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Insights in thermal field evolution of the Mont Blanc massif during Late Quaternary using luminescence thermochronometry

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Luminescence thermochronometry is based on the dynamic equilibrium of trapped charge in defects of minerals such as quartz and feldspar, due to environmental radiation and temperature dependent detrapping of the trapped electrons during rock exhumation. This method enables the thermal history of rocks to be quantitatively constrained. We apply the method on the actively eroding Mont Blanc massif, and investigate whether it can be used to quantify the geothermal history of the area. This setting was chosen because it has been previously shown with a thermal model that continuous cooling of the alpine Mont Blanc crystalline massif has occurred for 12,000 years due to infiltration of water from the surface (Maréchal et al. 1999). Here we analyze samples from the Mont Blanc tunnel (12 km) with present-day ambient temperatures of 10-35 °C. Both Optically Stimulated Luminescence (OSL) and Thermo-Luminescence (TL) of K-feldspar extracts were explored. The results reveal that there was a rapid increase in cooling during the last 10-200 ka and that luminescence thermochronometry may be used to quantify changes in the near surface geotherm. Using thermal modelling, we quantify the relative contributions of exhumation and advection through fluid infiltration, and find the change in cooling are heavily affected by changes in the geotherm related to hydrothermal fluid.