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ABSTRACT

ACTIVE TECTONICS (NEOTECTONICS) RESEARCH IN TRINIDAD AND TOBAGO: REVIEW AND SYNTHESIS

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Trinidad and Tobago sits in an actively deforming plate boundary. Active structures are currently being explored for petroleum, engineered, and built across. By applying GPS (Global Positioning System), paleoseismology, Quaternary geology, and geomorphology techniques we are beginning to understand the kinematics, history, and seismic risk of some of these active structures. This new geodetic and geologic information should be included in updates to the current earthquake-only-based national seismic risk map. There are at least three principal active faults in Trinidad and Tobago: 1) the Central Range dextral-transpressive transform fault, and 2) the Los Bajos dextral-oblique (?) fault, and 3) the North Coast/South Tobago normal-dextral fault system.

According to GPS, paleoseismology trenching, and geomorphic mapping, the Central Range fault is the principal active transform fault in the Trinidad/Tobago segment of the Caribbean-South American plate boundary. With a GPS-estimated slip rate of 12+/-3 mm/yr, it takes up ~60% of the 20 mm/yr of ~eastward current plate motion. This fault may be locked and could pose a significant seismic risk for Trinidad: 1) it is not currently creating small (creep-related) earthquakes; 2) it does not obviously offset cultural features built across it (e.g., Plaisance Park, Navet Dam); 3) where observed in paleoseismic trenches (Bonne Aventure, Tabaquite), it cuts > 2710 year old sediment, and is blanketed by an unbroken < 550 yr. old packet of sediment (ages from ^{14}C analyses). Because it is oblique to current plate motion, a fem mm/yr of active shortening must occur across this fault that is probably currently building the Central Range surface topography and an underlying crustal root. A pull-apart basin is required in the Gulf of Paria to link the Central Range transform with the active Venezuelan El Pilar transform. Geomorphic analyses of the landscape features of northern Trinidad (coastlines, alluvial fans, rivers, and surface elevations) clearly reflect long-term west-down titling and sinking into the Gulf of Paria pull-apart.

The Los Bajos fault is presumed active based on its sharp geomorphic expression that we have mapped using a DEM. We trenched young sediments (yet undated by ^{14}C) across the Los Bajos fault trace and observed recent faults. But, because of extensive pitch dike intrusions, however, we could not rule out that the faults were simply intrusion-related. The current GPS data permit a few mm/yr of strike slip across the Los Bajos fault. The Los Bajos fault could extend eastward into the southern offshore (Columbus Channel). The lack of earthquakes on this structure suggests that it may also be locked, but we clearly need more data to better evaluate its risk.

The sub-sea South Tobago/North Coast fault system ruptured violently during the 1997 M 6.6 earthquake. We captured this earthquake with GPS at two stations in Tobago, and used the GPS displacements to estimate the fault geometry and slip. This low-angle (28°), WSW-striking, dextral-normal fault reactivated and reversed motion on the sub-Tobago-terrane thrust via gravitationally driven, northward sliding of the obducted dense Tobago terrane oceanic forearc, plus a fraction of dextral plate motion.