Abstract:

Moraines are often used to reconstruct the extent and chronology of past glaciations. A common method to estimate the timing of their formation is cosmogenic nuclide exposure dating. However, the accuracy of the method is often affected by post-depositional processes and signal inheritance from prior exposure.

This thesis aims to evaluate the controls on moraine denudation and preservation and derive implications for the reliability of exposure dating. A global dataset of 10083 samples dated with ^{10}Be was compiled and grouped into 3243 moraine ridge groups (1620 suitable for the analysis with ≥ 3 samples). Clustering of moraine ages, used an indicator of dating quality, was compared to climate, topography, ice mass type, or sample size.

Only 23 % of analysed moraines showed well-clustered exposure ages, increasing to 46 % after removing outliers. The highest proportion of well-clustered ages was observed for moraines between 10 to 15 ka and significantly decreased for older and younger moraines. The well-clustered moraines were also more frequent in milder climates with higher temperatures and precipitation and lower annual temperature ranges. Nevertheless, the findings highlight the importance of considering also glacial dynamics. Poorly clustered regions (the Antarctic Ice Sheet, mountain glaciers, icefields and icecaps in Greenland, northeastern Asia, and High Asia) are likely affected by the extreme climate conditions and their complex glacial histories.

A key implication for sampling strategies is the effect of sample size. While 36 % of the examined moraines comprised only three samples per moraine, sampling at least four boulders significantly increases the likelihood of obtaining a well-clustered age by approximately 20 %.

Keywords: moraines, cosmogenic isotope ^{10}Be, denudation, Pleistocene