Sujet proposé pour un début de contrat en octobre 2017

TITRE du SUJET : New insights into the volcanic history of Guadeloupe and interactions with faulting from Remotely Operated Vehicule (ROV) observations offshore Les Saintes (Guadeloupe), Subsaintes cruise (1-25 April 2017).

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The islands of Guadeloupe Archipelago (Figure 1) result from the growth of several distinct volcanic arcs and their associated carbonate platforms. The oldest volcanism in the area consists in andesitic lava flows, breccias and associated intrusives from an old Oligocene volcanic arc that overlains remnants the Mesozoic ophiolitic complex of Upper Jurassic (145 Ma) that forms the La Desirade island. The volcanic history of the area is based almost exclusively on the ages of subaerial volcanic units. Since the upper Pliocene (~3 Ma) volcanic activity of the inner or recent arc resulted in the formation of the island of Basse-Terre and Les Saintes Islands through explosive and effusive subaerial alkaline volcanism that followed an initial phase of submarine build-up that produced predominantly calc-alkaline andesites with subordinate basaltic andesites and dacites. Present-day volcanic activity is found at the Soufriere volcano (Guadeloupe), while at les Saintes the most recent volcanic event is 0.88±0.01 Ma old. Submarine volcanic activity preceded the construction of the different islands, and numerous submarine volcanic centers have been identified throughout the area between Les Saintes and Dominica. However, there is no evidence of active volcanism in the area, although there is evidence of fossil hydrothermal activity. No volcanic samples have been recovered from the submarine volcanic edifices. Hence the composition and style of the volcanism, its link to the subaerial units, and its temporal evolution, are unknown. What is the age and nature of underwater volcanic and tectonic interactions responsible for the build-up of the volcanic arc, and their link to the subaerial volcanic history? To address this question, we will use new data (ROV, AUV) that will be collected during the Subsaintes cruise (1 – 25 April 2017, N/O L'Atalante). We plan to carry out extensive sampling of selected submarine volcanic centers and associated lava units. Combined sampling and microbathymetric surveys will allow us to characterize the morphology and structure of volcanic centers, determine the geochemistry and petrology of erupted products, determine eruptive style and chronologies, estimate erupted volumes, and establish the links with the subaerial volcanic units and eruption history. In addition we will address the interaction between volcanic activity and active tectonics of the area as evidenced by numerous recently faulted volcanic edifices.

For instance, we expect that the dating of the Roseau Trough seamount samples will yield relatively young ages with regard to the Lesser Antilles arc history, as suggested by the well-preserved structure of the seamounts. To access older volcanic units in the area (related to the onset of volcanism along the inner arc or volcanic history of the outer arc), we will exploit exposures of lava flows along fault scarps. Are volcanic units exposed along fault scarps the relicts of the early phases of submarine volcanism prior to the emergence of the Les Saintes islands? These units can also be coherent with this subaerial volcanism. Age constrains on the footwall would also be important to understand the tectonic evolution of the area. The dating of lava flows (fault scarps, seamounts) coupled with microbathymetry and geomorphological studies, provides a unique opportunity to estimate for the first time the rates of submarine volcanic emplacement and

effusion in the Lesser Antilles arc, and to help understand how the submarine component of the arc construction operates. At present this part of the volcanic system is basically unknown, and we stress that no studies of submarine volcanism in this area are available, as only an isolated submarine edifice was studied in detail, Kick'em Jenny at the southern part of the arc. The bathymetry shows clearly at the summit of some structures eruptive craters that are well preserved. This suggest that these craters are either unaffected by either mass-wasting and tectonism, or that recent eruption resurface the seafloor burying both older mass wasting and tectonic structures. This study would thus provide the first, extensive characterization of submarine volcanic activity in a very active sector of the Antilles arc.

Finally, we will try to connect the submarine volcanic activity with subaeraial volcanic activities. The analysis of the future behavior of an active volcano and hazard assessment must rely on the most refined reconstruction that is possible of its eruptive past. While rock sampling with the ROV will provide the possibility to date individual volcanic units, sediment records may hold a continuous volcanic and seismic history of the area. Onshore volcanic records are difficult to decipher as they are not continuous, and obscured by erosion, sedimentation, and collapses of volcano flanks. Marine tephrochronological studies (Caraval cruise, IODP Expedition 340) have allowed a correlation of tephra with subaerial eruptions in the area. For example, cores from the Caraval cruise, recovered offshore Montserrat, record 250 000 yrs of volcanic history over 5 m, yielding a much greater number of magmatic events than previously identified onland. We will thus complement the ROV studies with ROV coring within and around the Roseau Trough to obtain a recent (a few kyrs), continuous history of sedimentation and volcanism, which would thus complement existing studies because a) no drillcore records are available offshore near Guadeloupe, and b) the upper part corresponding to the most recent Holocene volcanic/sedimentary history was not recovered within Caraval cores. This is particularly important because marine tephrochronology will provide much stronger constraints to limited onland evidence for the recent identification of at least 5 new major explosive eruptions from La Soufrière of Guadeloupe. All the data collected will be integrated into the large scale geologic and geodynamic model of the Lesser Antilles arc and carefully screened to further investigate magmatic evolution, eruptive activity and links with tectonic activity.

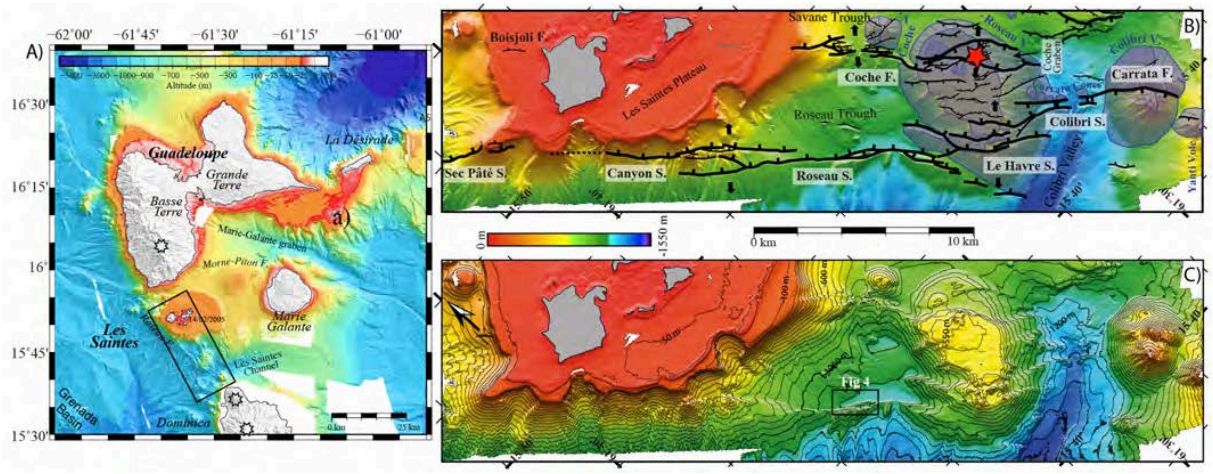

Figure 1. A) Regional map showing the area surrounding the Les Saintes Islands, where the extensional graben (Roseau Trough) linking Dominica and Les Saintes. The box corresponds to maps in B) and C). B) Tectonic interpretation superimposed on the shipboard multibeam data acquired during the BATHYSAINTES cruise (PIs. N. Feuillet & C. Deplus), with a resolution of 10 m. Note the faults dissecting and interacting with volcanic centers. The red star indicates the location of the 2004 Les Saintes Mw6.3 epicenter, followed by aftershocks throughout the area (see Figure 3). C) Bathymetry of the area (without tectonic interpretation) showing the location of the microbathymetric surveys carried out during the ODEMAR cruise with an AUV (2-m resolution per pixel, purple outline) and an ROV (0.25-0.1 m resolution per pixel, red outline).