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Structure and rheology of the lithosphere below southeastern margin of India and Sri Lanka, and its conjugate segment of the east Antarctica: Implications on early breakup history and margin formation

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The eastern continental margin of India has evolved as a consequence of rifting and breakup between India and east Antarctica during the early Cretaceous. Plate reconstruction models for the breakup of eastern Gondwanaland by many earlier workers have unambiguously placed the southeast margin of Sri Lanka and India together as a conjugate segment with the east Antarctica margin that extends from Gunnerus Ridge in the west to western Enderby basin in the east. In this study, we present results of integrated analysis of gravity, geoid, magnetic and seismic data from these two conjugate portions in order to examine the lithosphere structure and early seafloor spreading, style of breakup, continent-ocean boundary (COB) and rheological characteristics at these margins. The interpreted COB lies at a distance of 55-140 km on the side of southeast margin of Sri Lanka and India, whereas, it lies at a distance of 190-550 km on the side of east Antarctica margin. The seismic profiles and the constrained potential field models across these two segments do not show the existence of seaward dipping reflector sequences or magmatic underplating suggesting that these segments have not encountered major magmatic activity. While, significant crustal thinning/stretching is observed at the east Antarctic margin, the Cauvery offshore had experienced limited stretching with faulted Moho interface. Further, the conspicuous residual geoid low in the Cauvery offshore basin is inferred to be due to a continental crustal block. The modelled Lithosphere-Astenosphere Boundary (LAB) in these two margins is located around 110-120 km depth with slightly thicker lithosphere at the east Antarctica margin. In addition, the interpretation of magnetic anomalies provided structure of the oceanic crust generated through seafloor spreading processes with age and magnetization data constrained from the identified magnetic anomalies in the respective margins. Using the Bouguer coherence method, we computed spatial variations in effective elastic thickness (Te) at these margin segments. The estimated Te values at the Indian margin ranges between 5-8 km in the southeast of Sri Lanka to around 10-12 km in the Cauvery offshore which decrease further north to < 5 km in the Cauvery-Palar basin. Along the east Antarctic margin, the Te values ranges between 5-10 km in the Gunnerus ridge region, 35-40 km in the western Enderby basin which decrease further towards the central Enderby basin up to 20 km. In this study, the above results have been analyzed in terms of early breakup mechanism and subsequent evolution of these two conjugate segments.