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Dating of Holocene lateral moraines in the western Southern Alps, New Zealand, applying Schmidt-hammer exposure-age dating (SHD)

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Research on Holocene mountain glacier chronologies has recently intensified due to the importance of mountain glaciers as key indicators for past and present climate change. This progress is closely connected with major improvements in modern dating techniques and the application of multi-proxy approaches adapted to specific local/regional conditions. Despite recent progress there is, however, still a need for better spatial differentiation and a lack of generally accepted concepts for global and inter-hemispheric correlation of Holocene glacier chronologies. Furthermore, the "geomorphological uncertainty" inevitably connected with numerical dating of moraines in neotectonic active mountain ranges characterised by highly dynamic geomorphological process systems requires careful consideration of any subsequent palaeoclimatic interpretation. During the past few years Schmidt-hammer exposure-age dating (SHD) has revealed its potential to successfully challenge those specific circumstances.

The Southern Alps of New Zealand have provided one of only a few suitable study sites for investigating Holocene glacier chronologies in the mid-latitudinal Southern Hemisphere. Recent years have seen a significant increase in terrestrial cosmogenic nuclide dating (TCND)-ages published for the Southern Alps, mainly for the last Glaciation, but also for the Holocene. The availability of a regional 10Be-production curve has improved the calibration of TCND-ages. These studies applying TCND alongside previous chronological studies using a variety of different dating techniques focus, however, primarily on a few selected glacier forelands east of the Main Divide in Aoraki/Mt Cook National Park. Bad accessibility and methodological problems account for comparatively few investigations on glacier forelands west of the Main Divide.

Chronological studies applying Schmidt-hammer exposure-age dating (SHD) were performed on six glacier forelands in the western part of the Southern Alps/New Zealand. Although lithological heterogeneity prevented a regional age-calibration curve to be established, local age-calibration curves for La Perouse and Strauchon Glaciers could be derived. They show similar linear equations and trends/slopes, and enabled a preliminary assessment of the representativeness of individual 10Be TCND-ages obtained from the other forelands. No mid- and early-Holocene advance periods were detected. Clusters of moraine ages date around 2800, 1850 – 1450, and 1100 – 900 years ago, followed by the Little Ice Age (LIA) commencing c. 500 years ago. There is no good agreement with earlier radiocarbon-based studies in the western part of the Southern Alps, as well as with recently published TCND-chronologies from glacier forelands east of The Main Divide. This at least partly could be the result of different approaches to the palaeoclimatic interpretation of the dated samples rather than of spatial differentiation.

The results obtained from this recent study do not support an elsewhere proposed general asynchronous glacier behaviour between the mid-latitudinal northern and southern hemispheres. They also show that due to the specific environmental conditions in the Southern Alps, more investigations are needed before a "regional" Holocene glacier chronology robust enough to allow reliable intra-hemispheric and global correlations can be undertaken.