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Apatite fission-track thermochronometric constraints on the exhumation and evolution of the southeastern Indian (Tamil Nadu) passive margin and the role of structural inheritance

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After rifting from Gondwana in the Late Jurassic – Early Cretaceous, and subsequent opening of the Indian Ocean basin, the continental margins of India developed into typical passive margins. Extensional tectonic forces and thermal subsidence gave rise to the formation of both on-shore and off-shore basins along the southeastern passive margin of the Indian continent, along the Tamil Nadu coast. There, basins such as the Cauvery and Krishna-Godavari basin, accumulated Meso- and Cenozoic (Early Cretaceous to recent) detrital sediments coming off the rifted blocks and the Tamil Nadu hinterland. In places, deep rift basins have accumulated up to over 3000 m of sediments. The continental basement of Tamil Nadu is chiefly composed of metamorphic rocks of the Archean to Palaeoproterozoic Eastern Dharwar Craton and the coeval Southern Granulite Terrane (e.g. Peucat et al., 2013). Several crustal scale shear zones crosscut this assemblage and at least some are considered to represent Gondwanan sutures (Santosh et al., 2012). Smaller, younger granitoid plutons intrude the basement at several locations and most of these are of Late Neoproterozoic age (Glorie et al., 2014). In this work metamorphic basements rocks and the younger granitoids were sampled for a apatite fission-track (AFT) thermochronometric study. A North-South profile from Chennai to Thanjavur mainly transects the Salem block of the Southern Granulite Terrane, and crosscuts several crustal scale shear zones, such as the Cauvery, Salem-Attur and Gangavalli shear zones. Apatites from over 30 samples were used in this study. AFT ages all range between about 190 and 120 Ma (Jurassic – Early Cretaceous). These mainly represent the slow, shallow exhumation of the basement during the rift and early drift phase of the Indian plate from Gondwana. AFT mean track lengths vary between 11 and 13 μm and are typical of slowly exhumed basement. Thermal history modelling (using the QTQt software by Gallagher, 2012) confirms that internal regions of fault blocks experienced a slow and steady cooling to ambient temperatures throughout the Meso-Cenozoic, while younger samples, mainly positioned closeby or inside the shear zones, additionally record a more moderate to rapid cooling since the Early Cenozoic.