# Recent advances in phytolith carbon research

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**Résumé**

Phytolith carbon (phytC) analyses have opened several lines of investigation in paleoenvironmental and crop domestication studies through radiocarbon (14C) dating, and CO2 sequestration capabilities through encapsulation in plant biosilica particles. These investigations require that phytC is from a photosynthetic origin as well as its host-plant tissues. As intuitively appealing as the atmospheric carbon (atmC) to phytolith assumption may be, a number of investigations showed that phytC 14C signatures for contemporary plants display anomalous 14C values of hundreds to thousands of years [1]. It appeared that soil carbon (soil-C) pollution in plant tissue and phytoliths was to blame [2]. Therefore, stronger evidence based on isotopic phytolith analyses using quality sounded experiments (aboveground and belowground carbon manipulations) and multiple laboratories was required to address this issue. The non-photosynthetic source hypothesis was addressed using comparative isotopic measurements (14C and 13C) of phytC, plant tissues, atmospheric CO2, and soil organic matter [3]. Simultaneously, multiple lines of investigations were carried out on phytolith extraction and purity evaluations [4], which in turn better constrain phytC concentrations. Here, we provide evidence that 14C phytC offsets occurred in association with a soil-C contribution to phytC, regardless of the phytolith extraction protocol adopted, and that phytC is from a mixed carbon pool (between soil-C and atmC). A continuous ramped temperature procedure under an oxygen stream was also used to evaluate the decomposed products of phytC (low-temperature reactive versus thermochemically resilient [3]). Meanwhile, NanoSIMS analyses of phytolith polished sections were used to locate phytC in the phytolith siliceous structure and to give insight into the nature of the organic matter (OM) [5]. Through Raman spectroscopy we found that the phytC chemical structure changed depending on growth conditions [6], while labeled amino acids (15N and 13C) provided conclusive evidence of the phytoliths' direct occlusion of carbon acquired by plant-root [7]. This presentation will briefly review these findings, which have rebutted traditional concepts, as well as address technical questions raised by opposing researchers during its development: Can isotopic fractionation and/or over-oxidation during phytolith chemical extractions be invoked as an explanation for the anomalous 14C phytC ages [8]? What does "old" uptake of soil-C to phytC really means when the 14C results show both positive and negative offsets [3,8]? How can heterogeneous carbon pools (such as phytC) be partitioned by distinctive chemical extractions and heating treatments [3], while homogeneous pools cannot [9]? What are the confounding factors that dissuade the use of phytC as a dating material [8] and CO2 sink [3]?

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6 Gallagher et al. 2015. Front. Plant Sci. 6, 753, doi: 10.3389/fpls.2015.00753

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8 Santos et al. 2016. JAS 71, 51-58. doi:10.1016/j.jas.2016.04.015
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**Mots-Clés:** phytolith carbon, radiocarbon dating, isotopes, NanoSIMS, Raman, Thermo analysis