

## ***Interactive comment on “Holocene environmental changes in the highlands of the southern Peruvian Andes (14° S) and their impact on pre-Columbian cultures” by K. Schitteck et al.***

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### Formal Issues

1. Does the paper address relevant scientific questions within the scope of CP? YES 2. Does the paper present novel concepts, ideas, tools, or data? YES 3. Are substantial conclusions reached? YES 4. Are the scientific methods and assumptions valid and clearly outlined? YES 5. Are the results sufficient to support the interpretations and conclusions? YES 6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES 7. Do the authors give proper credit to related work and clearly indicate

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their own new/original contribution? YES 8. Does the title clearly reflect the contents of the paper? YES 9. Does the abstract provide a concise and complete summary? YES, but it could be shortened without losing relevant information. 10. Is the overall presentation well structured and clear? YES 11. Is the language fluent and precise? YES, however, a quick check by a native English speaker could enhance a few grammar and collocation issues. 12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? YES 13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? NO 14. Are the number and quality of references appropriate? YES 15. Is the amount and quality of supplementary material appropriate? No supplementary material available.

### General comments

The paper submitted by Schittek et al. to CP is a very interesting, well-founded and very adequately implemented work that presents the multi-proxy results of a high resolution paleoenvironmental record of the past 8600 yrs at Cerro Llamoca (CLP, located at 4450 m a.s.l.). The climatic meaning of these results and their archaeological impact are discussed. The relevance of this paleoenvironmental record to understand past climatic changes in the Andes is evident in the light of its chronological resolution, the particular location of the record, and the strength of the chronological model that rests on 50 radiocarbon dates. It is worth noting that, even taking into account the 15 discarded dates and the remaining low frequency of valid recent dates (a fact expectable due to the high deposition rate in the last 4 m of the core), to the best of my knowledge, this record constitutes one of the best dated paleoenvironmental sequences in the whole south-central Andes. The paper presents a clear and organized structure that strengthens the argumentation and the paleoenvironmental trends observed. The methodology is well-suited and the results are also efficiently summarized. Figures are of a general good quality, but font sizes are almost illegible in most of them. Conclusions are perfectly reasonable in the light of the evidence presented. The general discussion is interesting, particularly the section related to As, Mn and Fe retention

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and release in relation to environmental shifts. Beyond the frequent equifinality of the results of such parameters in sediment analysis, and the difficulty of obtaining reliable interpretations about them, the authors treat those results with the proper care, offering interesting insights about As dynamics in peatlands. I consider that section 5.2. is very detailed and presents a good picture of the general paleoenvironmental trends at CLP and their relation with the position of ITCZ, the main forcing agent of these the changes. In this section the authors also mention the discrepancies in the timing and effects of Mid-Holocene aridity across the Andes. Nonetheless, a detailed explanation of possible relations between the effects observed on CLP record and other records in the Andes is lacking. I consider that this section could be improved by discussing these changes (and others observed at CLP) in the light of the available information in neighboring areas in the Andes, and taking into account the particular spatial resolution of each of the proxies analyzed. This task could help to obtain valuable information of different spatial scope that supplements the excellent chronological resolution of the presented data. In my opinion the weakest part of the paper is section 5.3., due to the shallowness of the archaeological discussion. This problem is particularly detectable because the title of this paper promises to deal with environmental changes and “their impact on pre-Columbian cultures”. Regarding this, despite the clear fit between the Archaeological Silence and a sustained dry phase (Figure 6), almost no further discussion about the mechanisms or archaeological processes that took place during these periods is developed. From my point of view, to deal with the actual impact of climatic or environmental changes on societies implies a more detailed set of questions, particularly when a high resolution paleoenvironmental record is available. I consider that the focus in this case should be on disentangling which environmental variables have affected social organizational patterns. For instance, the authors stated that the earliest occupation in the area dates back to 5.25 Ka, coinciding with a moment characterized by “a transition to wetter conditions”. But, in my opinion, the relevant question should be why this did not take place before. Was the environmental instability suggested by Mn/Fe ratio (Fig. 3) a key variable determining the timing and tempo of peopling in

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the area? Other similar questions should be made in order to analyze the impact on societies, for example: How has environmental predictability or stability influenced the organization of settlement patterns? Which subsistence strategies have been modified to face environmental uncertainty installed for long periods such as the one occurred during Ica stage (Mn/Fe ratio Fig 6.)? I believe that the archaeological discussion will gain a lot in terms of its contribution if these comments are addressed and included in this manuscript by the authors.

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