



Contemporary suspended sediment fluxes and accumulation processes in the small proglacial Sætrevatnet sub-catchment, Bødalen, Western Norway

S. Liermann and A. A. Beylich

Geological Survey of Norway (NGU), Trondheim, Norway (susan.liermann@ngu.no)

A combination of different process monitoring, lake sediment coring and sediment analysis methods and techniques were applied in order (i) to ascertain the hydro-meteorological controls of runoff generation, suspended sediment transport and sediment accumulation on the delta and in Lake Sætrevatnet and (ii) to define the role of the small proglacial lake Sætrevatnet within the basin-wide catchment routing system of the Bødalen valley-fjord system (Nordfjord area, western Norway). Within the Bødalen valley investigations of sediment transfer and sediment accumulation processes were focused on the small proglacial Sætrevatnet area in upper Bødalen.

The proglacial Sætrevatnet valley segment shows the characteristic seasonal weather-depended runoff variation for glacierized drainage basins. Suspended sediment concentration varied closely related to water discharge. Hence, significant suspended sediment transport is associated to high runoff conditions during thermally induced summer glacier melt (when 61.9% of the annual suspended sediment yield was recorded in 2010) as well as to single extreme rainfall events (19.8% of the annual suspended sediment yield was recorded during a single extreme rainfall event in 2010). Solar radiation and the magnitude and frequency of extreme rainfall events were found to be crucial for the rate of sediment transport within the Sætrevatnet sub-catchment. Altogether, the annual suspended sediment yield is with 24.2 t km⁻² notable lower as compared to other glacierized basins worldwide.

Delta accumulation rates at the inlet of Lake Sætrevatnet of 4 cm yr⁻¹ in 2009 and 3.5 cm yr⁻¹ in 2010 as well as a mean annual delta advance of about 3 - 4 m as calculated from comparisons of aerial photographs point to an ongoing and rapid sediment infill of the Sætrevatnet valley basin. Lacustrine sediment sequence analysis and 210-Pb and 137-Cs dating of samples taken from the Lake Sætrevatnet confirm high annual accumulation rates. Based on a basic CSR model (with the assumption of a constant rate of 210-Pb supply) and additionally validated by 137-Cs activity an annual lake sedimentation rate of 1.7cm was calculated. Both the low suspended sediment yields and the high accumulation rates emphasize the importance of bedload and nearly to the channel beds transported sediments for the Sætrevatnet lake system.

As a result, Lake Sætrevatnet currently traps about 80-85 % of the sediments delivered from the upstream located glacial and proglacial system highlighting the importance of small ephemeral lakes within larger valley-fjord sediment routing systems.

As a next step the potential yearly pattern of laminations (varves) is discussed in association with the calculated sedimentation rates within the Sætrevatnet valley segment.

ITRAX (XRF) analysis, magnetic susceptibility measurements and the interpretation of the potential varve/lamination thickness and composition enable the identification of different sedimentary processes and related discharge mechanisms within the Sætrevatnet sub-catchment. Rhythmites are tentatively associated to regional meteorological variables (temperature; precipitation, e.g. heavy rainfall events). Analysis of grain size composition, density and carbon (TOC, inorganic carbon using LECO) are carried out to characterize the laminated structure and to identify possible sediment sources.