A BROAD BAND, PERMANENT OBS INSTALLED OFFSHORE TARRAGONA (NE SPAIN)

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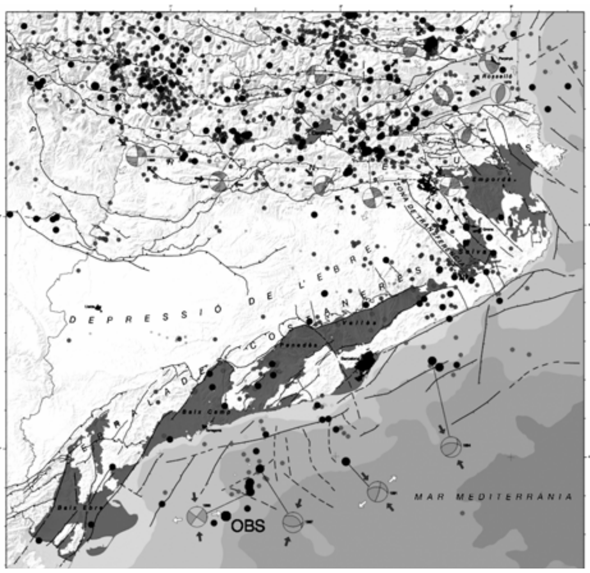
SUMMARY

The Institut *Cartogràfic de Catalunya* (ICC) and the *Observatori de l'Ebre*, in collaboration with the Spanish oil company *Repsol Investigaciones Petrolíferas*, are carrying out a project with the aim of improving the knowledge of the seismicity and seismic risk in the Tarragona region (north-eastern Spain). Within this framework, in August 2005 a permanent ocean bottom seismometer (OBS) was installed inside the security perimeter of the Casablanca oil platform, which is located 40km offshore Tarragona. The OBS station has a three component broad band sensor and a differential pressure gauge (DPG). They were submerged at about 400m to the SW of the oil platform and were deposited at about 150m depth. Data are digitized on-site and are transmitted through a submarine cable to the platform, where they are recorded. A continuous mode and almost real time VSAT satellite data transmission from the platform to the data center at the ICC is expected for 2006. This step will imply the total integration of the OBS station into the ICC seismic network. Since the OBS is operative, some local as well as distant seismic events have been recorded. A seismic noise study from the OBS recordings shows a quite noisy behaviour. The causes are being analyzed. A DPG signal analysis is also being performed.

INTRODUCTION

On August, 12th 2005 a permanent Ocean Bottom Seismometer (OBS) and a differential pressure sensor (DPG) were installed near the Casablanca oil platform, at about 40km from the coast of Tarragona (figure 1). The project has the goal of improving the area's seismicity understanding, which is densely populated and industrially very active.



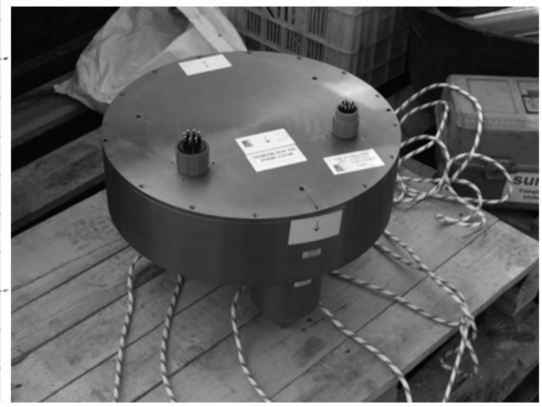


Figure 1: Left: OBS before its installation. Right: OBS location on the *Mapa de Sismicitat de Catalunya 1977-1997* (ICC, 1999).

The project, which is pioneer in Spain, is being carried out by the *Institut Cartogràfic de Catalunya* (ICC) and the *Observatori de l'Ebre* with the collaboration of *Repsol Investigaciones Petrolíferas S.A.* and it is being financed by the *Ministerio de Educación y Ciencia* (CASABLANCA REN2003-06577), FEDER funding and the ICC.

INSTRUMENTAL SPECIFICATIONS

- CMG-3T (Güralp Systems): flat instrument velocity response from 50 Hz to 120 sec.
- DMA24 digitizer in the cylinder top.
- The horizontal sensor has the capability of levelling in between ±10 degrees.
- The casing of the sensor is manufactured with titanium (grade 5) with double "O" rings.
- Differential pressure sensor (DPG).

INSTALLATION PROCESS

The installation operations began on August 9th at the commercial harbour of Sant Carles de la Ràpita, where the material preparation started on board of the ship Boluda Abrego, from which the maneuvers were done.

The OBS was loaded onto the ship, which sailed to the immersion point, where was submerged and deposited on the seabed (figure 2). In order to control the process, a submarine robot sent images that were watched from the ship. Additionally, an uninterrupted signal analysis was made. The OBS was installed at about 400 m SW from the platform, in the security area of the Casablanca field, and at a depth of about 150 m (figure 2).

Figure 2. Left: OBS' immersion. Right: Submarine robot image from the OBS and the pressure sensor deposited on the seabed.

Once the sensor was installed, the ship sailed to the platform, launching the cables with adequate ballasts, so that they stay buried in the sea bottom (figure 3).

Figure 3: Cables' launching once jointed with ballasts.

At the platform, the connections to the equipment to store the seismic data were made. The submarine cables that were closest to the platform were stuck to its structure in order to reduce the signal noise.

FIRST RESULTS

As an example, some seismic events recorded on the vertical component are shown: Japan earthquake on August, 16th 2005. Mw=7.2 (figure 4).

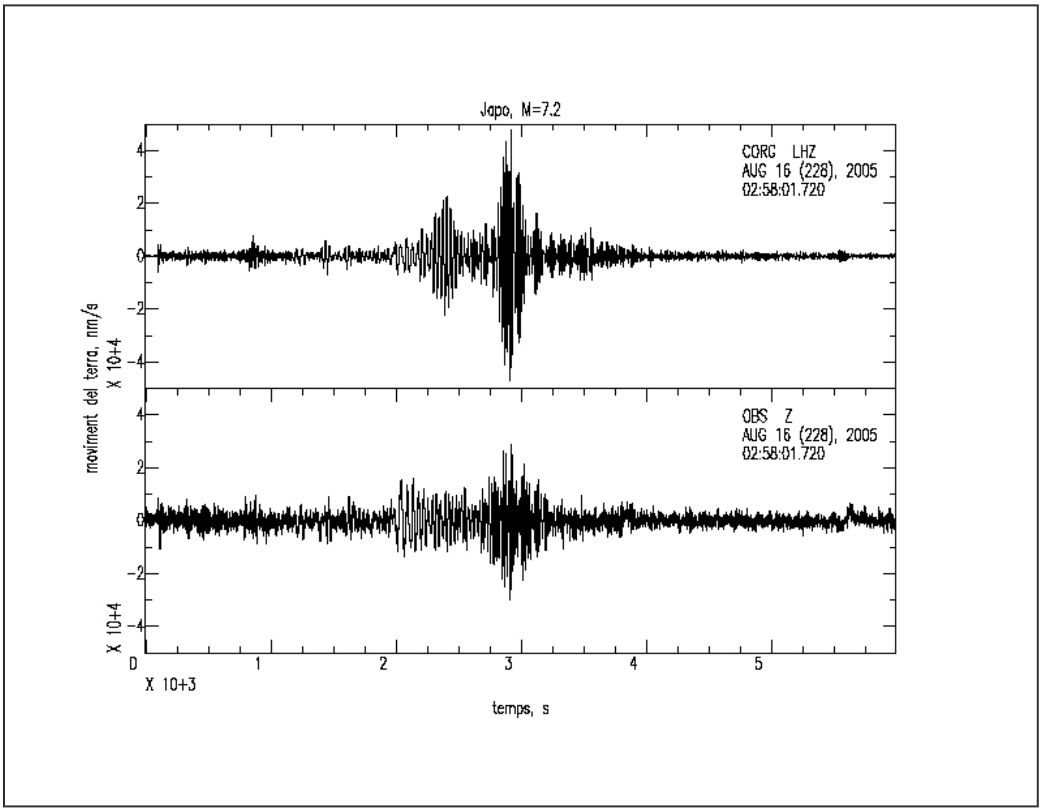


Figure 4: Non-filtered vertical records from the OBS (bottom) and CORG terrestrial station (top). One hour and forty minutes at one sample/second are represented.

Local event offshore Tarragona on August, 22nd 2005. M=1.4 (figure 5).

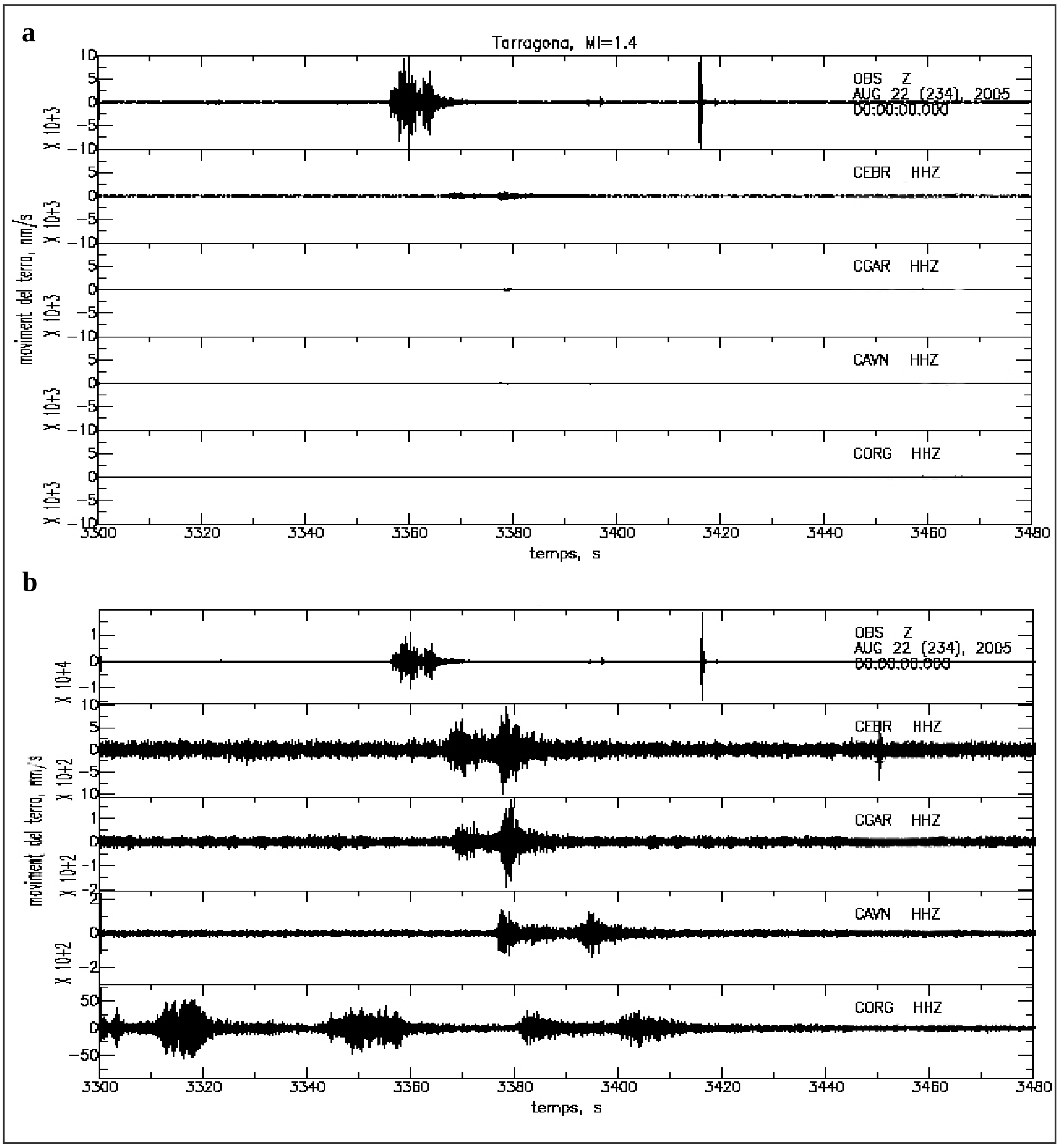


Figure 5: High pass (1Hz) filtered vertical records from the OBS (top) and some terrestrial stations. Three minutes at 100 samples/second are represented. a: All records are plotted at the same scale. b: Records are scaled at its own maximum amplitude.

PRELIMINARY NOISE ANALYSIS

The acceleration power spectral density (psd) of the OBS vertical component was computed for 5 minute periods at 3:00h, 9:00h, 15:00h and 21:00h every day between August, 14th and October, 16th 2005. The same study for the horizontal components has also been done, but the time period for which data are available is much shorter, because these sensors have had many tilt problems. There is not any significant difference between the psd at the different moments of the day, so only results at 3:00h are shown.

The average curves show a high noisy behaviour in relation to the Peterson models (1993) and to the Catalonia network terrestrial stations (figure 6). The main difference observed is the noise between 0.2Hz and 3Hz. The causes are being analyzed.

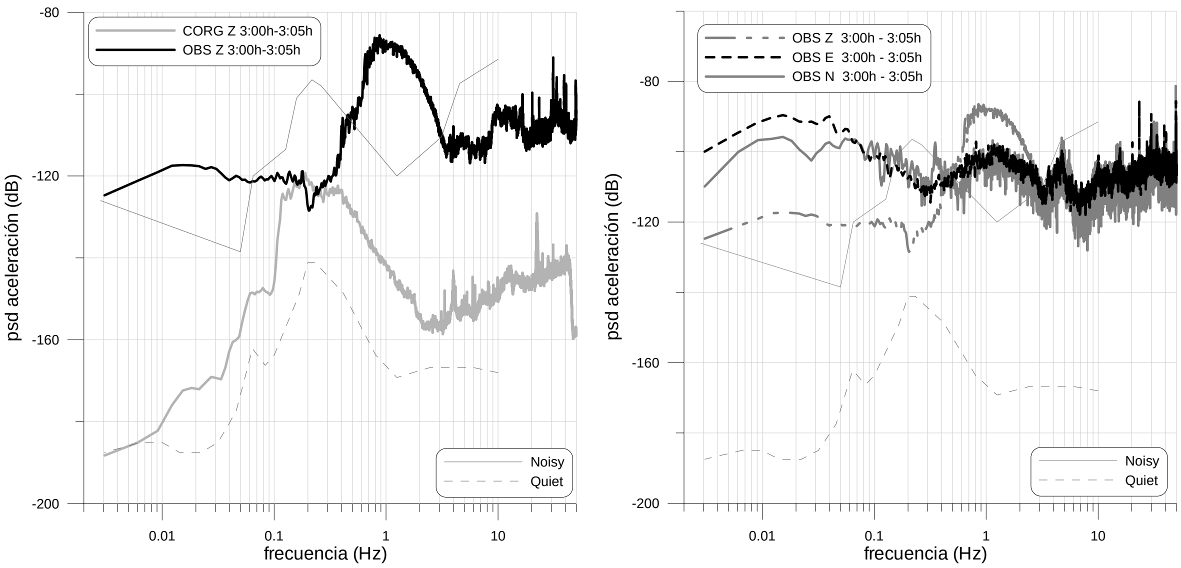


Figure 6. Left: Mean of the acceleration psd for the OBS and CORG terrestrial station vertical components.The Peterson psd curves (1993), noisy and quiet, are also shown. Right: Acceleration psd averages for the three OBS components, together with the Peterson models (1993).

A similar psd study for the differential pressure gauge (DPG) has been done for the same period as the vertical OBS component. Figure 7 shows this result together with the OBS vertical component acceleration psd. The DPG has been calibrated for frequencies between 0.05Hz and 5Hz.

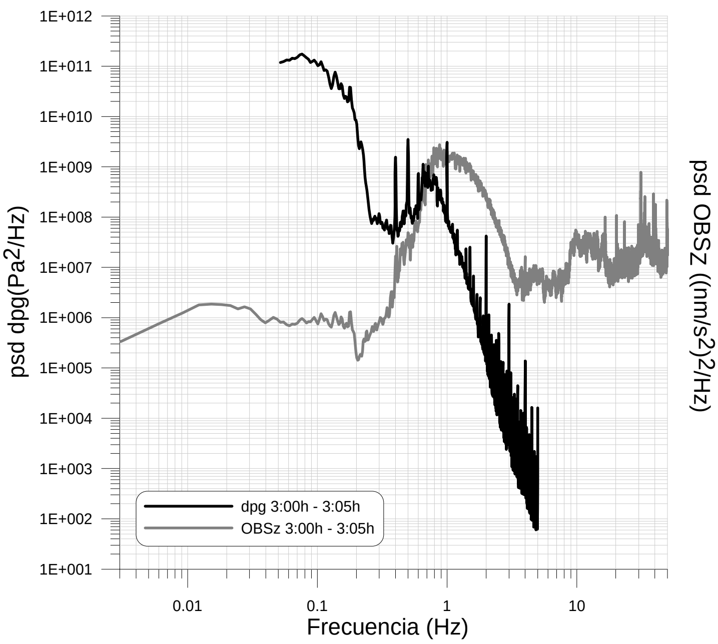


Figure 7: Mean of DPG psd together with the acceleration psd for the OBS vertical component.

CONCLUSIONS AND FUTURE GOALS

OBS integration to the Catalonia seismic network is expected. Data will be transmitted via satellite from the platform to the ICC seismic data reception center to be processed together with the terrestrial station data.

The OBS is very noisy between 0.2Hz and 3Hz. A site effect study will be performed in order to explain this behaviour.

For OBS vertical component low frequencies, DPG data will be used to reduce noise due to ground deformation under long-period ocean-wave loading and OBS horizontal data will be used to correct current and tilt effects (Webb and Crawford, 1999; Crawford and Webb, 2000).

Once the noise study has been carried out, an earthquake signal analysis will be performed.

The ANTARES project (Deschamps et al., 2005; Deschamps et al., 2006) in the Ligurian Sea includes a similar OBS and DPG instrumentation as in ours, but the site conditions are quite different. A joint analysis from data and technical aspects from both projects is in mind.

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