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Constraining past ice-extent and post-glacial erosion by combining OSL and 10Be surface exposure dating

Benjamin Lehmann (1), Pierre G. Valla (2), Georgina E. King (2), Susan Ivy-Ochs (3), Olivia Kronig (3), Marcus Christl (3), and Frédéric Herman (1)

(1) Institute of Earth Surface Dynamics, Faculty of Geosciences and Environment, University of Lausanne, CH-1012 Lausanne , (2) Institute of Geological Sciences and Oeschger Center for Climate Research, University of Bern, 3012 Bern, (3) Laboratory of Ion Beam Physics, ETH Zurich, 8093 Zurich, Switzerland

In this study, we present a new approach to evaluate post-glacial bedrock erosion in mountainous environments by combining 10Be and optically stimulated luminescence (OSL) surface exposure dating (Haberman et al., 2000; Sohbati et al., 2011; Lehmann et al., 2017). It relies on the idea that both OSL-signal bleaching and 10Be concentration within a rock sample depend on the exposure time and the surface erosion rate. We developed an iterative approach that enables us to invert OSL bedrock and 10Be concentration into exposure time and erosion rate.
We then apply our approach to a well-constrained glacial environment: the Mer de Glace glacier (Mont Blanc massif, France). Samples were collected on granitic bedrock surfaces between the LGM ice surface (∼2505 m.a.s.l, Coutterand et al., 2006) and the present-day glacier (1920 m.a.s.l), covering ∼600 m of elevation over which the ice has fluctuated since the LGM. Our results exhibit increasing exposure age with sample elevation, from 0.2 ± 0.1 to 21.0 ± 1.4 ka, and an integrated erosion rate varying from 0.5 to 5 mm.ka-1 since the Last Glacial Maximum. We thus propose that combining OSL and 10Be surface exposure dating would enable to constrain both paleo-glacier fluctuations and weathering processes during the Lateglacial to Holocene times.

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