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Mission Report of the SHAKE scientific cruise

Short Term Scientific Mission (STSM) within the project *"Impact of Fluid circulation in old oceanic Lithosphere on the seismicity of transForm-type plate boundaries: neW solutions for early seismic monitoring of major European Seismogenic zones (FLOWS)"*

1. Purpose of the visit

The purpose of the visit was to participate in the second leg of the SHAKE cruise, onboard the B/O Sarmiento de Gamboa, from May 15th to May 23rd, 2015, in the Alboran Sea. The two main purposes of this second leg were 1) to acquire high-resolution Sparker 2D seismic profiles on the active fault systems in the Alboran Sea, and 2) to perform in-situ investigations using the ROV "Max Rover", in order to observe the seafloor expression of active faulting in the area. During the first leg of the SHAKE cruise, very high-resolution bathymetry had been successfully acquired using two AUV from IFREMER. These data, processed onboard, were used to choose the accurate locations for both the seismic acquisition and the ROV dives. Sparker acquisition and ROV dives were to be performed in six chosen locations: the North-South fault system, on the slope of the Adra shelf, the Carboneras fault, south of the Campo de Dalias promontory, the Djibouti platform, the Al-Idrissi fault in the north Moroccan margin, the Cabliers bank, and the Yusuf ridge.

2. Description of the work carried out during the visit

The Sparker acquisition was fully handled by the technician from a private contractor (Geomarine Inc.), and was performed during the night time. I was affected to the observation of geological features during the ROV dives. The objective was to find a seafloor expression of active faulting. One direct expression would be a fault scarp. An indirect evidence of activity would be fluid escape at the seafloor, associated to carbonate crust precipitation at the seafloor, triggering appearance of life (corals, mollusca, fishes, crustacean). For each dive, a log was written, detailing the different events of the dive, with associated time and depth, along with the ROV approximate location at the time of observation. Several box-cores (about 30-cm long surface sediments) were recovered using the ROV automated arm. Further analyses on cored samples should provide data about the sedimentary record, the sedimentation rate and a time span of sediment emplacement. At several of the above chosen locations, gravity cores were recovered, of a maximum length of about 2 m, and when possible on both sides of the fault path. Given an average

sedimentation rate of 3 cm/ky, this length should give a sedimentary record of about the last 70ky, but also indication of anomalous sedimentation rates, possibly linked to the fault activity.

3. Description of the main results obtained

Despite our efforts, we were unable to spot any seafloor expression of fault activity using the ROV. The seafloor around the active faults of North-South, Carboneras, Al-Idrissi, and Djibouti was too smooth, and no scarp was seen. At several locations, the ROV crossed back and forth the fault path, but the difference in height between the two compartments of the fault was always expressed as a gentle slope, almost invisible on the narrow aperture of the ROV high-definition video-camera. We could not either spot any active pockmark. At every locations, the fault path was clearly visible on the AUV micro-bathymetry, as well as pockmark fields, with meter to tens of meters-wide pockmarks, but the change in scale of observation was obviously too big between the high-resolution tool and the direct observation. We lacked an intermediate scale, the one we get onland by stepping back from an outcrop to visualize a landscape ranging between hundreds of meters to one kilometer.

However, each dive brought a lot of information on the living organisms and habitats perspective. We were able to sample a piece of coral mounds basement on the Tofiño bank, asserting for the first time its beach rock origin. Further dating may provide information on when this structural high emerged and was eroded. From one of the dives on the coral mounds of the Cabliers site we also brought back a piece of volcanic tuff, which can be linked to the recent volcanic activity at Ras Tarf and Tres Forcas Cape.

4. Future collaboration with host institution (if applicable)

In the framework of habitat mapping, we will provide the multibeam bathymetry acquired on the Tofiño bank during previous cruises (MARLBORO-2 and SARAS in 2012, chief scientist Elia d'Acremont) in order to further interpret the data acquired onboard the IRIS mission, mainly the observations from the ROV dives.

5. Projected publications/articles resulting or to result from the STSM (if applicable)

One paper on the above mentioned collaboration.

6. Confirmation by the host institute of the successful execution of the mission

7. Other comments (if any).