ICG2022-59, updated on 28 May 2023
https://doi.org/10.5194/icg2022-59
10th International Conference on Geomorphology

The use of Schmidt-hammer for relative-age dating of glacial, periglacial and paraglacial deposits in NW Spain

Javier Santos-González, Rosa Blanca González-Gutiérrez, Amelia Gómez-Villar, José María Redondo-Vega, Sergio Alberto Peña-Pérez, Adrián Melón-Nava, and Alfonso Pisabarro-Pérez
Department of Geography and Geology, Universidad de León. Campus de Vegazana, s/n, 24071 León (Spain)
(jsango@unileon.es)

The Schmidt-hammer has been used in Geomorphology for the last decades. The effectiveness of the method has been proven by several authors, but some limitations also exists. In this work, this procedure has been tested in glacial and periglacial landforms in five different massifs in the province of León (northwestern Spain): Vizcodillo, Arcos del Agua, Muxivén, San Isidro and Peña Pieta. Tested landforms include moraines, rock glaciers, polished outcrops, talus slopes, blockfields and a debris avalanche. Quartzite has been widely used for this purpose, but granodiorite, shales and sandstones have also been tested. Results show that Schmidt-hammer data generally agree with geomorphological reconstructions. They also show strong correlation with cosmic-ray exposure ages where they exist. Rebound values are high, ranging from ≈70-72 in the oldest landforms (last glacial stage) to ≈77-80 in the most recent ones, with small differences within massifs.
In Vizcodillo, four glacial stages have been clearly differentiated since the last local glacial maximum. In Arcos del Agua, periglacial deposits show two different stages of rock glaciers generation and a progressively younger age for different talus slopes related to deglaciation. At both sites, the blockfields are younger than rock glaciers. In Muxivén, Schmidt-hammer data agree with the cosmic-ray exposure dating results, indicating that most of the postglacial deposits were generated due to rapid deglaciation during the Bølling-Allerød period. In San Isidro, the results show two possible stages for rock glaciers. In Peña Prieta, different glacial and periglacial deposits were tested, but poor results were obtained.
Relevant differences have been observed depending on the lithology. The mean coefficient of variation in the rebound values of the boulders was 3.1% in Arcos del Agua (quartzite), 3.5% in Vizcodillo (quartzite), 3.8% in Muxivén (quartzite), 4.7% in San Isidro (quartzite sandstones), but 9.9% in Peña Prieta (granodiorite). The differences between boulders of the same landform were also clearly greater in Peña Prieta than in the other massifs, with the quarzitic areas showing the most robust results. Although it has been used in previous works with good results, in this study granodiorite presented a significant dispersion in the rebound values of the boulders, due to the fact that its internal composition is coarse-grained and presents grains with different resistance. Shales could not be correctly tested because they offered great dispersion in the data. The results addressed the importance of selecting suitable and comparable areas on boulder surfaces for Schmidt-hammer impacts, with resistant and homogeneous lithology showing better results. Conversely, areas with high lithological heterogeneity or coarse-grained boulders may not to be suitable for the Schmidt-hammer method. Further surface exposure dating is needed to establish a calibration curve in this area.