MORPHOLOGICAL EVIDENCES OF RECENT SUBMARINE LANDSLIDES ON THE LIGURIAN MARGIN (NORTH-WESTERN MEDITERRANEAN): FIRST RESULTS FROM THE MALISAR CRUISE

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Abstract

The MALISAR cruise acquired in august 2006 new high-resolution data, including EM300 bathymetry and backscatter imagery, 3-5 kHz and seismic-reflection profiles, on the Ligurian margin, between Nice (France) and Genova (Italy). These data revealed the presence of numerous small- and large-scale failures related to high sediment supply coming from the Var and Paillon rivers or related to the presence of active faults.

Keywords : Ligurian Sea, Continental Slope.

Submarine landslides are the one of the major mechanism of sediment remobilisation and transfer from the slope to deep-sea environment [1-3]. Their main triggering mechanisms are usually earthquakes, fluid seepages or anthropogenic activity [4]. Submarine landslides occur preferentially in areas that present conditions prone to failure: sediment under-consolidation, high-slope gradient, high sedimentation rates, variability in the texture and physic-mechanical state of the sediment strata. When landslides occur in shallow water depth, they can also have a strong impact on coastal environments by generating tsunamis [5-6].

The Ligurian Basin experienced recently such a mass-wasting event: on October 16^{th} 1979, a failure involving about 8 x 10^6 m^3 of material occurred in shallow-water depth during infilling operations related to the construction of the new Nice harbour [7]. Since 1975, at least 25 x 10^6 m^3 of aggregates were deposited on the narrow shelf, at a water depth ranging from 10 to 15 m, to increase the surface of the airport in a seaward direction. The failure affected both under-consolidated silty-clayey deposits of the upper continental slope and some of the landfill aggregates. Eight minutes after the failure occurred, three successive waves, 2-3 m height, were generated and broke along the coastline between Nice and Antibes.

The Ligurian Basin has been frequently affected by earthquakes (four historical earthquakes in 1564, 1644, 1817 and 1887), and tsunamis (1564, 1817, 1887, 1979). Based on the 1979-event experience, earthquakes might have generated tsunamogenic failures on the Ligurian slope in the past.

To analyse the distribution of failures on the slope, and to study their triggering mechanisms and their relationship with tsunamis, the MALISAR cruise (august 2006) acquired EM300 multibeam bathymetry in the area between Nice and Genova, from about 100 m to 2500 m water depth, as well as 3-5 kHz profiles, and 24- or 72-multichannel seismic profiles. The dataset reveals numerous fresh scarps and mass-transport deposits involving several km^3 of sediment. The second part of the cruise will take place in 2007, and will collect SAR (side-scan sonar) and AUV data, as well as cores over the whole area.

Offshore the Nice city (France), mass-wasting events mainly affect the upper part of the slope, in areas close to the Var and Paillon river mouths, where volume of fresh sediment delivered by rivers is the highest. Small-scale failures (<100 m wide) are mainly located near the shelf break; they are the most abundant type of failures and are restricted to the uppermost layers (up to 10 m) of slope sediment. Larger-scale failures (up to 400 m wide) are located deeper on the slope and they affect deposits over greater thickness (up to 40-50 m). Smaller failures mainly result from the under-consolidation state of slope sediment during periods of high sedimentation rate, while the triggering of larger failures probably requires an external constraint such as an earthquake-induced acceleration of the seafloor.

Between Nice (France) and Imperia (Italy), failures are several kilometres wide and affect slope deposits over 100 to 300 m. They are located near the base of the slope, between 1300 and 2000 m of water depth. One of the most impressive scarp is located in the epicentral area of the 1887 earthquake. The location of failures is controlled by the presence of numerous active faults related to the salt tectonic affecting the basin or of deeper crustal origin.

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