

***Interactive comment on* “Comment on: “Possible source of ancient carbon in phytolith concentrates from harvested grasses” by G. M. Santos et al. (2012)” by L. A. Sullivan and J. F. Parr**

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Authors comment on “Comment on: “Possible source of ancient carbon in phytolith concentrates from harvested grasses” by G. M. Santos et al. (2012)” by L. A. Sullivan and J. F. Parr.

Response to Referee’s comments - Hodson (2012a)

We agree with the referee’s comments.

Response to Referee’s comments - Hodson (2012b)

We agree with the referee’s comment and have included reference to Song et al.’s

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recent relevant (2012) paper in our manuscript.

Response to Referee's comments - Evett (2012)

We agree with the referee's general comments.

Response to Evett's (2012) specific comment below: Page 13775, line 12: The term 'carbon fractionation mechanism' suggests the authors are referring to carbon isotope fractionation (a valid but implausible alternative hypothesis), when the intended meaning, based on both on line 6 on the same page and further discussion on P. 13776, lines 7-9, is carbon partitioning mechanism. Unless the authors are indeed referring to carbon isotope fractionation, which would require further explanation, the word 'fractionation' should be changed to 'partitioning'.

We agree with this comment from the referee and have changed 'fractionation' to 'partitioning' in the text.

Response to Evett's (2012) specific comment below: Page 13778, lines 25 and 27: Unless the authors are arguing for the carbon isotope fractionation hypothesis, which Santos et al. clearly are not, 'fractionation/partitioning' should be changed to 'partitioning'.

We agree with the referee and have revised this section accordingly.

Response to Evett's (2012) specific comment below: Page 13776, lines 16-17 – The sentence within the quotation marks is a paraphrase, not a direct quote from Santos et al. (2012). The quotation marks should be removed and a comma placed between 'literature' and 'that', as well as (1996) and 'and'.

We thank the referee for this comment and have made the requested correction in the revised paper.

Response to Evett's (2012) specific comment below: Page 13780, line 34 – commas should be placed after each author's last name.

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We have made the requested correction in the revised paper.

Response to comments of Santos et al (2012b)

Response to Santos et al's (2012b) comment 1) Selective use of two of twelve 14C phytC dates reported in the progress report by Sullivan et al. (2008). Santos et al (2012b) have the following explanation for ignoring the "modern" PhytOC dates from 10 litter layers in our study: "In the Santos et al. (2012) publication, we discussed just 2 phytC results from Sullivan et al. (2008) (Table 1): the leaves harvested from the living plants themselves, and the green litter. This is because the only sample in their entire dataset for which the age of the original bamboo leaf tissues is known absolutely and that is unequivocally not contaminated by soil organic matter (SOM) is the sample of leaves picked from the living bamboo, with the recently senesced litter a close second. For all other litter samples, contamination by SOM and effects of bioturbation cannot be completely discounted."

We find this explanation for ignoring the "modern" PhytOC dates from the other 10 litter layers in our study puzzling as it is inconsistent with Santos et al's (2012a) own use of PhytOC dates in their paper.

Firstly, all of the litter layers comprised of bamboo leaves in our study are only a few years old and are unquestionably of "modern" origin using Santos et al (2012a) own definition of "modern" being "decades to a few hundred years old". That the ages of the 10 underlying litter layers were not "known absolutely" should not rule out consideration of their PhytOC ages in this context of their study. For example, a lack of knowledge of the absolute age of the Kandara phytoliths isolated from a mineral soil layer and thought to be between decades to a few hundreds of years old, did not impede Santos et al's (2012a) extensive use of this phytolith source (See Fig. 1) to examine the effects of different extraction procedures on the PhytOC dates of "modern" phytoliths.

Secondly, we find Santos et al's (2012b) other reason for ignoring the "modern" PhytOC dates from the other 10 litter layers (the top 7 of which were comprised of undecom-

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posed bamboo leaves), i.e. because of potential contamination by soil organic matter, also puzzling being inconsistent with their own use of PhytOC dates in their paper. For example, one of the main sources of phytoliths used in Santos et al (2012a) to examine in detail anomalous dating phenomena in “modern” phytoliths (namely, the Kandara phytolith isolate) was itself comprised of phytoliths extracted from the “upper 1 cm of the soil (litter excluded)” (Bremond et al 2005). Furthermore, Santos et al. (2012a) considered data from multiple papers where PhytOC dates were obtained from phytoliths isolated from mineral soil layers. In all of these situations potential contamination by soil organic matter would have been a much more realistic concern than was the case in our study where litter layers were used.

Response to Santos et al’s (2012b) comment 2) Inefficiency of phytolith protocols

We agree with the objectives expressed here by Santos (2012b). However the main point we made in our manuscript in this regard was not addressed by Santos et al (2012b) in their reply. This is that Santos et al’s (2012a) definitive statement “We show that current extraction protocols are inefficient since they do not entirely remove recalcitrant forms of C from plant tissue” is not supported by their data. We maintain that what Santos et al. (2012a) have shown - and as stated in our manuscript this is a valuable contribution - is that the phytolith extraction technique they used is prone to this problem, rather than showing that all current phytolith extraction protocols cannot entirely remove non-phytolith carbon from plant tissue.

Response to Santos et al’s (2012b) comment 3) Fractionation or partitioning?

We agree that the term ‘fractionation’ in the context of this paper could well be taken to mean ‘isotopic fractionation’ and have changed our manuscript accordingly consistently using ‘partitioning’ to indicate fractionation of isotopes by different means.

Response to Santos et al’s (2012b) comment 4) Sample preparation: contamination removal and biosilica carbon yields. We agree with the general discussion expressed here by Santos (2012b). However the main point we made in our manuscript in this

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regard was not addressed by Santos et al (2012b) in their reply: namely, that employing phytolith extraction techniques that alter or deplete PhytOC, is an additional important problem for non-dating purposes involving PhytOC such as the accurate determination of the PhytOC yields of plants and examinations of the nature of PhytOC. We believe that the problems of over-extraction of PhytOC and the alteration of PhytOC during phytolith isolation procedures are serious methodological challenges additional to the problem of avoiding contamination of PhytOC.

Response to Santos et al's (2012b) comment 5) Supporting evidence for old phytC ages

Contrary to Santos et al's (2012b) assertion here, that "Surprisingly the authors also dismissed the works of several researchers cited in Santos et al. (2012)" and that we disregarded those reports, we did not dismiss the works of any of the researchers mentioned here by Santos (2012b). All of these reports that Santos (2012b) believe we have disregarded concern anomalies between carbon dates using PhytOC with expected dates. We chose not to cite these works in our manuscript as they had already been cited in Santos et al (2012a) and we did not take issue with any of them. The fact that we embraced these works rather than dismissed them is evidenced by the very first sentence of our manuscript's abstract: "Santos et al. (2012) address the important issue that ^{14}C dating of the carbon occluded in silica phytoliths (PhytOC) isolated from contemporary plant materials can produce ages that are incompatible, being often several kyrs older, with both their known recent origin and the ^{14}C age of the bulk plant material."

Response to Santos et al's (2012b) 6 Summary Santos et al (2012b) state in their Summary "To simply look the other way and sweep these anomalous phytolith ^{14}C dates into the abyss of the literature footnotes is perilous to the growth and development of this exciting field of research."

We fully agree. Indeed our manuscript argues that no relevant data be left discarded

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and unexplored. Accordingly we maintain our contention that full sets of relevant data should be used to test hypotheses, not just partial sets of data.

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