Holocene tsunami identification from coastal sedimentary archives in the Lesser Antilles

Duration: 18 months, start at beginning of 2022.

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Location: 9 first months in Chambéry, France ; 9 following months in Rimouski, Québec

Profile: The candidate should have completed a thesis in sedimentary geology and have expertise in sedimentology and geochemistry and/or in the analysis of physical and magnetic properties of sediments and if possible, experience with seismic reflection data analysis.

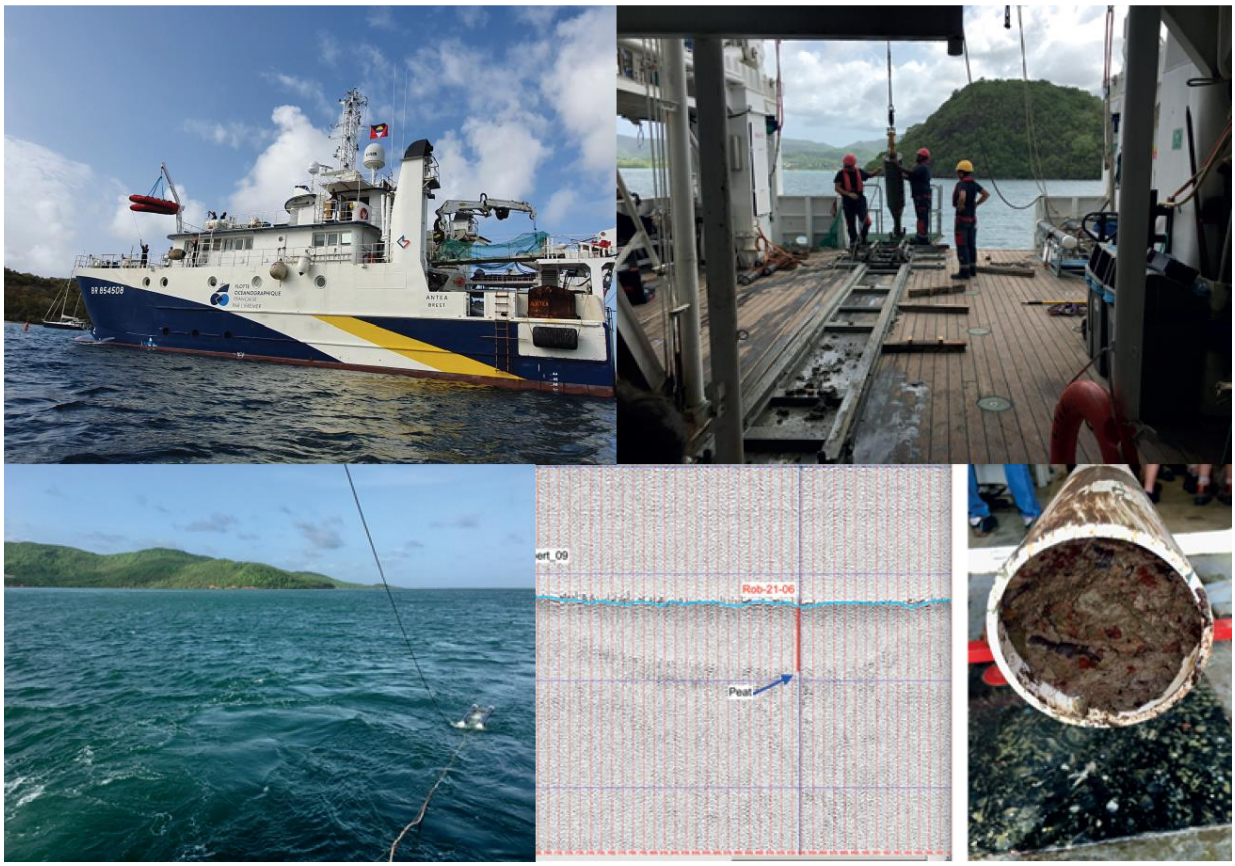
Project: Megathrust earthquakes linked to subduction zones are responsible for sudden vertical movements that can promote both very large tsunamis and sedimentary destabilization also responsible for tsunamis. These catastrophic phenomena have major and lasting consequences on the morphology of the coasts and on the coastal communities. The strongest earthquakes typically have return periods of around 200 to 1000 years (Goldfinger et al., 2012; Minoura et al., 2001) and instrumental and historical records are insufficient to estimate their frequency. It is therefore necessary to use the sedimentary archives as records of strong earthquakes and tsunamis (Monecke et al., 2008; St-Onge et al., 2012).
The Caribbean Arc is a densely populated area associated with subduction of the North and South American plates beneath the Caribbean plate. Major earthquakes have affected Guadeloupe and Martinique in 1690, 1839, 1843, 1974, and 2007 (Feuillet et al., 2004; 2011; Robson, 1964). The strongest event was the 1843 earthquake that destroyed Pointe-à-Pitre in Guadeloupe and caused 1500 deaths (Saint-Claire Deville, 1843). This earthquake was also marked by the subsidence of several islands in the bay of Pointe-à-Pitre. Over the last millennium, some tsunamis have been identified in this region, including one in 1450 AD in the Anegada area with a possible origin in the Puerto Rico subduction zone affecting much of the Caribbean (Engel et al., 2016, Atwater et al., 2017; Biguenet et al., 2021). Recent tsunami modelling shows that this event is probably related to a megathrust earthquake and may also affect the Quebec coast (Cordrie et al. submitted). On the Holocene time scale, very few events have been identified so far (Engel et al., 2016).

Key questions remain unanswered at the Lesser Antilles:
What might be the maximum magnitude and return period of large earthquakes? Could a large earthquake and related tsunami occur in the next few decades? How have such past events affected human communities, especially along the coast?

The answers to these questions are the general objectives of the CARQUAKES program (PI: N. Feuillet) which has received funding from the Agence de Recherche Nationale (ANR) for the 2018-2022 period. Important data have already been acquired during the 2016 campaign whose objective was to identify sedimentary archive records of strong earthquakes in the deep marine environment (Seibert et al., 2020). As part of this program, we also explored coastal areas to identify traces of large earthquakes and

tsunamis in the northern arc through the study of lagoon systems (Biguenet et al., 2021). In the summer 2021, the CARESSE (PI: E. Chaumillon) expedition on board the R/V Antea allowed for exploring coastal areas with seismic survey and coring to reconstruct the history of cyclones, tsunamis and tectonic events (earthquakes) during the last millennia that affected the Caribbean Arc. In addition to the lagoons in the Northern part of the arc, this mission explored areas around both the Martinique and Guadeloupe volcanic islands never exploited at these time scales, while these areas show for the last century records cyclone records (Sabatier et al., 2021).

The specific objective of this 18-month postdoctoral project is therefore the identification in sedimentary records of large earthquakes, coastal vertical motions associated with earthquakes and tsunamis during the last millennia in coastal sites around Martinique and Guadeloupe.



R/V Antea during the CARESSE expedition in English Harbour (Antigua), Coring operations in Fort de France Bay (Martinique), Seismic profiling in Baie du Robert (Martinique), Examples of core and seismic reflectors correlation in the Baie du Robert (Martinique).

Methodology: Marine submersion generated by tsunamis resulting from seismic events can transport highly variable sediments, from sludge to multi-ton blocks depending on hydrodynamic conditions and sediment sources (Dawson et al., 1988; Goff et al, 2012). These deposits observed onshore or in semi-enclosed nearshore environments are often associated to erosive coarse deposits on soils, peats, or muds (Morton et al., 2007; Chagué-Goff et al., 2011; Biguenet et al., 2021). In these deposits, ripup clasts can be found that were torn off by the tsunami wave (Morton et al., 2007). The identification of

the most suitable sites for the preservation of nearshore sedimentary records requires seismic reflection (Chaumillon et al., 2004).

The tsunami sediment record is also consistent with deposits associated with backwash after the uprush event (inland wave runoff). The backwash has a high erosive potential in drainage areas and transports large amounts of sediments offshore (Goto et al. 2014, Milker et al., 2013, Paris, 2010, Sakuna-Schwartz et al., 2015, Riou et al., 2020). In order to recognize and reconstruct these events, a multiproxy approach will be applied by combining 1) seismic and bathymetric (Chaumillon et al., 2004), 2) sedimentary with granulometry, mineralogy, physical and magnetic properties and thin sections (Sabatier et al., 2010; St-Onge et al, 2012; Biguenet et al., 2021), 3) mineral and organic geochemical at the core and thin-slice scales (SEM-EDX) (Sabatier et al., 2012; Biguenet et al., 2021), 4) anisotropy of magnetic susceptibility (Rapuc et al., 2018), 5) X-ray tomography (Paris et al., 2019) and 5) age modelling with short-period radioelement data (Bruel and Sabatier 2020), radiocarbon (Sabatier et al., 2010) and paleomagnetism (St-Onge et al., 2004; Bieber et al., 2021).

Application: Send a detailed CV and motivation letter **before November 5** to the 4 following address:
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