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APPLICATION OF HIGH-RESOLUTION SEISMO-ACOUSTIC METHODOLOGIES IN THE STUDY OF THE SEAGRASS POSIDONIA OCEANICA (L.) DELILE

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1. Introduction

The distribution of the Mediterranean seagrass Posidonia oceanica has been widely assessed using acoustic methodologies. However, informations on P. oceanica internal structure obtained with seismic methods are still very rare. In the framework of the multidisciplinary project CARBOMED (Proyecto Intramural de Frontera, PIF-2005, CSIC, Ref. 200530F0232), a seismo-acoustic survey was carried out in Port Lligat Bay (Catalonia, NE Spain) with the aim to assess the volume potentially occupied by P. oceanica organic deposits (known as "matte"), detect its internal structure and highlight the morphological and sedimentological characters of the study area (Fig. 1). A first calculation of the potential volume of P. oceanica deposits in Port Lligat Bay was estimated in about 175.000 m3 [1].

Figure 1: Navigation tracks of the seismo-acoustic records acquired in Port Lligat Bay during the Carbomed Project. Track in red: profile 71 (Fig. 2). Track in yellow: profile 8 (Fig. 3). Red dot: core site

2. Data and Methods

The high resolution parametric echosounder "Innomar SES 2000 compact" was used to acquire 75 seismo-acoustic records spaced from 5 to 40 m each others, for a total length of about 7.5 km. The positioning system was a differential GPS (DGPS) Trimble AGP 132. The echosounder was characterized by a primary frequency of 100 kHz and secondary frequency ranging from 5 to 12 kHz. Pulse Repetition Rate was up to 30/sec and the beamwidth of ±1.8°. Each seismo-acoustic record has been acquired twice, using secondary frequencies of 10 and 6 kHz. The lower secondary frequency (6 kHz) gave the best result because of its higher resolution and relatively higher penetration, and the records obtained with this configuration were used for this study. The shallow water of the study area (depth from 3 to 6m) produced high amplitude multiples.

3. Results and discussion

Here we present an interpretation of seismo-acoustic records and of data from a core collected in the matte of Port Lligat bay with the final aim of reconstruct the dynamics of P. oceanica since it was established in the study area. The acoustic masking of the internal structure of the seagrass and the presence of multiple reflectors due to the reduced depth of the area (maximum 4 m) did not allowed to associate a specific seismo-acoustic facies to the matte of P. oceanica. Nevertheless, in some sectors it was possible to detect a strong reflector, from 2 to 6 m depth, that was interpreted as the initial substratum where the seagrass established for first time (Fig. 2). Also, sporadic sandy areas, apparently no more than 4 m thick, were identified interlayered with the P. oceanica matte (Fig. 3).

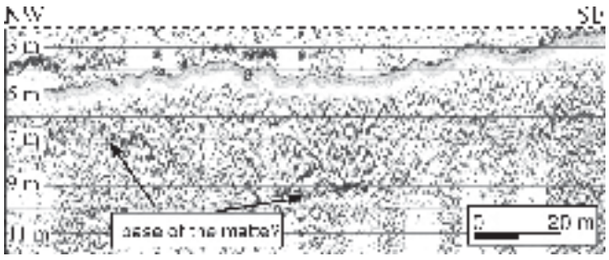

Figure 2: Seismo-acoustic record N. º 71 showing the potential base of the matte, on which P .oceanica established.

A core collected on the P. oceanica meadow showed the presence of a dense matte for the first tens of centimeters downcore, degrading to sandy sediments with rhizomes and leaf sheaths for a total depth of 6 m. The base of the core presented gravely bioclastic sediments and its depth correlates, in a seismic record near the core location, to the reflector interpreted as the base of the P. oceanica matte. Assuming a growth rate of P.oceanica of 1.3 to 4.1 mm y-1 [2,3], the gravel deposits observed at the base of the core may be aged between ca. 1500 and 4500 yrs BP.

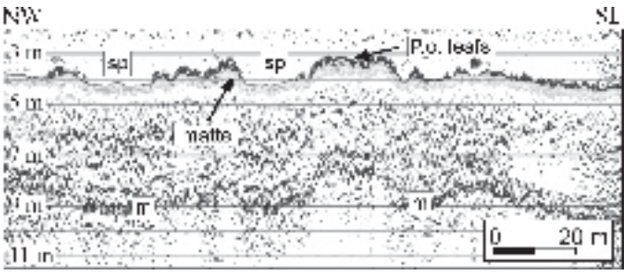

Figure 3: Seismo-acoustic record N. º 8 showing the different seismic facies recognized in the area. P.o: Posidonia oceanica; sp: sand patches; m: multiple

4. Conclusions

The application of seismo-acoustic methodologies revealed a reliable method in the study of the internal structure of P. oceanica. However, the dispersion and masking of the acoustic signal through the P. oceanica did not allow to totally detect the base of the matte. Preliminary results allow us to conclude that in Port Lligat Bay P. oceanica probably developed on gravely sediments, mainly constituted by less fragmented gastropods and bivalves, and probably deposited in a very shallow coastal setting, characterized by moderate hydrodynamic energy. Given the high spatial variability of matte accretion rates observed in the bay, the forthcoming radiocarbon dating of the bioclastic gravel deposits will be essential to relate their actual position and age with the geological moment during which the P. oceanica meadow established in the bay as the sea begun to invade it.

5. Acknowledgements

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FIRST HIGH RESOLUTION MULTICHANNEL SEISMIC EXPERIMENT ON THE RV HESPERIDES: PROCESSING AND APPLICATION TO THE CARBONERAS FAULT ZONE OFFSHORE (ALBORAN SEA)

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1. Introduction

The IMPULS project is based on a multidisciplinary and integrated onshore-offshore neotectonic and paleoseismological study of the Carboneras Fault Zone (CFZ) at the SE margin of the Iberian Peninsula. Recently published marine geophysical data from the HITS 2001 cruise [1] reveals the seafloor morphology along the offshore Carboneras Fault segment as an upwarped 5-10 km wide deformation zone bounded by subvertical faults. With the purpose of studying the paleoseismological parameters of the CFZ offshore we carried out a marine cruise in 2006 onboard the RV Hespérides. The main goals were to image the internal geometry of the offshore continuation of the Carboneras Fault Zone, to estimate a Late Quaternary slip rate of the marine segments and to calculate the recurrence interval. High-resolution marine geophysical methods are crucial in paleoseismological studies because of the need to focus on the upper meters below the seafloor to accurately calculate the paleoseismological parameters of the fault during the Late Quaternary. In order to obtain the resolution required to study the vertical geometry of active faults in South Iberian Margin (e.g the Carboneras Fault) we tested a new high-resolution multi-channel seismic system onboard the RV Hespérides.

2. The IMPULS 06 cruise: High-Resolution MCS experiment

During the IMPULS cruise, we implemented new technologies on board the RV Hespérides, such as a high-resolution multi-channel seismic acquisition. The source, a 10 m long airgun array, was specially designed to favor high frequencies, comprising eight guns, four Bolt, model 900LLX-T, and four Sleeve Guns I. The configuration (2x40, 2x55, 2x30 and 2x20 cubic inches) equals an array of 4.75 liters of volume. Gundalf software was used to specially design the gun array to provide with an adequate signal for the IMPULS survey. The energy peak obtained is larger than the one obtained with the classic cluster Sleeve Gun array, and the band width reaches even higher frequencies, up to 300 Hz. To trigger and synchronize the gun array, we have used the Minipulse gun controller (Hydrasystems) able to work with a total of 8 guns.

To record the high-resolution multichannel seismic data, a "GeoEel" Geometrics (USA) digital streamer was rented funded by the Acción Especial STREAMER (MEC). The streamer is 573 m long, with 300 metres of active section (6 active sections of 50 metres each). Each of the active sections is configured to form 8 channels, totalizing 48 channels separated of 6.25 m. The distance from the aft of the vessel until the first active section is of 93 m.