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Modern and Little Ice Age sediment accumulation rates in fjords of Svalbard

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Fjords are unique estuaries that have been known to act as efficient sediment traps. The fjords of Svalbard are of subpolar type and are characterised by a modern sediment accumulation rate that is usually in range of 0.5 mm to 1 cm y^{-1}. In the recent past the Svalbard region experienced Little Ice Age (LIA) cooling and post-LIA, 20th century warming. The LIA cooling was probably the interval with the coldest climate of the entire Holocene. The objective of the present study was to determine if these climatic changes were reflected in changes of sediment accumulation rates in fjords.

Two settings were studied in detail, the first supplied mostly with sediments from meltwater rivers (central Billefjorden) and the second affected directly by tidewater glaciers during LIA and combination of sources in post-LIA period (inner and central Hornsund). The sediment accumulation rates were reconstructed by applying ^{210}Pb, ^{137}Cs and AMS^{14}C datings.

The Billefjorden (details in Szczuciński et al. 2009) is characterised by modern sediment accumulation rate decreasing from more than 0.39 cm y^{-1} at the fjord head to 0.08 cm y^{-1}close to the fjord mouth. However, during the LIA the sediments accumulated at a much lower rate of 0.02 cm y^{-1} in the central fjord basin. In Hornsund, a rapid advance of tidewater glaciers at the beginning of LIA resulted in accumulation rates of over 10 cm y^{-1}. The sediment accumulation rates during the most of LIA was lower than 1 mm y^{-1}, and post-LIA rates increased again to around 0.25 to 0.7 cm y^{-1}.

The differences in accumulation rates between LIA and post-LIA periods are most likely related to the rapid retreat of glaciers during the 20th century, when most of them withdrew up to several km. The post-LIA increases in temperature and a negative glacier mass balance resulted in a larger meltwater discharge transferring substantial amounts of sediments released from the glaciers, as well as those eroded from previously stored unconsolidated glacial sediments. The rapid accumulation at the beginning of LIA in settings directly affected by advancing tidewater glaciers is likely caused by decreasing distance to the sediment source and massive redeposition of fjord sediments by advancing glaciers.

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Szczuciński W., Zajączkowski M., Scholten J., 2009. Sediment accumulation rates in subpolar fjords - impact of post-Little Ice Age glaciers retreat, Billefjorden, Svalbard. Estuarine, Coastal and Shelf Science 85(3): 345-356.