

# India collided with Asia at ~56 Ma in Tibet: Evidence from stratigraphy and palaeontology

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Timing of the initial India-Asia collision has been investigated from magmatic, metamorphic, palaeomagnetic, sedimentary, and palaeontological records, however, the ages proposed for the initial collision still remain highly divergent, ranging roughly from ~65 Ma to ~35 Ma. Among all the geologic records, sedimentary strata from the Tethyan Himalaya have shown great potential for providing precise and convincing constraint on the timing of the collision. Based on the lower Paleogene succession in south Tibet, larger benthic foraminifera from the Zongpu (Gamba area) and Zhepure Shan (Tingri area) limestones and calcareous nannofossils from the overlying green Youxia Formation have been studied, and a high-resolution biostratigraphy in these areas has been constructed [1-2]. We found there was a tectonic uplift event close to the P/E boundary, characterized by the deposition of a conglomerate layer at Gamba and rapid change of larger foraminiferal assemblages from *Miscellanea-Ranikothalia* to *Alveolina* at Tingri. Carbon isotope data measured from bulk carbonates show that the tectonic uplift coincided with the Carbon Isotope Excursion during the Paleocene-Eocene Thermal Maximum, therefore providing a precise age of ~56 Ma for it. To the north of Gamba and Tingri areas, the first Asian-derived detritus at Sangdanlin has been detected from the base of the Sangdanlin Formation [3]. According to the ages of the youngest zircon grains from the basal Sangdanlin Formation, its maximum depositional age was reinterpreted and assigned to  $54.9 \pm 1.6$  Ma by us. Roughly, time equivalence between the tectonic uplift at the distal part of the Tethyan Himalaya (Gamba and Tingri) and provenance change at the proximal part of the Tethyan Himalaya (Sangdanlin) has been ascribed to the initial development of a foreland basin resulting from the India-Asia continental collision. Besides, the ~56 Ma India-Asia collision is also tenable by employing the elastic flexure theory of foreland basin and the published convergence rates between India and Asia in the early Eocene (personal communication with David Rowley and Paul Kapp). Consequently, we tentatively conclude that the initial India-Asia collision in Tibet took place at least ~56 Ma ago [1].

[1] Q. Zhang et al., *J. Geol.* 120, 175-189 (2012).

[2] Q. Zhang et al., *Int. J. Earth Sci.* 102, 1427-1445 (2013).

[3] J. Wang et al., *J. Geol.* 119, 293-309 (2011).

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Key words: India-Asia collision, biostratigraphy, Tibet, Tethyan Himalaya, 56 Ma