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East African Fracture Zones: a long lifespan since the breakup of Gondwana

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Gondwana splitting started during the Early Jurassic (ca. 180 Ma) with the separation of Antarctica and Madagascar from Africa, followed by the separation of South America and Africa during the Middle Jurassic. Thanks to recent seismic profiles for petroleum exploration, the architecture of rifted margins and the transform faults zones, which developed as a result of the relative motion between tectonic plates have been recently evidenced and studied along the whole eastern and south-eastern Africa (*i.e.*, in the Western Somali Basin, the Mozambique Basin, the Natal Basin, and the Outeniqua Basin). Yet, the structure and overall kinematic evolution of the three major transform faults zones together – *i.e.*, the Agulhas, the Davie, and the Limpopo Fracture Zones – that control the opening of these major oceanic basins remain poorly studied. The interpretation of an extensive regional multichannel seismic dataset coupled with recent studies allows us to propose an accurate regional mapping of the crustal domains and major structural elements along the rifted margins along the whole eastern and south-eastern Africa. We provide new constraints on the structuration and evolution of these three transform systems. Although our findings indicate common features in transform style (*e.g.*, a right-lateral transform system, a wide sheared corridor), the deformation and the thermal regime along these systems appear quite different. In particular, we show that the Davie and Agulhas Fracture Zones recorded spectacular inversions during the transform stage whereas transtensional deformation is observed along the Limpopo Fracture Zone during its activity. This suggests that faults activity controls vertical displacements along transform margins, minimising other processes such as thermal exchanges between the oceanic and continental lithospheres across the transform fault and flexural behaviour of the lithosphere. This different style of deformation may be explained by two main forcing parameters: (i) the magmatic conditions that may modify the rheology of the crust, and (ii) the far-field forces that may induce a rapid change of regional tectonic stress. Further, in the Davie and Agulhas cases, the major transform faults postdate the development of the rift zone-controlling faults. Thus, there are no pre-existing structures that control the initiation of a

transform fault zone. Conversely, the Limpopo margin shows an intracontinental transform faulting stage. In both cases, a minimum of several Ma is required to establish a complete kinematic linkage between the two-active spreading centers. During this period, the rifted segments opening possibly triggered rift-parallel mantle flow, which progressively favors the decoupling in-between the continental domain and the future oceanic domain. In the post-drift history, rapid changes of regional tectonic stress are recorded and show that some transform margins are excellent recorders of large plate kinematic changes.