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The break-up of the Indian subcontinent from Gondwana: constrain by detrital zircon U-Pb dating of mid- Paleozoic-early Cenozoic strata in eastern Nepal

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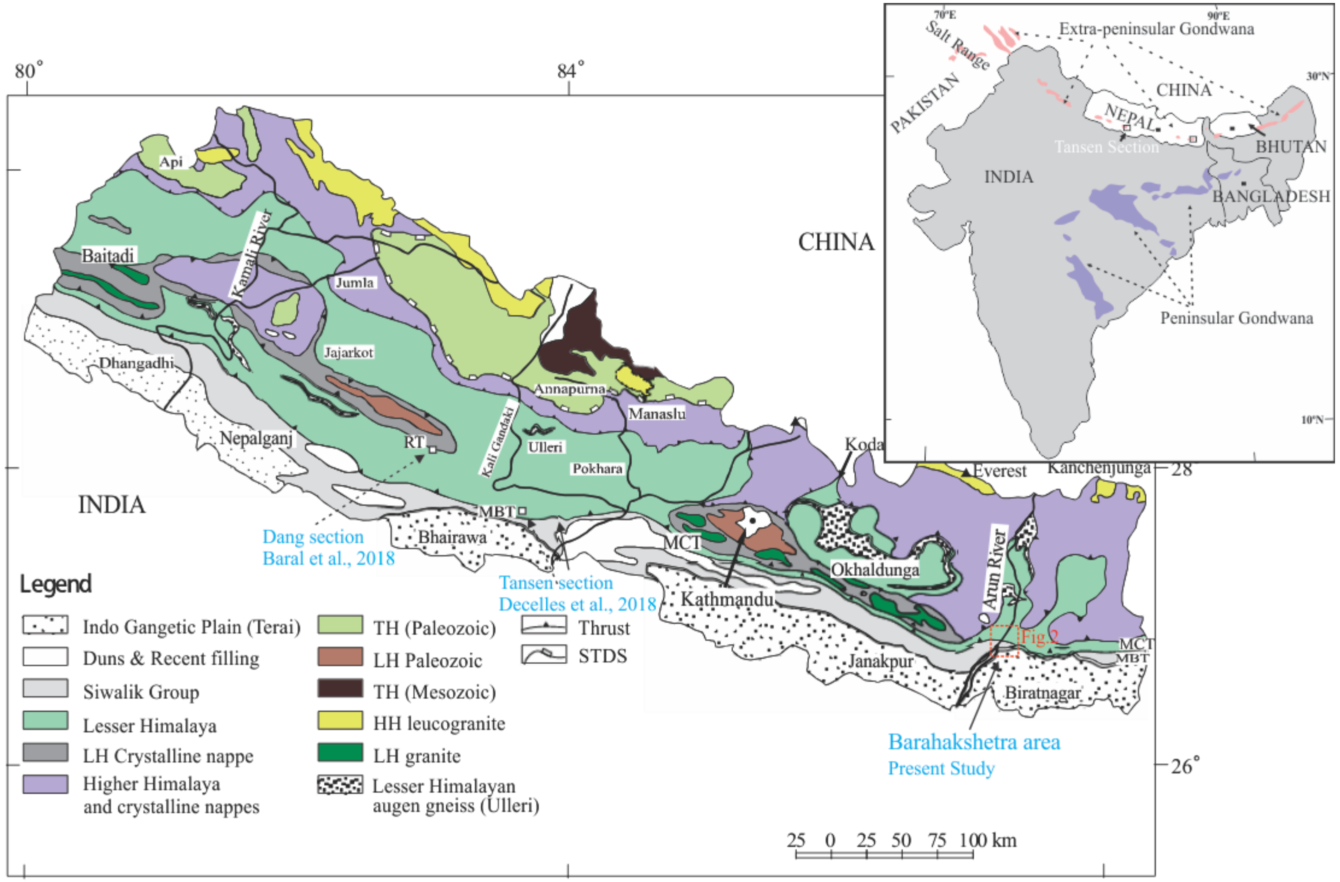
Introduction

During the final assembly of the Pangea supercontinent, several Gondwanan plates collided with Laurasia, resulting in the crustal thinning and the crustal viscosity lowering, which ultimately formed several sedimentary basins along with alkaline magmatism during Carboniferous to early Triassic (Chatterjee et al., 2013). After the final assembly of Gondwana, over again, it started to break-up into several ephemeral ribbon continents (e.g., Avalonia, Cadomia and Cimmerian) opening the Rheic, Paleo-Tethys and Neo-Tethys oceans at consecutively younger Paleozoic era (von Raumer et al., 2003, Segev, 2002).

It is a debate about the amalgamation of the Indian continent with other small continents during/after initial rifting from Gondwana during Paleozoic and much of the Mesozoic era (Ali and Aitchison, 2008). Some research has shown that the break-up of the supercontinent was initiated in the Mid-Jurassic, succeeding the rifting of other continents like South American-Africa separating from Madagascar-Seychelles-India-Antarctica-Australia (Jokat et al., 2003). While some argue that Madagascar was separated from India-Seychelles during Late Cretaceous (Torsvik et al., 2000), afterward, the Indian plate moves northward with increasing velocity.

The present study is based on detrital zircon U-Pb geochronology of the rock samples from the Barahakshetra area, eastern Nepal and the results show that these sediments were mainly sourced either from the Stenian magmatism in Albany-Fraser orogeny or the East Africa-Nibua, also possibile from the east coast of India, and southwest Australia



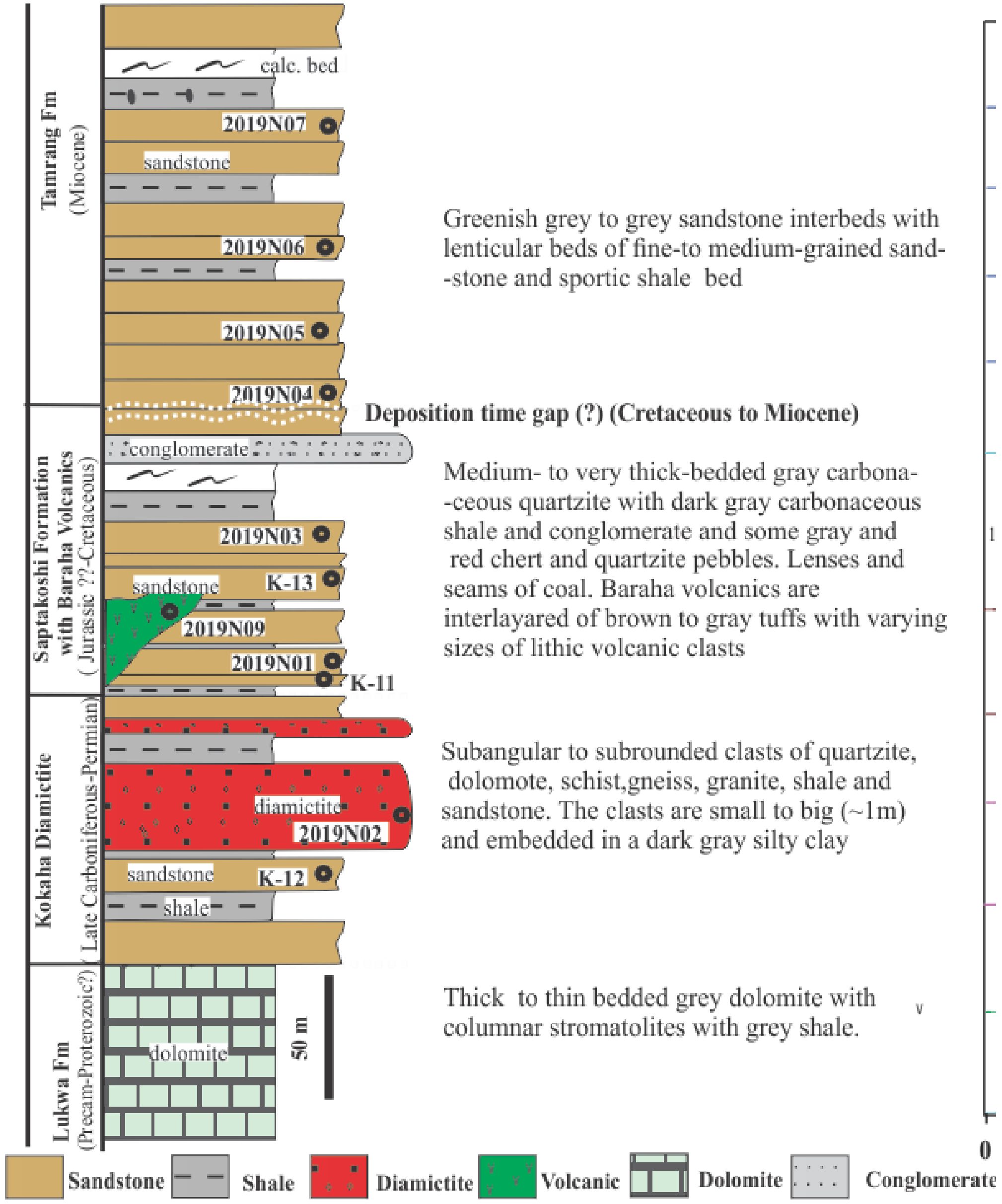
Geological map of Nepal (Upreti, 1999) and distribution of Peninsular and extra-peninsular Gondwana in Indian (insert) (Frakes et al., 1975)

Methods

The detrital zircons were obtained after crushing and sieving the sandstone samples (~2 kg) following the heavy mineral separation technique. Each sandstone sample was handpicked and attached to the double-sided tape, mounted with epoxy resin and polished to observed the zircon morphology and removed the outer weathering portion. The instrument, Agilent 7500a Inductive Coupled Plasma Mass Spectrometer (ICP-MS) attached with a New Wave Research UP193FX Excimer laser (New Wave Instruments, USA) was used for the geochronological age dating at Key Laboratory of Continental collision and Plateau uplift, Institute of Tibetan Plateau Research, Beijing China following the procedure given by Cai et al. (2012).

Results

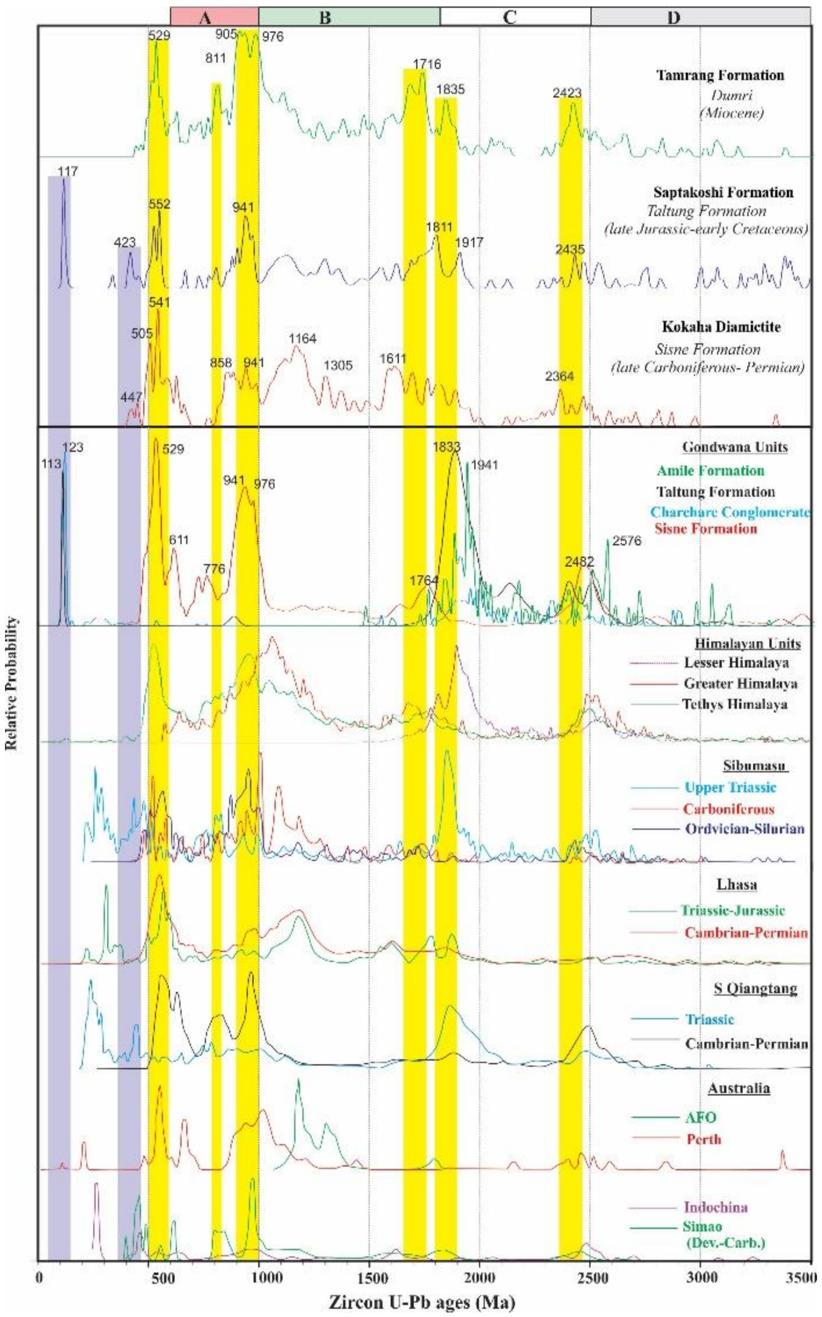
The majority of the obtained U-Pb ages from the DZ of Kokaha Diamictite clusters at ~490-700 Ma, 800-1300 Ma, and 1540-1970 Ma with a main peak at ~544 Ma, and subordinate peaks at ~890 Ma, 1178 Ma, and 1752 Ma. The U-Pb ages of the detrital zircons from Saptakoshi Formation clustered mainly at 400-580 Ma, 800-1000 Ma, 1050-2000 Ma with peaks at ~417, 531, 947, 1176, and 1806 Ma. These ages were somehow similar to the underlying late Carboniferous – Permian strata, while more interestingly there is presence of younger grains marking a peak at 123 Ma. The mean deposition age of the Saptakoshi Formation is calculated as 119.7 ± 4.8 Ma.



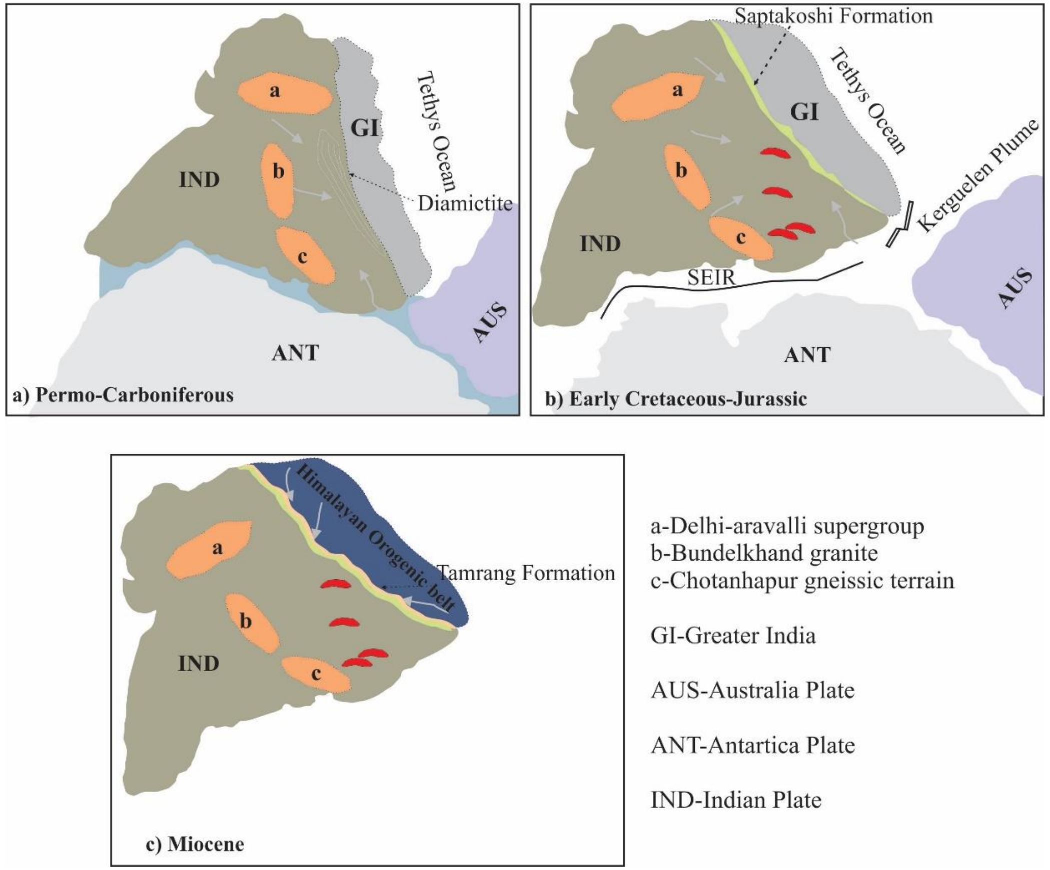
Columnar section of Gondwana sequence presented along the Barahakshetra area, eastern Nepal

Conclusions

During Permo-Carboniferous, the Indian continent was a part of the Gondwanaland, and it started to move apart from the Gondwana at early Mesozoic making a deposition of the Diamictite on the northern tip of the Indian continental margin similar to the glacial sedimentary cycles in South Africa, Antarctica, South American and India. The presence of younger detritus (~110-130 Ma) and Paleozoic peaks in Saptakoshi Formation were mainly sourced from the Indian peninsular along with the East Africa, Arabia-Nubia, Eastern coast of India, and Northern Australia and the Cretaceous ages are close affinity of the Rajmahal Basalt in Indian plate. The detritus in Gondwana sequence in Lesser Himalaya or Tethys Himalaya possibly are from the same source or recycled from TH till Permian, and onwards there was input from the Lhasa terrane, South Qiangtang terrane, and Indo-China blocks.



Normalized probability plots of zircon ages from the Gondwana sequence in eastern Nepal (Barahakshetra area), compared to the age probability curves from Indochina, Australia, South Qiangtang, Lhasa, Sibumasu and Himalayan units. References are in the main text.



Paleographic reconstruction of Gondwana and deposition of the sediments in the Gondwana basin (Chatterjee et al., 2013, Sakai, 1989, van Hinsbergen et al., 2012)

References

- ALI J. R. & AITCHISON J. C. 2008. Gondwana to Asia: Plate tectonics, paleogeography and the biological connectivity of the Indian sub-continent from the Middle Jurassic through latest Eocene (166-35 Ma). *Earth-Science Reviews*, 88**,** 145-166.
- CAI F., DING L., LEARY R. J. *et al.* 2012. Tectonostratigraphy and provenance of an accretionary complex within the Yarlung-Zangpo suture zone, southern Tibet: insights into subduction-accretion processes in the Neo-Tethys. *Tectonophysics*, 574**,** 181-192.
- CHATTERJEE S., GOSWAMI A. & SCOTESE C. R. 2013. The longest voyage: Tectonic, magmatic, and paleoclimatic evolution of the Indian plate during its northward flight from Gondwana to Asia. *Gondwana Research*, 23**,** 238-267.
- JOKAT W., BOEBEL T., KÖNIG M. & MEYER U. 2003. Timing and geometry of early Gondwana breakup. *Journal of Geophysical Research: Solid Earth*, 108.
- SEGEV A. 2002. Flood basalts, continental breakup and the dispersal of Gondwana: evidence for periodic migration of upwelling mantle flows (plumes). *EGU Stephan Mueller Special Publication Series*, 2**,** 171-191.
- TORSVIK T. H., TUCKER R. D., ASHWAL L. D. *et al.* 2000. Late Cretaceous India–Madagascar fit and timing of break-up related magmatism. *Terra Nova*, 12**,** 220-224.
- VON RAUMER J. F., STAMPFLI G. M. & BUSSY F. 2003. Gondwana-derived microcontinents — the constituents of the Variscan and Alpine collisional orogens. *Tectonophysics*, 365**,** 7-22.