

## **First attempt to study rock glaciers in New Zealand using the Schmidt-hammer – framework and preliminary results**

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Although not uncommon within the dryer eastern parts of the Southern Alps, New Zealand, comparatively few previous studies have previously focused on rock glacier dynamics and spatial distribution. Neither investigations of their chronological constraints nor any studies on actual rock glacier velocities have yet been carried out. Rock glaciers and periglacial processes still largely constitute a largely unexplored albeit potentially valuable field of research in the Southern Alps.

The high-altitude valley head of Irishman Stream in the Ben Ohau Range between Lakes Ohau and Pukaki, roughly 30 km southeast of the Main Divide, contains a few morphologically intact rock glaciers and some appear to be active features (Sattler et al. 2016). Previous work focusing on the Late-glacial and early Holocene moraines in the valley head below the rock glaciers (Kaplan et al. 2010) provided  $^{10}\text{Be}$ -ages that could be utilised as fixed points for SHD (Schmidt-hammer exposure-age dating). Apart from detailed Schmidt-hammer sampling on the Late-glacial and early Holocene moraines, two altitudinal transects from the toe to their apex have been measured in detail on selected rock glaciers. On each of the multiple ridges of the rock glacier surface three sites of 50 boulders have been sampled with one impact each by the hammer (an N-type electronic SilverSchmidt by Proceq). Apart from getting some age constraints of these periglacial features in comparison to the well-dated moraines, the Schmidt-hammer measurements also had the aim to provide some insight into their genetic development resulting in a quite complex morphology of the rock glaciers and partial interaction with some of the moraines.

Both altitudinal transects reveal a clear and continuous trend of increasing means (i.e. less weathered/younger exposure ages) towards their apex. The values for the individual ridges show, however, a transitional character with adjacent ridges albeit the abovementioned trend not statistically significant different in age, a phenomena known from similar studies on rock glaciers elsewhere. Already during sampling it became obvious that with increasing altitude and decreasing distance to the valley headwall the percentage of freshly appearing boulders vs. weathered boulders with a distinct micro-relief is getting higher. The means of the lowermost ridges of the rock glaciers show, however, no significant difference to the early Holocene moraines dated to c. 11.5  $^{10}\text{Be}$  ka ago. This may indicate that rock glacier formation initiated shortly after Termination 1 during the early Holocene and partly overrode some parts of the early Holocene moraines.

During the field work, a network of 46 differential GPS points has been established to start future monitoring of any potential rock glacier movement. It will allow exploring the climatological control on rock glacier behaviour in in the Southern Alps, as well as comparisons with current velocities measured in the European Alps.

### References:

Kaplan, M.R., Schaefer, J., Denton, G.H., Barrell, D.J.A., Chinn, T.J.H., Putnam, A.E., Anderson, B.G., Finkel, R.C., Schwartz, R. & Doughty, A.M. (2010): Glacier retreat in New Zealand during the Younger DryasStadial. *Nature* 467, 194-197.

Sattler, K., Anderson, B., Mackintosh, A., Norton, K., de Róiste, M. (2016): Estimating permafrost distribution in the maritime SouthernAlps, New Zealand, based on climatic conditions at rock glacier sites. *Frontiers in Earth Science - Section Cryospheric Sciences*. doi: 10.3389/feart.2016.00004.

