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Intra-plate deformation, great earthquakes and nascent plate boundary in the Wharton Basin, Indian Ocean

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The traditional understanding of plate tectonics posits rigid plates primarily undergoing deformation at narrow plate boundaries. However, the equatorial Indian Ocean presents a unique scenario with a diffused deformation zone spanning approximately 3000 km within the Indo-Australian plate. Past investigations have identified N-S compression in the Central Indian Ocean basin and strike-slip motion along N-S trending reactivated fracture zones of a fossil spreading center in the Wharton Basin located at the eastern margin of the Indian Ocean. Recently, the massive Wharton Basin twin earthquakes of April 11, 2012, challenged the existing conceptions in two significant ways. Firstly, their substantial magnitudes (Mw 8.6 and 8.2) underscored the potential for a significant localized deformation along a previously identified fracture zone (F6a), suggesting its candidacy as a nascent plate boundary between India and Australia. Secondly, the foreshock ruptured along a complex set of faults oblique to the presumed north-south direction of slip motion along fracture zones, indicating the existence of additional fault systems. To address these fundamental challenges, the MIRAGE experiment was launched, gathering a comprehensive suite of geophysical data in the Wharton Basin, encompassing high-resolution bathymetry over ~90,000 km2 and 12 seismic lines totaling 3450 km in length, intersecting two IODP borehole sites. The objectives of my Ph.D. project entail analyzing the MIRAGE dataset to: (1) Assess intra-plate deformation regionally and explore the potential of F6a as a nascent plate boundary, (2) Investigate the relationship between north-south trending fracture zones and newly discovered oblique shear zones, and (3) Probe into the role of intra-plate deformation in the subduction process.

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