



## **Stream water composition changes in the Vosges Mountains (NE France): long-term study and liming experiment.**

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The Vosges Mts (Eastern France) is a medium altitude hercynian massif almost completely forested. Low alkalinity streams occur on sandstone in the north at low altitude, and in the south on granite at higher altitude. Our work is based on (1) a long-term and functional analysis of chemical composition of streams since the fifty-year decrease of atmospheric pollutant, and (2) an experimental total liming (dolomite, lime, gypsum and KCl) of catchments. The historical analysis has showed a marked acidification and a continuous demineralization of water draining sandstone since fifty years. The acidity and the mineralization of streams draining granites rich in weatherable minerals has decreased since thirty years. The granite rich in plagioclase is drained by a large proportion of acid streams. These waters are demineralised since twenty years and the Al concentrations have decreased since ten years, without pH changes. Compared to similar studies realized in other European countries, the Vosges massif data

fits between the north-western areas and the more continental polluted areas. The mixing liming of dolomite and dolomitic limestone, gypsum and KCl has caused a brutal and durable increase in Ca, Mg and pH in the stream of granitic catchment riche in sodic plagioclase. The dynamic of chloride tracer have showed a rapid contribution of soil waters to the humid area and stream, while a small fraction has infiltrated deeper into the soil. Soil surveys confirm that the lateral drainage is related to the occurrence of impermeable layers of periglacial origin (fragipan) within soils on granite. On Quartzitic sandstone layers, except a direct effect during the flood before the liming, the increase of concentrations is very weak. The majority of chloride, Ca and Mg are infiltrated deeper into the permeable sandy soils, without contributing directly to the stream flow. The thickness and the high porosity of the weathered sandstone appeared as a major factor delaying the response of the streams to environmental changes. Hydrologic, isotopic, chemical arguments suggest that the mean residence time of water and mineral elements in catchment is more than several decades This study underlines the importance of hydrological conditions when comparing stream compositions at different time intervals. From this work a method for assessing stream acidity variations over the long term is suggested. This work suggests a reasoned politic of acidity correction in stream water of Vosges mountains.