Characteristics and frequency of large submarine landslides at the western tip of the Gulf of Corinth based on a **grid of 600 km high-resolution seismic profiles**

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1. Abstract

Coastal and submarine landslides are frequent at the western tip of the Gulf of Corinth, where small to medium failure events (10^6-10^7 m^3) occur on average every 30-50 years. These large sliding events mainly result from slope failures in, or close to, the submarine Gilbert-type fan-deltas. These deltas are 400m high, have steep 15° to 35° delta fronts incised by gullies and bordered by active faults running along or near the coastline (Becker et al., 2015). Slope failure trigger tsunamis, and consequently represent a significant hazard.

We realize here an inventory of the large mass transport deposits (MTDs) that result from submarine landslides based on geophysical data acquired by the Renard Center of Marine Geology of the University of Ghent with a "CENTIPEDE" Sparker seismic source combined with a single-channel high-resolution streamer as receiver. In the high-resolution seismic profiles, mass transport deposits have been identified based on their typical seismic facies made of discontinuous to chaotic reflections

Most of mass wasting deposits are clustered and are defining multi-MTDs temporal "events", based on common un-deformed underlying or overlying reflections that can be followed across the basin. Six large sliding events are identified, and their associated deposits locally represent 30% of the sedimentation since 130ka in the main western Basin. The definition of sliding events reflects here a clustering of submarine landslides in a relatively short period of time. The most recent sliding event demonstrates that MTDs grouped within the same event may not occur at the same moment. By contrast, the synchronicity of different submarine landslides has been suggested for 3 other sliding events from the complex shape of the large MTDs they include and suggests an earthquake triggering. The average recurrence interval for large earthquakes (Mw 6-7) has been estimated in the central part of the Gulf of Corinth at ~500 yr during the Holocene, and ~400 yr for the period 12-17 ka (Campos et al., 2013). Therefore, large sliding events in the westernmost Gulf of Corinth were less frequent than Mw 6-7 earthquakes, during both the Holocene and the last glacial period. Consequently, while large earthquakes could have triggered some sliding events, other factors contributed to the occurrence of such large sliding events.

Processes that might have "pre-conditioned" or triggered sliding events in the Gulf of Corinth need to show a return period of at least 2.5 ka over the last 12 ka in order to fit the sliding event frequency. Two likely main pre-conditioning factors have been identified. The first one is the reloading time of slopes, which varied with the sedimentation rate. Average sedimentation rate (excluding the thickness of MTDs) reaches ~2.4 mm/yr for the Holocene and ~ 0.4 mm/yr for the previous 120 kyrs. This is in line with the fact that only one large

sliding event was recorded during the ~60 ky-long Last Glacial. In addition, sedimentation supply was not constant during the Holocene. Fuchs (2007) identified two main phases of land degradation between 6.5 and 8.5 ka, and from ~4 ka onwards. Two sliding events occurred at the end of these periods of high sediment supply. The second pre-conditioning factor is sea level changes and the associated modification in water circulation. At 10-12 ka, the rising waters in the Ionian Sea flooded the "Lake Corinth", the sea level continued to increase from ca. -60 m to its present elevation until 5.5-6 ka, and bottom currents appeared in the study area (Beckers et al., 2016). The deposition of sliding event occurred at 10-12 ka, when these dramatic changes in water depth and water circulation that occurred. We conclude that the overall temporal distribution of MTDs result from the time-dependent evolution of pre-conditioning factors, rather than from the recurrence of external triggers.

Finally, it is likely that these sliding events have triggered large tsunami waves in the whole Gulf of Corinth, in some cases much larger than those reported in historical sources. Indeed one MTD stands out as a particularly large feature (a little less than 1 km^3 in volume). This is about two orders of magnitude larger than the range previously proposed for the size of submarine landslides in the westernmost Gulf of Corinth.

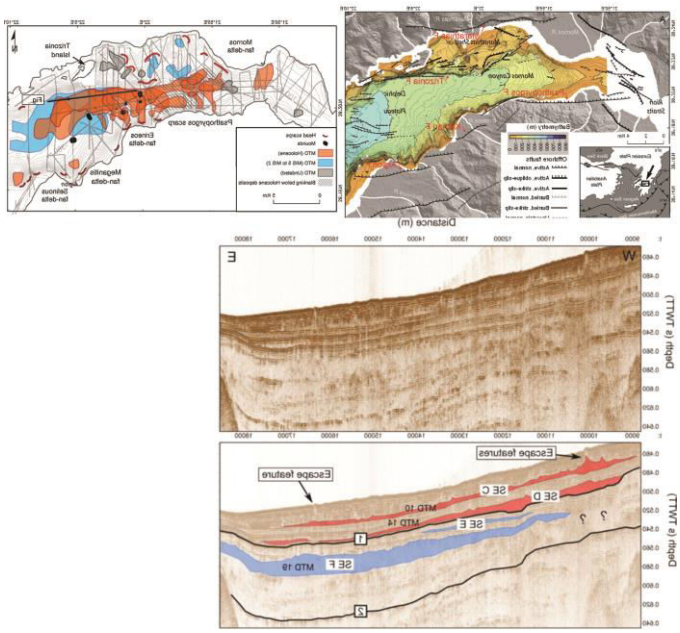

Figure. Top left: Study area; Top right: Inventory of mass transport deposits (MTDs) at the westernmost Gulf of Corinth for the last ca. 130 ka; Bottom: E-W Sparker seismic profile showing the mass transport deposits imaged

2. References

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