SHELF/SLOPE EXCHANGES AND SUBMARINE CANYONS: LABORATORY MODELLING

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Abstract

Preliminary laboratory experiments on the interaction of a coastal current and a submarine canyon using a rotating platform are presented. The influence of canyon on the behaviour of frontal current and the associated exchange processes between the shallow and deep parts of the basin are analyzed under quasi barotropic conditions. A strong influence of the canyon on the dynamics of the frontal current is clearly observed, mainly due to a downslope flow through the near bottom viscous layer. Comparison with recent field observations are presented.

Keywords: Submarine canyons, shelf/slope exchanges, laboratory experiments.

The continental slope is characterized by a very specific dynamics of the water flows and could be considered as a frontal zone of potential vorticity due to the rapid change of the depth with off-shore distance. The variability and structure of the circulation within the canyons themselves depend on various forcing factors bringing alterations in planktonic communities and in matter transfers between the shelf open ocean zones.

An experimental device to analyze the interaction of a coastal current with a submarine canyon incinsing the bottom slope has been designed [1]. The device was composed of tank of water over a rotating platform containning a cone to simulate the sloping bottom and including a canyon. A coastal current was obtained releasing lighter colored fluid trhough a source in the cone vertex axisymmetrically positioned. Two sets of experimental runs with similars basic parameters but with and without the presence of a submarine canyo were provided. In both cases an axisymmetric anticyclonic frontal current was initially forme. After a while, its width increased and then a near bottom viscous layer downslope flow was formed at the front of the anticyclonic current while the position of the front remained stationary. When the canyon is present a considerable part of the downslope flow as well as the frontal current were trapped by the canyon at its downstream wall (Fig. 2 a,b). Both up and down canyon currents have been also observed and the downward flow at the downstream wall was responsible for the major fluid exchange from the quasi-axisymmetric frontal current (Fig. 2b). This fluid was transported much below of the outer edge of the frontal current until a depth level where it continued to flow along the slope downstrean the canyon.

An interesting consequence of the above results is the strong downslope flow near the bottom boundary layer inside the canyon and their implications on shelf/slope mass transfer. These results could explain the internal structure of particulate fluxes observed in a field experiment carried out in the Palamós canyon (Northwest Mediterranean), in which nera-bottom particulate were higher at the head of the canyon and in the downstream wall than in the upstream wall (Fig. 3).

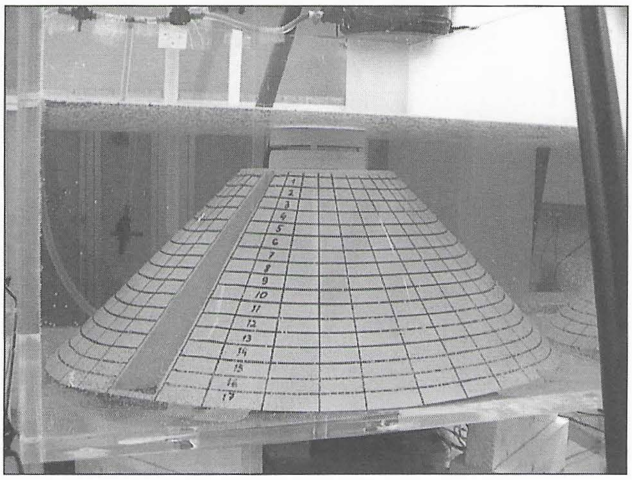

Fig. 1. Laboratory set up to study the interaction of a coastal current and a submarine canyon.

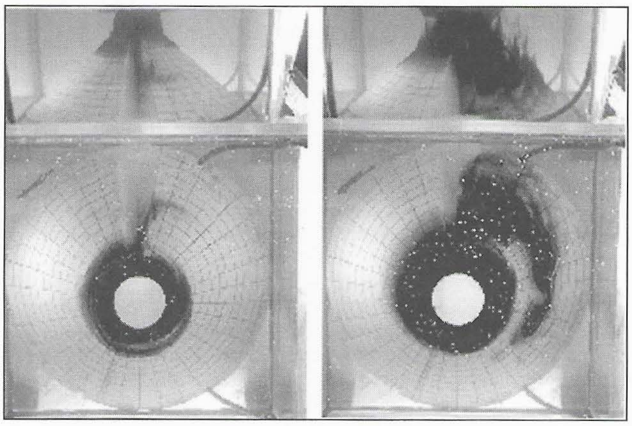

Fig. 2. Experiments for the quasi barotropic case including tha canyon at two different times.

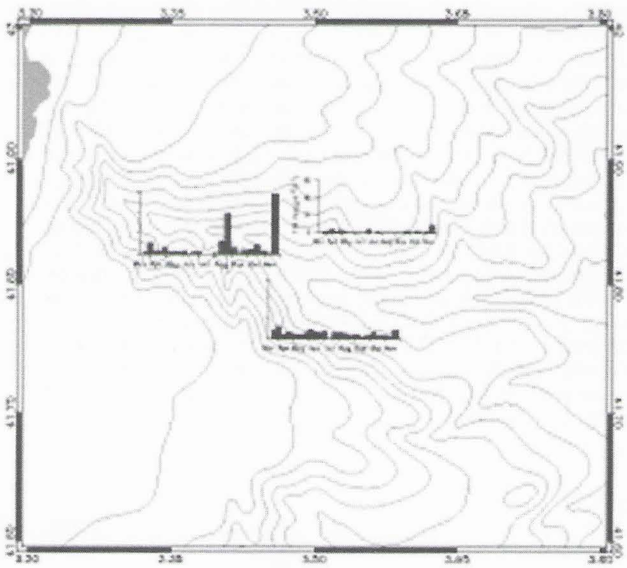

Fig. 3. Particulate fluxes near the bottom at three locations in the Palamós canyon during the field experiments.

References

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