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Sediment transport along the Cap de Creus Canyon flank during a mild, wet winter

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Cap de Creus Canyon (CCC) is known as a preferential conduit for particulate matter leaving the Gulf of Lion continental shelf towards the slope and the deep basin, particularly in winter when storms and dense shelf water cascading coalesce to enhance the seaward export of shelf waters. During the CASCADE (CAscading, Storm, Convection, Advection and Downwelling Events) cruise in March 2011, deployments of recording instruments and vertical profiling of the water column properties were conducted to study with high spatial-temporal resolution the impact of such processes on particulate matter fluxes along the CCC. The most remarkable feature in terms of sediment transport was a period of dominant E-SE winds from 12 to 16 March, including two moderate storms of significant wave heights = 4-4.5 m. During this period, a plume of freshened, relatively cold and turbid water flowed at high speeds along the southern flank of CCC in an approximate depth range of 150-350 m. The density of this water mass only reached $\sim$ 28.78 kg m^{-3}, indicating that it did not cascade into the canyon and that merely downwelled into it forced by the accumulation of seawater along the coast during the storms and by the subsequent strong cyclonic circulation induced over the shelf. Suspended sediment load in this turbid intrusion was comparable at three heights above bottom where turbidimeters were installed (10, 75 and 115 meters above bottom) on the southern canyon flank and oscillated between 10 and 50 mg l^{-1}. Current speeds were also comparable in the depth range profiled by ADCPs (40 to 150 mab) and reached values up to 90 cm s^{-1} during the peak of the strongest storm (13 March, Hs = 4.5 m). Sediment transport at 75 mab on the southern canyon flank was estimated at 1-1.5 ton m^{-2} for the entire deployment while very close to the bottom (5 m above) in the canyon head it was less than 0.6 ton m^{-2} during the same period. We provide a rough estimation of 10^5 tons of sediment transported through the canyon along its southern wall during a 3 day-long period of storm-induced downwelling. Following the veering of the wind direction (from SE to NW) on 16 March, downwelling ceased, currents inside the canyon reversed from down to up-canyon, and the turbid shelf plume was evacuated from the canyon, most probably flowing along the southern canyon flank and being entrained by the general SW circulation after leaving the canyon confinement. This study highlights that remarkable sediment transport occurs in the CCC, and particularly along its southern flank, even during mild and wet winters, in absence of cascading and under limited external forcing. The sediment transport associated to eastern storms like the ones described in this paper tends to enter the canyon by its downstream flank, partially affecting the canyon head region. Sediment transport during these events is not constrained near the seafloor but distributed in a depth range of 200-300 meters above the bottom.