

What can we learn from ice collected in high mountain rockfall scars? Three examples from the Mont Blanc massif (France)

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The study of the ice (cryostructures, cryostratigraphy, types and age) that partly fills the fractures in rockwall permafrost is necessary to better understand the increasing frequency/volume of rockfalls in the high alpine rockwalls.

Typically inaccessible, this ice is visible only when a rockfall occurs, exposing previously hidden ice. Over the past two years in the Mont Blanc massif, the two largest rockfalls of the decade and a smaller one allowed to start the documentation of the rockwall permafrost ice.

The first one (44,387 m³) occurred at the Tournier spur in the north face of the Aiguille du Midi (3842 m a.s.l.), above the Pélerin glacier, on Sept. 29, 2017. A collapse of about 10,000 m³ had already occurred in this sector in 2007. Following the 2017 event, massive ice was observed in the upper part of the scar. Ice observations and sampling were carried out with a sling-helped drop by a helicopter in the upper part of the scar. The sampled area formed a 15-m-high and 1-m-thick overhanging ice wall characterized by a horizontal bedding of very varied layers of ice in terms of type (translucent, white, bulky, with or without rock debris) and thickness. First results on dating indicate an ice age (micro-¹⁴C) of several thousand years.

The second collapse (42,433 m³) occurred in the steep SE face of the Trident du Tacul (3639 m a.s.l.) in the Géant glacier basin on Sept. 26, 2018. Massive ice was here also largely present in the upper part of the scar after the collapse. Sampling was done by abseiling down the face to a 15-m-large and high ice wall. From a cryostructure point of view, dozens of pluri-decimeter layers of white ice interspersed with dark beds producing very varied schemes with inclined parallel layers in some places, and developed folds in others.

A last rockfall of about 7000 m³ occurred on Dec. 4, 2018 at the foot of the east face of the Tour Ronde (3793 m a.s.l.), in the Géant glacier basin too. A 45-m-high pillar collapsed along a vertical rock plan that remained for several weeks largely covered with massive ice. Sampling took place at the top and bottom of the scar, where a 6-m-high, 4-m-wide and 30-cm-thick ice wall was characterized by thick bands of translucent to white ice, interspersed with three thin layers of brown-yellow colored ice.

These three cases show the wide variety of ice in permafrost rockwalls, possibly with very different origins and formation processes that we intend to elucidate through ice dating, cryostructure and cryostratigraphy analyses.