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Riverine export of particulate organic carbon in mountainous headwater catchments

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The riverine export of biospheric carbon to the ocean, where it is eventually deposited in marine sediment and hence preserved from oxidation, is an important long-term carbon sequestration mechanism. Erosion is the dominant control on carbon export [1], and a number of studies have documented the high fluxes of particulate organic carbon (POC) exported from active mountain belts, especially during extreme precipitation events [2]. While these events also mobilize fossil carbon from bedrock, runoff erosion driven directly by precipitation removes primarily the uppermost layers of soil and vegetation, thus shifting the exported POC towards biospheric composition [3]. However, detailed information on the sources and mechanisms of organic carbon mobilization in the stream network is still scarce.

The POC exported by three alpine headwater catchments in the Alpthal (Central Swiss Alps) was sampled at different discharges and analyzed for carbon isotopes and biomarker signal of alkanes, fatty acids and glycerol dialkyl glycerol tetraethers (GDGTs).
This study aims to describe the response of different biomarkers to rising discharges to quantify the influence of hydrology on the exported biomarkers and the isotopic signal of the POC and, if possible, to fingerprint the sources of the carbon in the landscape that are mobilized.

Preliminary results suggest that all biomarkers respond to changes in discharge, however the changes are small, which complicates the carbon source fingerprinting. Carbon isotopes indicate that the exported carbon composition is a result of three endmembers mixing, one of modern age corresponding to vegetation and topsoil, one fossil and one pre-aged. Additionally, the POC composition varies significantly between the three rivers showing that observances from only one catchment are not enough to generalize processes.

[1] Galy, V. et al. 2015 - Nature, 521(7551), 204-207.

[2] Hilton, R. G., et al. 2008 - Global Biogeochemical Cycles, 22(1).

[3] Smith, J. C. et al. 2013 - Earth and Planetary Science Letters, 365, 198-208.