Central Range Continental Transform Fault, Trinidad: Update - New GPS Evidence for Creep, and Geological and Hazard Implications

Chris Churches[1], John Weber[1], Richard Robertson[2], Pete La Femina[3], Halldor Geirsson[3], Kenton Shaw[1], Machel Higgins[2], and Keith Miller[4]

[1]*Department of Geology, Grand Valley State University, Allendale, MI 49403 USA*
[2]*Seismic Research Centre, The University of the West Indies, St. Augustine, Trinidad and Tobago*
[3]*Penn State University, University Park, PA 16802 USA*
[4]*Department of Geomatics Engineering & Land Management, The University of the West Indies, St. Augustine, Trinidad and Tobago*

Abstract

Most transform faults on continental plate boundaries exhibit stick-slip behavior and are locked during the interseismic period. Important exceptions include the Hayward, Parkfield, and central segments of the San Andreas faults. Studying how and why fault creep occurs has implications for our understanding of how faults work in general and how to better assess their associated seismic hazards. Trinidad is located along the Caribbean-South American (CA-SA) dextral transform plate boundary. Triangulation-to-GPS geodetic measurements have shown that the 072° striking Central Range Fault (CRF) is the active transform fault in Trinidad, accommodating ~two-thirds of the total ~20 mm/yr CA-SA plate motion, with an interseismic slip rate of 12 ± 3 mm/yr. We build on this earlier work using new GPS data collected between 1994 and 2014 from a set of ~25 continuous and episodic GPS stations. 2-D elastic fault dislocation modelling of the new GPS velocity field gives a best-fit (reduced $\chi 2$ = 4.119) interseismic slip-rate of 14 ± 1 mm/yr and a fault locking depth of 0.083 ± 0.153 km (model parameters given at 1σ uncertainty, determined via the empirical bootstrapping method). The shallow locking depth is well resolved, indicating that the CRF largely creeps. However, a sparsity of data along the eastern part of the Central Range fault leaves open the possibility of some interseismic locking there. Our new results are consistent with the one prehistoric (~2.7 - .55 ka) earthquake trenched along the CRF being of small magnitude or possibly related to a slow-slip event, and with the low permanent neotectonic, strike-slip strain recorded/observed in the walls of the fault. We propose that a rigid northern block is juxtaposed against a weak and thick Paleogene-shale-rich covered southern block along a sharp 072° striking inherited (?) boundary, along which the neotoectonic strain concentrates. The lack of sharp, conclusive creep offsets that were searched for, but not observed on the ground could mean that the CRF creeps across a relatively broad (dm-scale?) zone. We plan to establish a series of creep arrays and a network of microseismometers and additional cGPS stations to better quantify the behavior of the CRF.