



Subject offered for a contract starting october 2015

SUBJECT TITLE: Earthquakes and tsunami in the Lesser Antilles arc: insights from subaqueous paleoseismology

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Second Advisor/ Supervisor:

Host lab/ Team : *please fill in and leave out meaningless information*

IPGP- Tectonic Team – UMR7154

Financing: Doctoral contract with or without assignment

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Presentation of the subject: (1 or 2 pages)

The Lesser Antilles subduction zone is poorly known and the historical earthquake catalog is too short (500 years) to allowed the estimation of large earthquake recurrence time in this area. For example, an earthquake as large as the 2011 Tohoku megathrust earthquake in Japan may recur every 1000 years (K. Minoura et al., 2001). Existing models to predict earthquake recurrence over the long term have not been successful, thus paleoseismology is really to only way to address long-term earthquake recurrence.

The main objective of the Ph-D project is to perform a submarine paleoseismological study based on marine sediment records to decipher the earthquake history along the Lesser Antilles subduction zone. In recent years, offshore paleoseismology has been attempted in several subduction zones and has yielded spectacular results. Goldfinger et al., (2012) restored the catalog of large earthquakes in subduction Cascadia over 10,000 years and found that their recurrence time was about 500 years, and smaller segmented ruptures were found that repeat every ~ 220 years. Unlike other phenomena (eruption, flood, local shallower and smaller earthquakes, volcano flanks or local reef platform destabilization) very large subduction earthquakes offshore can trigger turbidity currents over a wide area (at least as wide than the rupture zone). It is possible, to find coseismic turbidites/homogenites in most basins and channels systems of the upper plate, above the rupture area.

We propose to establish a broad catalog of earthquakes over the late Quaternary in the northern part of the Lesser Antilles on the basis of analysis of several sediment cores that will be collected in basins, at the mouth of the main canyons and along major tributaries over a distance of 500 km between Martinique and the Virgin islands during the CASEIS cruise scheduled in May 2016 (R/V Pourquoi Pas? Ifremer, 38 days). Multibeam bathymetric data, imagery and 3.5 kHz seismic profiles will be also acquired to identify and map the channels and basins in areas where no data is yet available. Analysis of the geophysical data is essential to have information on the possible sources of turbidites or homogenites and to correlate those markers from a site to another one.

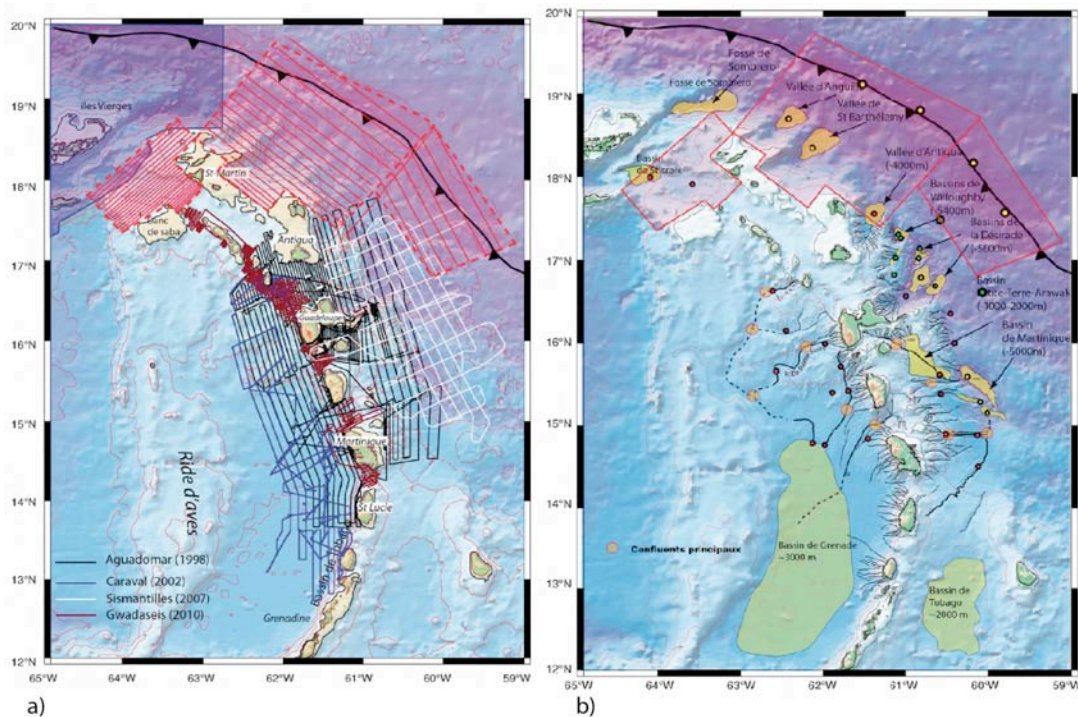


Figure 1: a) Profiles CASEIS for the acquisition of geophysical marine data (in red, 38 days on board of the R/V Pourquoi Pas ? IFREMER, seismic, bathymetry, imagery, chirp, calipso cores) b) location of calipso cores that will be sampled on board.

A multidisciplinary approach will be adopted to characterize (by age and nature) the sedimentary structures as markers of seismic activity and to propose a chronostratigraphy of these events: texture analysis with 2D and 3D X-ray images, structure of superficial and more ancient sediments with diagraphy X, granulometric and microgranulometric analyses with lasers, ^{14}C dating of foraminifera and organic material, $\delta^{18}\text{O}$ isotopic stratigraphy, and radioactivity profiles with ^{210}Pb and ^{137}Cs for historical events. Magnetic tools will be used to characterize sediments such as high-resolution analyses of susceptibility and magnetic grain size analysis on a selection of samples.

The PhD student will participate to the cruise with 23 others scientists from eight different research institutions. All the instruments needed for core analyses are available at the various institutions involved in the project. The students will collaborate with several scientists involved in the project at GEOAZUR, IFREMER, ISTEP, ISTERRE Chambéry, LSCE, Oregon state University (USA). The results of thesis will allow to better constrained the seismic, tsunamigenic and volcanic hazards in the Lesser Antilles arc, a densely populated and very touristy area of the Caribbean.

Références :

- Goldfinger, et al., 2012, Turbidite Event History: Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone, USGS Professional Paper 1661-F, Reston, VA, U.S. Geological Survey, p. 184 p, 64 Figures. <http://pubs.usgs.gov/pp/pp1661f/>
- Goldfinger, C., Submarine Paleoseismology Based on Turbidite Records: Annual Reviews of Marine Science, v. 3, p. 35-66, 2011
- Beck C., Reyss J.L., Leclerc F., Moreno E., Feuillet N. and GWADASEIS Cruise Scientific Party, Identification of deep subaqueous co-seismic scarps through specific coeval sedimentation in Lesser Antilles: implication for seismic hazard. Nat. Hazards Earth Syst. Sci., 12, 1755–1767, 2012
- Polonia, A. Bonatti, E., et al. Mediterranean megaturbidite triggered by the AD 365 Crete earthquake and tsunami. Nature, Scientific reports, vol. 3, 2013.