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# Post-glacial sediment instabilities in Hardangerfjorden, Western Norway

Benjamin Bellwald (1,*), Berit O. Hjelstuen (1), Hans Petter Sejrup (1), and Haflidi Haflidason (1)

(1) Department of Earth Science, University of Bergen, Allégaten 41, N-5007 Bergen, (*) Correspondence: Benjamin Bellwald, benjamin.bellwald@geo.uib.no

Submarine mass movements are significant processes in fjord environments and a severe geohazard to infrastructures and populations along fjord coastlines. This study focuses on the 160 km-long Hardangerfjorden system, of which the inner 65 km of the fjord represents the main survey area. With a width varying between 1-10 km and a maximal water depth of 860 m, Hardangerfjorden is deeply cutting into Precambrian rocks. The fjord system was, furthermore, completely covered by ice during the Last Glacial Maximum, and its catchment area is still partly glaciated today by the Folgefonna and Hardangerjøkulen ice caps. The goal of this study is to better understand the triggering mechanisms of slides and turbidity currents within this fjord system. It further aims to reveal new knowledge about mass movement frequencies for the time period since the last glacial. Therefore, to address these questions, we combine TOPAS seismic profiles and densely gridded multibeam data with up to 20 m long sediment cores.

In the study area, the general flat fjord bottom rises with a gradient of c. 1° from 860 m to 210 m landwards and is flanked by up to 79° steep sides. The fjord seabed is further cut by several c. 15 m high slide escarpments. Slide escarpments of the same height as those observed at the fjord seabed are also identified along the fjord flanks which have gradients of c. 10°. The sediments deposited in the fjord basins are characterized by acoustically well-laminated glacimarine/hemipelagic units that are interfingered by several acoustically transparent lenses, interpreted to be slide debrites. These slide debrites are commonly deposited along high-reflective seismic stratigraphic horizons and can be linked to the observed slide scars. The different mass movement deposits make up a significant amount of the total sediment package in the fjord. Seismic profiles revealed 8 large slide debrites, up to 16 m in thickness for the uppermost 80 m of the sediment package that is deposited in the deepest part of the fjord, whereas in the innermost part of Hardangerfjorden these slide debrites are characterized by up to 12 m thick wedges that are pinching out over short distances.

We note that the observed seabed slide escarpments in the inner part of the Hardangerfjorden are associated with up to 0.6 km2 cone-shaped depocenters of higher sediment flux from the fjord flanks. Processes involved in the build-up of these rapidly deposited depocenters may thereby have acted as potential triggering mechanisms for slides and turbidity currents moving towards the deeper parts of the fjord. Beside sediment mobilization caused by other mass movements or higher sedimentation rates, geomorphology (sills, hanging fjords, slope gradients), climate (floods, glacial outburst, snow avalanches), tectonics (earthquakes, uplift) as well as gas release may also have the potential for slope instability in the Hardangerfjorden system.