FROM THE OUTER PART OF THE GULF OF CADIZ: NEAREST-SEIS CRUISE.

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Abstract- We will explain the first interpretations from a marine refraction and wide-angle reflection seismic profile acquired in the outer part of the Gulf of Cadiz in November 2008, in the framework of the NEAREST-SEIS cruise

Keywords- wide-angle reflection, refraction, Gulf of Cadiz, seismic hazard, NEAREST project.

INTRODUCTION

The Gulf of Cadiz is located in the SW Iberian Margin and horsts the present-day convergent boundary between the Eurasian and the African plates (4.5-5.5 mm/yr) [e.g. 1, 2]. The region is characterized by an intense seismic activity of moderate magnitude [e.g. 3], although large historical and instrumental events (Mw ≥ 8.0) have also occurred [e.g. 4, 5].

Numerous marine geophysical cruises have been carried out in the region during the last 20 years [e.g. 6, 7] to advance the knowledge of its complex geodynamic evolution. One of these cruises (NEAREST-SEIS) was carried out in October-November 2008, in the framework of the EU-FP6 Nearest project aiming at evaluate the feasibility of a tsunami early warning system in the area. Two wide-angle reflection and refraction seismic profiles using for the first time the pool of Ocean Bottom Seismometers (OBS) acquired by the Marine Technology Unit (CSIC) together with landstations were acquired during the cruise (Fig. 1A). The main objectives of the NEAREST-SEIS cruise were to provide information about the geometry of the crust-mantle boundary and the physical properties of the crust, revealing the deep geometry of the main faults, and identifying the nature of the crust and the limits of the different crustal domains in the region. In this paper we show samples of the data acquired with the new Spanish OBS, we describe the processing made, as well as the first results obtained from the preliminary analysis of the profile P1.

DATA AND METHODS

The NEAREST-SEIS cruise took place from 27th October to the 13th November 2008 onboard the Spanish R/V Hesperides (P.I. V. Sallarès). We acquired two wide-angle reflection and refraction seismic profiles (Fig. 1A) using a set of 30 Ocean Bottom Seismometers (OBS) for the profile P1 and 15 OBS for the profile P2, as well as complementary acoustic (swath bathymetry and sediment profiler) and gravity data. The OBS pool consisted on 17 short period instruments of LC2000 model, recently acquired by UTM to the Scripps Institution of Oceanography (La Jolla, US), and 19 MicrOBS model from Ifremer and Université de Bretagne Occidentale. The seismic source consisted of an airgun array with total of 7 Bolt airguns (model 1500LL), organized in 2 arrays. The main array was approximately 12 m long and the secondary consisted of a single gun towed off the stern on amidships. The capacities of the guns deployed during this survey were 500, 1000, 500, 255, 265 and 1000 c.i. in the main group, and the other was of 1000 square inches on amidships, for a total volume 4520 c.i. The separation between guns was of 2.5 m between plates and of 0.8 m in the case of the cluster that consists of the 255 and 265 c.i. guns, all of them working at a depth of 12 m [7]. The water wave arrival was used to relocate the instruments in the seafloor using an in-house developed grid search algorithm. The processing sequence included: de-bias; a whitening deconvolution (0.5); a butterworth band pass filter (4-18 Hz); and Automatic Gain Correction (an equalization of the traces in the time domain). The data have comparable quality in both types of instruments.

PRELIMINARY INTERPRETATION OF THE MODEL

The data identified in the record sections have been used to construct a travel-time tomography model along the two profiles. Aside from the instruments, data and processing sequence, in this work we present also an example of the information that can be obtained with a dense array of OBS. The selected profile is P1, which extends 356 km with NW-SE trend from the Tagus Abyssal Plain, over Gorringe Bank, across the Horseshoe Abyssal Plain and the Coral Patch Fault, up onto Coral Patch Ridge and finally to the fold and thrust belt in the Seine Abyssal Plain (Fig. 1A). In terms of apparent velocity we identified the following four domains from the recorded sections: a) in the Tagus Abyssal Plain (TAP) we identified a moderately thick layer (1-2 km) of low velocity sediments (<3 km/s) on top of a very high-velocity basement (> 7 km/s); b) in the Horseshoe Abyssal Plain (HAP) we identified a moderately thick layer (1-2 km) of low-velocity sediments (<3km/s) on top moderately thick layer (1-2 km) of higher-velocity sediments (3-4 km/s), and this on top of a high-velocity basement (>7 km/s); c) the Gorringe Bank (GB) appears similar to the Horseshoe Abyssal Plain but titled to SE; and d) the Seine Abyssal Plain (SAP) where we identified a moderately thick layer (1-2 km) of higher-velocity sediments (3-4 km/s) on top of a lower velocity basement (>5-6 km/s).

CONCLUSIONS

The cruise can be considered as a success in the sense that it has allowed acquiring a unique data set of Wide-Angle Seismic (WAS) data along two long profiles crossing most of the potentially seismogenic/tsunamigenic structures off the SW Iberian Margin. It is important to note that all the OBS that were deployed during the full survey were successfully recovered, and all of them recorded continuously during the airgun shooting phase. The airgun array was proved to be efficient enough to produce seismic energy at the low frequencies required to record identifiable signal at the long distances characteristic of WAS experiments, regardless of the limited capacity of the source in terms of size and power of compressors. The data recorded with both types of OBS have comparable quality. The processing applied to the dataset has significantly improved the quality of these, allowing us to identify seismic phases up to more than 150 km from the OBS in some cases. From the first interpretations of the data we have divided the study area into four domains based on the apparent velocity observed in the recorded sections: the TAP, the HAP, the GB and the SAP.

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