Determining when India collided with Asia to form the Himalayan mountains

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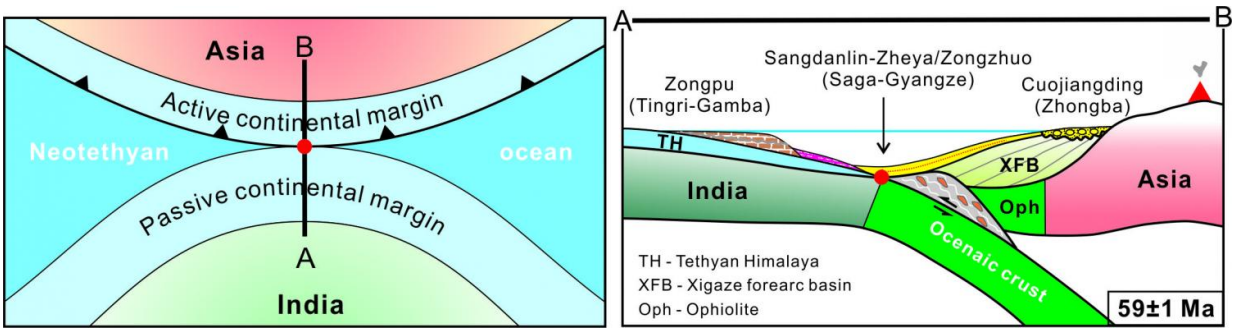

Definition of the initial collision time and reconstructed cross-section of the crusts during the earliest stage of the India-Asian collision. (Left: A sketch illustrating the definitions of initial collision time when oceanic lithosphere disappeared between the two continents, and the edge of the lower-plate continental margin reached the trench and started to subduct below the overlying plate; Right: Reconstructed cross-section of the crusts based on the stratigraphic record from southern Tibet during the earliest stage of the India-Asian collision) Credit: ©Science China Press

The collision between the Indian subcontinent and the Asian landmass resulted in the formation of the Himalayan Mountains and the rise of the Tibetan Plateau, with consequent major climatic and environmental changes around our planet. Placing precise constraints on the timing of the India-Asia continental collision is essential to understanding the subsequent geological and topographic evolution of the orogenic belt as

well as the tectonic uplift of the Tibetan Plateau and their effects on climate, environment and life. A recent study has precisely constrained the timing of the initial India-Asia continental collision via the accurate analysis of the sedimentary record preserved along the collision zone.

The related research, titled "Constraining the timing of the India-Asia continental collision by the sedimentary record," has just been published in *Science China Earth Sciences* in both Chinese and English. Professor Xiumian Hu from Nanjing University is the first and corresponding author. Based on the detailed study of fossils and detrital minerals contained in strata exposed along both sides of the Yarlung-Zangbo suture zone in Tibet, a team of Chinese and Italian researchers has determined with unprecedented accuracy when India and Asia first came into contact by pinpointing major changes of sedimentary style and in provenance of detritus. In previous studies, researchers have used a variety of approaches to date this major tectonic event, including paleomagnetism and biostratigraphic or radiometric dating of sedimentary magmatic and metamorphic rocks, coupled with structural, stratigraphic and sedimentological observations. Fierce debate often ensued, because different research teams used different indicators and criteria to define continental collision and tentatively assess the chronological sequence of progressing orogeny.

This new research starts from a clear definition of collision onset as the timing of first contact between the opposite edges of the Indian and Asian continental crusts following complete consumption of intervening Neo-Tethyan oceanic lithosphere at a point. By accurately dating with multiple methods the turbiditic deep-sea sediments derived from both India and Asia and deposited in the trench just south of the zone of initial collision, the researchers have precisely constrained the India-Asia collision onset as middle Palaeocene (59±1 million years ago). Initial continent-continent collision preceded by 20 million years the final disappearance of marine seaways from the Himalayas, and by 30 million

years, the accumulation of massive fluvial gravel and sand deposits in the Indo-Gangetic plain of northern India. Researchers also show that there was no major diachroneity of collision onset from the central to the western Himalaya.

This study represents a major contribution to understanding plate tectonics and continental dynamics, and is of great significance, not only as far as the India-Asia collision, Himalayan orogeny, Tibetan-Plateau uplift and consequent Cenozoic climatic change are concerned, but also because it provides a reference standard useful to investigate the process of continental collision and to reconstruct its progress in time resulting in the full growth of huge mountain belts.

More information: XiuMian Hu et al, Constraining the timing of the India-Asia continental collision by the sedimentary record, *Science China Earth Sciences* (2017). DOI: 10.1007/s11430-016-9003-6

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