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Landslide and earthquake events recorded in distal turbidites in the deepwater basins of the Western European Margin

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Turbidites are of major economic importance in regards to sand distribution for hydrocarbon and aquifer reservoirs. However, more recently turbidite event histories have been studied in order to derive hazard assessments. Turbidite occurrences can be linked to earthquake and landslide activities, exemplified in the Horseshoe and Madeira Abyssal Plains respectively on the Western European Margin.

The Moroccan Turbidite System, which comprises the Agadir Basin, Seine Abyssal Plain and Madeira Abyssal Plain, records major landslide events from the Moroccan and West Saharan margin and island flank collapses from the Madeira and Canary archipelagos. ODP core from the Madeira Abyssal Plain and from the aprons of Gran Canaria can extend these records of major landslides back to 15 Ma. The events associated with continental shelf failures here can be correlated to points of sea level minima or maxima (Weaver & Kuijpers, 1987), whereas volcaniclastic events are associated with terminuses in volcanic island cycles. Piston coring has enabled recovery of high resolution records in these basins back to 200-500 ka and exceptional records to 1 Ma in the Madeira Abyssal Plain. The events recorded in the Madeira Abyssal Plain are related to the largest events capable of generating turbidites with large volume and runout. Piston coring around the Canary and Madeiran archipelagos have shown a great number of smaller events that are not recorded in the Madeira Abyssal Plain, thus providing a complete landslide archive of both major catastrophic and minor events.

Event histories in the Tagus and Horseshoe Abyssal Plains extend back to $\sim$130 ka. The most recent events in the last 20 ka have been linked to earthquake and tsunami records (Gracia et al., 2010). Indeed, this link between turbidites and seismology has been demonstrated on the modern Cascadia margin (Goldfinger et al., 2003). However, earthquakes generating large volume and margin-wide turbidites on each event is not true for Sumatra or indeed for the all events in the Tagus Abyssal Plain or Agadir Basin. Indeed, where significant sediment accumulations have not been generated between earthquakes, large earthquakes cannot necessarily produce failures and ensuing turbidite currents recorded in the basin.

Study of the turbidite internal architecture can demonstrate potential modes of generation and thus provide additional information regarding the hazards. Turbidites with multiple-stacked repeating sequences of sand and mud (subunits) can be linked to multistage landslide mechanisms. This is the case for the El Golfo, Icod and Las Playas II collapses in the Canary Archipelago. However, events in the Horseshoe Abyssal Plain and Sumatra trench also show these subunits but are thought to relate to earthquake triggers.

The present study shows the importance of using turbidites in deriving records of paleoseismicity and landslide activity. However, these records are often incomplete and knowledge of the sediment delivery and depositional processes of the turbidite are essential for critiquing the records. This is so that appropriate trends can be identified and future predictions better made.