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A comprehensive study on India-Madagascar paleo-fit in the Gondwana Supercontinent

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This study addresses one of the most disputed problems in the history of the earth science, which is on the paleo-fit of India and Madagascar continents in the Gondwana Super Continent Assembly. The study contributes new constraints on, and definitions of, the reconstructed plate margins of India and Madagascar based on flexural isostasy along the western continental margin of India (WCMI) and the eastern continental margin of Madagascar (ECMM). We have estimated the nature of isostasy and crustal geometry along the two margins, and have examined their possible conjugate structure. Here we utilize elastic thickness (Te) and Moho depth data as the primary basis for the correlation of these passive margins. We employ the flexure inversion technique that operates in spatial domain in order to estimate the spatial variation of effective elastic thickness. Gravity inversion and flexure inversion techniques are used to estimate the configuration of the Moho/Crust-Mantle Interface that reveals regional correlations with the Te variations. These results correlate well with the continental and oceanic segments of the Indian and African plates. The present study has found a linear zone (˜1680 km) of anomalously low-Te (1-5 km) along the WCMI, which correlates well with the low-Te patterns obtained all along the ECMM. We suggest that the low-Te zones along the WCMI and ECMM represent paleo-welding zones of lithosphere thermally and mechanically weakened by the combined effects of the Marion hotspot and lithospheric extension due to rifting. Based on the present Te results, we have produced a precise India-Madagascar assembly during the time of their rifting (see Figure below), which is confirmed by the Moho geometry and the bathymetry of the conjugate shelf margins, and by the matching of tectonic lineaments, lithologies and geochronological belts between India and Madagascar.

Figure Caption: Elastic thickness structure of the western margin of India and eastern margin of Madagascar (left), correlation of similar Te zones of India-Madagascar conjugate margins (centre), and the paleo-fit of India and Madagascar deduced from the Te correlations justified by the fit of shear zones (Ratheesh Kumar et al., Gondwana Research, 2014).

Keywords: Gondwana, Paleo-fit, elastic thickness