EGU2020-1482
https://doi.org/10.5194/egusphere-egu2020-1482
EGU General Assembly 2020

Potential of detailed geomorphological mapping for the study of Holocene glacier chronologies: Mueller Glacier, Southern Alps/New Zealand

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The investigation of Holocene glacier chronologies has been recognised as a key element of research on mountain glaciations in the light of current global change. They can be utilised as high-resolution palaeoclimatic archives for the immediate and more distant geological past. During the past few decades considerable progress has been achieved, in particular due to substantial improvements of the ability to accurately date glacial landforms such as terminal moraines essential for reconstructing past glacier margins and subsequent analysis in the context of glacier advance/retreat periods. The Southern Alps of New Zealand are among the few suitable study sites for the investigation of Holocene glacier chronologies in the mid-latitudinal Southern Hemisphere that consequently have drawn attention.

Since early studies of Holocene glacier chronologies in the mid-20th century, mapping of the investigated glacier forelands has been an integrated part of almost all scientific approaches regardless of the individual dating methods that may have been applied. These mapping attempts serve the identification and positioning of certain glacial or glaciofluvial landforms subsequently allowing the reconstruction of former glacier margins. They frequently also provide information about the location of sample sites for the various dating techniques applied. If detailed geomorphological mapping schemes are in use, such maps additionally support the interpretation of any chronological data by identifying the genetic origin of any landform investigated, thus enabling to link the latter to different dynamic stages of the glacier. Additionally, such maps may highlight related uncertainties such as postdepositional disturbance or potentially unclear morphodynamic relationships to the glacier's behaviour.

Reviewing recent publications it seems, however, that some appraisal of such detailed geomorphological mapping is often traded-off against the impressive progress with up-to-date dating techniques and high-resolution digital elevation models or satellite/aerial imagery. Unfortunately, the latter do neither qualify as geomorphological maps *per se* or fully serve the abovementioned purposes. The widespread applied common GIS software has, furthermore, limitations with respect to its graphic capabilities and unintentionally entails negligence of established and well-suited signatures or mapping schemes.

A detailed geomorphological map of the glacier foreland of Mueller Glacier, Southern Alps/New

Zealand is presented as a case study. It follows an established geomorphological mapping scheme ("GMK 25") that has been adequately modified to fit both purpose and selected scale. Despite several glacier chronological studies have been conducted on this glacier foreland and the site is considered as a regional key site for related research, this map constitutes the first of its kind. The detailed geomorphological map is utilised to assess discrepancies among existing chronologies by reviewing the morphometric properties and genetic origin of those landforms that have been dated. It reveals that potential postdepositional modification of some landforms investigated had not been appropriately considered with certain previous studies. As a result, the evidence of few glacier advances needs to be classified as weak.

Summarising, detailed geomorphological mapping is still essential for the study of Holocene glacier chronologies and should not lose its prominent position or even disappear.