Wavelets

Searching for Blind Faults: Subsurface Imaging in Haiti

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On January 12, 2010 Haiti suffered a major earthquake (Mw = 7.0) causing tragic loss of life as well as infrastructure. While the epicenter of the event was located by the worldwide network of seismic stations, no surface expression of the earthquake fault has yet been unambiguously identified. Thus, key geologic components of the devastating rupture are not well understood. The Haiti Subsurface Imaging (HASI) Project (led by the University of Houston and supported by Geoscientists Without Borders, TGS, and the SEG Foundation) aspires to find expression of this "blind" fault. We have made two geophysical reconnaissance surveys in Haiti to date: undertaking ten days of seismic, GPS, and gravity surveys in the epicentral Léogâne Delta region (2012 and 2013 surveys) as well as GPS and gravity surveys near Port-au-Prince (2013 surveys). The primary goals of the HASI project are to: a) assist in continuing to build Haiti's geoscientific and hazard-assessment capabilities, b) characterize the physical properties of the epicentral region's near-surface sediments, and c) find geophysical evidence of the fault(s) that are thought to have given rise to the 2010 earthquake.

Personnel (faculty, staff, and students) from the University of Houston have worked with graduate students from Haiti's National University and geoscientists from the Haitian Bureau of Mines and Energy (***Figure 1***). This collaboration has provided an excellent platform to understand Haiti's geology and hazards, help building technical capacity, assist with the development of Haitian personnel, and provide an international experience for students.

We have used two different seismic recording systems in Haiti: the autonomous nodes (GSRs generously loaned to us by Global Geophysics) and cabled recorders (Geometrics' Geodes). In addition, we had various sources: a sledge hammer for the 2012 surveys, then the GISCO accelerated weight drop (slanted to excite both P and S waves) as well as the Propelled Energy Generator for the 2013 surveys (***Figure 2***).

These reconnaissance surveys delivered reasonable seismic data (***Figure 3***). Several hundred millisecond seismic data is imaging up to about 300 m depth. Migrated sections from both years showed disruptions and discontinuities in the reflectors. However, from the earthquake's hypocentral location and magnitude, we anticipate that the top of the blind fault could be some several kilometers deep. While our shallow seismic lines showed some evidence of faulting, the images were not clear enough and the discontinuities were not necessarily part of the larger fault system required to create the 2010 earthquake. Thus, to further develop Haitian geophysical capabilities and create more detailed and deeper seismic sections, we plan to return to Haiti in March, 2014 with a larger seismic source and more recording channels. With Haitian help, we hope to illuminate the blind fault, better understand the Haitian subsurface, and assist in advancing Haiti's technical capabilities.

Figure 2: Seismic sources in Haiti: a) Vertical accelerated weight drop source (PEG), b) Slanted accelerated weight drop (GISCO) on the line.

Figure 1: Haitian and Houstonian geophysical research team after completion of 2013 Léogâne seismic surveys.

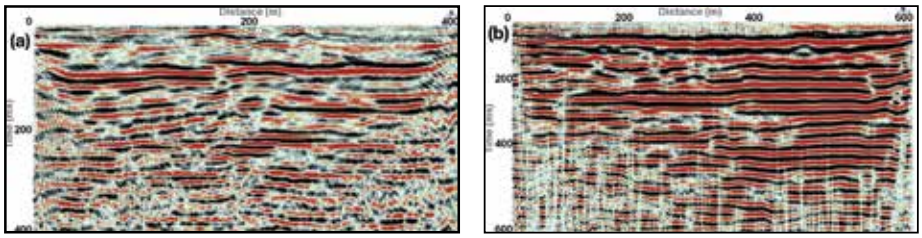

Figure 3: a) P–wave time migrated section using a hammer source and cabled vertical geophones, b) P–wave time migrated section using vertical weight drop and cabled vertical geophones. Some disruptions in the reflector continuity may be indicative of faulting.