

## Plate tectonic reconstruction of India and Madagascar closing through the Mascarene Basin

### Student Article

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The Indian Ocean (Fig. 1) was created by fragmentation and dispersal of a continental assemblage, Gondwanaland. In this context, the western continental margin of India and the adjacent ocean basins were evolved by rifting and subsequent drifting of India first from Madagascar, creating the Mascarene Basin, and then from Seychelles, creating the conjugate Arabian and Eastern Somali basins. Since the hydrocarbon occurrence in passive continental margins is closely associated with its spatio-temporal evolution, plate tectonic reconstructions of these margins and adjacent oceanic basins are found to be very useful to provide important constraints on conceptual evolution of hydrocarbons.

The plate tectonic reconstruction of western continental margin of India with its conjugate region of Madagascar has been directly addressed or indirectly depicted in a number of earlier studies. However the proposed relative configurations of India with Madagascar in their pre-drift tectonic scenario vary in different models. The formation of Indian Ocean is associated with Indian Plate (IND), African Plate (AFR) and Antarctic Plate (ANT) to cite the major plates (Fig. 1). Therefore, the India-Madagascar (IND-MAD) reconstruction can be achieved by considering different plate circuits - either by considering movement of IND directly to AFR (closing the Arabian, Eastern Somali and Mascarene basins) or by a combination of movements of IND to ANT (closing Central Indian and Crozet basins) and then IND-ANT

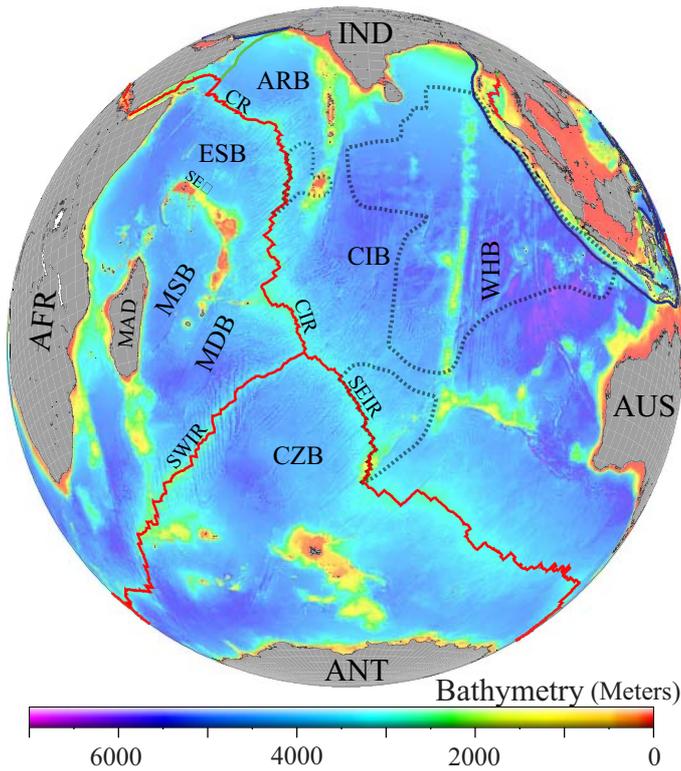


Fig. 1. Bathymetry of the Indian Ocean along with the plate boundaries. Thick lines with red/blue/green colours for divergent/convergent/transform boundaries and dotted black lines for zone of deformation in the Central Indian Basin. CR: Carlsberg Ridge; CIR: Central Indian Ridge; SWIR: Southwest Indian Ridge; SEIR: Southeast Indian Ridge; ARB: Arabian Basin; ESB: Eastern Somali Basin; MSB: Mascarene Basin; MDB: Madagascar Basin; CZB: Crozet Basin; CIB: Central Indian Basin; WHB: Wharton Basin; SEY: Seychelles Plateau

to AFR (closing the Southwest Indian Ridge). The absence of detailed magnetic anomaly information from Mascarene Basin forced all those studies to follow the IND-ANT-AFR circuit to obtain India-Madagascar reconstruction models in their pre-drift scenario (e.g. Fig. 2a). Since those models were not accounted for the deformation in the Central Indian Basin, subsequent studies (e.g. Fig. 2b) applied a correction for reflecting this deformation in the India-Madagascar configuration. However, since the detailed understanding on

the deformation still remains vague, the models created based on IND-ANT-AFR circuit needs improvement.

Recently, Eagles and Wibisono (2013) published magnetic anomaly picks and rotation parameters for different ages of the Mascarene Basin from its initiation to cessation of spreading (between ~ 88 Ma to 61 Ma). These information enabled to obtain a better-constrained IND-MAD juxtaposition model through direct IND-AFR (more specifically, India-Seychelles-Madagascar) circuit. This was achieved first by closing the conjugate Arabian and Eastern Somali basins for 61 Ma using rotation parameters of Royer et al. (2002) to bring India attached to the northern flank of the Mascarene Basin and then to obtain India-Madagascar pre-drift juxtaposition by closing the Mascarene Basin from 61 Ma to 88 Ma. Following this circuit could avoid the effect of the Central Indian Basin deformation, since all these rotation parameters were computed from conjugate magnetic anomaly picks from the oceanic crust unaffected by that deformation. The present model (Fig. 2c) also matches well with IND-MAD close-fit reconstructions of Yatheesh et al. (2006) or Müller et al. (2008), where the Alleppey-Trivandrum Terrace Complex was depicted as conjugate of a bathymetric notch in the Northern Madagascar Ridge. However, compared to those models, the present model shows considerably more gap between India and Madagascar. This gap suggests possibility of a wider continental rift zone between India and Madagascar that might have later fragmented to form smaller continental blocks of Laccadive Plateau, Seychelles Plateau and Laxmi Ridge.

References:

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4. Yatheesh et al., 2006, *Gondwana Research* 10, 179-185.

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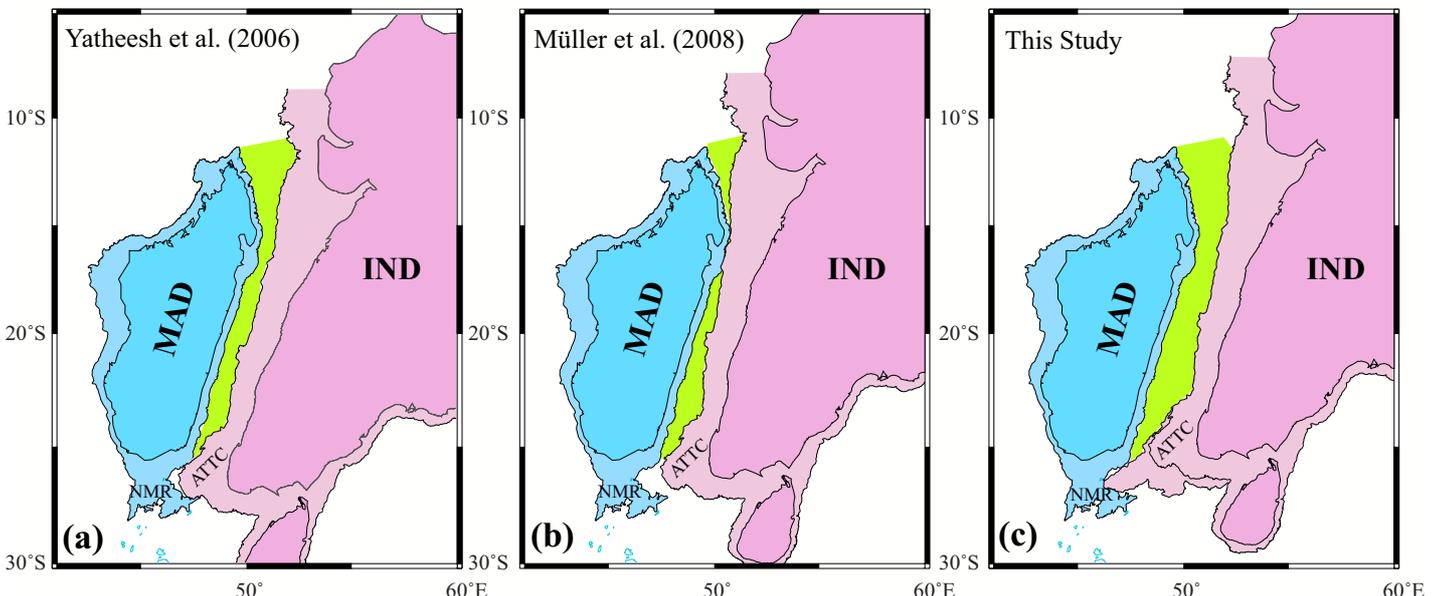


Fig. 2. India-Madagascar juxtaposition models based on [a] Yatheesh et al. (2006); [b] Müller et al. (2008); [c] Present study. The green shaded region represents the possible continental rift zone between India and Madagascar. ATTC: Alleppey-Trivandrum Terrace Complex; NMR: Northern Madagascar Ridge.