

***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.***

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General comments

The paper uses airborne electromagnetic (AEM) data to construct a geological model of a sedimentary basin. The workflow is sound and well described. The requirement

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for (and difficulty of) interpreting the geological interfaces is made clear.

The application of AEM measurements, whether B field or not, for the purpose of hydrogeological investigations in a new area (The White Volta basin) is sufficient to warrant publication.

The NW-SE trend of the paleovalleys seen in Figure 7 is not apparent on any map. I suspect this direction is really just the direction perpendicular to the flight line. However, the three valleys might be the one system meandering across the line three times, so the trend of the paleovalley might be NE-SW. I suggest being more cautious in interpreting the direction unless you have a good map constructed from data from multiple closely spaced lines.

The geological significance of the paleovalleys is very interesting. It provides a piece of evidence that might be key in resolving the history of glaciation in this region. Hopefully publication of the discussion and ideas of this paper helps to stimulate further ideas on this and geological work is initiated that resolves this question.

Specific comments The introduction starts to draw conclusions, but no evidence has been presented. Try and restrict the introduction to background and the problem you want to solve and examples of previous work along the same lines. With conclusions in the introduction, the introduction reads like a repeated and longer version of the Abstract, which it should not be.

Sometime Fig. is used in the text, other times it is spelt out in full. I am not sure if this is the style of the journal. Check the instructions to authors.

It would reduce confusion if the relationship between the formations in Figure 1b and the groups defined in the text (Bombouaka and Oti-Pendjari) were clarified

Figure 4 is referred to in the text prior to Figure 3. Perhaps they could be swapped.

It would help if the colours on Figure 5 corresponded to those on Figure 1 b in some way. Also, it would help if the legend of Figure 5 was in stratigraphic order.

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Figure 6 and all the colours are confusing. Is this figure really necessary? It would help if all the 3D view angles in Fig 5 and both images of figure 6 were the same.

Figure 7 and Figure 2a are both of the same line, but do not agree. Are they different parts? Perhaps state this in a caption.

On Figure 7, the Kodjari lies below the Panabako Upper. Is this stratigraphically correct? Further, the deepening of the top of the Lower Panabako near 120000 (m) is not supported by the resistivity data as the material above it is yellow, just like the material below it. I would put this boundary higher. See the red line on the annotated pdf. This also gives a section that makes more sense stratigraphically, as younger Kodjari will not be below older upper Panabako.

In section 2.1 study area, the Bombouaka and Oti-Penjari groups are mentioned, but other groups, later referred to (or mentioned in the Abstract) are not mentioned (Was-sangara, Supergroup 1, Kwaku, Supergroup 2). I suggest adding a geological section with all formations and groups and supergroups listed.

Figure 1b has North to the left, all others have N to the right, except Figure 8. Being consistent can reduce confusion.

Technical comments Line 24 and 25: the abstract talks about a valley, then calls it valleys, which is inconsistent.

Line 38: "scenario simulations" is vague. Try and be more specific about what this means.

Line 41: perhaps funding statements should be in the acknowledgement.

Line 41 to 44: these sentences are conclusions not introductory. In the Introduction, the background and problem should be outlined.

Line 56: Voltaian is not introduced yet. Is this a shorthand adjective for something related to the White Volta Basin. Or is the Voltaian Basin and the White Volta Basin

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two different things?

Line 60: Can "scenario" be removed without loss of meaning?

Line 69. Here in a subordinate clause, you imply the Kofjari formation is associated with the Marinoan glaciation. In the Abstract, you imply it is the pre-Marinoan. Perhaps the sentence or Abstract can be rewritten to be clearer.

Lines 69 to 79: These are conclusions drawn from your study and should be in the conclusions after you have presented the evidence.

Line 82: Nasia basin is not mentioned in the introduction, but the White Volta Basin and Voltaian Basin are, so the Nasia Basin comes as a surprise. Perhaps it is a drainage basin, not a sedimentary basin. Line 124: Perhaps change "stacking in time" to "averaging down the decay".

Lines 125 to 128: The "optimal lateral time-dependent stacking window" is a vague statement that could be interpreted in many ways. This should be expanded out to describe precisely what you have done. It sounds like a spatial averaging that varies lateral width by window. Give more details about this. What were the widths, etc.

Line 132: Is thickness also a model parameter, or is the thickness fixed?

Line 200-201. I suggest labelling this resistive body on the section with a symbol like an asterisk, so people can see it immediately. I was initially confused as I expect conductive features to be hotter colours, so perhaps you could mention this at some point encouraging people to look at the colour scale.

Line 203. I think I see these two resistive structures at about 100 m depth below. I would be more confident if they were marked with a symbol.

Line 219. Change "first" to "uppermost"

Line 221. the "was undertaken" is confusing. Do you mean the outcrop was Panabako sandstone or the borehole drilled there intersected this sandstone? I have suggested

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a different wording in the pdf version of the manuscript, but this might not be what you mean.

Line 232. Before “fresh”, add “unfractured”.

Line 250. This sentence is repeated in the next line below.

Line 264. Does “is confined” mean outcrop or more generally “appears at depths”.

Poubogou Formation section. You mention twice the grading upwards into the Panabako. Once is sufficient.

Line 269. Change poor resistive to low resistivity.

Kodjari formation. You say it lies on the topmost units of the Bombouaka group, but make clear it lies unconformably on these.

Bimbila Formation. The text mentions Chereponi and Bunya members, but Figure 7 shows the -1 shale and +1 subdivisions. Be consistent. Mentioning a new formation name with no stratigraphic section is confusing.

Structural interpretations. It would be better to list the age that the Oti rocks are younger than, not older than, make clear the duration of the unconformity. Perhaps the >600 Ma should be <600 Ma.

Line 325. I had trouble seeing these, so I suggest being more specific “Three characteristic U-shaped” valleys were interpreted on the AEM data between 123 and 133 km on the profile as narrow resistive features at the base of the Upper Panabako cutting into the lower Panabako marked with # symbols on Fig. 7).” Put the three symbols # or similar on the figure.

Line 333. Here the dates are 635 – 1000 Ma, but in the paragraph above 600 – 950 Ma. Perhaps you could be more explicit in explaining why you have made a change of each date.

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Line 334. You say the date is of the Bombouaka group, but the range of this group has not been defined in your paper. The paleochannels must come after the end of the lower Panabako, but I suspect the group does not end between the lower and upper Panabako. Paleovalleys can be created during or after a formation is deposited, as they can cut through the formation. You should be explicit as to when you think the glaciation occurred, within or after the upper Panabako. If you are not sure, state this.

Line 337. Give an explanation of how you arrived at a date of 1100 Ma; perhaps a citation for the person that did the dating.

Line 394. Change paleochannel to paleovalleys for consistency.

Other minor grammatical and wording suggestions are in a marked-up pdf version of the manuscript.

Please also note the supplement to this comment:

<https://www.solid-earth-discuss.net/se-2019-145/se-2019-145-RC1-supplement.pdf>

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

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