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Understanding the effect of hydrology on chemical weathering in the European Alps with Li and Sr

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Knowledge of source, distribution and magnitude of chemical weathering fluxes is essential to understand the evolution of critical zone (CZ). Two trace elements, lithium (Li) and strontium (Sr) can be used as powerful weathering proxies as Li isotopic fractionation gives insight into the extent of weathering whereas Sr isotopes traces the signature of the weathering source. Though these two elements have previously been applied in understanding weathering fluxes, the influence of hydrology (such as the role of mixing of different water bodies, or relation with water transit time) and erosion rates on their concentration and isotopic fractionation is not well understood. We measured the Li and Sr concentrations and isotopic compositions in 5 small river catchments of size less than 3 km^2 in the Alpine region with various runoff and erosion rates, where time series of event samples and base flow samples were both collected. We investigated the concentration (C) and isotope composition (I) vs discharge (Q) relationships in each catchment and compared the flash flood events and baseflow samples from different seasons. In the Laval and Brusquet catchments from the Draix-Bléone CZO, Li concentrations shows chemostatic behaviour for discharge above 100 Ls^{-1} but a negative relationship with discharge below this value; whereas Sr concentrations show a negative C-Q relationship. The higher Li (17.09 μM) and Sr (134 μM) concentration values are associated with very low discharge (< 0.09 Ls^{-1}). For individual flood events, we observe C-Q relationships that are either positive, negative or chemostatic depending on season and previous precipitation events, which shows the important role of water residence time in setting stream chemistry. These results have important implications for our understanding of the controls on weathering fluxes and thus for modelling past and future CZ trajectories in the Alps.