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# The Hinlopen-Yermak Landslide, Arctic Ocean - Geomorphology, Landslide Dynamics and Tsunami Simulations

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Swath bathymetry data from the glacier-fed, northern Svalbard margin reveal geomorphological details of a large, submarine landslide, the Hinlopen-Yermak Landslide. Multiple, planar escarpments have several hundreds meters of relief, with a maximum headwall height exceeding 1400 m at the mouth of the Hinlopen cross-shelf Trough. Within the scar area, the landslide created a rugose seabed geomorphology, with little mass-transport deposition in the immediate vicinity of the major escarpments. Beyond a pronounced constriction, the occurrence of semi-transparent acoustic units on seismic profiles indicates that the mass-transport deposits are likely the accumulation of remolded and/or fluidized debris flows that are in places hundreds of meters thick. The surface expression of the mass-transport deposits is hummocky with flow structures, arcuate pressure ridges, and rafted blocks. Smaller debris lobes close to the landslide sidewalls are the result of secondary, marginal failures. At the outer rim of the extensive mass-transport deposits, numerous rafted blocks rise from the semi-transparent sediment unit, and tower hundreds of meters to 450 m above the surrounding debris. The maximum remobilized volume from the slide scar area, estimated from pre-landslide bathymetric reconstruction, is in the order of 1350 km3. The headwall heights, the ratio of excavated volume and slide scar area, and the height of the rafted blocks are large compared to other landslides documented on siliciclastic margins. The

position, thickness, and shape of the mass-transport deposits illustrate the high mobility of sediments involved in submarine landsliding. Their dimensions require numerical modeling to understand landslide dynamics and the potential to generate tsunamis. In the simulations of the sediments dynamics, large blocks are rafted by a loose debris flow derived from the disintegrating landslide material in the headwall area. The main failure process completes after approximately 1 hour. The upper slide scar is probably not the source area for the large rafted blocks. The Hinlopen-Yermak landslide most likely created a significant tsunami, considering that remobilized sediment volume, initial acceleration, maximum velocity, and possible retrogressive development govern landslide-generated tsunamis. Steep waves implying dispersive and non-linear effects probably were more pronounced than for most other tsunamis induced by submarine landslides because of the combination of high speed and the substantial thickness of the mass transport. Propagation and coastal impact of the tsunami is simulated by a weakly non-linear and dispersive Boussinesq model. Close to the landslide area, the simulations return sea-surface elevations exceeding 130 m, whereas sea-surface elevations along the coasts of Svalbard and Greenland are in the order of tens of meters.