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The use of the Schmidt-hammer for dating paraglacial and glacial landforms in central Austria

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The Schmidt-hammer is a portable instrument traditionally used for concrete stability testing by recording a rebound value (R-value) of a spring loaded bolt impacting a surface. This R-value is proportional to the compressive strength of the rock surface and gives a relative measure of the surface hardness. High R-values are indicative of a lower age and low R-values indicate a higher age. In this study, the Schmidt-hammer method was applied at different landforms at two study areas in Austria, at the Schöderkogel-Eisenhut area, Schladminger Mountains (12°02'E, 46°15'N; SA1) and at the Valentin Valley-Eiskar area in the Carnic Alps (12°54'E, 46°37'N; SA2). SA1 is dominated by mica schist whereas SA2 by different types of carbonatic rocks. At SA1, five relict rock glaciers and adjacent landforms (one Lateglacial moraine and deposits of a recent rock fall event) were studied. On each of the five rock glaciers, four to six locations close to the central flow line between the frontal ridge and the rooting zone were measured. At SA2, one rock glacier like landform, one moraine ridge dating from the Little Ice Age (LIA) in front of the Eiskar Glacier, supraglacial deposits of the same glacier and adjacent landforms (one Lateglacial moraine and deposits of a recent rock fall event) were examined. The results at SA1 show comparable results at all five rock glaciers with lowest values at the front and statistically significant higher values at the rooting zone. The difference between the highest and lowest mean R-value at study site 1 is 21.2 (24.4 vs. 45.6.). The differences between the highest and the lowest mean R-value at each of the five rock glaciers are 13.1 at the Gamskar Rock Glacier (28.1 vs. 41.2), 14.1 at the Eisenhut Rock Glacier (26.0 vs. 40.1), 13.6 at the Sulzkogel Rock Glacier (32.0 vs. 45.6), 15.2 at the Breitdach Rock Glacier (26.1 vs. 41.3) and 9.9 at the Schöderkogel Rock Glacier (24.4 vs. 34.3) indicating long formation periods if compared to other studies at comparable lithologies. Results from the SA2 show a total R-value range of between 36.4 and 51.1. The differences between the mean R-values of landforms of substantial different ages in the Valentin Valley (a rock glacier like landform: 36.4, a Lateglacial moraine: 39.1, and a recent rock fall deposit: 40.0) are only small (3.6). By contrast, the mean R-values in the Eiskar area are between 32.5 and 51.1. The R-values from the three sites on the LIA moraine reveal similar results (35.5 to 38.4) whereas the difference between the highest and lowest mean R-value on the adjacent supraglacial deposit of the Eiskar Glacier is 18.6 (51.1 vs. 32.5). Presumably, small differences in the structure of the carbonatic bedrock in the headwall of the Eiskar area explain the huge differences in the R-values of sites in identical topographic settings. The small mean R-value difference of substantially different old landforms in the Valentin Valley might also be explained by small differences in the carbonatic bedrock. By contrast, the results from the five rock glaciers in the SA1 with a much more homogeneous lithology strongly confirm the usability of the Schmidt-hammer method on rock glacier surfaces. Converting the relative ages to absolute ages is a more difficult task. The comparison of the results from the two SA highlights the importance of homogeneity of the studied bedrock when using the Schmidt-hammer as a relative age dating method.