Schmidt hammer exposure-age dating of the debris accumulation of three large rock slope failures in the Southern Swiss Alps

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The occurrence of large rock slope failures in an Alpine environment is influenced not only by morpho-structural and lithological characteristics of slopes, but also by the regional glacial history. The latter plays a significant role on slope stability, as the glaciers pressure exerts a variable load on the valley flanks and may lead to weakening of slope strength. To understand the strong relationship between the deglaciation and the large rock slope failures following it, a detailed geochronological assessment of both processes is essential.

In the Southern Swiss Alps, in the territory between the five valleys north of Bellinzona (Riviera, Valle Leventina and Valle di Blenio in Canton of Ticino, Val Calanca and Valle Mesolcina in Canton of Graubünden), several debris accumulations of large rock slope failures can be observed. The objective of this research is to define the exposure-age of three rockslide/rock avalanche deposits in Ludiano (Valle di Blenio), Norantola (Valle Mesolcina) and Bodio-Cauco (Val Calanca), through Schmidt hammer exposure-age dating (SHD).

Schmidt hammer, also called concrete sclerometer, allows to measure a rebound value (*R*-value), which is directly proportional to the strength of the rock surface. Under the same climate conditions and for the same lithology, this can be directly correlated with the surface weathering and therefore to exposure-age. *R*-values were calibrated thanks to measurements carried out on surface of known age, determined from historical sources and from cosmogenic nuclide dating (CND). In the first category, boulders from the Monte Crenone rock avalanche of 30th September 1515 were used (De Pedrini *et al*. 2022, Geogr. Helv. 77). Surfaces interested by CND are several boulders of the Chironico rock avalanche (Claude *et al*. 2014, Swiss J. Geosci. 107) and four erratic boulders deposited by the Ticino glacier above Claro (Riviera valley) and in Gudo (Piano di Magadino) (Scapozza *et al*. 2022, this volume).

By linear regression, the following SHD of the investigated surfaces could be obtained: 16.15 ± 0.98 ka for the Ludiano rock avalanche deposit; 15.97 ± 1.04 ka for the Norantola rock avalanche deposit; 15.77 ± 1.07 ka for the glacial erosion surface (*roches moutonnées*) in Serravalle (Semione); 13.98 ± 1.26 ka for the Bodio-Cauco rockslide deposit. All these exposure ages indicate a collapse of the investigated rock slope failures only a few centuries after the deglaciation, which occurred for the lower and middle parts of the Valle Mesolcina, Valle di Blenio and Valle Leventina between 16.94 and 16.25/15.96 ka b2k.

Both deglaciation and dated rock slope failures occurred during the Greenland Stadial GS-2.1a of the INTIMATE event stratigraphy, dated between 17.48 and 14.69 ka b2k (Rasmussen *et al*. 2014, Quat. Sci. Rev. 106) or, at least, at the beginning of the Greenland Interstadial GI-1 (14.69–12.90 ka b2k), in particular during the events GI-1e (14.69–14.08 ka b2k), GI-1d (14.08–13.95 ka b2k) and GI-1c (13.95–13.31 ka b2k), characterized by the first significant temperature increase after the Last Glacial Maximum.