Response to the comments of reviewer #1

Manuscript esurf-2022-35, Mansouri et al.

"The Permian-Triassic transition in the Blue Nile Basin: insights from petrography and geochemistry of sandstones"

Dear Reviewer,

We accordingly appreciate the time and effort of reviewer 1 in getting very constructive feedback on our manuscript, which helped to significantly enhance the quality of our manuscript. Below please find our response to the main comments of the anonymous reviewer 1. We are able to incorporate changes to reflect most of the suggestions provided by reviewer 1.

Regarding the abstract part we have tried to include the results and main findings of the studied area accordingly but concerning the comment on the abstract about adopting a more concise writing style, and focusing a bit more on the key scientific we will consider the comment in the revised manuscript.

In the introduction part, we tried to address the previous hypothesis on PTB and also new studies. However, regarding the missing recent literature, we will provide the new relevant papers recommended by the reviewer and new literature in the revised version.

Concerning geological settings and addressing the lack of enough information about tectonics, climate, lithology, basin fill, and basin architecture, we should point out that, there is not enough information and studies on this area despite this section being very appropriate to study the PTB event. An evolutionary model of the Nile River Basin is still lacking. The few existing studies are on the stratigraphy and palynology of this section. In fact, our study is a primary study in this area reporting petrography, geochemistry, and heavy mineral analysis for the first time. This paper can be used as a base study for people who would continue working on the Permian-Triassic succession of the Blue Nile Basin in Ethiopia and post-glacial deposits research. The reason that there is more information about the Early and Middle Paleozoic rather than on the Permian and Triassic is due to the comprehensive petrographical and geochemical study of them in comparison to the Permian-Triassic Fincha sandstone. Also, one of our main hypotheses and the first aim of our study was to see that is there any recycling of glacial deposits happened by Fincha sandstone or not. For this reason, we used their information in the paper to give a comprehensive overview of the older intervals to provide an appropriate scheme for comparison.

For the technical comments about sampling we would like to emphasize that natural outcrops where sampled, which are assigned to paleontologically well dated subformations (F1-F5), but do not provide a continuous record. Instead, our strategy was to analyse a similar number of samples (n = 7 - 8) for each of the three time intervals before, around and after the Permian-Triassic Boundary in order to compare those and to derive a general trend of sediment composition in the basin. Samples within each subformation/time interval were chronologically ranked according to their relative position at the escarpment and with respect to the crystalline basement as well as by lithostratigraphic criteria. This point will be better explained by our revision. We did not attempt to carry out a high-resolution study which would have been not possible at the existing natural outcrops.

For the heavy mineral analysis, the reason that we focused on a narrow grain size window (63-125 µm) despite the highly encouraged bordering grain size window (40-500 µm) (Garzanti et al., 2006; Caracciolo et al., 2020) was as follow: to get an average of the provenance signature (Caracciolo et al., 2020), to follow the strategy to minimize the sorting factors on the heavy mineral suite (Morton, 1985), and the most important one, implementing our geological questions and aim of our study to ensure comparability with corresponding data from previous studies (Edaga Arbi Glacials and Enticho sandstone; Lewin et al., 2020).

Concerning comments related to petrography, we classified the feldspar types and we mentioned them in the table. 2. Rock fragments have been classified according to their origin but in the case of metamorphic rock fragments due to low-grade types in the most cases, we didn’t specify them in the text. This is a good point, which has not been clarified appropriately in the text. All petrographical information including rock fragment types, feldspar types, grain sizes, and the interstitial components are available in detail and will be added in a more comprehensive style in the revised manuscript.

In the heavy mineral part for graphical representation, we used the common graphs which are using in many papers about heavy mineral analysis in case of representing the heavy mineral assemblages. The reason that we used the graph displayed in Fig.11 instead of using a biplot was to give a vertical variation of the grain morphology with heavy mineral indices to better show the changes with stratigraphic trends – the main purpose of the paper. Fig.9 was intended to show grain properties and give a primary picture of the discussed morphological features. We will follow the advice to drop this figure. Furthermore, we will add a biplot for the heavy mineral indices as well. Explaining differences in composition by weathering, hydraulic sorting, and diagenesis, we tried to implement weathering as a possible explanation. We are aware that some elements and also the CIA are sensitive to diagenesis. The Permian samples show higher carbonate cementation which is mentioned in the text. We will further clarify this and omit the CIA in our data evaluation. Instead, we will use petrographic criteria to make some statements about possible climate control on sand composition when revising the manuscript.

In the discussion part, we aimed to discuss arguments for changes in the source area, recycling of glacial deposits, and climatic changes including expected extreme conditions around the PTB. To gain that, we subdivided the discussion part into five subchapters to explain, relate, and compare our main findings with literature and previous works. We agree that the discussion could be shortened and some repetitions deleted. The discussion about the CIA will be deleted.

All point-by-point comments regarding to grammar, shortening some parts, avoid reporting equations will be implemented during the revision.

Caracciolo, L.: Sediment generation and sediment routing systems from a quantitative provenance analysis perspective: Review, application and future development, Earth Sci Rev., 209, 103226, https://doi.org/10.1016/j.earscirev.2020.103226, 2020.

Garzanti, E., Ando, S., Vezzoli, G., Ali Abdel Megid, A., El Kammar, A.: Petrology of Nile River sands (Ethiopia and Sudan): Sediment budgets and erosion patterns, Earth Planet. Sci. Lett., 252 (3-4), 327‐341. https://doi.org/10.1016/j.epsl.2006.10.001, 2006.

Lewin, A., Meinhold, G., Hinderer, M., Dawit, E. L., Bussert, R., and Lünsdorf, N. K.: Heavy minerals as provenance indicator in glaciogenic successions: an example from the Palaeozoic of Ethiopia, J. African Earth Sci., 165, 103813, https://doi.org/10.1016/j.jafrearsci.2020.103813, 2020.

Morton, A.C.: Heavy minerals in provenance studies. In: Zuffa, G.G. (Ed.), Provenance of Arenites, 148, NATO-ASI Series., Springer, Dordrecht, The Netherlands, pp. 249‐277, 1985.