

## Weathering of bedrock surface after glacier retreat in the Swiss Alps

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This paper discusses how the strength of intact bedrock surface has been changed within twenty thousand years in an alpine environment. The strengths of rock surfaces were measured in the Upper Engadin, Swiss Alps, where the history of glacier retreat after the Last Glacial Maximum has been well investigated. The glacier distributions of three main stadials are evident in the study areas, which are the Little Ice Age (AD1850), Younger Dryas (12 ka) and Oldest Dryas (15-18 ka). Forty-one roches moutonnees and twenty-four rock walls of glacial troughs were selected for this research, which consist of granodiorite, diorite, gneiss or limestone. The rebound values of Schmidt hammer and Equotip hardness tester, and P-wave velocities were measured as indices of surface weathering. To compare bedrock surfaces and the intact parts, two blocks were sampled from two gneiss roches moutonnees with different ages. Their specimens, not including the weathered surface, were provided for an elastic wave test, uniaxial compression test, radial compression test and Equotip test.

These tests suggested that the strength of rock surfaces has been reduced through the last 20,000 years, except for that of limestone. The decrease in the strength is remarkable at the early stage of the weathering. In particular, the decrease rates of granodiorite and diorite can be approximated by logarithmic curves. Although granodiorite and diorite roches moutonnees exposed after the Little Ice Age are mostly unweathered, gneiss rocks with the same age have already been weathered over large parts of their surfaces. Unloading from overlying glaciers weakened the surfaces of gneiss rocks, reflecting their schistosity parallel to the surface. In contrast, the surfaces of limestone rocks have been constantly renewed by dissolution. Therefore, the weathering duration does not affect the surface strength of limestone but increases its surface roughness. The surface strength of rock walls of glacial troughs is controlled by occasional rock exfoliation owing to the gravity, as well as by weathering conditions.

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