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Impact of agriculture on silicon availability in soils: a paired site approach

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Silicon (Si) is the second most abundant element of the Earth's crust, after oxygen. Plants play an important role in the terrestrial Si cycle, which is altered by agriculture. Silicon is recognized as a beneficial element for plants which show highly variable Si content (from below 1 to higher than 100 mg g^{-1} dry weight) depending on the plant type and the soil type. Poaceae, as rice and wheat, are considered as Si accumulators since they contain more than 10 mg Si g^{-1} dry weight. The question is: does continuous wheat cultivation induce a depletion of available Si in soils on a long-term ? Si is indeed used as fertilizer in some countries (Japan, China, South America and USA (Florida)) to overcome the depletion of the bioavailable Si in rice cultivation. Is such a depletion also observed for wheat cultivation in French soils?

To answer this question we selected paired sites on different soil types and parent material to compare the impact of land use (crop and forest) on Si soil availability. Both loess and calcareous parent materials were selected. On these two parent materials, two stages of soil development were selected: Luvisol and Albeluvisol for loess, and Calcosol and Calcisol for calcareous parent material. These soils differed by their pH, < 2 μm content and organic carbon (OC) content. OC content and pH also differed between forest and cultivated land uses. Si extracted by $CaCl_2$ was also measured to estimate Si availability. Si availability increased with the pH, as a result, Si availability was lower in forested soils than in cropped soils. The difference was higher for Albeluvisol and Luvisols that had lower pH than Calcosol and Calsisol.

Solid phases contributing to available Si will be discussed in the light of soil phytolith contents, mineralogical characteristics of the < 2 μm fraction (X-ray diffraction, particle size distribution by laser particle-sizer, CEC determination) and Fe-oxides extractions (Tamm, CBD). Results showed that available Si is mainly extracted from clay minerals in the considered soils.

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