# Submarine Paleoseismology along Transform Boundaries: A Seismo-tectonic Signal From Offshore Sedimentation of the 2010 Haiti Earthquake

McHugh, C. M. (1, 2),Seeber, L. (2), Cormier, M.-H. (3), Hornbach, M. (4), Momplaisir, R. (5) Sorlien, C. (6), Steckler, M. (2), Waldhauser, F. (2)

(1) Queens College, CUNY, Earth and Environmental Sciences, Flushing, NY, USA
(2) Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY, USA
(3) University of Missouri, Department of Geological Sciences, Columbia, MO, USA
(4) Southern Methodist University, Department of Earth Sciences, Dallas, TX, USA
(5) Universite d'Etat de Haiti, Port au Prince, Haiti
(6) University of California, Earth Science, Santa Barbara, CA, USA
Corresponding Author: McHugh, C.M. (cmchugh@qc.cuny.edu)

The Mw 7.0 January 2010 earthquake in Haiti was one of the deadliest in history. It involved multiple faults along or near the main Enriquillo-Plantain Garden Fault (EPGF). This left-lateral transform is a branch of the northern Caribbean plate boundary across southern Hispaniola. The main rupture was strike-slip but almost all aftershocks had thrust mechanisms, and surface deformation may have been concentrated on anticline forelimbs driven by blind thrust faults. The earthquake generated mass-wasting and turbidity currents that were sampled from the Canal du Sud slope, a basin at 1500 m to the deepest area at 1700 m. The T-H units recovered from the slope and deep basin are similar in composition. The Leogane Delta, upslope from the sampling sites, is rich in this lithology that has been linked to oceanic basement rocks exposed on the southern Haitian peninsula. In contrast, the T-H unit recovered from the basin at 1500 m perched behind a thrust anticline has a greater concentration of Ca derived from Ca rich sources such as the Tapion Ridge on the southern peninsula. The Tapion Ridge is a compressional structure associated with thrusting along the EPGF.

The T-H unit beneath the 2010 deposit has a 14C age of 2400 cal yrs BP, and interpreted as an earthquake triggered deposit. Notably absent from the record are younger turbidites that could have been linked to the historic 1770 AD and other similar earthquakes expected from GPS rates across the EPGF.

Two hypotheses are being considered for this long gap in T-H sedimentation. One proposes that during relative high stand of sea level fringing reefs are trapping sediment on the shelf and that a critical accumulation is needed to generate failure. Many large local earthquakes could have occurred before reaching this critical thickness. Low sedimentation rates (6 cm/1000 yrs) support this. Our preferred hypothesis links T-Hs to earthquakes with a large thrust component such as the 2010 event to generate failure. This hypothesis accounts for earthquakes producing no turbidites versus those that do, and for the fracturing sampled along 8 km of the perched basin. We propose that thrust earthquakes along the Tapion Ridge segment of the EPGF reoccur at ~2000-year intervals and this sedimentary signal is preserved in Canal du Sud.

The proximities of sedimentation events to inferred earthquake ruptures are consistent with previous findings for the North Anatolia fault beneath Marmara Sea where we have tentatively linked T-H units to earthquakes for the past 5000 years including historical earthquakes in 557 AD, 740 AD, 1063, 1343, 1506, 1766, and 1912. Large earthquakes in the Marmara Sea have an average recurrence interval of ~350 years. This is consistent with a constant slip rate for the NAF for the mid to late Holocene. These results point to the significance of submarine paleoseismology for understanding the long-term record of ruptures along tectonic boundaries.