Answer to Anonymous Referee #1 (https://doi.org/10.5194/egusphere-2022-708-RC1):

Thank you for accepting to be a referee, and the time spent to review this manuscript. We appreciate the comments. We have updated our manuscript accordingly and hope to answer the questions satisfactory, in the following. Where we references to manuscript lines, these are the lines in the new, revised manuscript.

The introduction part is not well-appealing at present, several important references related to passive margin studies and related to geophysical investigation especially electrical resistivity are missing. Authors are advised to present the introduction part and make a connection.

We found your comment helpful in realizing, that we're missing an introduction to typical geophysical observations at passive margins. Therefore, we added a passage about the typical characteristics seen in geophysical surveys at l. 33 ff. If you have further suggestions for important references, which could benefit our introduction, we would be grateful to have them, so we could include them in our manuscript.

Otherwise, we chose to keep the introduction short, because the second part of the manuscript contains a thorough literature review of the geological setting of the Namibian passive margin. We decided on this form and extensive geological setting, to clearly characterize the margin based on previous research and to be able to reference it in the following discussion of our results. We did not aim to review global passive margins in this manuscript, but focus on the South-East Atlantic margin. In the later discussion, we compare our results to other passive margins (e.g. the Norwegian and Australian margins).

What's the novelty of this work while already number of inversion techniques have been presented coupled with various modeling schemes?

The inversion technique and modeling schemes are not a part of this manuscript. They have already been presented in Avdeev et al. (1997), Moorkamp et al. (2010), Moorkamp et al. (2011), Jegen et al. (2016), and Franz et al. (2021).

This manuscript focuses on a more thorough geological discussion of the results. The novelty here is the interpretation of joint inversion results of the Namibian margin. We provide a parameter analysis using a clustering approach of the parameters electrical resistivity and density, which is not available for the Walvis Ridge margin. The new mapping of these two parameters may guide future joint inversion approaches.

The geology section can be briefly presented rather than defining several phases separately. Authors should focus on depositional history and the relevant tectonic episodes.

Thank you for this comment. We have added a paragraph about the post-break up depositional history (l. 204 ff.). It is indeed an important part of the geological setting, because we discuss sedimentary processes related to our results in the later part of the manuscript.

The defined geodynamic phases corresponds to relevant tectonic episodes in the formation of the Namibian passive continental margin.

How does the authors justify the overlap in the electrical resistivity and density plots during clustering analysis in Figure 3? Have the authors considered standardized resitivity-lithology correlation? I guess NO. If yes, how? Also, it is very difficult to distinguish the symbols and colors presented, it can be further simplified for understanding, especially when compare these results to Figure 4.

The joint inversion algorithm results in regularized, smoothed electrical resistivity and density models. Combined with the applied soft clustering approach, we inevitably experience overlap of the defined clusters (l. 266 ff.). The overlapping values between to domains, e.g. both sediment and crustal domain contain electrical resistivity values between ~0.5 and ~20 Ωm with density between ~2300 and ~2700 $kg \cdot m^{-3}$ are the reason we decided to include the differentiation into three distinct domains. We found it hard to distinguish sediment, crustal, and mantle anomalies without this separation. Li & Sun (2022) have reported similar issues with the reliable identification of parameter relationships associated with the depth of anomalous bodies. We have added this reference to our manuscript, when describing the domain differentiation (l. 247 ff.). The definition of the domains is guided by seismic investigations, which have a good sensitivity for layer boundaries, i.e. sediment basement and acoustic Moho.

Resistivity in itself is not unique. Additionally, the large scale 3D MT inversion does not yield precise absolute electrical resistivity values but aims to interpret large scale variations and localized anomalies. Therefore, a pure resistivity-lithology correlation is inadequate. The main idea of this manuscript is the mapping between two separate geophysical parameters and correlation with tectonic units. Hence, we use the advantages of joint inversion to improve resistivity guided interpretations, which were presented in Jegen et al. (2016).

The results presented in vertical section along Profile P100 and the cross-plots in Figure 3 are not strongly correlated, there exists overlap in the resistivity values for crustal sediments and others.

The data presented in figures 3 and 4 is identical. Figure 3 shows a parameter cross plot for all model cells of the 3D models used in the cluster analysis. This includes model cells in a proximity of 10 km to our MT stations (shown in figure 1, cf. l. 259 f). Most of the data points of figure 3 are therefore represented in either figure 4 or 5, which are the perpendicular profiles P100 and P3 (fig. 1). Therefore, they show the spatial distribution of the defined parameter clusters.

Concerning, the overlap of the parameters in the sediment and crustal domains, please refer to our previous response. The domain separation is specifically included to be able to differentiate between sediment- and crustal anomalies.

Also, these figures can be better presented.

We have experimented with different ways to visualize our data and came to the conclusion, that the included figures present our results best. The depiction of all clusters by their physical parameter in figure 3 shows the results of the performed clustering. The two vertical sections in figures 4 and 5 allow for a spatial correlation of the clustering results in order to interpret them in the context of geological variations and match them with the tectonic episodes described in section 2.

If you have additional suggestions to improve presentation, we would appreciate them.

Again, going back Figure 3, plus, this is too random to get useful conclusions about relationships of two variables.

Indeed, the initial mapping of electrical resistivity and density of our joint inversion models seemed random. This is the reason why we performed this analysis, using a clustering approach to identify individual groups. This approach prevents personal bias. We additionally separated our models in three depth domains based on seismic results (see previous response concerning parameter overlap) to emphasize geological differentiation. By spatially correlating the clustering results (as shown in figures 4 & 5), we compare the identified clusters to our resistivity and density models, as well as to independent seismic models. From this correlation we conclude our interpretations concerning lithological units and tectonic episodes.

Why the electrical resistivity and density values are lower in Cluster cru-A? the authors did not justify well. Please justify

It’s true, that this is a surprising results. We interpret the cluster cru-A to represent series of interlayered sediments and basalt flows (seismically imaged as seaward dipping reflectors, SDR). Our model’s electrical resistivity and density values are within the bounds of downhole geophysical logs in similar environments (l. 456 ff.). The history of the Namibian passive margin includes several periods of high sedimentation rates, especially during and shortly after continental break-up. These high sedimentation rates can explain, thick sedimentary layers withing the SDR packages. The new paragraph about the depositional history at the Namibian margin (l. 204 ff.) aids this explanation, and we have also added a sentence referring to this increased sediment input in the discussion (l. 481 ff.).

Another important factor in the low crustal resistivity values, is the MT method’s sensitivity to conductors (cf. Bedrosian, 2007), and the deficiency of both applied methods (marine MT and satellite gravity) to resolve thin basaltic layers (l. 483ff.).

Line 315: The cluster’s cells are distributed in all model areas and summarize mostly shallow ranges above 10 km. In this case, 10 Km is not a shallow depth. Also, the authors stated that 189-210 Km on Profile P100, whereas the cross sections don’t exceed 100 Km, how would the authors justify this depth contrast and the inferences made?

We understand that this was incomprehensible.

With the expression “shallow ranges” we refer to the “shallow” or upper crust. The wording was changed to “upper crustal ranges” (l. 372).

The reference to kilometre 180-210 is referring to horizontal profile kilomtre. We added this to the manuscript (l. 373).

Lines 365-375, I would like to know the ranges defined for low, very low, high and very high etc?

Thank you for pointing out this missing information. We added the values to our manuscript (l. 431 ff.)

100 km depth Aur 500 km k profiles using MT Data, are not authentic, please justify.

Jegen et al. (2016) and Franz et al. (2021) discuss the resolution and uncertainty of the electrical resistivity models. Synthetic tests have verified, that the vertical extent of anomalies may not always be reproduced accurately, i.e. shallow conductors may be vertically smoothed. This may be explained by large vertical cell size, and in some model areas by insufficient station spacing. Additionally, we may not differentiate between high absolute resistivity values at depth, i.e. a change in resistivity at Moho depth. Nevertheless, the synthetic tests have proved the need for generally high resistivities (>2000 Ωm) at lower crustal and upper mantle depth (clusters cru-D and man-D), and the need for upper crustal conductors identified by cluster cru-A. Thus, our model tests proved a reasonable sensitivity for the most important model features, which we aim to interpret.

Although our clustering includes all inversion model cells (up to 300 km depth), we have confined our interpretation mostly to the upper 100 km (shown in figures 4 and 5), due to reduced sensitivity below. The models reach this deep to prevent boundary influences from the 1D background model needed for inversion (cf. Franz et al., 2021).

And there is no relationship between conductance and density (it should be a cross verification while resistivity to density relations is defined)?

Magnetotelluric data are, particularly for shallow conductors, mostly sensitive to electrical conductance, i.e. the conductivity-thickness product. When interpreting conductivity anomalies, we are thus faced with ambiguity. By calculating the electrical conductance, i.e. multiplying the cell's conductivity values with the cell's thickness, we can verify the distinction between the two sediment clusters. The analysis emphasizes, that the distinction is not only an effect of sediment thickness, as the two clusters also clearly vary in conductance. We are therefore confident, that the two clusters summarize different lithological units (cf. l. 337 - 345).

Additionally, we evaluate whether the effect is biased by an inaccurate discretization of sediment thickness due to a large vertical cell size. For this, we "revert" the conductance calculation by dividing conductance by precise sediment thicknesses derived from seismic data. The resulting electrical conductivity values are in the range of the model's values (cf. l. 580 – 586).

Figure 7, I don't understand the smallest values (0.3-3 Ohm-m) in a depth range of 0-10 Km (even onwards). Can the author justify such an anomaly ?

We are similarly surprised by these results. Please refer to our previous answer to the question "*Why the electrical resistivity and density values are lower in Cluster cru-A?*". In summary, we believe that this conductive anomaly in fact images packages of interlayered thick sediments and volcanic flows.

The overlay with the seismic sections by Gladczenko et al. (1998) in figure 7 emphasizes the immense depth (10 km and more) of the seismically imaged SDR sequences. These thicknesses have been confirmed by various authors, e.g. Bauer et al. (2000); Elliott et al. (2009); and Koopmann et al. (2016).

Also, there are several grammatical mistakes, and some sentences are very difficult to understand, please do a complete overhauling for the English write up.

We kindly asked a native English speaker colleague to help us revise the manuscript.

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