TRANSFER OF SEDIMENTS AND ORGANIC MATTER BY A MARINE STORM IN THE CAP DE CREUS CANYON (GULF OF LION, NW MEDITERRANEAN SEA)

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Abstract

In the Mediterranean basin, marine storms, often associated with flash floods of coastal rivers, are episodic and intense physical processes that are capable of transferring terrestrial organic matter to the continental shelf and up to the deep sea by strong bottom currents along submarine canyons. In order to study accurately such an event, an oceanographic cruise (CASCADE) was performed in the Gulf of Lion (NW Mediterranean Sea) in winter 2011. Two mooring lines equipped with a near-bottom sediment trap (25 m above bottom) were deployed at 290 m and 365 m water depth on the southern flank of the Cap de Creus Canyon. In order to characterize and to assess the origin of the particulate matter fluxes, the total mass flux, amino acids, opal, particulate organic carbon (POC), as well as its stable isotopic ratio (δ13C) were determined.

Keywords: Canyons, Organic matter, Stable isotopes, Gulf of Lyon, North-Western Mediterranean

In the Mediterranean basin, marine storms are episodic and intense physical processes that are often associated with flash floods of coastal rivers. These events are capable of transferring terrestrial organic matter to the continental shelf and up to the deep sea by strong bottom currents along submarine canyons. With the aim of improving our knowledge on the transfer of material during extreme meteorological conditions, an oceanographic cruise (CASCADE) was performed in the Gulf of Lion (NW Mediterranean Sea) in winter 2011 [1]. This period is favorable for the study of intense meteoroclimatic events and the resulting hydrodynamic processes such as dense shelf water cascading or storm events. During the CASCADE cruise, two mooring lines equipped with a near-bottom sediment trap (25 m above bottom) and a current-meter profiler, were deployed at 290 m (Trap 1) and 365 m (Trap 2) water depth on the southern flank of the Cap de Creus Canyon (Gulf of Lion) from the 4th to the 21st of March 2011 (sampling interval of 35 h) (Fig.1). In order to characterize particulate matter transfers, the total mass flux (TMF), amino acids, opal, particulate organic carbon (POC), as well as its stable isotopic ratio (δ13C) were determined from the trapped material.

Fig. 1. Location of the Study Area and CASCADE mooring line model

An intense marine storm occurred during the cruise (from the 12th to 16th March 2011) with simultaneously flash floods at several nearby coastal rivers (e.g. Agly River: flood peak of 1089 m3 s−1 with a return period of 15 years, for information the averaged runoff is 6.5 m3 s−1). At the peak of the storm, sediment traps collected around 150-200 g m−2 d−1 of POC and opal depleted materials. The grain size distribution of the trapped material showed that settling particles were predominantly (around 75%) composed of silts (4-63 µm), although a slight increase of clays (<4µm) was observed during the storm. Moreover, the δ13C values of bulk material varied slightly according to the TMF.

In order to improve our study on the trapped material, samples were fractionated into 3 size fractions: >63 mm, 4-63 mm and <4 mm [2]. In the marine storm samples (cups #7, 8, 9, and 10), the POC-richest grain size fraction was surprisingly the coarse material (POC > 4%), followed by clays (POC > 2%) and silt (POC > 1%) which tend to prove that organic-rich aggregates or biological debris were associated to the coarse lithogenic material. The δ13C values of each of the grain size fractions were relatively constant within the silt and coarse fractions (between -25% and -24%). In contrast, an isotopic δ13C discrepancy occurred within the clay fraction of trap 1, more exactly in cups #7, 8, 9, and 11, which exhibited a more terrestrial isotopic signature (around -27%). Terrestrial clays deposited into continental shelf sediments and the southern canyon flank were likely resuspended during the hydrodynamical processes of the storm which explain the 13C-depleted values obtained during this period. On the other hand, the 13C-depleted obtained after the peak flood (cup #11) may indicate a more direct transfer of riverine organic material absorbed on clays.

This study show that the quality (nature and origin) of the trapped organic material during a storm changes according to the size of particles. Further grain size studies should be performed on the trapped material during low mass fluxes in order to get an overall view on the off-shelf export of particulate organic material through canyons of the NW Mediterranean Sea.

References