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Controls on margin development during the breakup of East Gondwana

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During the Early Cretaceous East Gondwana began to internally fragment. This rifting split East Gondwana into two independent plates. One plate consisted of India, Sri Lanka, the Seychelles, & Madagascar and the other East Antarctica & Australia. During this separation, India and its now-subducted northern extent rifted away from East Antarctica and Western Australia. Seafloor formed during this breakup can be found along the present-day margins offshore East India, Western Australia and East Antarctica. The timing of East Gondwana breakup and our understanding of margin development has historically been poorly constrained as many previously proposed models are require either unlikely plate motions and/or are unsupported by the geophysical data.

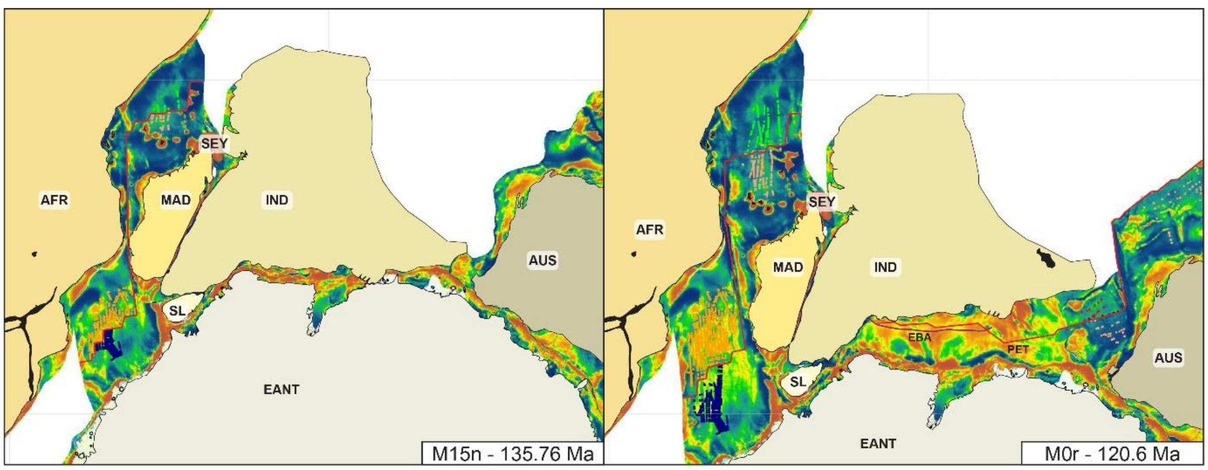

Figure 1. The breakup of East Gondwana from M15n to M0r [1]. Free-Air-Gravity [2] shown in the marine domain. Interpreted magnetic anomalies [1] [3] [4] [5] shown as coloured points. AFR – Africa, AUS – Australia, EANT – East Antarctica, IND – India, MAD – Madagascar, Seychelles – SEY, SL – Sri Lanka, EBA – Enderby Basin Anomaly, PET – Princess Elizabeth Trough. Red Lines – Hypothesized Spreading Ridges, Black Polygons – Onshore Volcanic Emplacements.

Improving our understanding of East Gondwana breakup can provide critical insight into margin development during continental breakup. The margins formed during East Gondwana breakup preserve a wide range of morphological signatures, from narrow, volcanic margins characterized by Seaward Dipping Reflectors and Large Igneous Province emplacement, to wide asymmetric margins formed via hyperextension and mantle exhumation. We present a new tectonic model for the breakup of East Gondwana. This tectonic model is based upon constraints from our recently published plate model [1] and geophysical observations from the relevant margins.

We compare observations from the tectonic model and with recent results from numerical modelling. Tectonic observations suggest an association between narrow volcanic margins and regions of Archean craton. Results from our numerical models explain this observations and show that pre-breakup thermal structure of the lithosphere may act as a major control on rifted margin development. Somewhat counterintuitively, colder lithosphere may be more likely to develop into a volcanic margin. Colder pre-breakup lithosphere allows for deeper brittle faulting, a narrow zone of lithospheric thinning, and a greater likelihood of focused asthenospheric upwelling.

References

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