Solid Earth Discuss.,
https://doi.org/10.5194/se-2019-66-RC2, 2019

Solid Earth
Discussions
Open Access
EGU

Interactive comment on "Fault interpretation in a vertically exaggerated seismic section: evidence of conceptual model uncertainty and anchoring" *by* Juan Alcalde et al.

Javier Tamara (Referee)

javier.tamaraguevara.2013@live.rhul.ac.uk

Received and published: 5 June 2019

Summary

The paper address the impact of vertical exaggeration on the interpretation of seismic sections. Seismic sections in time with two different vertical scales (1:2 and 1:4) were given to students for interpretation. This resulted in 3 main interpretations of structural styles seen in both scales. The authors measured fault dips of individual interpretations and analysed the results of all the data.

General comments

Printer-friendly version

Discussion paper

1. Effect of background and expertise

In the introduction, it is mentioned that previous studies have shown that the background of the interpreters is essential. However, the authors do not seem to take into account the workflows and methodologies used during the interpretation, which may be related to the knowledge and experience of the interpreter. I suggest that the result of the study should be filtered based on knowledge and experience. You can divide the result, e.g. as undergraduate vs postgraduate, and use additional information such as knowledge and attendance to courses in structural geology or seismic interpretation to rank the knowledge of the interpreter. That information is already in the data collected.

2. Anchoring and bias effect

The authors interpreted that defining a reflection or set of reflections as horizons or faults may represent a form of anchoring. However, this seems different from the concept and examples described in the introduction where new data is given after an initial interpretation, and the interpreter does not see the necessity to adjust their interpretation.

In the discussion of anchoring, the authors mentioned “horizons cutting reflections” as an element that suggest anchoring. However, it is not possible to know how and where in the seismic section the interpreters defined the horizons and the faults, or where did they start the interpretation. Moreover, the authors also discussed that they could not know if the students changed their minds during the interpretation, or what elements within the seismic section were considered in the process. Therefore, it is not clear how the anchoring bias was defined.

The fact that experience was not taken into account is also a problem. “horizons cutting reflections” may reflect a lack of understanding of seismic interpretation.

3. Vertical exaggeration analysis

Although the exercise is related to the perception of the interpreter to the scale, the

Printer-friendly version

Discussion paper

authors based their analysis on the interpretation of seismic sections in time. It seems that the authors consider 1:2 and 1:4 represent vertically exaggerated displays of a 1:1 section. These scales are more likely to be display factors for seismic sections in time. A 1:1 display factor in time will be significantly different from a 1:1 section displayed in depth. The same problem will apply for other display factors in time, which will not be representative of the real scale of the structures in depth.

Moreover, the depth section will depend on the velocity model used for depth-conversion. For example, assuming an unrealistic and simple model of a constant velocity of 5000 m/s throughout the section, the 1:2 display ratio you used will be equivalent to a 1:$\sim$0.7 depth ratio, whereas at a velocity of 4000m/s, this will be equal to a 1:$\sim$0.9 depth ratio. This means the section with 1:2 display is more likely horizontally stretched and not vertically exaggerated. The analysis of the impact of vertical exaggeration should, therefore, be performed in a depth section and possible in PSDM section.

I suggest you depth-convert a section, so you have a reference for what a 1:1 section in depth looks like. Then compare these to the time sections given to the students and analyse the result taking into account the depth section. You can also consider additional display factors (e.g. 1:6, 1:8) in time to complement your study.

4. Fault dip data

The author should clearly state in the text that the measurements were made for comparison and are not representative of real fault dips.

The analyses of fault dips should be divided based on the conceptual models, as different assumptions were made for these. Mixing data from different conceptual models based on dip direction as in figures 4 & 6 seems inadequate. The authors mentioned that right-dipping reverse faults required higher angles than right-dipping normal faults so that both populations will differ due to the assumption made during the interpretation. Hence, these should be treated separately as in figure 5 & 7.

The data shows significant variability suggesting that the average should not be used.

In figure 8, the analysis of fault dips should take into account the position of the faults within the section. As they are, the results show too much dispersion and mix different conceptual models (right-dipping faults). It is not possible to correlate faults between different display scales. Hence, it is not possible to know if the perception changed due to the scale. As currently displayed (rose diagrams (Figure 7) and curves (Figure 8)), the results are difficult to interpret and should not be used.

I suggest that the authors subdivide the dataset based on the conceptual models and use plots of horizontal distance vs fault dip. For example, you can compare the horizontal distribution of the interpreted faults to see which faults are recurrent in the interpretations, and are located in similar places. Then for each location where faults are repeated, you can analyse the "dip" distribution and calculate a representative value for that population. This can then be compared between scales and plotted in figure 8.

Final remarks

Vertical exaggeration and anchoring are important aspects that should be taken into account during seismic interpretation. Research on the impact of these in the outcome of the interpretations can contribute to the seismic interpretation workflow. However, the way the experiments are designed and the way results are present are crucial.

Although the authors try to discuss the importance of vertical exaggeration and anchoring, the paper in its current state does not give support for their conclusions. The effect of anchoring is based on assumptions, and the existence of bias cannot be evaluated from the data and the analyses presented. The experiment, as described, is unlikely to support a discussion on anchoring and bias.

The use of time sections makes the results uncertain, and their analyses do not include the background and experience of the interpreters.

I suggest the methodology used to analyse the data needs to be modified. Current dia-

grams are difficult to analyse and sometimes combine the result of different conceptual models. Some of these do not support their discussion points.

I suggest the author should revisit the methodology and parameters used to analyse the data, as well as the way the results are displayed. This inevitably requires major changes in the way the paper is presented, including significant modifications to the text and figures. The discussion and conclusions should be reconsidered after these modifications.

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2019-66/se-2019-66-RC2-supplement.pdf

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2019-66, 2019.

Printer-friendly version

Discussion paper