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Sediment budget in a recently glaciated western Norwegian fjord

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Western Norwegian fjord-valley systems represent archives of changes in sedimentary processes, and typically exhibit a pronounced change in depositional environment related to the transition from glacial to interglacial conditions. During a glacial situation, the fjord-valley system is emptied of its sediments, indicating that most sediments present in the fjord today, was deposited during and after the retreat of the last deglaciation. The purpose of our investigations is to gain a better understanding of the volumes and frequencies of mass transport deposits (subaquatic mass movements such as mass flows, debris flows, slides, slumps, and turbidites) in a recently glaciated fjord-valley system since the deglaciation (approx. 11 700 years BP) by looking at Fjærlandsfjorden, a tributary fjord of Sognefjorden in western Norway. The fjord-valley system consists of steep hillslopes and deep fjord basins with reliefs of up to 1600 meters. Jostedalsglaciar, the largest glacier on mainland Europe (ca. 473 km²), currently feeds into the catchment of the fjord basin.

Here we present results from a cruise with R/V G.O. Sars in 2018, where sediment cores, TOPAS seismic profiles and bathymetric data were collected from Fjærlandsfjorden. The integration of high-resolution seismic (<30 cm vertical resolution) and bathymetry (3-5 m resolution) allows us to estimate the total volume of sediments within a fjord setting. By revealing when and how the sediments are deposited, we can establish sedimentation rates with a high spatial and temporal resolution within the fjord basin. X-ray Computed Tomography (CT-scanning) has been particularly useful to characterize sedimentary deposits as it allows for 3D visualization and analysis with ultra-high-resolution (50 µm voxel size) allowing us to see individual silt-sized grains in the sediment cores.

Seismic data reveal that the Fjærlandsfjorden basin infill consists of basal till, overlain by a thick, acoustically well-laminated glacial marine unit (up to a maximum thickness of ~105 meters thickness), occasionally disrupted by acoustically transparent lenses interpreted to be mass transport deposits (rock avalanches and debris flows). A 2-3 m thick hemipelagic unit drapes the glacial marine unit. Results reveal that ~90 % of the total sediment volume within the fjord basins was deposited as meltwater plumes during the retreat (mainly calving along the fjord) of the margin of the last glacial ice sheet. The retreat began at the mouth of Sognefjorden at the termination of the Younger Dryas Chronozone around 11 700 cal. yrs BP, to a frontal position at the head of Fjærlandsfjorden around 10 700 cal. yrs BP. The remaining volume of sediments are divided into mass transport deposits (MTDs) such as avalanches, debris flows, and flood-related

turbidites as well as hemipelagic sedimentation. The largest MTD is a massive rock avalanche measuring up to 5 million m³ that most likely caused a large tsunami when it occurred.