Phytolith as medium of coupled biogeochemical cycles of silicon and carbon: a case study of China

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Résumé

The coupled biogeochemical cycles of silicon (Si) and carbon (C) in terrestrial biomes that are regulated by plant activities play a significant role in controlling atmospheric CO2. Phytoliths, the biogenic silica deposited within plant tissues during plant growth, generally take the shape of plant cells where biogenic silica precipitates and occlude 0.2–5.8% of organic carbon for most high plants. Carbon sequestered wthin phytoliths may be enriched in soils and sediments for hundreds to thousands of years depending primarily on the chemical composition and morphology of phytoliths, and soil and climatic conditions. Phytolith C sequestration is considered to be one of the most important biogeochemical C sequestration mechanisms. Here we review recent advances in phytolith C sequestration study and estimate the potential of phytolith C sequestration in China. The results show that the phytolith-occluded carbon (PhytOC) production rates among terrestrial biomes in China decline as croplands> forests> grasslands. Furthermore, active management measures such as rock powder amendment, organic mulching, partial plant harvesting, and growing Si-accumulating plants to enhance aboveground net primary productivity (ANPP) and silicon fertilization have great potential to promote the phytolith C sink. However, further studies are required to demonstrate the magnitude, exact mechanisms involved, and the cost of these management measures on phytolith C sequestration in various terrestrial biomes, and to make phytolith C sequestration a globally significant biogeochemical C sequestration mechanism.

Mots-Clés: carbon sink, terrestrial ecosystems, grassland, forest, cropland

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