Origin, location and molecular characterization of phytolith carbon: insights for the phytolith carbon cycle

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Résumé

Phytoliths contain occluded organic compounds called phytC. Recently, phytC content, nature, origin, paleoenvironmental meaning and impact in the global C cycle have been the subject of increasing debate. Inconsistencies were fed by the scarcity of in situ characterizations of phytC in phytoliths. Here, using cutting-edge technics, we present new data allowing to further characterize phytC. The internal structure of harvested grass short cell phytoliths is reconstructed at high spatial resolution using 3D X-ray microscopy. Two pools of phytC, possibly differently protected from mineralization, are suggested from nanoscale secondary ion mass spectrometry (NanoSIMS) measurements. Plant absorption, translocation and occlusion of soil C in phytoliths is traced using 13C labeling. Simultaneously, the molecular composition of phytC is unraveled using pyrolyse-gas chromatography-mass spectrometry (Py-CG-MS) and dynamic nuclear polarization-solid-state nuclear magnetic resonance (DNP-SSNMR). The findings allow to precise the fluxes that need to be taken into account to quantify the phytC cycle at the soil/plant/atmosphere interface. This approach points out the lack of data required to estimate the phytC sequestration flux. The current available data suggest that there is no significant biosequestration of C by soil phytoliths in grassland ecosytems.

Mots-Clés: phytolith, carbon, biosequestration

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