Geophysical Research Abstracts
Vol. 17, EGU2015-1483, 2015
EGU General Assembly 2015
© Author(s) 2014. CC Attribution 3.0 License.

Investigating age and origin of ice-cored moraines in Jotunheimen and Breheimen/Southern Norway

Stefan Winkler (1), John Matthews (2), and Peter Wilson ()

(1) University of Canterbury, Department of Geological Sciences, Christchurch, New Zealand (stefan.winkler@canterbury.ac.nz, +64 (0)3 364 2769), (2) Swansea University, Department of Geography, Swansea, Wales, U.K., (3) University of Ulster, Environmental Sciences Research Institute, Coleraine, Northern Ireland, U.K.

Ice-cored moraines characteristic for the high-alpine zones in the Jotunheimen and Breheimen mountain regions of southern Norway have been recognised, described, and studied as early as during the 1950s and 1960s. These complex multiple-ridged, ramp-like moraines of up to 50 m in height occurring at comparatively small but high-lying glaciers differ considerably from those typical for the other glaciers at lower altitudes. The existence of their ice-core beneath rather thin debris cover and a spatial concentration in the north-eastern part of the regions with a higher snow line and stronger climatic continentality points towards their link with alpine permafrost.

Until today, there is no consensus about either the mechanisms of their formation or their age constraints. Based on few (possibly less reliable) radiocarbon ages retrieved from dust within the ice cores the innermost (proximal) ridges were, for example, interpreted as rather old and the outermost ridges as youngest. Consequently, the innermost ridges need to have survived successive overriding during more extensive glacier advances. Alternatively, these ice-cored moraines have also been interpreted as initial rock glaciers and the younger ages of the outer ridges explained by 'pressing-out' of material from the base of the moraine by its own weight and gravity. Other theories developed include also a mixture of traditional push moraine processes and deformation structures caused by the glacier advancing in a permafrost environment ('push-deformation moraine').

Because reliable age constraints for individual ridges of those complex ice-cored moraine complexes are crucial for any interpretation of their mode of formation, this study aims to provide insights into their age and origin by applying high-precision Schmidt-hammer exposure-age dating (SHD). Local SHD calibration curves using moraine ridges dating from the last 50 years to the Preboreal (c. 9700 years ago) have been used to give age estimates for individual ridges of three selected ice-core moraine complexes in Jotunheimen and Breheimen. The results ranged from c. 3900 years to modern age at Gråsubreen, c. 400 to 250 years at Vesle Juvbreen and 2250 to 1600 years at Østre Tundradalskyrkjabre. The R-value distributions were often negatively skewed and interpreted as related to weathered boulders from reworked surfaces, hence all moraine ages obtained need to be seen as maximum age estimates.

The abovementioned theory that the inner proximal moraine ridges are the oldest and overridden several times can, however, be rejected on basis of the SHD results alongside the theory of these moraines being rock glaciers. Instead, the ice-cored moraine complexes are considered to be glaciotectonic structures produced by the interaction of polythermal glaciers and permafrost during the late Holocene. All the individual ridges were essentially formed over the 'Little Ice Age' glacier advance from material deposited earlier during multiple Neoglacial events. The considerable size of the moraine complexes is attributed to the accumulation of material from these different events over a long period of time and their survival during periods of glacier retreat when the ice cores did not melt and paraglacial activity remained ineffective in the periglacial environment.