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Rockwall erosion in high mountain areas: Estimation from in situ-produced 10Be concentrations measured on supraglacial clasts (Mont Blanc massif, France)

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Rockwall erosion due to rockfalls is one of the most efficient erosion processes in the highest parts of mountain ranges. It is therefore important to quantify this erosion to understand the long-term evolution of mountainous topography. In this study, we analyze how the ^{10}Be concentration of supraglacial debris can be used to quantify the rockwall erosion in a glacierized catchment. We first analyse the cascade of processes that move a block from a rockwall to a supraglacial location and propose a quantitative estimate of the number of rockfalls statistically mixed in a supraglacial sand sample. This model incorporates the extent of the rockwall, a power law distribution of the volume of the rockfalls and the mean glacial transport velocity.

In the case of 10 glaciers of the Mont Blanc massif, the ^{10}Be concentrations obtained from 45 supraglacial samples vary from 92 ±3 to 1.69 ± 0.3 × 10^4 atoms g^{-1}.

Our analysis suggests that part of the ^{10}Be concentration dispersion is related to an insufficient number of amalgamated rockfalls that does not erase the stochastic nature of the rockwall erosion. In the latter case, the concentration of several collected samples is averaged to increase the number of statistically amalgamated rockfalls.

Variable and robust ^{10}Be-derived rockwall retreat rates are obtained for 25 distinct rockfall zones in the Mont Blanc massif and vary from 0.07 ±0.01 to 4.33 ±1.2 mm.a^{-1}. These retreat rates depend mainly on the slope angle, orientation and thermal regime (presence/absence of permafrost in particular).