Slope instability in the Sea of Marmara and relationship with active faulting

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The assessment of earthquake hazards in the vicinity of Istanbul requires a characterization of active faults, but also an evaluation of the effect of the earthquakes on slope stability and associated tsunamis. In the Sea of Marmara, known historical tsunamis have been triggered either by coseismic displacement or by landsliding (Altinok et al. 2001; Hébert et al. 2005). Indeed, tsunamis generated by strike slip faulting are generally small because of low vertical motion of the seafloor, but submarine landslides following earthquakes may also contribute to tsunamis generation. Significant tectonic subsidence and offshore mass movements have actually been observed related to the 1999 Izmit-Kocaeli earthquake (Kuşçu et al. 2005).

The zones of instabilities along the slopes of the Sea of Marmara are mapped from high resolution multibeam bathymetric data. A distinction is made between large creeping slopes with a possible catastrophic evolution into debris flow, and instabilities related to steep canyons slopes. Numerous slope failures and scars incise the upper slope, particularly near the head of the canyons and within their flanks. These submarine mass movements consist of small volumes but may participate to tsunami source, because they occur at relatively shallow water depths. On the other hand, wider areas (20 to 80 km^2) of the entire slope are affected by active gravity sliding processes. These features show complex seafloor morphology, with evidence for multiple slope failures (imbricated scars), retrogressive evolution (extensional scarps above recent failures) and creeping motion (rough and hummocky seafloor). Catastrophic events occur occasionally since related debris flows can be found downslope in the basin. Evidences are debris layers in cores and transparent lenses interbedded with the sedimentation visible on the 3,5kHz echosounder profiles.

The most known catastrophic submarine mass failure occurred around 17 kyr BP to the northeast of the Çınarcık Basin (Özeren *et al*. 2006). The scar area of around 32.5 km^2 consists of two parts: a creep-like movement on the east and a slump in which the vertical displacement reaches around 1000 metres on the west. Slope instabilities can also be observed in the southwestern part of the Tekirdağ basin, over an elliptical area of about 76 km^2.

So we remark that the largest two active creeping masses are located at active fault bends at both extremities of the Sea of Marmara and may relate to different sedimentary input or to the termination of recent seismic ruptures (i.e., the Ganos rupture to the west, and Izmit rupture to the east).

Réferences:

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