Geophysically constrained microplate fragmentation model and terrane-controlled evolution of Mesozoic basins – rifted North Atlantic borderlands, offshore Newfoundland, Canada

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The continental shelf offshore eastern Newfoundland comprises a collage of fault-bounded microplates, assembled during the closure of the Iapetus Ocean and the formation of the Pangea Supercontinent during the Mississippian. These inherited terranes and structural fabrics were later reactivated through multiphase rifting of the North Atlantic between 237–66 Ma. Rifting along offshore Newfoundland occurred in three to four transtensional phases which increased basin accommodation space and sediment infill. Each rift phase is represented by distinct tectonostratigraphic packages displaying: (1) Basal rift onset unconformities (ROU) underlying syntectonic clastic units which thickening into active fault zones; (2) Back-stepping shore proximal deposits formed during tectonic and thermal subsidence; and lastly (3) Waning post-rift basin deepening often associated with capping carbonate marker units (e.g., Petrel, Marker-A, Rankin, Iroquois carbonates). These rifting phases were driven by global plate motions including: (1) Late Triassic to Early Jurassic rifting of Africa away from North America; (2) Middle Jurassic rifting away of Iberia; (3) Late Jurassic to Early Cretaceous oblique rifting of Baltica from the margin including Ireland; and (4) Early Cretaceous to Late Cretaceous extension associated with the opening aulacogen between Baffin Island/Labrador and Greenland.

Recent peer-reviewed dynamic tectonic publications modeled in the ®GPlates freeware package led to interest in the development of an original 4-D dynamic micro-plate model for the MAGRiT geophysical group. This thesis project will provide a needed dynamic tectonic model that can simulate the microplate motion, and deformation patterns along the North American borderlands of offshore Newfoundland. The model is constructed to be infinitely expanded upon by future researchers as interpretations become more refined, and future datasets become available. This model will improve visualization and constrain the timing and distribution of structures, providing better control on the spatial-temporal relationships for of hydrocarbon source units, reservoir facies, and evolution of structural and stratigraphic traps, aiding future hydrocarbon exploration along the margin. This study focuses on the deformable North American plate margin with implications for Mesozoic basin evolution and contributes key detailed spatial – temporal tectonic stress information to refine global plate motions across relevant conjugate margin pairs (e.g., Ireland and Iberia).

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