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Potential improvement of Schmidt-hammer exposure-age dating (SHD) of moraines in the Southern Alps, New Zealand, by application of the new electronic Schmidt-hammer (SilverSchmidt)

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The Southern Alps of New Zealand are among the few key study sites for investigating Holocene glacier chronologies in the mid-latitudinal Southern Hemisphere. Their characteristic highly dynamic geomorphological process systems prove, however, to be a considerable challenge for all attempts to date and palaeoclimatologically interpret the existing Holocene moraines record. As a multi-proxy approach combining 10Be terrestrial cosmogenic nuclide dating (TCND) with Schmidt-hammer testing, the recently developed Schmidt-hammer exposure-age dating (SHD) has already shown its potential in this study area (cf. Winkler 2005, 2009, 2013).

An electronic Schmidt-hammer (named SilverSchmidt) was introduced by the manufacturer of the original mechanical Schmidt-hammer (Proceq SA) a few years ago. It offers, in particular, facilities for much easier data processing and constitutes a major improvement and potential replacement for the mechanical Schmidt-hammer. However, its different approach to the measurement of surface hardness – based on Q-(velocity) values instead of R-(rebound) values – is a potential drawback. This difference effectively means that measurements from the two instruments are not easily interconvertible and, hence, that the instruments cannot be used interchangeably without previous comparative tests of both instruments under field conditions.

Both instruments used in this comparative study were N-type models with identical impact energy of 2.207 Nm for the plunger. To compare both instruments and explore interconvertibility, parallel measurements were performed on a selected number of boulders (10 boulders per site with 5 impacts each, at least 2 sites per moraine) on moraines of homogeneous lithology but different established ages covering the entire Holocene and the Late Glacial. All moraines are located east of the Main Divide of the Southern Alps at Mueller Glacier, Tasman Glacier, and in the outer Tasman River Valley. All paired samples (n = 50) were collected so that the plunger impacts of both instruments were set close together on the rock surface (to avoid any influence of modifications to the surface by consecutive impacts on the same spot). In order to test their performance at the higher and lower end of surface hardness, similar paired sample tests were also made on the full-metal test anvil.

The results of paired samples for all sites/moraines reveal that Q-/R-value pairs are closely clustered for young surfaces but more scattered for the older ones with a corresponding moderate R2 for a calculated linear trend. The greater variability of the older, weathered surfaces with greater scatter and hence higher standard deviations and broader confidence intervals has been recognised in numerous previous Schmidt-hammer studies and is elated to the effects of micro-scale lithological variability, which becomes a more pronounced influence with time exposed to subaerial weathering. But most important, Q-values and R-values are closely related and Q-values are systematically higher than R-values by c. 10 – 12 units over most of the operational range of both instruments. Linear conversion equations indicate a conversion factor in the order of + 11 units is applicable when converting R-values to Q-values. These estimates agree well with data obtained on the standard test anvil.

Given the apparent interconvertibility of the two instruments, the SilverSchmidt is regarded as a potential replacement for the mechanical Schmidt hammer. This enables, moreover, continuity in study areas with existing R-value data archives. However, when comparing data sets of different age, adjustments must be made for any changes to the instrumental calibration value over time.

References:

Winkler, S. (2005): The 'Schmidt hammer' as a relative-age dating technique: potential and limitations of its application on Holocene moraines in Mt Cook National Park, Southern Alps, New Zealand. New Zealand Journal of Geology and Geophysics 48, 105 – 116.

Winkler, S. (2009): First attempt to combine terrestrial cosmogenic nuclide (10Be) and Schmidt hammer relative-age dating: Strauchon Glacier, Southern Alps, New Zealand. Central European Journal of Geosciences 1, 274 – 290.

Winkler, S. (2013): Investigation of late-Holocene moraines in the western Southern Alps, New Zealand, applying Schmidt-hammer exposure-age dating (SHD). The Holocene (online), doi: 10.1177/0959683613512169.