Solid Earth Discuss.,
https://doi.org/10.5194/se-2018-120-AC1, 2019

Interactive comment on "The crossdip correction as a tool to improve imaging of crooked line seismic data: A case study from the post-glacial Burträsk fault, Sweden" *by* Ruth A. Beckel and Christopher Juhlin

Ruth A. Beckel and Christopher Juhlin

ruth.beckel@geo.uu.se

Received and published: 5 March 2019

We would like to thank the anonymous referee for the constructive and helpful review. In the following, we will answer to the referee's comments and suggestions and describe adjustments made in our manuscript. The referee's comments are in italic font and our response is given in the intended blocks. Additionally, we will attach a new version of the manuscript with tracked changes as a supplement. Please note that this version of the manuscript contains changes suggested by both referees.

P 2 / L 18-19: " none of the existing correction methods is optimally suited to image a feature like a post-glacial fault" I would welcome some more discussion why these methods are not optimal in this specific case.

> We explain this point in more detail later when we discuss the previous applications of the crossdip correction, but we fully agree that a short explanation is required here and we added this to the manuscript.

P13 / L3-8: Which types of migration were tested?

> We tested a couple of different migration algorithms with different parameters including: Stolt migration with constant velocity and a stretching factor (best results), a phase shift migration with turning rays (very similar to the Stolt migration), Gazdags's phase shift migration with a 1D velocity model (quite strong artifacts), Kirchhoff migration using the smoothed stacking velocities (very smeared image, disrupted reflections) and FD migration with an interval velocity model derived from the stacking velocities (steeper reflections basically disappeared). We even tried the Kirchhoff and FD migration using a constant velocity model but the results were still not comparable to the results from the Stolt migration.
> We added a short listing of the tested migration methods to the manuscript.

P13 / L9-11: What was the velocity model used for? Was migration also tested with this velocity model? How was the migration result using the tomography result, compared to the 5.4 km/s constant velocity?

> We did not test using the velocity model from the tomography for migration since most rays did not penetrate the bedrock and therefore, the model only covers the top 50-200 m of the profile. Consequently, we would have to choose a velocity function for the deeper parts anyway. Directly below the surface, the tomography

model has of course a much higher resolution, but in this part, we have very poor data coverage due to groundroll muting. Since all migration algorithms that can handle 2D velocity models yielded blurred results, even for constant velocities, we decided to stick to the constant velocity Stolt migration.
Consequently, the tomography model was only used to get a better image of the velocity distribution in the shallow subsurface for comparison with potential shear zones.

P16 There is a discussion about the origin of the reflectivity. You are discussing about positive and negative impedance contrast which would mean either a mineralizated, or a shear zone. Were the polarity and shape of the reflections analyzed? Are there any indications about impedance contrasts or e.g. tuning effects?

The discussion of impedance contrasts and tuning effects is meant to point out potential geological structures that can cause the reflections. Unfortunately, the data quality does not allow a more detailed analysis of polarity and waveform of the reflections. The noise level is quite high in most parts of the profile and the source wavelet does not have a very impulsive nature – most likely due to interactions between the free surface and the very shallow sediment-bedrock contact. Even after deconvolution, the signal retains its ringy character. Therefore, a detailed analysis of the shape of the reflections would be, in our opinion, over-interpreting the data.
We have added a short comment about this to the manuscript.

I think it would be illustrative to add a figure showing a CDP gather for the real data example: before and after crossdip correction and a comparison of the stacked sections (as for the synthetic model in Fig. 3).

We agree that showing an example of a CDP gather before and after crossdip correction helps illustrating the correction. We have added one example including

a (comparably) very strong reflection, but we would like to stress that this example is **not representative** since most reflections are hardly identifiable in the CDP gathers and show up first clearly in the stack as coherent events contrasting with mostly uncoherent noise. This is likely similar in many hardrock environments and therefore, the crossdip analysis should be carried out on constant crossdip stack panels instead of CDP gathers.

Furthermore, we would like to thank the referee for pointing out the following, more technical issues in the manuscript. We implemented the suggested changes in the new version of the manuscript.

P4 / L10-13: It would be helpful to mark some of the mentioned aspects in Fig. 2. E.g. with A,B,...

P 5 / L5: add A and B: "crossdip at 0.4 s (A) and 1.2 s (B)"

P 5 / L6: mark the CDP 350 and 1350 in Fig. 2.

P 5 / L7: "visible in the stack (Fig. 3b)."

P11: The reference to Fig. 9 appears before the reference to Fig. 8 in the text. This should be in order.

P13 / L13-14: Add b c and d in the text.

P17 / L8: "has has"

Fig 2: Some colors are hard to see (e.g. the gray box and the white numbers)

Fig 3b: Mark the shifted reflection B as you did it in Fig. 3c for the double reflection

Fig 9: Add A1 - 3 and B1 - 4 also to c and d. This would make it easier to follow the descriptions in the text.

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2018-120/se-2018-120-AC1-supplement.pdf

---

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2018-120, 2018.