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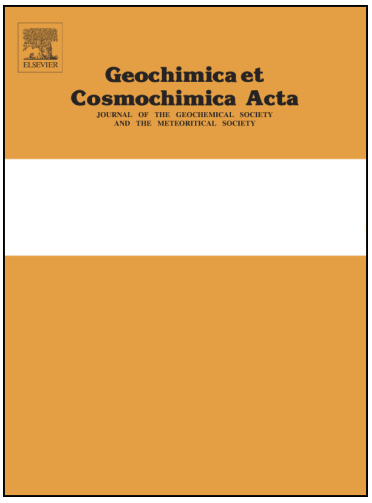

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Calcium biogeochemical cycle at the beech tree-soil solution interface from the Strengbach CZO (NE France): insights from stable Ca and radiogenic Sr isotopes

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Abstract

Calcium (Ca) is the fourth most abundant element in mineral nutrition and plays key physiological and structural roles in plant metabolism. At the soil-water-plant scale, stable Ca isotopes are a powerful tool for the identification of plant-mineral interactions and recycling via vegetation. Radiogenic Sr isotopes are often used as tracers of Ca sources and mixtures of different reservoirs. In this study, stable Ca and radiogenic Sr are combined and analysed in several organs from two beech trees that were collected in June and September in the Strengbach critical zone observatory (CZO) (NE France) and in corresponding soil solutions.

At the beech-tree scale, this study confirms the field Ca adsorption (i.e., physico-chemical mechanism and not vital effects) on carboxyl acid groups of pectin in the apoplasm of small roots. The analysis of the xylem sap and corresponding organs shows that although the Strengbach CZO is nutrient-poor, Ca seems to be non-limiting for tree-growth. Different viscosities of xylem sap between the stemwood and branches or leaves can explain $\delta^{44/40}$Ca values in different tree-organs. The bark and phloem ^{40}Ca-enrichments could be due to Ca-oxalate precipitation in the bark tissues and in the phloem. The results from this study regarding the combination of these two isotopic systems show that the isotopic signatures of the roots are dominated by Ca fractionation mechanisms and Sr, and thus Ca, source variations. In contrast, translocation mechanisms are only governed by Ca fractionation processes.

This study showed that at the root-soil solution interface, litter degradation was not the main source of Ca and Sr and that the soil solutions are not the complement of uptake by roots for samples from the 2011/2013 period. The opposite is observed for older samples. These observations indicate the decreasing contribution of low radiogenic Sr fluxes, such as

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