Uncertainties in breakup markers along the Iberia-Newfoundland margins illustrated by new seismic data

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Response to reviews

Reviewer 2: Frauke Klingelhoefer

The mansucript "Uncertainties in breakup markers along the Iberia-Newfoundland margins illustrated by new seismic data" by Annabel Causer, Lucía Pérez-Díaz, Jürgen Adam and Graeme Eagles present unpublished seismic data from the Southern Newfoundland Basin to study the impact of commonly used break-up markers for plate cinematic reconstructions of the initial ocean opening between the West Iberia and Newfoundland margins. The main conclusion is that in this region the "traditional" break-up markers do not allow to unequivocally discriminate the validity of the different plate tectonic rotational poles proposed in literature.

From this the authors propose:

1) Major Comments:

That new and better constrained reconstruction are needed to identify individual seismic profiles as parts of conjugate pairs. It is a bit unsatisfactorly that the main conclusion of this manuscript is that it is not possible to better constrain the opening using the data presented. A better constraint on the error of the different reconstructions could probably be done using the work of Hellinger, 1981 or Chang, Royer et al., 1991. A tool using these approaches is available in the free Gplates software (https://www.gplates.org/user-manual/HellingerTool.html).

No Action: *the reviewer has not appreciated the main aim of our manuscript, which is to use new data to highlight the large degree of uncertainty involved in interpreting breakup features of the kind that are often used to lead quantitative plate reconstructions. These aims are clearly outlined in section 1 (lines 87-105). Unfortunately, Chang's statistical tools are only applicable with Hellinger's fit criterion for seafloor spreading data. Regardless of how available these tools are in GPlates, they would only be applicable for a small subset of the cited plate reconstructions (those that only use seafloor spreading data). These tools are useless for assessing the uncertainty in geological markers like COBs off Iberia and Newfoundland, or transtensional basins in the Pyrenees. We do aim to take a quantitative statistical approach to understanding the study region in future work, based on a suite of purpose-built two-plate models for Africa, North America, Eurasia, Greenland and Iberia using a more modern and robust inversion scheme. This work is still in progress, and well beyond the scope of this manuscript.*

In my opinion, the manuscript is missing some information. It would be nice to know which software has been used for the plate cinematic reconstructions and for data processing. A short description of the seismic data processing, even if done by TGS would be of interest.

Action: *We have added detail on seismic processing to the revised manuscript (lines 254-265). The caption of figure 4 acknowledges plate modelling method used. Given that plate kinematic modelling is not the principal aim of our manuscript we don't see a need to include further details in the text.*

The discussion should be extended to give at least an impression of comparable margins. Is this uncertainty a general problem or only in this specific region, which has nonetheless been very extensively investigated? If only here, than why, for example are the magnetic anomalies especially unclear and uninterpretable or is this due to the large extend of serpentinised mantle material?

No Action*: we refer the reviewer back to our introduction section, in which the difficulties of interpretation at divergent continental margins in general are introduced by citing a previous global study in which some of us were involved. More specifically, as our study region is the type region for mantle exhumation in wide transition zones, we feel there is little to be gained from a detailed examination of comparable margins where the difficulties of interpretation are likely to be understood with reference to Iberia-Newfoundland.*

The manuscript has no acknowledgement section, but probably some free software ("Generic mapping tools" or other) were used and should be acknowledged.

Action: *GMT will be acknowledged in the final manuscript.*

Figures:

Figure 1: it would be nice to add the magnetc anomaly positions.

Action: *Done.*

Figs 5, 6, 7: all panels should be annotted a,b,c,d,e and explained in the legend. I think a classical offset and time annotation would be helpful, rather than just having a scale for one second and 10km. Middle panel have no indication for 0 s.

Action: *figures have been improved and re-labelled in response to the comments here and those of Reviewer 1.*

Figure 9: strictly spreaking there are no data shown in this figure, but mentioned in the caption.

Action: *this figure and its caption have been modified.*

Minor corrections:

L. 82 Furthermore -> Furthermore we

Action: *done.*

L. 94 missing ")"

Action: *done.*

L. 104 "(" too much

Action: *done.*

L. 169 Isn't M25 125 Ma age?

No Action: *M25 dates to ~155 Ma in the timescale of Gradstein et al., 2012, which we have used throughout.*

L. 177 "(" too much

Action: *done.*

L. 219-228 This is more "objectivs" than "Data and methods"

Action: *section has been refined.*

L. 229 allows -> allow

Action: *done.*

L. 239 Would be C2 nice to have more detail, seize of the airgun array, length of the streamer...

Action: *More detail has been added (Lines 254-265).*

L. 390 suggested -> suggest Gurnis, M., M. Turner, S. Zahirovic, L. DiCaprio, S. Spasojevic, R. D. Müller, J. Boyden, M. Seton, V. C. Manea, and D. J. Bower, Plate tectonic reconstructions with continuously closing plates, Computers & Geosciences, 38, 35-42, 2012. Hellinger, S. J. (1981). The uncertainties of finite rotations in plate tectonics. Journal of Geophysical Research: Solid Earth, 86(B10), 9312-9318. Chang, T., Ko, D., Royer, J. Y., & Lu, J. (2000). Regression techniques in plate tectonics. Statistical Science, 342-356.

No Action: *These references describe specific tools (Gurnis et al for GPlates, and Hellinger and Chang for one approach to statistical modelling of plate motions from seafloor spreading data) that we have not used at any point for this manuscript and have zero relevance to the discussion of Anomaly J at line 390.*