



Recent terminal moraine formation at Jostedalsbreen, South Norway, and its palaeoclimatic implication

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Due to the dominating trend of retreat at the majority of mountain glaciers worldwide, there have been only few potential opportunities to study recent terminal moraine formation at temperate (warm-based) mountain glaciers. A number of outlets of the Jostedalsbreen ice cap, South Norway, have been studied during the past 20 years. Those experienced the formation of terminal moraine formation during the 1990s when they underwent a frontal advance, followed by a period of stationary frontal positions. Detailed observations during the actual moraine formation, alongside morphological and sedimentological data are presented to reveal some insights into the processes and mechanisms involved in this recent moraine formation.

The interpretation of terminal moraines for their information about related frontal dynamics in connection with the investigation of Holocene glacier chronologies requires detailed knowledge about the predominating processes of moraine formation. Major aim of this study of recent processes of moraine formation was, therefore, to improve this interpretation. In particular, it should be tested whether there is any detectable relationship between magnitude/duration of frontal advances and moraine morphology.

At all glaciers, bulldozing was clearly confirmed as dominating process of moraine formation creating push moraines sensu Benn & Evans. Sediment characteristics of the sediment in the glacier foreland proximal to the recent terminal moraines were similar to those of the moraine ridges itself and the distal area. The sedimentological properties of the proglacial sediment are, in combination with the dynamics of the glacier front, responsible for the morphology and size of the recent terminal moraines. Seasonal advances of up to 30 m during the 1990s lead to moraine formation similar to that of the overall multi-year advance. Where the glacier front of these outlets rested on bedrock during the advance, no moraine formation took place. Limited oscillation around the culmination of the recent advance around the year 2000 caused partly multi-ridged moraine systems.

Because the mode(s) of recent terminal formation presented are considered as representative examples for moraine formation during the "Little Ice Age", specific care has to be taken if moraine morphology is interpreted related to glacier chronologies. Moraines formed by seasonal advances during stationary or even slowly retreating periods could well produce frontal moraines indistinguishable from those formed at the culmination of multi-year advances. The dimension of terminal moraines as described here is, furthermore, not simple related to duration and magnitude of glacier advances.