SEDIMENT GRAVITY FLOWS INDUCED BY TRAWLING IN THE PALAMÓS (FONERA) SUBMARINE CANYON

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Abstract

Seven mooring arrays equipped with sediment traps, current meters and turbidimeters placed near the bottom and in intermediate waters were deployed in the Palamós canyon. During the study period, frequent sharp turbidity peaks along with current speed increases were recorded in the canyon axis at 1200 m depth during spring and summer. These events have been identified as sediment gravity flows caused by trawling activities in the canyon walls.

Keywords: submarine canyons, sediment gravity flows, sediment fluxes, trawling

Introduction

Particulate matter fluxes have been measured in submarine canyons during the last decades (1, 2, 3, 4). Fishing activities often represent an issue when deciding mooring locations as they can damage the instruments. Usually, efforts are made in order to avoid interactions with fishing activities and to record natural processes. However, unexpected flux increases have been sometimes related with trawling activities causing resuspension around the mooring sites, although direct evidences relating them had not been obtained before. In this study, we were able to record sediment gravity flows produced by trawling activities in the Palamós canyon, also known as Fonera canyon. This submarine canyon is deeply incised in the Northern Catalonia continental shelf (North-Western Mediterranean) which favours an active shelf-slope sediment transfer.

Methods

To study sedimentary dynamics in this canyon, seven moorings arrays with current meters, turbidimeters and sediment traps installed near the bottom (25 m above bottom) were deployed along the main canyon axis at 470, 1200 and 1700 m depth, on both canyon walls at 1200 m depth and on the adjacent slope at 1200 m depth. One set of these instruments was also installed in intermediate waters (400 m depth) in the mooring located in the canyon axis at 1200 m depth

Results

In the Palamós canyon, the higher near-bottom turbidity signal, as well as downward particle fluxes, was not recorded in the canyon head, as expected, but in the mid-canyon axis at 1200 m depth. At this mid-canyon site, several events (more than 10 per month) of sharp turbidity increases, ranging between 5 and 40 mg l^{-1} took place mainly during late spring and summer (Fig. 1). Some of these events were also recorded in the canyon axis at 1700 m depth in late August but not correlated with those at 1200 m depth. The duration of these events ranged from 1 to 6 hours and they were associated to significant current increases. The current direction during these events was either downcanyon or across-canyon (i.e. coming from the walls). The fact that they practically did not occur in the canyon axis near the canyon head region indicates that these events were produced in the canyon walls and later were reoriented along the canyon axis. These high-turbidity events were correlated with periods of high downward total mass fluxes that were not recorded in intermediate waters at the 1200 m mooring site and did not show any direct relation with storms or river avenue periods.

Discussion and conclusions

The random occurrence of the high-turbidity events suggest that they are not produced by periodical processes such as internal waves and tides. The fact that they are mainly observed during late spring and summer, when wave energy and river discharge tend to decrease, makes difficult to relate them to a natural mechanism. The fact that all the turbidity peaks were produced in working days and during fair weather conditions, made us to investigate a possible relationship with trawling activities. Information supplied directly by fishermen showed that the northern canyon wall, just above the 1200 m canyon axis site, was intensively affected by trawling and that the working depth of the trawlers significantly increased during late spring and summer. In addition, a canyon gully intersects the main canyon axis right at the mooring site. All this indicates that trawling in the canyon walls can trigger sediment gravity flows that are channelled through this gully, and when they are produced deeper in late spring and summer, they reach the canyon axis. Thus, these man-induced sediment gravity flows could be a common process affecting submarine canyons at present times, which could be influencing sediment fluxes in these particular environments.

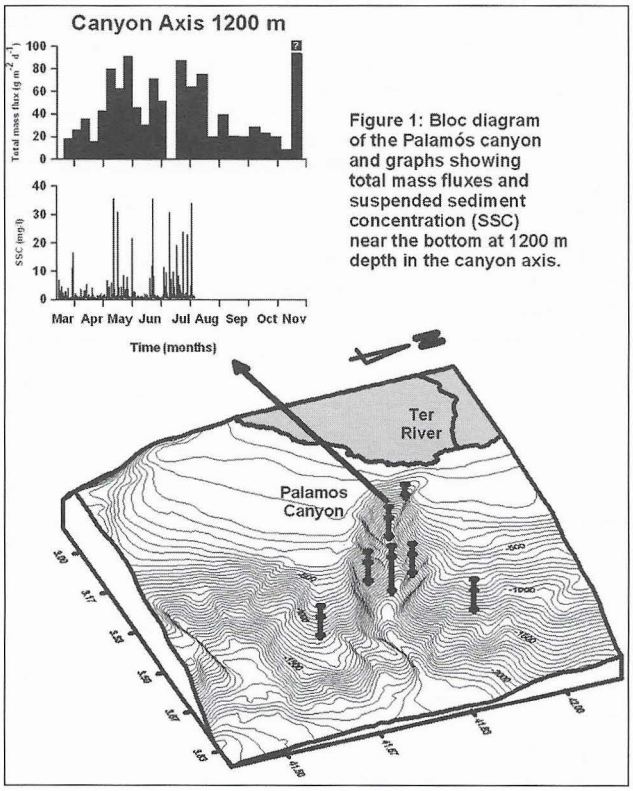

Figure 1: Bloc diagram of the Palamós canyon and graphs showing total mass fluxes and suspended sediment concentration (SSC) near the bottom at 1200 m depth in the canyon axis.

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