

## ***Interactive comment on “Bone char effects on soil: sequential fractionations and XANES spectroscopy” by Mohsen Morshedizad et al.***

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General comments:

The paper investigates chemical reactions in soil after the application of bone char produced with and without treatment with reduced S compounds. This is important because bone char is a potentially very efficient soil amendment in soil with low P availability and low pH which are very common in especially tropical areas. As bones are also a widely available P source production of bone char could also be a way of improving soil fertility which is feasible. A better understanding about the chemical reaction taking place in the soil after application could help us develop bone chars specifically designed to improve specific soil types.

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The paper provides this information by looking using chemical P extractions and XANES spectroscopy of both bone char samples before and after incubation in soil and on the entire soil. The changes that they observe are modest, except in a few cases, which probably reflect the fact that the changes are happening relatively slowly.

In general the paper is well organized, but in some sections the language is inaccurate. While it is usually possible to extract the meaning the reading flow becomes interrupted. Below I have indicated some places where this is the case under technical corrections, but I recommend to that the manuscript is checked by a professional copy editor.

## Specific comments

Line 123: Is there a good reason for using a different soil in the plant experiment?

Line 133: Please describe how the particles were separated from the soil.

Line 175: Please indicate some more details here. How was the normalization ranges (pre and post edge) selected and what was it?

Line 175: How was the LCI conducted? A lot of details are needed here. What was the fitting range. What was the objective function? What was the ma number of standard allowed in the fitting, etc.

Line 207-215: Why are you describing and presenting the results from the paper by Morshedizad and Leinweber (2017) here. If they are already presented in another paper, then it should suffice to include it in the discussion to the extent that it is relevant.

Line 210: Unit appears odd for a concentration? An accumulated concentration?

Line 238: What do you mean by insignificant? The numbers 0.01 to 0.05 does not seem to be founded on anything and the local pH changes were not measured.

Line 245: It is very difficult to separate the different graph in the figures. Is there any ways that the figures with XANES spectra can be made easier to read. Especially it is difficult to distinguish the BC lines from the Ca-Phytate.

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Line 247-249: It is virtually impossible for me to see that the spectra is shifted towards HAP. To me it appears that the post-edge shoulder at 2158 eV is more pronounced in the BC samples than in any of the standards. Is that correct and if it is the case what could be the explanation?

Line 256-258: In the results presented in Table 2, the same 3 standards were always used for the fitting. It that because it was always the same three standards that were selected?

Discussion: In general I would like you to related slightly more critically to you results of the LCF procedure. You end up with 3 standards, but how reliable is that? For example you identify Ca-phytate as a component, but in general it is difficult for distinguish different organic species P species with XANES. Does that mean that the analysis points more to organic compounds than to phytate? In general are you missing important references. In relation to this discussion, I also miss a discussion about the effect of the drying procedure on P speciation. When, for example, you dry BC particles separated from a soil, what precipitates of P are formed? When you have indications of the presence of easily soluble CaP compounds are they then formed from dissolved orthophosphate or other compounds in the process of can other compounds like HAP also be formed during the drying?

Line 388-390: It is difficult for me to verify from the figures that phytate appears like other CaP compounds. This reallt questions the results regarding the presence of Ca-Phytate in the samples however, which I believe could be a range of other CaP compounds.

Line 430: In addition to leaching of solubilized P compounds the could also have been taken up by the plant, right?

Line 456-457. I am in doubt what evidence supports this.

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Line 60-61: This sentence is a little awkward mentioning that is it an incubation twice.

Line 62-65: I would rephrase to . . . requirements, a considerable fraction of BC applied to the soil remains unsolluble in the short. . .

Line 65: The last part of this (very long) sentence comes a little out of context. Please rephrase, perhaps adding another sentence spelling out the last point more precisely.

Line 66: “has often been described in terms of”. Do you mean “Is defined as” or “consists of” or “is”

Line 68: “Variable” is not a good word. Maybe you mean “various”.

Line 69: Fertilization is not a non-equilibrium condition as you claim in this sentence. Please rephrase.

Line 78: . . . is well suited for identification of . . .

Line 81. . .soil samples makes it a promising . . .

Line 88. . .soil samples and provided evidence that the increase . . .

Line 90 . . . not clear what you mean by “applicable information”

Line 97: Poorly constructed sentence. You probably mean “Two particle fractions (1-2 mm abd 2-4 mm) of two bone char”

Line 98: Please give some more information on the S treatment. What reduced compounds was used? How was I blended and under what conditions?

Line 98: Poorly constructed sentence. You seem to claim that the S compounds are characterized in detail in the former paper, but I don’t believe that is the case.

Line 101-102: It that the extractants in parenthesis. Please give more details and a reference.

Line 103 and in the following . . .total P of 149

Line 106-108: Poorly constructed sentence.

Line 110: 3 pore volumes were added or leached through?

Line 111: Not clear what a leaching step is.

Line 113-114: Not clear what the outcome in this paper is and how it is different from the outcome described in this paper. Please be more specific.

Line 127: Not clear what natural temperature conditions are.

Line 129: Again, what do you mean by natural air conditions?

Line 164: Please indicate around here what samples you analyzed with XANES.

Line 174: I suppose the spectra were recorded in fluorescence yield model, but please indicated this.

Line 220: Sudden change in writing style. Before you called it NaOH-P.

Line 281: ...period in the ryegrass pot ...

Line 321: ...was identified by LCD analysis as the dominant ...

Line 341: What is positive loadings?

Line 346: What do you mean most inorganic? Either it is organic or inorganic. Please rephrase.

Line 376: Wu et al 2003 is missing in the reference list.

Line 377-380: You seem to argue that if you increase crystallinity of the sample the amount of HAP will increase. But you can have both amorphous and crystalline HAP so how can you my make that conclusion?

Line 434: Regarding the XANES results of the ryegrass cultivation. . .

Line 435: In the control soil. . .

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Line 445: What do you mean “practices” is “treatments” a better word?

Line 452: . . .through addition of S compounds proved more. . .

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