

Interactive comment on “New regional stratigraphic insights from a 3D geological model of the Nasia Sub-basin, Ghana, developed for hydrogeological purposes and based on reprocessed B-field data, originally collected for mineral exploration” by Elikplim Abla Dzikunoo et al.

Anonymous Referee #3

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This paper describes the establishment of a geological model by integrating information from different sources including airborne electromagnetic (AEM), electrical tomography and borehole data. In particular, this study shows that the 1D layered inversion of AEM data leads to a better structural characterization of the targeted geological formations than the CDI transform, which was previously provided by the contractor of the airborne

C1

survey. The AEM data also uncovers hypothetical U-shaped paleo-valleys which can have a high potential in term of ground water resource in the area. The latest finding as well as the overall approach consisting in rep-processing airborne EM data initially designed for other purposes is worth of publication. Nevertheless, some additional work including improvement of current figures and a more detailed description of the geo-modelling procedure is, in my opinion, needed before it can be accepted in Solid Earth. Accordingly, please consider the following suggestions.

1) More details about well data and how the geomodel was built:

This paper focuses on how reprocessed AEM data and data from wells provided new findings concerning the geology of the Nasia Sub-basin.

a)The AEM data part is well described. However, I think that too little is shown concerning data from wells. As a consequence, several statements connected to borehole information in the text can only be assumed by the reader without trusted facts.

b)A second consequence is, for me, a lack of details concerning the geomodeling procedure. For now, the Authors quite roughly describe it as “iterations between geologist and geophysicist”. Also, they state that such iterations were done at the processing stage as well. For now, I can hardly see in which manner the geological information influenced the processing and the inversion of AEM data? Maybe more details about this aspect would be helpful for the reader.

This said, I would recommend to present a more detailed example showing how these iterations worked in practice, and by including well data. Is this could be done for one relevant profile? Another way could be a sketch summarizing such iterations, with relevant details?

2) Is the regolith analysis and the associated ERT surveys relevant for this manuscript?

The main findings claimed by the title and the abstract are the benefit of AEM 1D inversion for better characterizing the geology of the area. The output of the regolith

C2

analysis and the associated ERT, are in fact not really mentioned in the abstract. If the authors wish to show these results, I think they should develop how this part helped them in yielding the final conclusions regarding the deeper geology.

Overall, I couldn't really see the link between the ERT and the AEM data, and thereby, the link between the regolith and the deeper formations.

3) Overall, I think the figures could be improved with more details and annotations.

a) Figure 3: please add annotations with some localities, or profile labels, or generic formations, to connect it to figure 1? Figure 3 is discussed after Figure 4 in the text.

b) Figure 4 needs annotations to illustrate the Authors' interpretation similarly to Figure 7.

c) Figure 6 is hardly interpretable as it contains too much information. In the legend, there are also many colors having the same label? If the authors want to develop the regolith part, it is maybe better to show a selected 2D transect with annotations, similarly to Figure 7?

d) For more clarity, Figure 5 and 6 should have a consistent angle of view and should be properly delimited/located in Figure 1 (or somehow connected to it in a better way). Maybe an annotated 2D vertical (or horizontal) section of the 3D model would be more readable?

4) The paleo valleys:

a) As they are part of the Panabako layers, the paleo valleys seem located in the area where a dense AEM survey was performed. If this is right, showing a 2D horizontal slice (xy) of the AEM resistivity model would confirm their direction or highlight their pattern. Or maybe it is only one valley?

b) The resistivity section in Figure 7 is displayed with a (more or less) 1:20 vertical exaggeration. Accordingly, can we reasonably conclude that the valleys have a U-

C3

shape? Or is this a typical airborne EM data footprint for a U-shape valley? Overall, can we actually characterize such a structural detail with a 1D approximation for the inversion of AEM data?

c) If yes, the U-shaped paleo valleys represent further indications of the presence of ice during the Cryogenian. However, for all I have understood from this topic, the snowball earth theory depends on the (questioned) reliability of the geo-localization of the present formations during the Cryogenian (mainly from paleo-magnetism), is this right? Only if this is question is still relevant according to the current knowledge, a discussion may be needed about this aspect too.

Sincerely,

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2019-145>, 2019.

C4