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Study of recent changes of weathering dynamic in soils based on Sr and U isotope ratios in soil solutions (Strengbach catchment- Vosges, France)

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Major and trace element concentrations along with U and Sr isotopic ratios of the main components of the water-soil-plant system of two experimental plots in a forested silicate catchment were determined to characterize the day-present weathering processes within the surface soil levels and to identify the nature of minerals which control the lithogenic flux of the soil solutions. This study allows recognition of a lithogenic origin of the dissolved U in the surface soil solutions, even in the most superficial ones, implying that the colloidal U is a U secondarily associated with organic matter or organo-metallic complexes. This flux significantly varies in the upper meter of the soil and between the two sites, due to their slightly different bedrock lithologies and likely also to their different vegetation covers. A long-time monitoring during the past 15 years was achieved to evaluate the response of this ecosystem to recent environmental changes. A clear decrease of the Ca and K fluxes exported by the soil solutions between 1992 and 2006 at the spruce site was observed, while this decrease is much smaller for the beech plot. In addition, the Sr isotope ratios of soil solutions vary significantly between 1998 and 2004, with once again a much more important change for the spruce site than for the beech site. It demonstrates that the source of elements in soil solutions has changed over this time period due to a modification of the weathering reactions occurring within the weathering profile. The origin of the weathering modification could be the consequence of the acid rains on weathering granitic bedrock or a consequence of forest exploitation incompatible with the nutriment reserve of soils with recent plantations of conifer, which impoverish soils. All together, these data suggest that the forest ecosystem at the spruce plot is in a transient state of functioning marked by a possible recent modification of weathering reactions. This study shows the potential of the approach combining the analysis of U and Sr isotopes in soil solutions and vegetation to evaluate this kind of phenomenon.