DENSE SHELF WATER CASCADES IN THE PALAMÓS CANYON. COMPARISON WITH THE CAP DE CREUS CANYON

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Abstract
The Palamós and the Cap de Creus submarine canyon heads were instrumented during two consecutive winters to study their respective role in the dynamics of the sediment transport on the northwestern Mediterranean Sea. Several events of dense shelf-water cascading (DSWC) were identified and compared among them. Sediment transport during DSWC at the Palamós canyon is significant during eastern and also northern storm events, but not related with river floods. However, the magnitude of transport events in the Palamós Canyon is one order of magnitude lower than in the Cap de Creus Canyon.
Keywords: Sediment Transport, Continental Margin, Western Mediterranean

Submarine canyons incised in continental margins are meant to be preferential pathways for the exchange of water and particles between the coastal area and the open sea. Hydrodynamics and sediment transport processes in submarine canyons depend upon several forcing conditions in the region such as general circulation, bottom morphology and atmospheric regime [1, 2]. The off-shelf sediment transport through submarine canyons, due to storms and river floods, can be significant and recently dense shelf-water cascading (DSWC) has been identified as an important transport mechanism able to generate high sediment fluxes in submarine canyons [3]. DSWC can transport large amounts of water and sediment, reshape submarine canyon floors and rapidly affect the deep-sea environment [4]. DSWC is seasonal, resulting from the formation of dense water by cooling and/or evaporation over the shelf, and occurs on both high- and low-latitude continental margins. The aim of this study is to determine the presence of DSWC events at the Palamós canyon head during winter conditions, and to compare these events with the contemporary ones recorded in Cap de Creus canyon head.

The Cap de Creus Canyon, located at the northwestern Mediterranean Sea belongs to a complex network of submarine canyons cutting the Gulf of Lions continental margin. The Palamós canyon is located 20 km southward from the Cap de Creus canyon. The head of both submarine canyons reaches the continental shelf-edge by the 90 m depth contour, and the canyon rims are about 2 - 3 km away from the coastline (Figure 1). At the southern end of the Gulf of Lions, storm-induced downwelling can be combined with DSWC and enhance sediment transport through submarine canyons during winter-time [3]. The Cap de Creus submarine canyon has been intensively studied during the past years as it acts a major transport conduit during DSWC events. On the contrary, little information exists about the sediment transport processes operating within the Palamós submarine canyon [5].

Observational work during this study consisted of a series of field measurements carried out with two instrumented moorings during winters 2006-07 and 2007-08 deployed at the heads of the Palamós and Cap de Creus submarine canyons around 300m depth (Fig. 1). These moorings were equipped with a current meter with temperature, conductivity, pressure and turbidity sensors, placed at 5 m above the seafloor. Multibeam bathymetry from both canyon heads was also acquired and used to determine the canyon axis morphology, which was considered to compute down-canyon fluxes. Forcing conditions were obtained from oceanographic buoys and gaps in the wave height and peak period time series were filled with models outputs. Daily river discharges from nearby rivers were also analyzed.

Sediment transport events during winter 2006-2007 and winter 2007-2008 were quite similar. Down-canyon current velocities >60cm/s were detected in the Cap de Creus Canyon, and >40cm/s in the Palamós submarine canyon. Increases in current speed were associated with subtle drops in temperature (~1 ºC) related to DSWC, and peaks of suspended sediment concentrations (SSC) of ~160 mg l^{-1} in the Cap de Creus Canyon, and ~6 mg l^{-1} in the Palamós canyon head. Two eastern storm events that generated temperature and current fluctuations were registered between 16th and 19th of February 2007 and between the 2nd and 5th of January 2008. These storm events enhanced DSWC events at both submarine canyons. A northern storm event on the 6th of March 2008 also occurred, but only generated DSWC at the Palamós, and not at the Cap de Creus Canyon.

During the study period there was no relation between sediment transport events and nearby river discharges. The amount of sediment transported during the DSWC events is one order of magnitude greater at the Cap de Creus canyon than at the Palamós Canyon. This corroborates the idea that most of the off-shelf sediment transport in the northwestern Mediterranean during DSWC events occur at the southwestern end of the Gulf of Lions, through the Cap de Creus Canyon [3, 4].

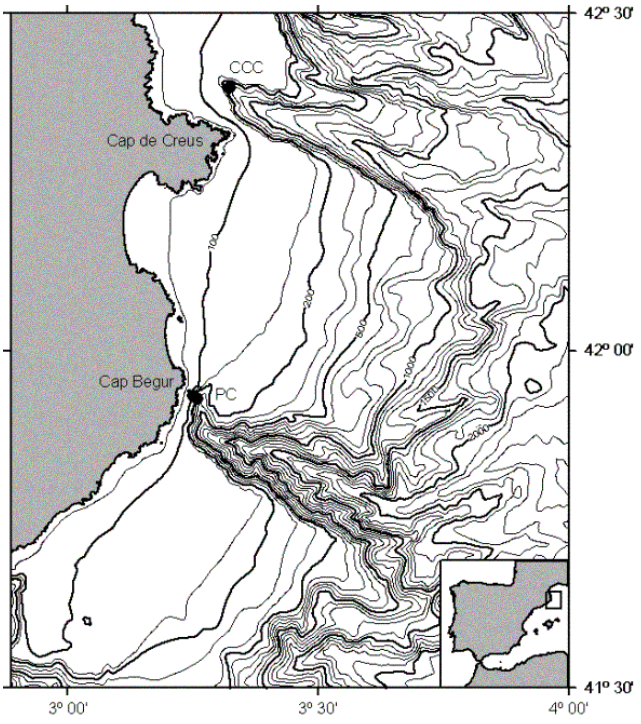

Fig. 1. Location of the two moorings in the Palamós Canyon (PC) and in the Cap de Creus Canyon (CCC).

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