya, separated from the Lesser Himalaya by the Main Central Thrust (MCT), mainly contains metasedimentary rocks ranging in age from Proterozoic to Ordovician and affected by Oligo–Miocene Himalayan metamorphism. The Tethyan Himalayan zone is separated from the Greater Himalaya across the South Tibetan Detachment Surface (STDS). Paleozoic to Paleogene marine sediments are widely exposed in the Tethyan Himalaya. The Cenozoic pre-collision related Tethyan Himalayan sequence varies between

Please cite this article as: Jiang, T., et al., The youngest marine deposits preserved in southern Tibet and disappearance of the Tethyan Ocean, Gondwana Research (2015), http://dx.doi.org/10.1016/j.gr.2015.01.015