Project Lake Azuei, Haiti: Data Acquisition in the Field

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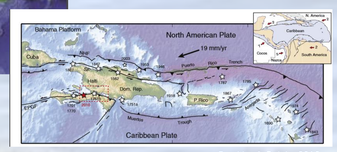
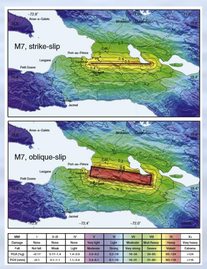
Abstract

Earthquakes are vibrations caused by rocks breaking under stress during transform, convergent or divergent tectonic plate movement. During this process, stored energy builds up until it exceeds the strength of the rock causing the rock to fracture along the fault. On January 12, 2010, Haiti was devastated by a magnitude 7.0 earthquake. The earthquake struck 25 km, southwest of Port Au Prince, Haiti's capital, affected over 3 million people and was responsible for 220,000 fatalities. Initial assumptions lead scientist to believe the cause was movement between the Caribbean and North American plates along the Enriquillo-Plantain Garden strike slip fault system. After further investigation, this was ruled out due to lack of surface deformation. However, it was later determined that Haiti's catastrophic event occurred because of slip along the Leogane fault due to an oblique blind thrust fault. To mitigate potential future loss of life, property and to educate the community on seismic hazards, an international scientific collaboration project was put in place between the University of Rhode Island, Herbert Lehman College and the State University of Haiti. The project objective was to survey the floor of Lake Azuei, located 30km east of Port Au Prince. Lake Azuei is bisected by the Enriquillo Plantain Garden Fault, and bounded north and east by Haiti's fold and thrust belt. We carried out a geophysical survey of the lake floor and subsurface using CHIRP and resolution multi-channel seismic reflection. Combing the resulting high resolution 3-D images of deformation structure with dating data provided by core samples of the lake floor sediments, we will gain a better understanding of past seismic events and the rate of deformation as well as the potential locations and magnitudes of future earthquakes. This poster focuses on the project's data acquisition phase at Lake Azuei, Haiti.

Introduction



Symithe & Calais, 2016.



Symithe & Calais, 2016.

On January 12, 2010, Haiti was devastated by a magnitude 7.0 earthquake. The earthquake struck 25 km, southwest of Port Au Prince, Haiti's capital, was responsible for more than 200,000 fatalities and affected over 3 million people. Initial reports speculated that the Enriquillo-Plantain Garden Fault had ruptured due to the movement of the Caribbean plate 2 cm/yr eastward with respect to the North American plate (Sloan & Cormier, 2015). Later, it was determined that the cause was east-northeast transpressional slip occurring along the Leogane fault, an oblique blind thrust fault (Sloan et al., 2015). Although the outcome of this catastrophic event led to the tragic loss of life and property, the amount of accumulated elastic strain release was lower than expected (Sloan et al., 2015), leaving great concern of the next hazard along with an abiding threat for the Haitian community.

Project Lake Azuei: Haiti, was put in motion by Drs. Marie-Helene Cormier and Heather Sloan to gain a better understanding of past earthquake hazards. Due to the proximity of Haiti's location, directly on a plate boundary between the Caribbean and North American Tectonic Plates, it is a region prone to earthquake. Our purpose as research assistants, was to aid scientists with a geophysical survey of the lake seafloor and collect data using seismic equipment. The objective of the project was to observe evidence of past seismic events; evidence of ongoing deformation; and to determine the rate of deformation. This information will help to predict potential earthquake hazards.

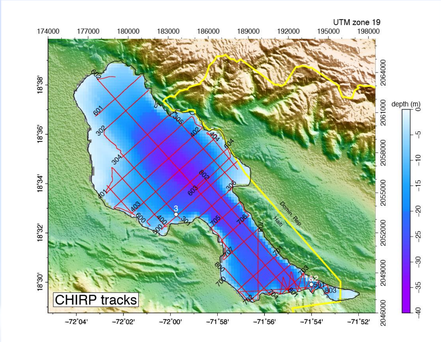
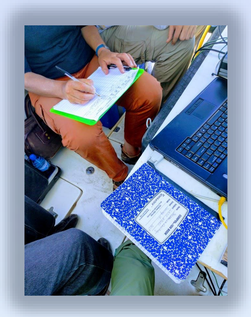


Figure 1. Cormier, 2017.



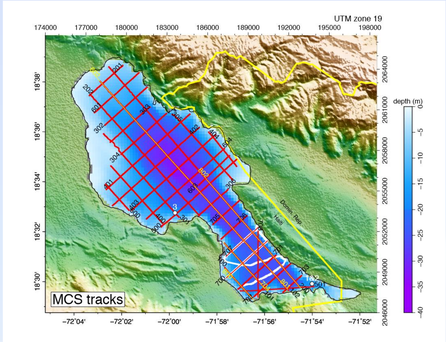
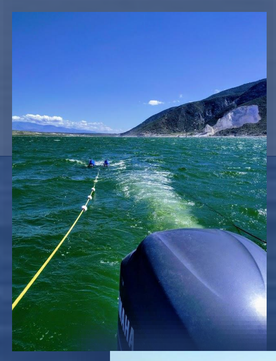


Figure 2. Cormier, 2017.

Methods

Our team used a small boat to conduct our study upon Lake Azuei; this craft was used to transport our geophysical equipment and scientist crew. The boat traveled along pre-drawn lines, which were organized in a grid pattern (see fig.1 & 2), to collect seismic data of Lake Azuei sediments. The pieces of equipment used to acquire the seismic reflection data were a Hegg Marine Systems Bubble-Pulse (along with a 24-channel hydrophone streamer) and a Teledyne Benthos CHIRP (Sloan et al, 2015). The Bubble Gun seismic source sent out a frequency of 70-700 Hz, achieving a depth of penetration from 100-200 meters; this produced seismic data profiles that, though less precise, showed deeper geological features. The CHIRP seismic source had a frequency of 2-20 Hz, and was able to achieve detailed images of geological structures close to 30 meters below the surface. Detailed logs were taken during acquisition on the boat, and were used to better understand the data collected. After reviewing the CHIRP seismic data, our team selected sites in Lake Azuei that were best for carrying out sediment coring. A raft was then assembled that was big enough for a team of people to safely operate the sediment coring equipment while on the water.



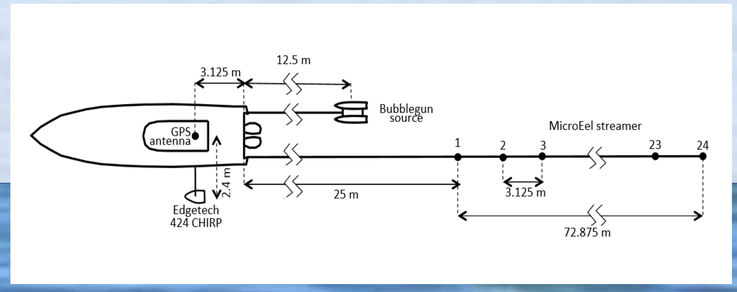
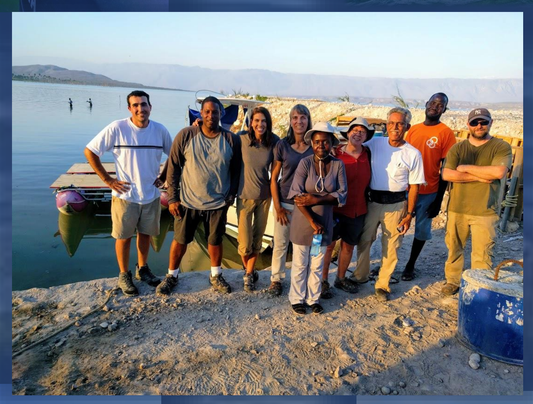
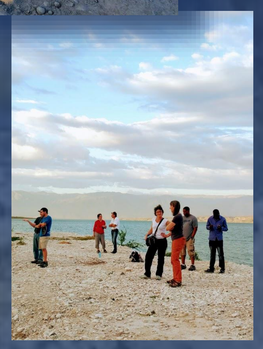


Figure 3. Boat and instrument setup diagram. Cormier, 2017.





Initial Results

The seismic data collected concurred prior predictions, showing deformation (see fig. 4) within the sediment layers along the lakefloor. Our results will have a profound effect on the Haitian community; other regions with similar hazard threats; as well as afford the opportunity to mitigate the future loss of life and property. Sediment cores are currently undergoing analysis for dating.

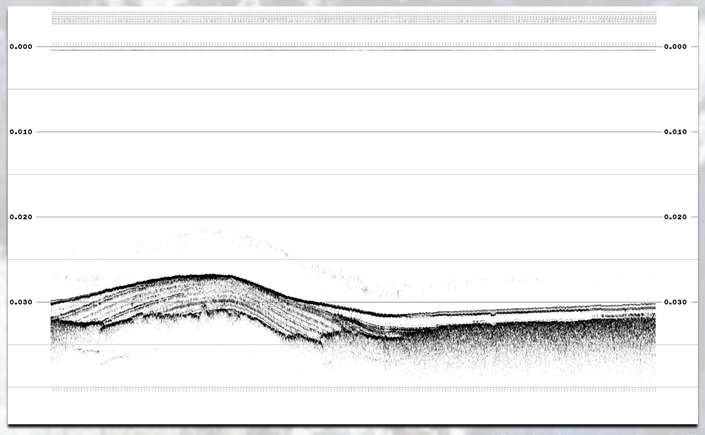


Figure 4. Fold in Lake Azuei sediments. Cormier, 2017.