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Small-scale mass wasting on the continental slope offshore Lofoten, northern Norway

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Swath bathymetry and side-scan sonar data, co-registered with high-resolution seismic records, from the continental slope off the Lofoten Islands, northern Norway, reveal evidence of repetitive small-scale mass wasting in water depths between 500 and 2500 m.

Based on a morphological analysis of the sediment evacuation area, various styles of failure have been identified: i) the first type forms an up to 4.7 km wide and 100 m deep slide scar, with relatively steep headwalls and sidewalls (up to 32 degrees). Run out distance is long and extends beyond the western limit of the surveyed area. This morphology is similar to other large slide scars along the Norwegian-Barents-Svalbard margin. ii) Stair-case pattern of secondary escarpments form a second type of morphology. These are found over a distance of up to 10 km from the headwall. Head scarps and secondary scarps have a height of up to 30 and 50 m, respectively, and are most likely indicative of a retrogressive landslide development. iii) A third type of mass movement processes is more subtle, as it is only identified from the side-scan sonar data, but cannot be discerned from the swath bathymetry data. This type is characterized by an along-slope fabric of smaller escarpments, delineating 10 – 15 m thick failing sediment blocks or slabs with variable dimensions. These zones with sediment slabs can be up to several hundreds of meters wide and are sharply delineated by shear margins or escarpments. There is evidence of different stages of development of the sediment slabs.

For all the instabilities identified, the basal zone of deformation runs parallel to the undisturbed sea floor nearby. This indicates the presence of a slip plane or “weak layer” which may have been the depth where the initial deformation and flow of sediments took place. In our study area, these “weak layers” occur at varying stratigraphic depths, the shallowest (type iii), only a few meters beneath the sea floor, the deepest (type i) approximately 100 m beneath the sea floor.

It is inferred that these different types of mass wasting originated from asynchronous slide events because of differences in the amount of draped/infilled sediments.