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Solid Earth Discussions

Interactive comment on "High resolution reflection seismic profiling over the Tjellefonna fault in the Møre-Trøndelag Fault Complex, Norway" *by* E. Lundberg et al.

Anonymous Referee #1

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This paper is a presentation of a geophysical characterization over the Tjellefonna fault in Norway. The authors present two seismic reflection profiles and three resistivity profiles that show interesting results of the shallow surface structure. Taking into account the difficulties in the acquisition process, especially in the seismic data, the authors achieve important results to understand the internal structure of the study area. The content of the manuscript seems appropriate for SED but several issues need to be solved before publication.

The main concern about the manuscript is about one of the objectives proposed in the abstract and the introduction. The Tjellefonna fault and the topographic lineament

observed coincide in the study area towards the south-west but not towards the north-east. The authors use seismic and resistivity profiles to understand and explain this issue. In my opinion several considerations must be taken into account. First of all, the divergence between Tjellefonna fault and the topography is treated in a very confusing way during the paper. For example, Figure 2, which should be the reference in all the paper, does not include the trace of the main fault. Furthermore, in several sentences in the manuscript both features seem to be related in all the study area (for example, line 1 in page 252). Besides that the objective to explain the divergence of these two features towards the north-east is not accomplished. At this point it is also important to bring out the use of secondary fracture term in the manuscript. In my opinion it is not clear if you refer to a set of fractures associated to the main fault or a different set of fractures in the topographic lineament direction.There is no evidences of a secondary system of faults and fractures in the topographic lineament direction not at least from the seismic reflection and resistivity profiles. In this case, we would expect a set running almost parallel to the topographic lineament (approximately 30° from the main fault). The reflections inferred from the travel-times modeling seems to relate all these fractures to the main fault and they follow, more or less the main fault direction. The only evidence is the resistivity profile RP4 which shows a lithological change close to the topographic low but the strike of this fault cannot be inferred. In any case it is not possible to state that this is a secondary fracture zone responsible of the topographic lineament. If you have a look at Google Earth images of the study area is possible to see two sets of fractures (according to Tjellefonna fault direction and topographic lineament) but it is not observed in the results presented in this manuscript. For this reason, the authors have to provide more evidences of this issue to include it as an objective of this work.

Comments, suggestions and corrections:

- In the description of the study area, just in the beginning of the Introduction, there are several references to different important features related to MTFC: North Sea basin, Møre and Vøring basins, WGR and Børgefjell. I think that could be useful to locate

this features in Figure 1. At least those features that are relevant to understand the geological context.

- Several comments related to figure 2: 1. The Geological Setting section provides a good picture of the regional context of the study area. However, I would appreciate more references to the local features that are relevant to understand the final interpretation of the results. This could be done using figure 2 that are not referred in this section. A good description of the local geology will help to understand what you are looking for and why you are acquiring this geophysical data set. You also need to clearly locate the study area within the Western Gneiss Region.

2. Looking at figure 1, it seems that the topographic lineament and the Tjellefonna fault do not coincide. Please plot the fault in Figure 2 to better understand the tectonic and geological setting. Your paper is focused on this fault and it is missing in this figure. Include the topography (contour lines) of the map it will be useful to understand the topographic changes in the study area.

3. The manuscript and the figures must be consistent. In figure 2 the seismic and resistivity profiles are named in a different way than in the manuscript. For example, seismic reflection profile number 1 is labeled as SP1 but in the text is always referred as Profile 1. I really think that the nomenclature in figure 2 is easier to follow and locate the profiles because it clearly differentiates between seismic experiments (SP) and resistivity profiles (RP). In the manuscript the authors refer to both experiments as Profile that it is very confusing.

- Include the reference to figure 2 when you explain the 2D resistivity profiles at the end of Data Acquisition section. Remove the reference to figure 3 in line 22 page 246.

- In line 8 (page 247) you write: “we produced two separate stacks of Profile 2 that were merged before interpretation”. Could you explain something else about that? Did you use two different stacks in different intervals of CDPs? A sentence explaining that will be useful.

- The travel-time modeling of the reflections observed in the shot gathers and the stacked sections need to be explained a little bit more. A few sentences explaining how you proceed, the steps followed, the calculations of the reflection coefficients, how you decide the geometry of the reflectors. Is a 3D modeling? I guess so. In this case, is there any problem in the fact you have 2D seismic profiles? Can you assure that this is the only possible solution for the travel-time modeled? Please state the reasons why the modeling results for the reflectors are the right one.

- The sentence: “The antiform indicated in the geological map (fig 2) is also marked on Fig .4 for comparison” (line 26, page 248) is not needed. It’s fine in the figure caption but not in the text. Add the reference to figure 2 in the next sentence where you tell us the good correlation between seismics and surface geology. You can add the reference to figure 2 in this sentence. Add a label indicating antiform axis in the figure will be useful to understand much better figure 4b.

- I would really appreciate to see the processed shot 95 (Fig. 6) with and without the modelled travel-times for reflections R1-R5. It will be possible to see much better how the modelled times fits the data.

- At the end of the first sentence in page 251 :”of 160 m and the delay . . . “ include a reference to Figure 12.

- Page 253 line 22. The sentence: “Nasuti et al. (2011) showed the existence . . . “ refers to a Profile. We need to know if your talking about resistivity or seismics. With the right nomenclature meant before will be more clear.

- Page 255 line 20. Change the word concordant for related.

- In Figure 14 the resistivity profiles are really difficult to differentiate. The Fold Hinge Line mapped at surface and the interpretation of the seismics seem they do not coincide, probably due to the figure perspective. The authors need to improve this figure because is the summary of the results obtained.