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Geochemical and isotopic evolution of soil solutions over the last 25 years in a forested granitic catchment (the experimental Strengbach watershed case, France).

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The upper most meter of the soil represents the most sensitive and the most reactive zone of surface facing anthropological or global changes.

Indeed, the processes and the exchanges which take place in this zone, in particular between soils, plants, waters, and atmosphere can be strongly modified by the disturbances of the environment.

It is the reason why it is essential to study the various compartments of the soil and in particular theirs time evolutions.

The soil solutions represent an essential vector of migration of elements within the soil profile and until the deeper levels feeding springs and rivers. Besides, they also reflect the atmospheric contributions and the processes such as the chemical weathering, the root uptake or the biological recycling.

Our study presents the variations over more than 20 years of the elemental and isotopic compositions of soil solutions along two profiles in a granitic environment undergoing acid rains in the 60s-80s, as well as an extensive forestry development.

Two experimental plots were monitored, which are part of the Environmental Hydro-Geochemical Observatory (OHGE; http://ohge.u-strasbg.fr) located on the small granitic watershed of the Strengbach creek, in the Vosges Mountain (North-East of France). Meteorological, hydrological and geochemical data are recorded since 1986. The soil solutions and the soils were analysed (elemental and isotopic compositions) at different depths, under beeches and spruces, and in both podzolic and acid brown soils.

The data covering more than 2 decades show important evolutions with time in the geochemical composition of the soil solutions from the both plots, both with respect to the elementary data and the isotopic ratios.

For instance, the annual chemical flux in soil solutions of certain nutrients such as the Ca strongly decreased in depth for more than 20 years, while they remained constant or increased for lithogenic elements as Na or Si.

The rain and throughfall records show that the annual dry and wet atmospheric inputs in Ca, Na, K, Mg, Si remain constant since 1986. Then the decrease of the Ca concentration with time, in the two profiles, cannot be related to diminution of dissolution processes nor to declining of atmospheric inputs.

At the same time, the evolution of the Sr isotopic ratios in soil solutions in depth below 30 cm, which become more radiogenic, shows that the source of elements also changed. Apatite, which is the main source of Ca in this system almost has disappeared from the upper most levels of soils. The contribution to the flux of Ca from secondary minerals such as clays or of exchangeable fraction increases. At the present time, these phases represent a new main source of Ca, more radiogenic in Sr.

All our results lead us to propose that the source of Ca in soils decreased for the past 20 years which raises the problems of the present-day nutrient availability in forested soils, such as those developed in acid granitic bedrock.