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Interactive comment on "Iron oxides in the cryoconite on the glaciers over Tibetan Plateau: abundance, speciation and implications" *by* Zhiyuan Cong et al.

Anonymous Referee #2

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The paper investigates the abundance, speciation and spectral absorption of iron oxides in five glaciers in the Tibetan Plateau. Samples were collected on the field and analyzed in the laboratory to retrieve their composition in terms of iron oxides, black carbon and organic matter. Measurements of the spectral absorption were performed on the collected samples and the partitioning of the absorption due to mineral dust, black carbon, and organic material was estimated. The study is quite an interesting contribution and in my opinion it deserves publication in "The Cryosphere". I have nonetheless few comments concerning the data treatment and discussion that I will detail in the following. I have in particular some doubt on the choices performed to treat absorption measurements and I would like the authors to improve this part by

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Discussion paper

adding more details and by performing some sensitivity calculations. Also the discussion would benefit of some more specific comments on the representativeness and implications of the results. This is why I suggest major revisions for the paper. A significant discussion on the part concerning chemical analysis has been already performed with regard to the comments of the other reviewer and I will not add other comments on this part.

Comments:

Abstract: please define what Cryoconite is also in the abstract

Section 2.6: In the procedure for MAC estimate of cryoconite you need to make assumptions on the MAC and you assume the MAC of fullerene, i.e. a proxy for BC, in your calculations. First, I am not sure to completely understand the procedure followed to retrieve the MAC of cryoconite and I would ask the authors to provide more details on this part; second, I wonder: which is the impact of the assumption on the MAC on the obtained results? I mean, what is the uncertainty in the retrieved MAC of cryoconite due to the fact of assuming the MAC of fullerene in calculations? It would have not been more appropriate to use a weighted average MAC between BC, dust, and organics based on their mass contribution to cryoconite estimated deposits? For a reference of the MAC of dust see for example the recent paper by Caponi et al. (2017).

Caponi, L., Formenti, P., Massabó, D., Di Biagio, C., Cazaunau, M., Pangui, E., Chevaillier, S., Landrot, G., Andreae, M. O., Kandler, K., Piketh, S., Saeed, T., Seibert, D., Williams, E., Balkanski, Y., Prati, P., and Doussin, J.-F.: Spectral- and size-resolved mass absorption efficiency of mineral dust aerosols in the shortwave spectrum: a simulation chamber study, Atmos. Chem. Phys., 17, 7175-7191, https://doi.org/10.5194/acp-17-7175-2017, 2017.

Always concerning Sect. 2.6, if available, it would have not been useful also to calibrate light attenuation against pure hematite and goethite minerals? This point has been probably already raised by the other reviewer, but I repeat the question.

Sections 3.3 and 3.4: take into account the Caponi et al. (2017) reference values for the MAC in the calculations. Also iron oxide and their speciation for dust samples from many regions worldwide was reported in that work, and these data can be useful for your data interpretation.

Sections 3.3 and Conclusions: I guess one interesting point to discuss based on your results and the comparison with the literature is the regional scale variability of iron content and its speciation and the impact on glacier absorptivity and albedo. I would develop this aspect more in the discussion. Could you also add some calculations of how much spectral albedo would change in relation to absorption by different species as found in your study? What about the seasonal and spatial representativeness of your data?

Section 3.3, Page 7, line 8: do you mean the effect of atmospheric aging on minerals? Please be more specific.

Page 8, lines 8-11: I guess this is basically your key conclusion and I would move it to Sect. 4. Also I suggest to add a brief discussion on the impact of the regional variability of iron oxides and their speciation, and the representativeness of your results compared to other regions of the world under the influence of other deserts with different mineralogical compositions.

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