SPATIAL-TEMPORAL VARIABILITY AND COMPOSITION OF DOWNWARD PARTICULATE MATTER FLUXES IN THE PALAMÓS SUBMARINE CANYON (NORTH-WESTERN MEDITERRANEAN)

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Abstract

Seven sediment traps were moored in the Palamós Submarine Canyon (NW Mediterranean) to study temporal and spatial variability of downward particle fluxes. Total mass fluxes and major constituents (organic carbon, opal, calcium carbonate and aluminosilicates) are presented here. The data obtained in the Palamós Canyon show some patterns similar to those observed in other studied submarine canyons along the north-western Mediterranean margin, although singular results were obtained in relation to the magnitude, location and timing of maximum fluxes, and to the occurrence of specific sediment transport events.

Keywords: Submarine canyons, sediment traps, particulate matter, sediment transport, downward fluxes

Introduction

The Northwest Mediterranean continental margin is indented by numerous submarine canyons, comprising about 60% of the total area in this region. Previous studies have highlighted the important role of submarine canyons in the biogeochemical cycles, particularly as channelling routes for off-shelf export of suspended organic matter.

The Palamós Submarine Canyon is one of the major canyons in this area, and its head is deeply incised in the shelf.

Material and methods

Six moorings equipped with seven sediment traps and eighteen current meters (some of them equipped with turbidimeters) were deployed inside and nearby the Palamós Canyon, three in the canyon axis at 470, 1200 and 1700 meter depth, two in the canyon walls at 1200 m depth, and two in the adjacent slope. Each mooring had a sediment trap 25 meters above the bottom.

The study lasted from March to November 2001, separated in two 4-month deployments. Subsampling and total mass flux were estimated according to the method described in (1). Organic carbon and calcium carbonate were measured using a LECO auto-analyser. Biogenic silica was analysed following the method described in (2). The lithogenic fraction was calculated as the difference between the total mass and the sum of the biogenic components.

Results and discussion

Total downward mass fluxes varied by more than three orders of magnitude inside the canyon. From 40 mg/m^2.d in the northern wall in summer to more than 100000 mg/m^2.d in the canyon axis at 1200m during the storm that took place in November 2001. The exact maximum amount is unknown, because that trap overfilled during the storm.

The trap at 470m, located at the head of the canyon, showed quite constant downward fluxes along the period of study, with a mean flux of 28758 mg/m^{2}d, but also a sharp increase in November. The canyon axis trap at 1200 m, presented a wide range of fluxes, from 8 to more than 100 g/m^{2}d, specially during summer. Deeper in the canyon axis, the trap at 1700m displays lower values (mean flux of 8484 mg/m^2.d), although there were two peaks of 40 and 60 g/m^2.d respectively, the latter corresponding to the November storm.

Regarding the downward fluxes in the canyon walls, these were higher in the southern wall, where the mean flux was 5157 mg/m^{2}d. In the northern wall, the mean flux was about three times lower than in the southern wall (1514 mg/m^{2}d). In both sites, there was a maximum of downward fluxes in November, coinciding with the occurrence of a major storm. Finally, in the open slope at 1200 m the maximum downward flux occurred in spring (230 mg/m^2.d), decreasing by an order of magnitude in summer. During the November storm, downward flux at this slope site was only 175 mg/m^{2}d. The mean downward fluxes at the open slope are from 4 to 70 times lower than inside the canyon.

Regarding particulate matter composition, the lithogenic fraction dominated the composition of the settling particles at all sites. At each location, the percentages of aluminosilicates and carbonates were relatively constant during the experiment. The maximum contents of opal and organic were coherent with the spring biological bloom in almost all traps. In general, the biogenic fraction was inversely correlated with the total mass fluxes. A seasonal pattern with higher fluxes in winter was more evident in the open slope. The sites at 470 m and 1200 m along the canyon axis showed relatively constant and low values of biogenic constituents throughout the year, whereas the rest of the sites displayed wider ranges of biogenic constituents and followed, to some extent, the slope seasonal pattern.

This spatial-temporal distribution of total mass fluxes and major constituents, allowed us to define two domains in the Palamós Canyon: an "inner" domain (<1200 m) constricted by the canyon topography and mainly influenced by lateral transport from the adjacent continental shelf in which the canyon is incised, and an external domain, where slope dynamics and seasonal trends are more important in determining the composition and amount of downward fluxes (3).

Table 1. Mean values of total mass fluxes and major constituents contents and fluxes in mg/m^{2}d, for each sediment trap.

	Canyon Axis 470 m		Canyon Axis 1200 m		Canyon Axis 1700 m	
	%	Flux	%	Flux	%	Flux
Total Mass Flux	100	28758	100	44284	100	8484
Lithogenics	72.6	20880	72.28	32007	70.35	5969
Carbonates	22.95	6600	24.35	10784	25.61	2173
Opal	2.07	595	1.82	808	1.95	166
Organic Matter	2.37	683	1.55	685	2.07	176

	Southern Wall 1200m		Northern Wall 1200m		Open Slope 1200m	
	%	Flux	%	Flux	%	Flux
Total Mass Flux	100	5157	100	1514	100	428
Lithogenics	70.21	3621	68.43	1036	58.17	249
Carbonates	24.14	1245	23.64	358	25.70	110
Opal	2.93	151	4.49	68	10.28	44
Organic Matter	2.73	141	3.50	53	16.12	25

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