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Interactive comment on “Turning sunlight into stone: the oxalate-carbonate pathway in a tropical tree ecosystem” by G. Cailleau et al.

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Referee 1

Very little mention is made of the ‘normal’ model for soil carbonate precipitation, through equilibration of the ^{12}C -rich high pCO_2 soil atmosphere with the less ^{12}C -rich lower pCO_2 atmosphere (e.g. Cerling, 1984; Cerling and Quade, 1993). In this (physicochemical) scenario, one would expect carbonates in the soils around these C_3 plants to have $\delta^{13}\text{C}$ of around -9 to -12 per mil. This reflects the soil zone and atmospheric CO_2 contributions to the carbonate. Indeed, the soil carbonates around the plants do have such values. However in the upper 20 cm of the soil zone, one normally expects slightly more ^{13}C rich compositions than lower down, due to a greater contribution to the soil carbonates from atmospheric CO_2 . Perhaps the authors could

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comment on this in their paper, to strengthen their argument. Authors' answer Yes, it is true. As we considered that the 'normal' model is well known, we decided not to refer to such a model and let the reader to form his own opinion regarding the iroko ecosystem. Nevertheless, things are a bit more complex as the atmospheric CO₂ is only a partial contribution. Most commonly, the soil respiration is the major contributor in such systems. One weakness in the model (Fig 7) is the absence of data on soil zone DIC. Can the authors elaborate on the reason for this? No samples taken? Samples too small?

Authors' answer : Field trips were performed during the dry season and no DIC sampling could have been performed at this time. In addition, no further sampling session has been possible due to the Ivorian civil war which started in September 2002.

Presumably the authors also have $\delta^{18}\text{O}$ data for the carbonates? Does this $\delta^{18}\text{O}$ reflect the composition of the meteoric water in the studied areas, or show any effects of evaporation which might have influenced carbonate precipitation? Does $\delta^{18}\text{O}$ correlate with $\delta^{13}\text{C}$? It would be interesting to know.

Authors' answer : no rain sampling was made on sites (no precipitation) and as a consequence, no data could be obtained for rain $\delta^{18}\text{O}$. We think that it is not possible to discuss such an issue as oxygen isotope data are not available.

The authors make much of the carbon-trapping potential of these ecosystems. What is the justification for 1) the assumption that the calcium comes from a silicate source, not a carbonate source (line 18), which (although depending on timescale) could be important for long-term CO₂ sequestration,

Authors' answer : See Cailleau et al 2004 (no carbonate in the basement, no carbonate input for atmospheric sources). The conventional soil pH (away from an oxalotrophic

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system) is too acidic to store airborne calcium carbonate. In addition, on a larger timescale (with a hypothetically different dust deposition regime), it seems unlikely that a Ca uptake could take place from an inherited airborne calcium carbonate.

and 2) can the authors estimate how much CO₂ these ecosystems might remove from the atmosphere over a given period of time?

Authors' answer : It has been estimated that approximately 980kg of carbon (as carbonate) are accumulated in the soil surrounding a studied iroko (Cailleau et al 2004). A recent ¹⁴C date, revising the tree's estimated age given in Cailleau et al 2004, gives an age of 170±30 yr. Consequently, 980kg of carbon represent 82000 moles of C and are equivalent to 3.5 tons of CO₂ withdrawn from the atmosphere during the tree lifetime (without counting the biomass).

How important are they to the modern and ancient global carbon cycles? The conclusions could also be made much stronger.

Authors' answer : The importance of these carbonate accumulations are discussed by Cailleau et al 2004. Nevertheless, refinement of the calculations, given in this paper supported by ¹⁴C, are presented in Cailleau's PhD thesis manuscript available at <http://doc.rero.ch/record/5512?ln=en>. Comparison to marine environments (Milliman 1993's data) is available on Page 74, figure 5.7. As an example, C sequestration deficit due to deforestation and logging of iroko in all Africa is evaluated as 1 to 2 orders of magnitude less than several types of marine environments such as coral reef complexes, banks/bays, and non-carbonate shelves.

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L 2 : Milicia excelsa replaces Milicia excelsa

L 19: agents replaces gents ; saprophytic is added before fungi

L 21: agents replaces gents

L 23: then is added before start

P.1079

L4: defined by ecological replaces defined by the ecological

L15: comma deleted after process

L20: Authors' answer concerning a reference to Berner's papers: as we are specifically speaking of the oxalate carbonate pathway related to the iroko tree, a reference to one of Berner's papers appears irrelevant in this case.

L23: this system works only in the presence replaces this system works with only the presence

P.1080

L1: we used microscopic replaces we propose to use microscopic

L14: involving replaces through the; saprophytic is added before fungi

L17: powdery replaces pulverulent

P.1081

L9: large replaces important

L18: were replaces have been

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L19: binocular microscope replaces binoculars

P1082

L6: binocular microscope replaces binoculars

L8: any possible replaces possibly

L13: centrifuged replaces centrifugated

L20: were replaces have been

L22: were replaces have been

L24: were replaces have been

L26: were replaces have been

P1083

L1: were replaces have been

L2: After replaces Next to

L6: was replaces has been

L11: does not replaces is not supposed to

L13: a good way to obtain replaces the only way to get

L14: were replaces have been

L16 were measured replaces have been performed

L18: V-PDB replaces PDB

P1084

L2: Authors' answer concerning "by important do you mean large?". Yes, large replaces important; Many replaces A lot

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L6: reflecting the replaces meaning

L8: feeders/borers replaces feeder/borer

L19: binocular microscope replaces binocular

L21: were replaces have been

P1086

L15: rhombohedron replaces rombohedron

L21: were replaces have been

P1087

L1: were replaces have been

L7: with the data replaces to the data

L10: was replaces has been

L11: were replaces have been

L12: were replaces have been

L24: only the top twenty replaces only the twenty first

P1088

L7: Experiments replaces Experimentations

L8: up to 600 replaces until 600

L16: incineration at over 500 replaces incineration over 500

P1089

L21: this flux (not measured in this study) should lead replaces this flux not measured in this study should lead

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P1092

L13: at the Biga site replaces at Biga site

L14: Authors' answer concerning could happen, instead of should happen? No, because as we are considering a system leading to carbonate accumulations, the steps mentioned in this section should happen (except for silicification)

L18: wounding replaces wounds

L22: starts building replaces constituting

L25: evidence replaces clue

L26: these two mineralizing phases replaces these two phases

L28: delete implication of the

P1093

L4: pseudomorphoses replaces pseudomorphosis

L6: based on field and petrographic observations replaces based on field observation as well as petrographic and diagenetic observations

L13: delete the before Fig. 5

L18: binocular microscope replaces binocular; top twenty replaces twenty-first

P1094 L2: I think you should add a comment here about the 'normal' situation for soil carbonates formed in the top 20 cm of the soil (relatively ^{13}C rich).

Authors' answer : We do think that this is going to lengthen the text, which already fairly long, without bringing any real input. Nevertheless, the remark regarding the C isotope distribution is pertinent.

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P1095

L2: delete important

L3: can replaces has to

L17: delete the

P1096 The conclusions can be strengthened to reflect the rest of the manuscript.

Authors' answer : The conclusions have been edited.

L.15: not otherwise expected replaces not expected

Figures: increase the font size in Fig. 7.

Authors' answer : The current format of the discussion paper will be increased and the authors think the size will be fine. In case the font will not be readable in the final proof version, a size increase will be applied.

Interactive comment on Biogeosciences Discuss., 8, 1077, 2011.

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