CENOZOIC STRATIGRAPHIC AND TECTONIC HISTORY OF THE GRENADA AND TOBAGO BASINS AS DETERMINED FROM MARINE SEISMIC DATA, WELLS, AND ONLAND GEOLOGY

by

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Cenozoic stratigraphic and tectonic history of the Grenada and Tobago basins as determined from marine seismic data, wells, and onland geology

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Dedication

To my girls, wife Anne and daughters Grace and Holland. You will always be the reason for my accomplishments in life.

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Abstract

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This thesis presents an integrated stratigraphic and tectonic evolution of the Grenada and Tobago basins using multi-channel seismic data collected in May, 2004, (BOLIVAR cruise), along with GULFREX seismic data collected by Gulf Oil Company in 1975. These reflection data, combined with UTIG OBS refraction data also collected with the BOLIVAR study in 2004 and with a compilation of previously published, onland geologic data in the southeastern Caribbean, constrain a multi-stage, Cenozoic tectonic history for the southern Lesser Antilles arc and flanking Grenada and Tobago basins. A new tectonic model for the Grenada and Tobago basins is based on three seismic megasequences. The striking similarity in the two basins' half-graben structure, smooth

basement character, deep-marine seismic facies, and similar Paleogene sediment thickness suggest that the two basins formed as a single, Paleogene forearc basin related to the now dormant Aves Ridge. This single forearc basin continued to open through flexural subsidence during the early to middle Eocene probably because of slow rollback of the subducting Atlantic slab. The Grenada and Tobago basins began to be divided during the early to middle Miocene, when the thinned crust of the forearc was inverted as a result of: 1) oblique convergence between the Caribbean plate and the passive margin of South America; and 2) intrusion of the Neogene Lesser Antilles arc. Observed transpressional shortening of the basins decreases from southwest to northeast. Total shortening in the southern Grenada basin varies from 5 km in the southern part of the study area to 1 km in the northern part of the study area. Shortening structures include inverted Paleogene normal faults, folds, and shale diapirism. The late Miocene to Recent period is characterized by divided depositional histories of the Grenada and Tobago basins. The Tobago basin is characterized by a 4-km-thick wedge of Plio-Pleistocene clastic sediments inferred to represent the distal progradation of the proto-Orinoco River. The Grenada basin becomes increasingly isolated from further continental sediment input by uplift of coastal Venezuelan ranges and the Neogene Lesser Antilles volcanic ridge.

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