Possible Sedimentary Evidence for Paleoearthquakes along the northern Lesser Antilles: preliminary results from the CASEIS cruise aboard the N/O Pourquoi Pas?

17-939

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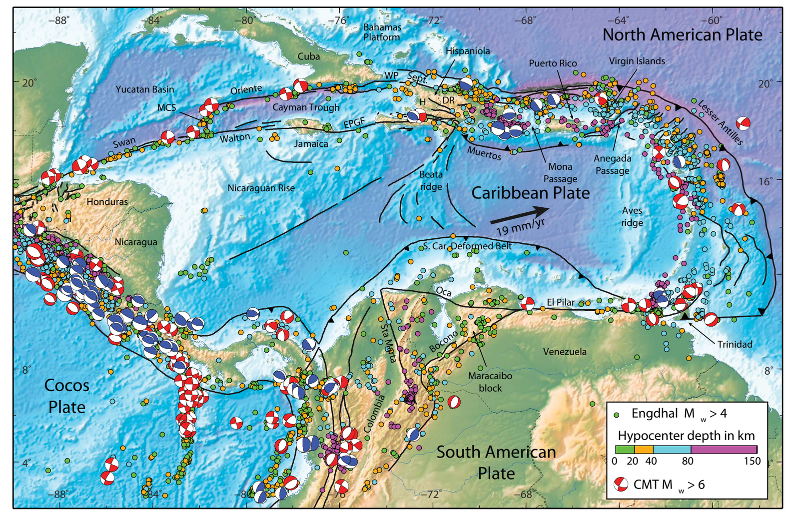
The Lesser Antilles subduction zone in the western Atlantic has a short historic record of earthquakes and little is known about the prehistoric record of great earthquakes and tsunami. The oblique convergence between the North America and Caribbean plates forms the Barbados Accretionary prism and may be a significant source of earthquake and tsunami hazard. The megathrust may be segmented due to the presence of several fracture zones in the subducting North America plate and active faults on the upper plate accommodate the plate convergence obliquity. In May and June of 2016, an international team of scientists conducted the oceanographic cruise CASEIS doi 10.17600/16001800 aboard the N/O Pourquoi Pas? with a goal to evaluate the seismogenic potential of the megathrust by using the turbidite paleoseismology method.

We selected core sites using both newly collected and existing high resolution bathymetric and seismic reflection data. Core sites include isolated slope basins, slope canyons, the subduction trench, and turbidite channel and levee systems. Sites were chosen to optimize for (1) isolation from confounding factors like storm-generated terrigenous sediment input, (2) site spacing to test for structural segment boundary determination, and (3) sites with isolated sediment source areas.

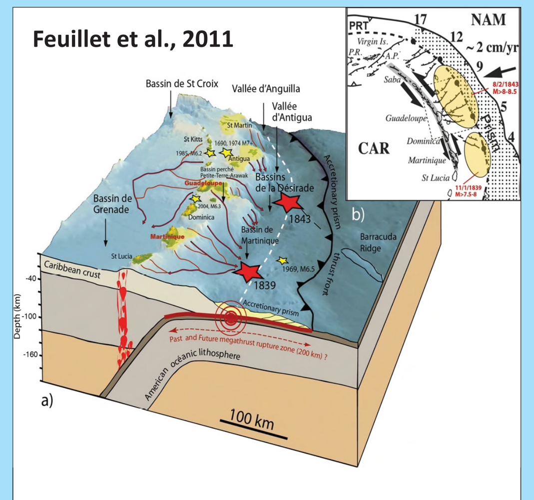
Our team collected 50 piston cores along the northern margin with lengths reaching up to 30m. We collected core petrophysical data including gamma density, P-wave velocity, magnetic susceptibility, resistivity, color reflectivity, and color imagery. U-Channels were collected for paleomagnetic analyses. We interpret that the sedimentary facies include turbidites and homogenites interbedded with hemipelagites and tephra. Preliminary stratigraphic correlation analyses, using the core petrophysical data & CHIRP high resolution seismic stratigraphy, suggest that these cores may include a sedimentary record of earthquakes in the form of turbidites and homogenites that span 100s of km.

Plate Tectonics

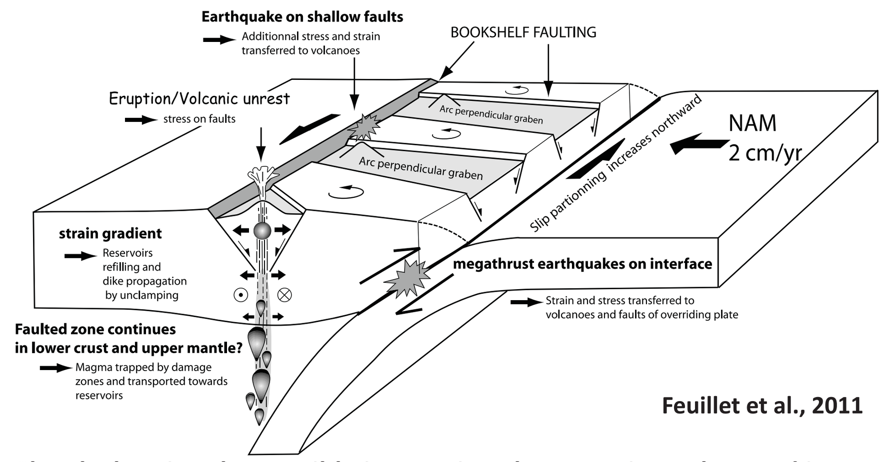


Seismotectonic setting of the Caribbean region. Black lines show the major active plate boundary faults. Colored circles are precisely relocated seismicity [1960–2008, Engdahl et al., 1998] color coded as a function of depth. Earthquake focal mechanism are from the Global CMT Catalog (1976–2014) [Ekstrom et al., 2012], thrust focal mechanisms are shown in blue, others in red. H = Haiti, DR = Dominican Republic, MCS = mid-Cayman spreading center, WP = Windward Passage, EPGF = Enriquillo Plaintain Garden fault.

Feuillet et al., 2011

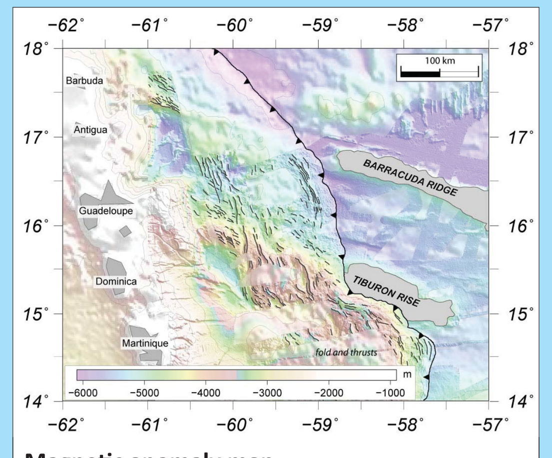


Historic earthquakes and possible flow paths.

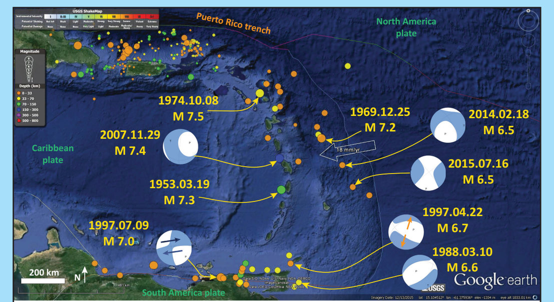


Feuillet et al., 2011

Sketch showing the possible interactions between intraplate and interplate earthquakes and volcanoes.

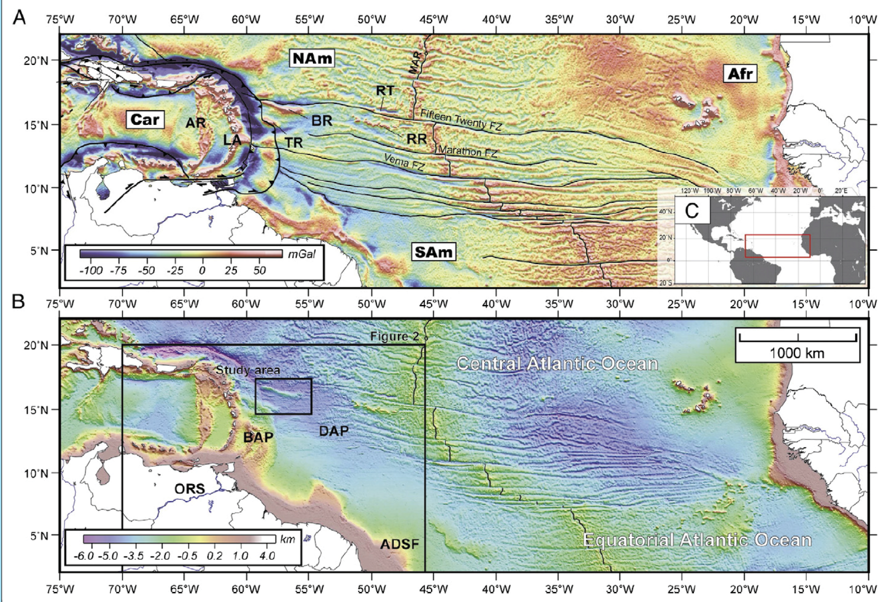


Magnetic anomaly map. Pichot et al., 2012



USGS Seismicity & Moment Tensors

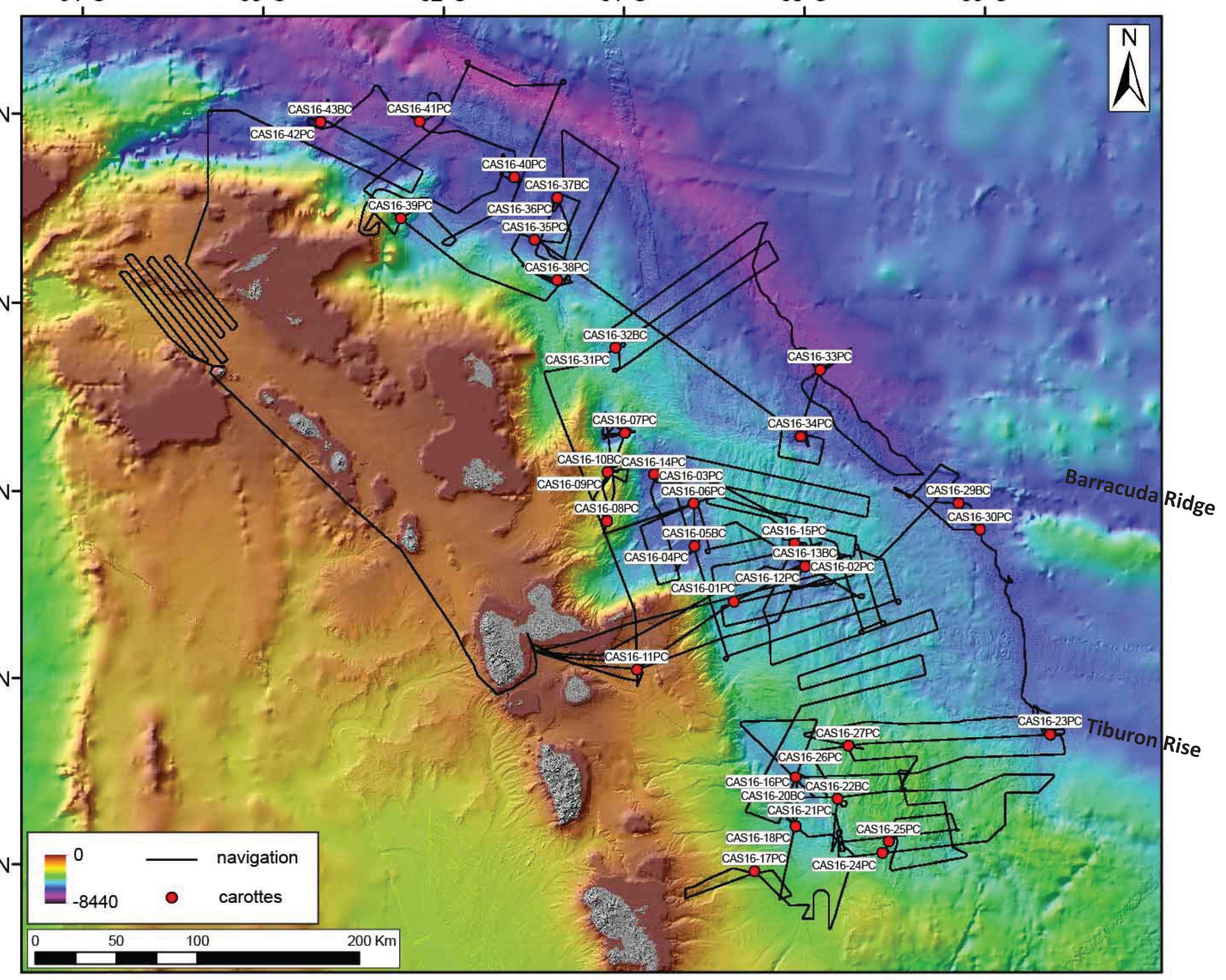
Patton, 2016

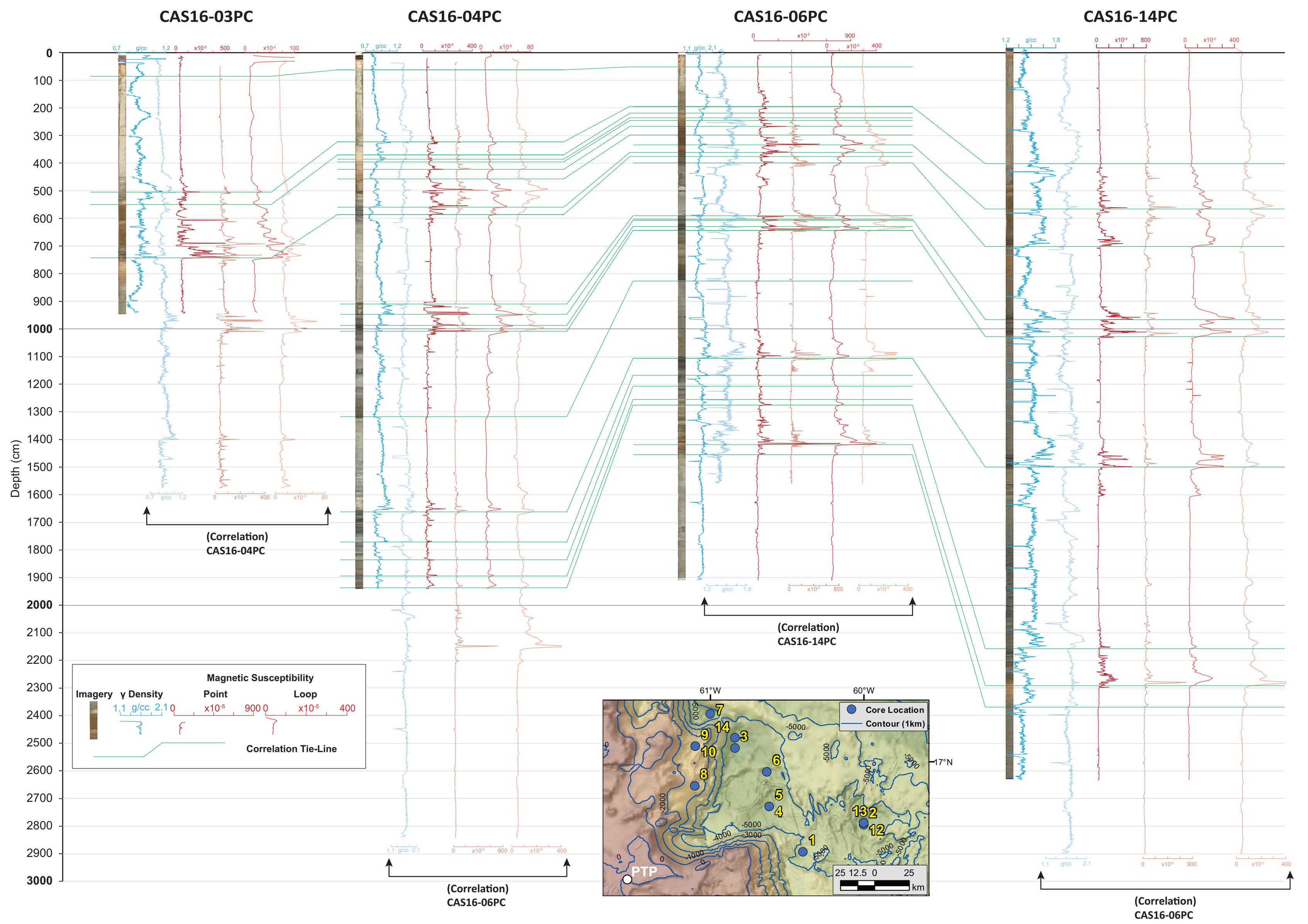


The Atlantic Ocean between 2°N and 22°N. A) 1×1 min-Satellite free air gravity map (V18.1 from Sandwell and Smith, 2009), with, NAm, North America Plate; Car, Caribbean Plae; SAm, South America Plate; Afr, Africa Plate; MAR, Mid-Atlantic-Ridge; AR, Aves Ridge; LA, Lesser Antilles; TB, Tiburon Rise; BR, Barracuda Ridge; RT, Royal Trough; RR, Researcher Ridge; Caribbean structural geology after Pindell and Kennan (2009).B) Bathymetric map (Smith and Sandwell, 1997) with, BAP, Barbados Ridge accretionary prism; ORS, Orinoco river system; ADSF, Amazon Deep Sea Fan, DAP, Demerara abyssal plain

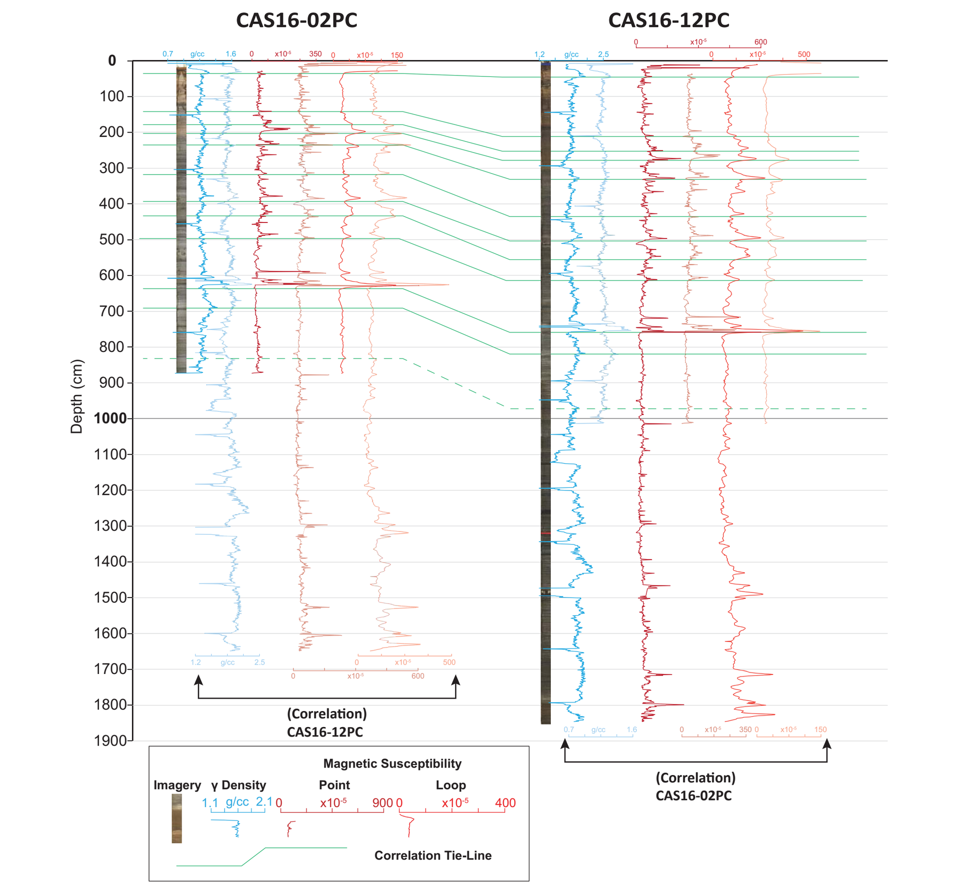
Pichot et al., 2012

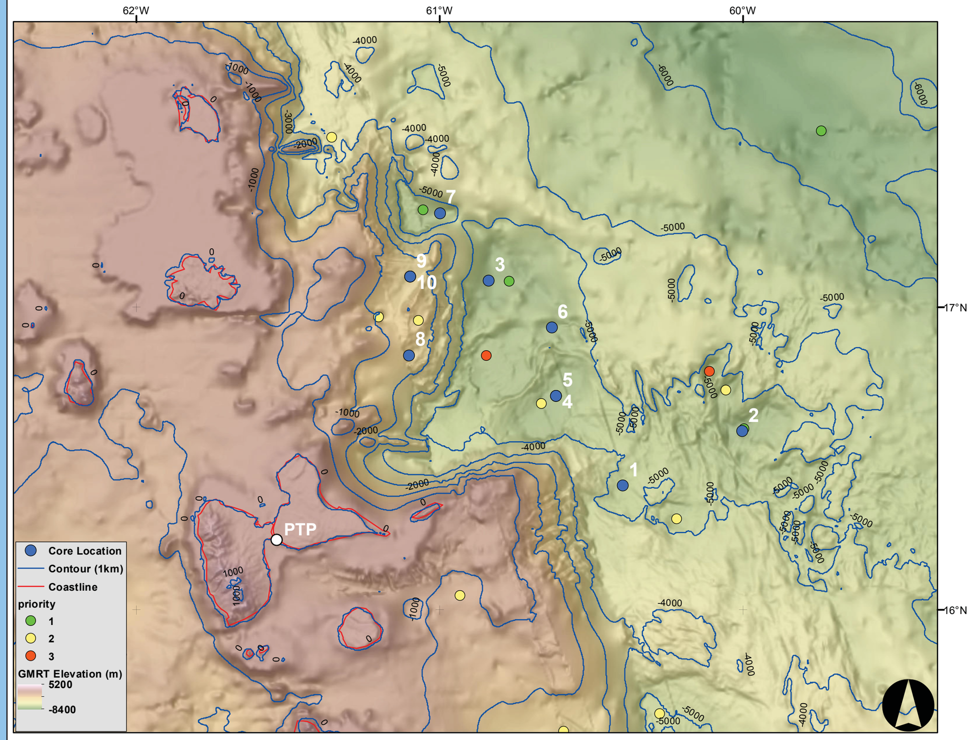
Core Location Map



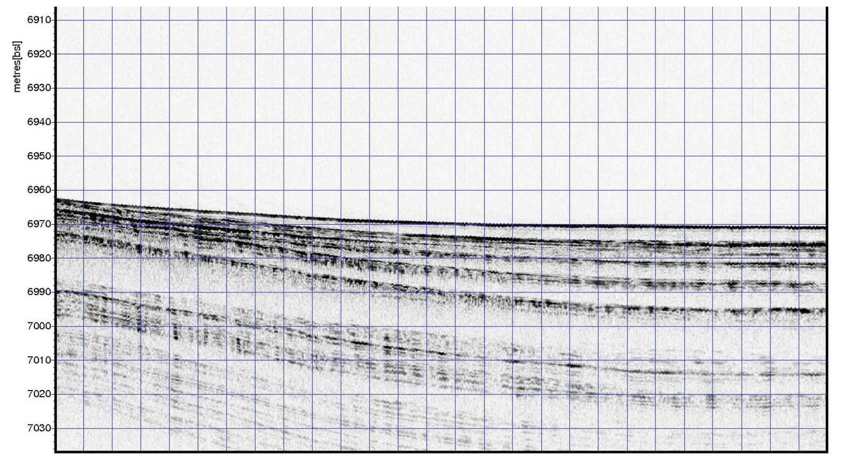


Correlation of cores 03PC, 04PC, 06PC, and 14PC. Core geophysical data are used to correlate stratigraphic layers between cores. For each core, from left to right, are plotted real color imagery (RGB), gamma density (grams per cubic centimeter) in cyan, point magnetic susceptibility (SI) in dark red, and loop magnetic susceptibility (SI) in light red. Core geophysical data from nearby cores are “flattened” (scaled vertically) for a comparison of the down-core geophysical similarities between deposits in different cores. From left to right: 04PC is flattened to 03PC; 06PC is flattened to 04PC; 14PC is flattened to 06PC; and 06PC is flattened to 14PC. Green tie-lines show the correlations for the bases of sedimentary deposits found in each core. The inset map shows the locations of these cores. These are preliminary correlations to demonstrate the viability of this method. With more work and numerical ages to validate the relative temporal superposition of these stratigraphic correlations will be needed to strengthen the confidence of these correlations.





03 & 14 PC



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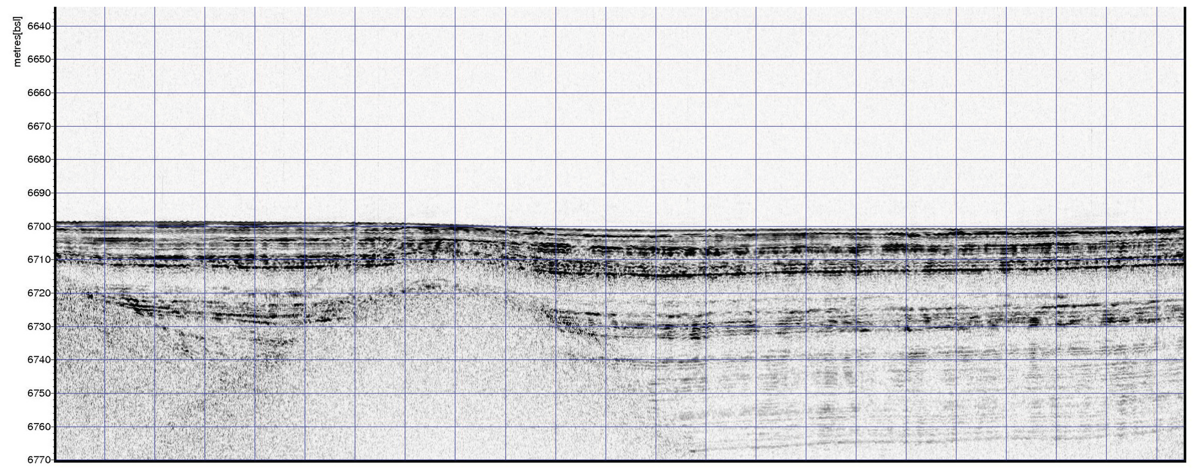
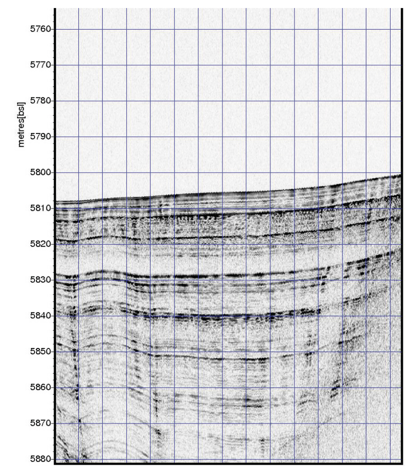
06 PC



CAS0061_D20160602_T054804-c_EV20

02 & 12 PC



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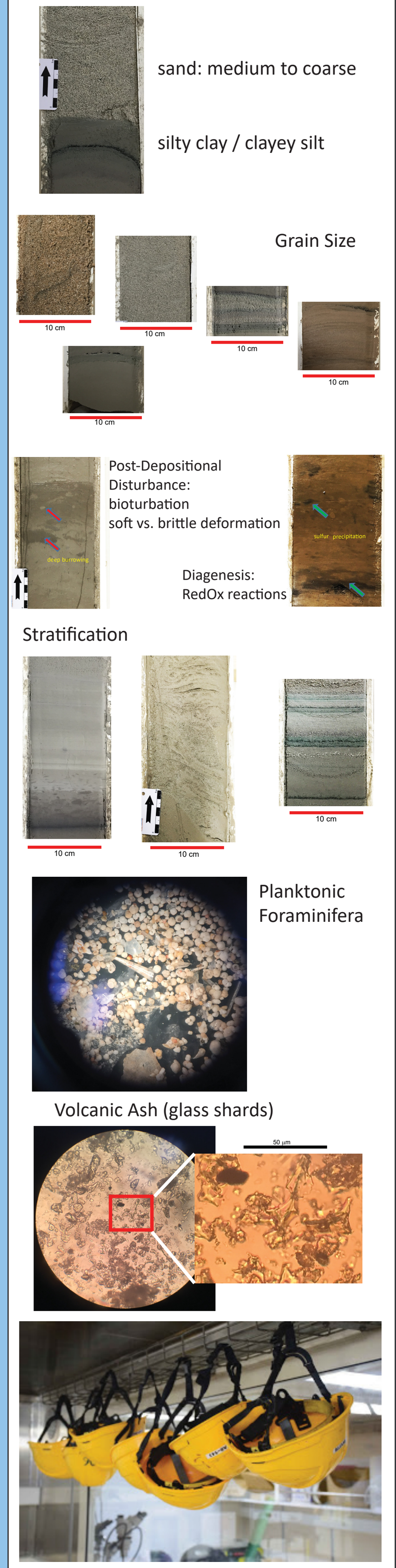
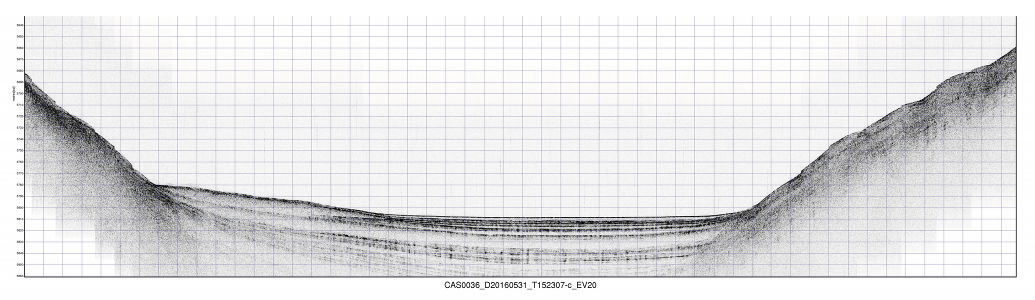
Sediment Core Observations



CASEIS16 Scientists

03 & 14 PC



04 PC