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Inherited transform weaknesses control structure and morphology of highly oblique rift-transform systems

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The factors controlling the structure and morphology of oblique rifted margins remain enigmatic. Key features requiring explanation include: (1) long transform fault systems (>300 km) with transpression or transtension, (2) rift segments with varying asymmetry and obliquity, and (3) complex, variable drainage systems along the rift. We use large-scale 3D coupled thermo-mechanical and surface process models to explore how inherited transform weakness zones influence the structure and morphology of oblique rifted passive margins. Our results show that the orientation of inherited weaknesses determines the degree of transpression or transtension along transform faults, while the extent of over- or underlap among weaknesses controls segment obliquity and asymmetry, shaping fluvial drainage networks. These findings provide a conceptual framework to interpret the key structural and morphological characteristics of oblique rifted margins in the Equatorial Atlantic, North Atlantic/Arctic, and Mozambique regions.