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Effect of different extraction methods on the morphological and chemical properties of phytoliths

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Rice plants are Si accumulators and the uptake of Si can significantly improve their growth and stress tolerance. The Si that is taken up polymerises in above-ground plant tissues and forms amorphous silicon bodies called phytoliths. When rice straw is left on rice fields this biogenic Si pool may be an important source of plant-available Si, especially in old, highly weathered soils. Reports on the bioavailability of phytoliths are, however, sparse and sometimes contradictory. To study the in-situ dissolution of phytoliths over time in the field requires the extraction of phytoliths from rice straw. Several different extraction methods have been proposed but their impact on the morphology and surface chemistry (and consequently the solubility) of the phytoliths is not well studied. We have tested four different extraction methods: (i) oxidation with H_2O_2, (ii) wet ashing, (iii) dry ashing, and (iv) microwave treatment to extract phytoliths from Si-rich rice straw (Oryza sativa L. cv. NSIC Rc222) from the Philippines. The effect of the extraction methods on the morphology of the phytoliths was analysed using confocal laser scanning microscopy, while changes in particle size and specific surface area were determined by dynamic light scattering and N2 gas adsorption at 77 K, respectively. Surface chemistry was analysed with X-ray photoelectron spectroscopy (XPS); bulk element composition was determined using inductive-coupled plasma–optical emmission spectrometry after microwave digestion. Dissolution experiments in mini reactors were carried out for assessing the solubility of phytoliths under conditions similar to those in the field. Data analysis is currently underway. First results using XPS suggest that dry ashing resulted in very clean SiO_2 surfaces suitable for tracking of surface transformations of phytoliths in soil.