

## ***Interactive comment on “Drill bit noise imaging without pilot trace, a near surface interferometry example” by Mehdi Asgharzadeh et al.***

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I appreciate the time and effort by reviewer 2 to correct my paper and I will strive to address all of his/her concerns to the best of my knowledge. I have organized my answers to follow each question individually and the changes in manuscript are given by page and line numbers so that the reviewer can find them in the attached pdf file that will eventually form my revised manuscript. I hope, I have answered all the questions but please let me know if you have more questions to be answered or discussed.

General comments: Question, I missed a more detailed discussion of possible shortcomings, necessary preconditions for applications (data sampling resp. distribution and extension of receiver locations), limitations of this approach (drilling depth, drill

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bit type, geology, signal-to-noise ratio) and comparison Answer: I added the disadvantages of using interferometric migration to the introduction (page 4, line 5-11). Although there is no separate section for preconditioning of the data, these steps have been discussed throughout the paper when the opportunity arises. I added a discussion related to the need for larger offset-to-depth ratios for focusing analysis and source signature estimation (page 4, line 18-26). I added a description of drilling mechanism and the bit type (page 4, lines 9-12). I added a part reasoning how signal-to-noise ratio was improved by larger depth and geology for the well under the study (page 14, line 11-13). The comparison with other SWD experiments is not straightforward as here we are dealing with near-surface conditions and shallow drilling depths. Offset is also very short, drilling method is different and there is no pilot trace recorded.

Passive seismic survey acquisition Question, Which kind of weight drop source was applied for the survey (see also the suggestion about a table with technical details below)? Answer: see Table 1 on page 6.

Analysis of seismic while drilling data.

Question, On page 6 it's mentioned that the application of interferometry to drill bit noise is a 2D process? Why, please explain. Answer: I reworded this part (page 10, lines 8-10). This was to say that the well (sources in the well) have to be in-line with the seismic line in order to meet the stationary source requirements of the IVSP interferometry as shown in Fig. 1. I have given references for this in the text. Please see also figure 2 in Schuster (2014) for more detailed explanation.

Question, Regarding figure 4, please make a statement about the signal-to-noise ratio of the crosscorrelated and stacked traces vs. active source traces. Answer: I added a statement that passive shot has obtained a signal to noise ratio comparable to that of active shot (page 10, lines 17-18).

Question, I assume the seismograms are trace normalized. The shear waves of the correlated traces seems to be stronger than in the active seismic survey. What are

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possible reasons for this? Answer: The drill bit rotation generates lots of shear waves energy.

#### Interferometry and virtual source migration

Question, The migrated images of the virtual shots and the corresponding active seismic shots in figure 5 reveal different depths of reflections. What kind of velocity model was used to image the active seismic shots? What are the differences to the 3 layer velocity model used for imaging the virtual shots? Answer: The stacking velocity (0,1640) and (1000, 2500) was used by processing team to produce stack volume where first value is time in ms and the second value is the velocity. The same function was used to migrate them in time using 3D post-stack Kirchhoff time migration algorithm. Using exactly the same values as in 3D seismic processing will result in non-coherent events and low signal to noise ratio of the passive image. On the other hand, velocity model in Figure 5 results in greater event coherency and larger signal to noise ratio in the migrated image than using simpler 3D survey velocity function. This velocity (Figure 5) was also used to depth convert 3D time volume. The mismatch in depth would be expected as a result of slight differences in velocities. Please note, I have reinterpreted the horizons (1-4) in figure 5 (d) and (e).

Question, The frequencies of the drill bit noise image is lower than that of the active shot image. Please make a statement on this and show average frequency spectrum for both images for comparison. This would allow the readers to get an impression on the resolution of both data sets. Answer: I added two spectrums in figure 5 and an statement to text (page 12, line 15-19).

Question, Does any of these reflectors are corresponds to the target reflectors mentioned in chapter introduction? Answer: Unfortunately, the interpretation cannot be published based on the confidentiality agreement with BHP minerals as this relates to a new Iron ore prospect in the region.

Summary and conclusions Question, under point 3 of the summary it is mentioned that

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drilling deeper wells leads to a large signal-to noise ratio in the final image. I have some doubts in this general statement because on the one hand the number stacked events increase but on the other hand the signal to noise ratio of the drill bit events are getting lower because of the longer travel path of the waves. Answer: I added this to point 3 on page 15 line 6-7.

Technical comments Question, A small table which summarizes technical information on the sources, receivers, recording system, drilling equipment would be helpful. Answer: The Table was added.

Remarks to the chapters Question, Figure 2: Improve the readability of the location of the survey area in the map on the left side. Answer: The map was replaced.

Question, Figure 3: Enlarge the screenshots or enlarge the scale in particular the time scale. Mark the ground roll events in the f-k diagram with an arrow instead of just with a line. Answer: Figure 3 was enlarged to be readable and arrows were added.

Question, Figure 4: Enlarge the screenshots or enlarge the scale in particular the time scale Answer: done.

Question, Figure 5: In c) and d) the labelling of the ordinate axes is missing. Answer: The labels are on top under the titles in (d) and (e).

Thanks again for your review and I hope my answers can address your concerns. With my regards Mehdi Asgharzadeh

Please also note the supplement to this comment:  
<https://www.solid-earth-discuss.net/se-2019-35/se-2019-35-AC2-supplement.pdf>

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2019-35>, 2019.

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