Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19395

Human and climate impacts on the Critical Zone dynamic over the past 10,000 years in the French Alps

WILLIAM RAPUC[1], DAMIEN GUINOISEAU[2], JULIEN BOUCHEZ[3], MATHIEU DELLINGER[4], JEROME POULENARD[5], PIERRE SABATIER[6], FABIEN ARNAUD[5] AND JÉRÔME GAILLARDET[7]

[1]CNRS - EDYTEM - Université Savoie Mont Blanc
[2]GEOPS, Université Paris Saclay (UMR 8148)
[3]Université Paris Cité, IPGP, CNRS
[4]CNRS - Université Savoie Mont Blanc
[5]Université Savoie Mont Blanc
[6]Université Grenoble Alpes-Université Savoie Mont Blanc-CNRS-EDYTEM, UMR 5204
[7]Institut de Physique du Globe de Paris

Presenting Author: william.rapuc@univ-smb.fr

Global anthropisation and climate change have direct impacts on the Critical Zone (CZ), driving both chemical weathering and physical erosion. Mountainous areas, such as the European Alps, hold a strong dynamic due to their inherent environmental conditions and because they have been impacted by human activities from millennia. To assess how climate and human activities affect erosion and weathering, we use lake sediments as an archive of the long-term evolution of the CZ. Such a retrospective approach offers the opportunity to observe pre-impact states, trajectories, and the history of climate and human forcings. Here, we measured isotopic proxies of erosion sources (Sr-Nd) and weathering processes (Li) in sediments from Lake Bourget (catchment of 4976 km^2), which is representative of the Northern French Alps. Within this catchment, we identify two main bedrock erosion sources with distinct geochemical composition: magmatic rocks in the Mont Blanc massif and sedimentary rocks at low to mid altitude. Using a multi-proxy approach combining source-to-sink and isotopic geochemistry (Nd and Sr) on a lake sediment sequence, we reconstruct the contribution of each of these sources through time and use it to discriminate the effects of climate fluctuations and human activities on erosion over the last 10,000 years. For lithium isotopes, the d^7Li values range from -3.87 to -1.36‰, d^7Li signal show a decreasing trend from 9450 to 3850 yr cal BP before increasing from 1350 yr cal BP towards the present. Because the contribution of the sources is known, Li isotopic composition combined with major and traces elements allow us to reconstruct the dynamics of the weathering state of soils through time. Our results confirm previous observation from other local lake records that the development of soils after the last glaciation until an optimum reached around 6000 years cal BP. From 3800 years onwards, our data show a dramatic increase in soil weathering linked to the increase in the intensity of human activities in the Alps. This dataset allows for the first time to question the effect of human activities and climatic fluctuations on soil alteration at the scale of the French Alps and the Holocene.