New estimates of global phytolith and phytolith-occluded carbon pools and fluxes

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Résumé

Phytoliths are microscopic grains of silica (SiO2nH2O) formed within plants. Phytoliths also contain small quantities of other elements and compounds, most notably organic carbon. Upon plant decomposition, phytoliths are released into soils where a small percentage can persist for thousands of years. Biogenic silica production by land plants is thought to be on par with that produced in oceans by marine organisms. Some researchers contend that the that the amount of C in phytoliths can be up to several percent. Thus, the rate of phytolith C (phytC) production may be quite large. This also implies that phytolith storage in biomass and soil pools may be a sizable and stable sequestration mechanism of atmospheric CO2. If this is true, then phytoliths may account for a large fraction of the total amount of C stored in biomass and soil pools. However, global phytC pools and fluxes have never been calculated. Here we assemble estimates of global phytolith and phytC cycling, using the global organic carbon cycle as a starting point. Phytolith silicon concentrations in organic C pools and fluxes were assumed to be between 1.2% and 4.0%. The concentration of C in phytoliths was found to be between 0.04 and 0.21%, based on several laboratory analyses and values found in the literature. Our findings indicate that phytC is a very minor component of all organic carbon pools and fluxes, in the range of $< 0.01\%$ to 0.04%. Our results indicate that 0.14 – 2.32 teramoles (Tmol) of phytC is produced annually, with a net land accumulation rate of < 0.01 – 0.05 Tmol yr-1. By comparison, global biomass C production is 4,787.28 – 5,453.33 Tmol yr-1, and the net accumulation rate is 49.95 – 116.56 Tmol yr-1. Soils contain the largest quantities of phytC, at 8.69 – 128.25 Tmol, while biomass contains 1.11 – 23.05 Tmol. In conclusion, we have found that phytolith C concentrations border on the trace level. Because of this, global phytC storage is not a major atmospheric C sequestration mechanism.

Mots-Clés: Biogeochemical cycles, phytoliths, occluded carbon, sequestration

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