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Slope instability and their consequences

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It is now well known that some of the submarine slope failures created destructive tsunami waves, which in turn can have devastating impacts on populations of coastal lowlands (Baptista et al., 1998, Bondevik et al., 1997). For example, the 1755 Lisbon event where an approximately 8.5 magnitude earthquake triggered a landslide and tsunami represents one of the largest natural catastrophes with approximately 60,000 casualties in Portugal alone (Garcia et al., 2003). The 8250 cal yrs. BP Storegga slide event caused a major tsunami with devastation along a several thousand km long coastline including Scotland and Norway. This major impact did not cause a high risk during that time because of the scarcely populated areas during the Stone Age. If such en event would happen today the risk (product of geohazard and destruction potential) would be very high. Submarine landslides are a widespread phenomenon on passive continental margins on both sides of the North Atlantic Ocean, and on active continental margins (e.g. McAdoo, B.G., et al., 2004; Mienert, J., 2004; Piper et al., 2003, Locat and Mienert, 2003, Solheim et al., 2005). Giant and medium size submarine landslides occur around Europe's margin, and some of the slides have a potential for generating a Tsunami. Giant landslides are found in high latitude margin settings while medium size landslides of several thousand square kilometres occur in both glacial-dominated margins of high latitudes and river-dominated settings of low latitudes. Submarine landslides are common and very effective mechanisms of sediment transfer from shelf and upper slope to deep-sea basins. During one single event enormous sediments can be transported on very gentle slopes over distances exceeding hundreds of kilometres. Individual mass movements involve simultaneous or successive material displacements including block detachment and translational sliding, block sliding, debris flow and mud flow. Although slide headwalls might present locally steep gradients (up to 23 degrees for the giant Storegga slide), the slope gradients of both the failed segment margins and the main slip planes are very low (2 degrees and usually < 1 degrees). The slip planes often correspond to mechanically distinct "weak layers" and can be created by climatically controlled changes in sedimentation rates and sediment types. Thus, we can state that a submarine landslide pre-conditioning is at least partially climate driven. In addition to the pre-conditioning factors, a final trigger is probably required for submarine landslides to take place. In high latitude passive margins, earthquake magnitude and frequency intensification due to post-glacial rebound has likely played a major role but gas hydrate destabilisation due to ocean warming may have significantly contributed. Therefore, we may ask whether there is any evidence from past sedimentary records that the frequency of submarine slope failures increases during a global warming scenario, a possible scenario of our future.

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