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Sharp changes in lake-levels preconditioning seismogenic mass failures in the Dead Sea

Yin Lu[1], Amotz Agnon[2], Shmuel Marco[3], Revital Bookman[4], Nicolas Waldmann[4], Nadav Wetzler[5], Ian Alsop[6], Jasper Moernaut[7], Michael Strasser[7], and Aurélia Hubert-Ferrari[1]
[1]University of Liege, Belgium
[2]The Hebrew University of Jerusalem, Israel
[3]Tel Aviv University, Israel
[4]University of Haifa, Israel
[5]Geological Survey of Israel, Israel
[6]University of Aberdeen, UK
[7]University of Innsbruck, Austria

Subaqueous mass failures that comprise slides, slumps and debris flows are a major process that transport sediments from the continental shelf and upper slope to the deep basins (both oceans and lacustrine settings). They are often viewed together with other natural hazards such as earthquakes, and can have serious socioeconomic consequences. It is increasingly important to understand the relationship between mass failures and climate-driven factors such as changes in water-level. Despite extensive marine investigations on this topic world-wide, the relationship between changes in water-level and mass failures is still highly disputed. This is due largely to the significant uncertainties in age dating and different potential triggers and preconditioning factors of mass failure events from different geological settings. Here, we present a 70 kyr-long record of mass failure from the Dead Sea Basin center (ICDP Core 5017-1). This sedimentary sequence has been dated in high accuracy (±0.6 kyr) and has similar responses to climate forcing. Moreover, the mass failure record is interpreted to be controlled by a single trigger mechanism (i.e. seismicity).
Based on the recent detailed study on the sedimentological signature of seismic shaking in the Dead Sea center, these seismogenic mass failures (seismites) account only for a part of the whole seismites catalog, suggesting that mass failure follows only part of seismic shaking irrespective of intensities of the shaking. This is evidenced by the common absence of mass failures following the in situ developed and preserved seismites (e.g., the in situ folded layer and intraclast breccias layer) which represent different intensities of seismic shaking. This feature implies that some non-seismic factor(s) must have preconditioned for the seismogenic mass failures in the Dead Sea center.
Our observations reveal decoupling between change in sedimentation rates and occurrence probability of these seismogenic mass failures, thus suggesting that a change in sedimentation rate is not the preconditioning factor for the failure events. While 79% of seismogenic mass failure events occurred during lake-level rise/drop in contrast to 21% events occurred in the quiescent intervals between. Our dataset implies that seismogenic mass failures can occur at any lake-level state, but are more likely to occur during lake-level rise/drop due to the instability of the basin margins. In addition, the seismogenic mass failures occurred more frequently during glacials (characterized by highstand and high-amplitude lake-level changes) than during interglacials, as a result of the morphologic characteristics of the lake margin slopes and different lithologies (e.g. halite) influences which are both connected to the glacial-interglacial lake-level changes.

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