Contemporary Off-shelf Sediment Transport on the Ebro Margin (COSTEM)

M-23

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SUMMARY

The COSTEM project deals about the study of contemporary sedimentary processes that control the shelf-to-slope sediment transport and the sedimentary dynamics at the outer shelf, submarine canyon heads and continental slope of the Ebro margin. This margin has been intensively investigated from the sedimentary point of view. Nevertheless, no previous research has addressed the study of the mechanisms controlling the off-shelf sediment transport and the characteristics and fate of the exported particles towards the slope. Preliminary results suggest that most of the transport occurs across the southwestern end of the Ebro margin, in the Gulf of Valencia, where the width of the shelf dramatically decreases favoring the advection of suspended particles towards the continental slope (Fig. 1). Swath bathymetry conducted in this margin reveals the presence of two large sediment wave fields on the Valencia continental slope (300-750 m depth), which indicate preferential accumulation in that region. This morphology contrasts with the one from the continental slope in the central part of the Ebro margin, where numerous submarine canyons, apparently controlled by slope instability processes, develop (Fig. 2). Hydrographic sections across the sediment wave fields reveal the presence of multiple intermediate nepheloid layer detachments that suggest active resuspension processes (Fig. 3). Data from three moorings recently deployed on the continental slope and rise and from one tripod placed on the Valencia shelf will provide direct observations to asses the role played in the sedimentary dynamics of the area by high energetic events, such as major storms, internal waves and the formation of dense shelf waters and its subsequent down-slope cascading (Fig. 4).

REGIONAL SETTING

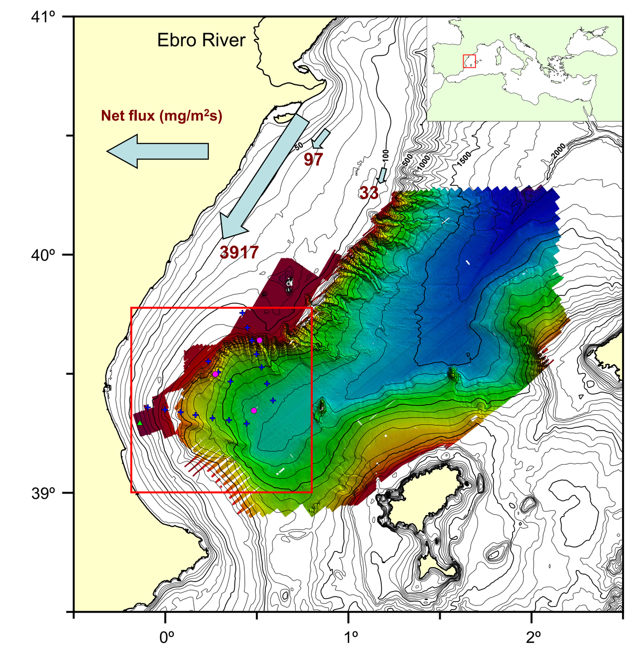

Figure 1. Bathymetric map of the Ebro continental margin showing the location of the COSTEM study area (red rectangle and enlarged map in Figure 2). Arrows indicate the near-bottom net fluxes at three locations (12, 60 and 100 m depth) across the central part of the Ebro shelf measured during the FANS project (after Palanques et al., 2002). Note that the fluxes were directed towards the SSW and along-margin and that their magnitude decreased offshore. These preceding studies stated that maximum near-bottom sediment fluxes in this margin are associated with wave-storm events, strong wind induced currents and the presence on near-inertial internal waves at the base of the thermocline (Puig et al., 2001; Palanques et al., 2002). These results suggest that most of the off-shelf transport in the Ebro margin has to occur on its southwestern end, in the Gulf of Valencia, where the width of the shelf decreases dramatically and the advection of suspended particles can cross the isobaths and reach the continental slope region.

Palanques, A., Puig., P., Guillén, J., Jiménez, J., Gracia V., García, M., Salat, J., Sánchez Arcilla, A., Stive, M.J.F., Madsen, O. (2002). Near-bottom suspended sediment fluxes on a river-influenced, tideless fetch-limited shelf (The Ebro Delta, northwestern Mediterranean). Continental Shelf Research, 22: 285-303.

Puig, P., Palanques, A., Guillén, J. (2001). Near-bottom suspended sediment variability caused by storms and near-inertial internal waves in the Ebro mid continental shelf (NW Mediterranean). Marine Geology, 178: 81-93.

STUDY AREA

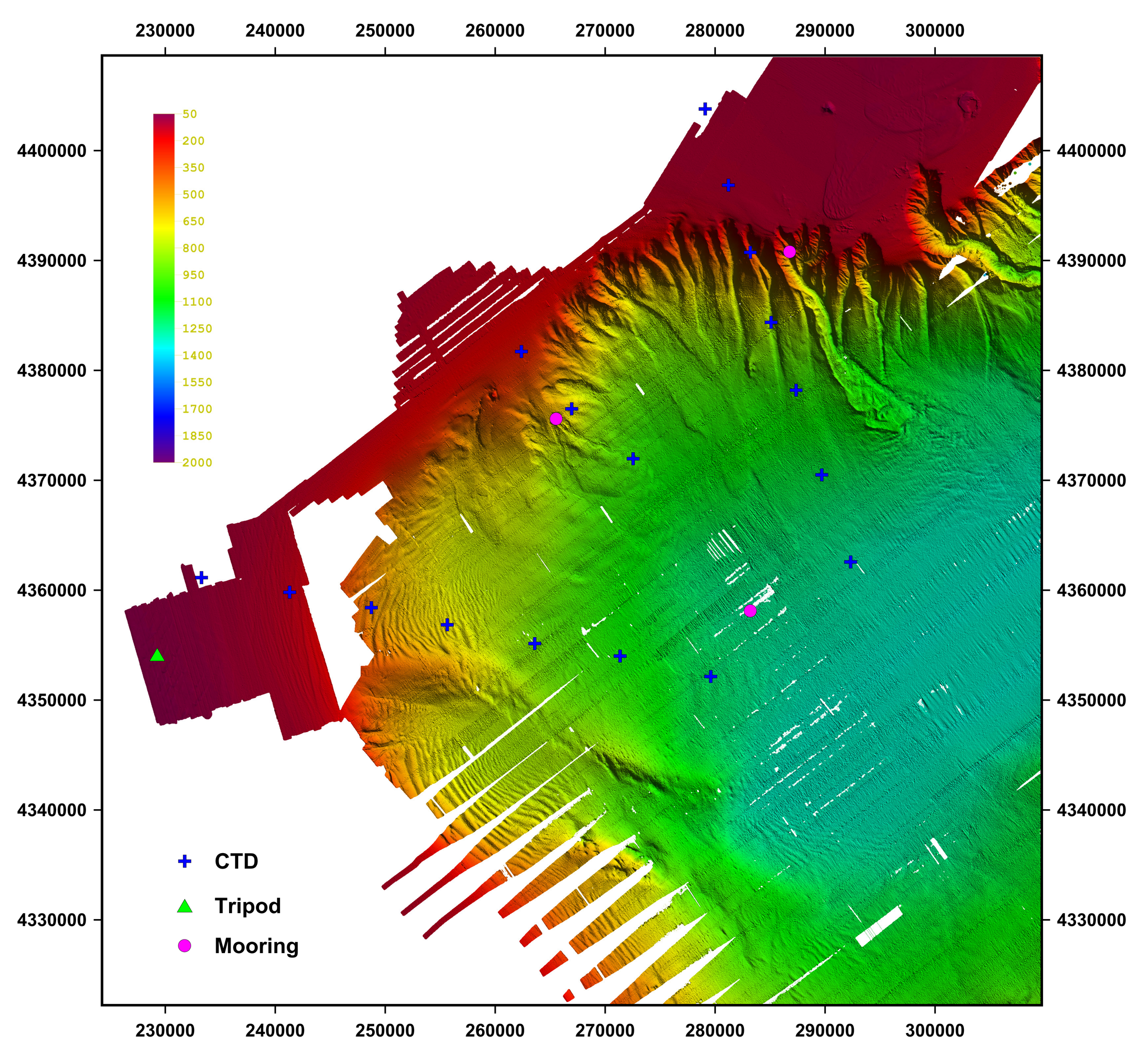

Figure 2. Swath bathymetry from the study area showing the location of the three moorings (magenta dots) and the tripod (green triangle) deployed in the Gulf of Valencia shelf, slope and rise, and the positions of the CTD casts (blue crosses) conducted in May and September 2010 during the first two cruises of the COSTEM project. Note the different morphology between the northern margin sector, characterized by a network of submarine canyons, and the transition towards the south, where a smoother continental slope covered by large sediment wave fields is found around 300-750 m depth.

HYDROGRAPHY AND NEPHELOID LAYERS DISTRIBUTION

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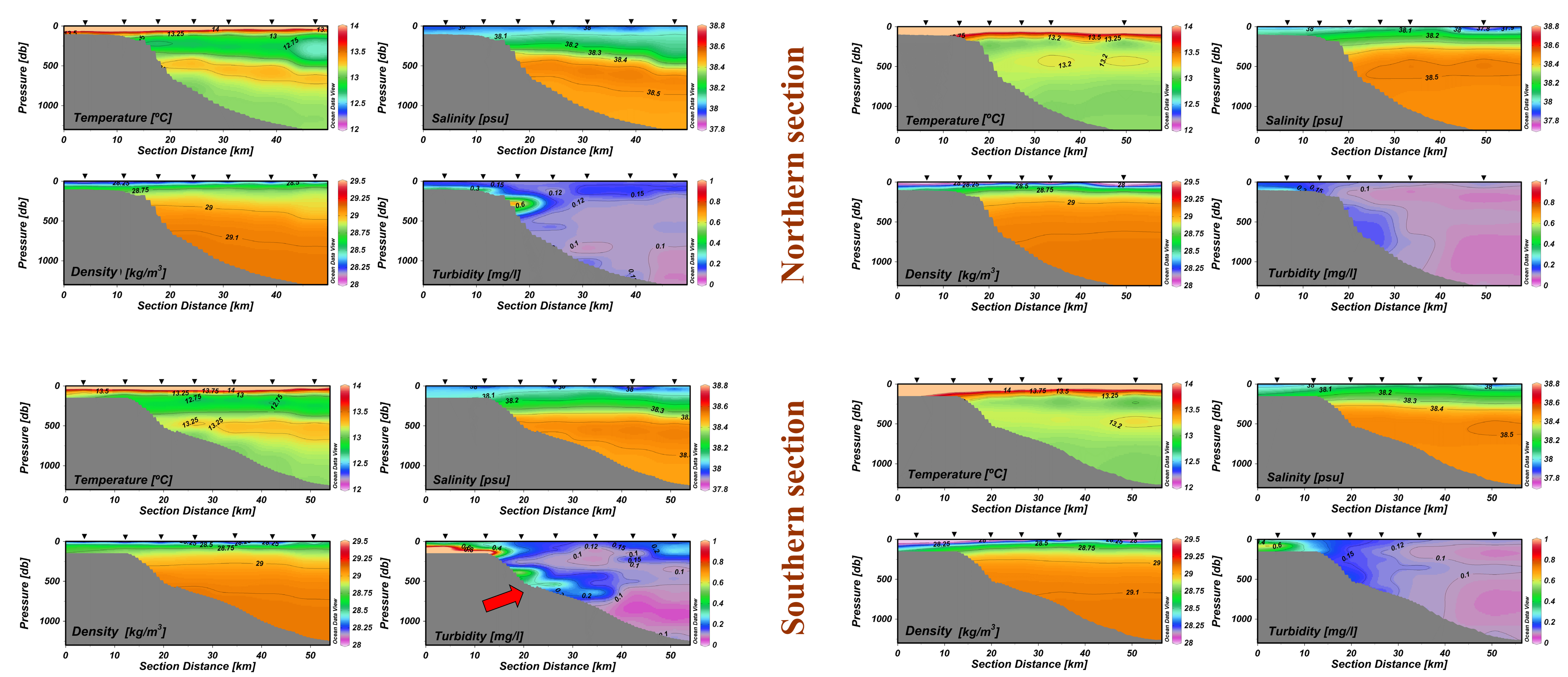

Figure 3. Distribution of water temperature, salinity, density and turbidity along the two main hydrographic sections conducted in the COSTEM study area during May and September 2010. Note the detachment of a thick intermediate nepheloid layer (INL) in the southern section in May 2010 (red arrow) on the continental slope area and around the depth range where one of the sediment wave fields develops. This region also coincides with the depth where the warmer and saltier Levantine Intermediate Water (LIW) interacts with the seafloor. Such INL was not observed in the northern section in May 2010 and suggests the presence of internal waves in the southern part of the margin, which eventually can generate high levels of shear and turbulence and cause resuspension and/or maintain particles in suspension. The INL was absent in September 2010, which denotes the intermittence of the resuspension mechanism throughout the year. Small triangles indicate the positions of the CTD profiles.

MOORING TIME SERIES

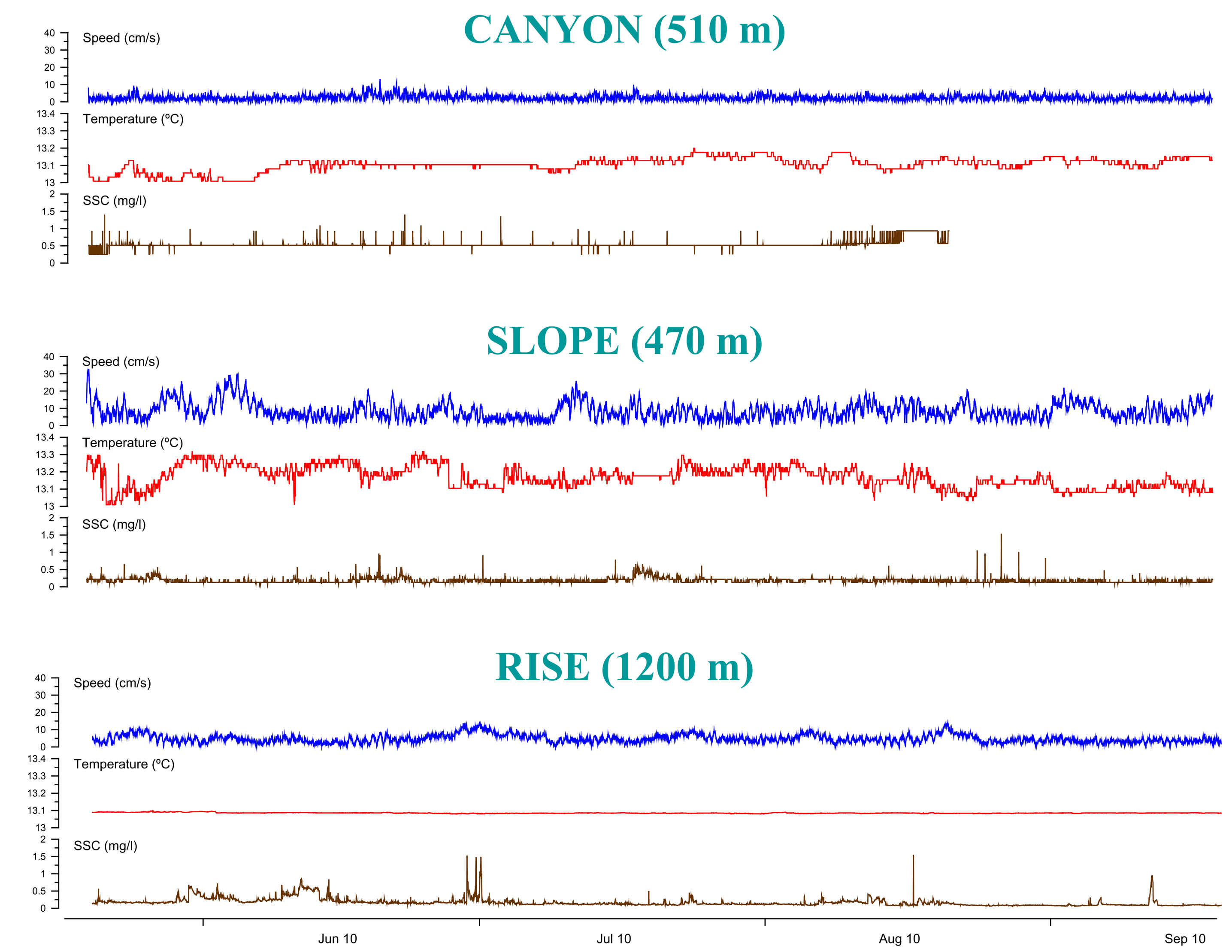

Figure 4. Time series of near-bottom (i.e. 5 m above seafloor) current speed, temperature and suspended sediment concentration (SSC) measured during the first deployment period at the three mooring locations. Note the larger current velocities at the slope compared with the ones recorded inside the submarine canyon at similar depths and in the continental rise. Current fluctuations on the slope occurred preferentially at near-inertial frequencies along with changes in water temperature presumably linked to internal waves. SSC was low and showed sporadic increases at the slope and basin sites without displaying a clear link with current velocities or a correlation between both moorings.