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Landslides and mass wasting processes on the Sumatra convergent margin imaged on multibeam bathymetry

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The December 26th 2004 earthquake in the Indian Ocean was the largest for over 40 years and created the most devastating tsunami ever recorded, with fatalities around the Indian Ocean of over 200,000. Earthquakes are a commonly cited mechanism for triggering submarine landslides that have the potential to generate damaging tsunamis (e.g. Papua New Guinea 1998, Grand Banks 1929 and Storegga 8,200). Thus earthquakes and submarine landslides are closely tied and the runups of over 35 metres measured in northern Sumatra, close to the 2004 tsunami source, might therefore be expected to be caused at least in part by local landslides. However, mapping of the convergent margin offshore of Sumatra using swath bathymetry, supported by single and multi-channel seismic and seabed photography reveals that seabed failures mainly comprise small-scale failures, that modelling demonstrates did not contribute to local runups. The failures are located within the Aceh forearc basin and on the outboard margin of the accretionary prism and are of three types. Within the forearc basin they are debris flows. On the outboard of the accretionary prism the seaward faces of young thrust folds they comprise cohesive slumped blocks up to one hundred metres high and up to several kilometres long and debris flows. Where the young thrust folds are absent, a deeply dissected, steeply sloping, accretionary prism, with incised gullies indicates incremental failure, mainly through headwall erosion, that creates turbidity flows. Although most SMFs are small, the most recently acquired multichannel seismic data images rare slipped blocks up to 900 metres thick located off Simeulue Island. None of the features mapped are of very recent origin, which throws into perspective our widely view that large earthquakes are responsible for SMF. The main control on seabed failure appears to be the small volume of sediment entering the re-

gion from the downgoing plate. There is little sediment derived from the land, that that is trapped within the forearc basins. The large slumps forming in the southern part of the surveyed area appear to be controlled along a structural style that is different to that to the north.