Solid Earth Discuss.,
doi:10.5194/se-2016-91-RC2, 2016

Solid Earth Discussions
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Interactive comment on "High-resolution shear wave reflection seismics as tool to image near-surface subrosion structures – a case study in Bad Frankenhausen, Germany" *by* Sonja Wadas et al.

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Received and published: 14 September 2016

General Comments

This is a very interesting case study using seismic data acquired with the ELVIS shear wave vibrator source to map subrosion structures in the urbanized area of Bad Frankenhausen. Four new high-resolution shear wave profiles are presented showing faults and fractured areas that correlate with low seismic velocities. The authors conclude that these structures are caused by subrosion in the near surface and are most probably the cause of the inclination of a church tower. The used scientific methods

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and assumptions are clearly presented. Results and discussion are elaborate and sufficiently support the interpretation and conclusions of the presented study. The abstract is concise and summarizes the main points.

The article is well structured and the topic (geophysics, structural geology) is relevant for Solid Earth. I therefore recommend it for publication with minor revisions.

I have a few comments which are suggestions that I hope may help in improving the quality of the paper.

Specific Comments

The sections “Seismic survey” and “Data processing” appear partly too detailed, especially the description of pre-processing steps. Shorter and more concise description emphasizing the essential information on the measuring setup and processing would benefit the reader. However, as the FK-filter is crucial, this part could be supported with a plot of the FK-spectrum and the applied filter in figure 8. Alternatively, make a reference to the FK-plot in table 2.

Figure 4 shows the location of a P-wave profile which is further discussed in chapter 6 for comparison with profile S4. For me as a reader, it would be interesting to compare these two profiles, however, the profile was not accessible as referenced (Wadas et. al., 2016). Please ensure that the work is referenced properly or include the P-wave data.

The authors mention that the profiles were acquired with two different generations of the ELVIS source and two pictures are provided in figure 6. I am missing a comparison of these sources, what are the differences and which profiles were acquired with which source? If there are no differences in data quality, mentioning the two source types and the figure seem unnecessary.

Technical Comments

The numbering of the figures, parenthesis and use of capital letters should be checked

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in the text.

There are some inconsistencies writing S/N ratio or signal-to-noise ratio in the text, please check.

Please also check that the terms “reflector” and “reflection” are used correctly.

The term Tertiary is not used anymore and should be substituted by Paleogene or Neogene (e.g. Page 3 Line 29 and following, Figure 1).

Page 3 line 12 Kelbra is not shown in the map

Page 4 line 2 . . .south of Kyffhäuser. . .

On page 4 “3 Seismic survey” the chapter starts by giving a general introduction of the position and elevation of the profiles. Adding the length of the profiles would give an idea about the special dimension of the study.

Page 4 line 14 (Fig. 2)

Page 4 line 18 (Fig. 3a)

Page 4 line 20 ”. . .which exceeds the inclination of the leaning tower of Pisa at 3.97”

Page 5 line 2 the authors write about profile 4: “To meet the requirements of this challenging investigation area the equipment and the configuration used for the shear wave reflection seismics had to be adapted by splitting the streamer.” – It is not clear what is meant by that as the receiver number seems to be constant for all profiles (figure 7). Please clarify what is meant.

Page 5 line 7 ”. . .(e.g. Dasios et al., 1999; Inazaki, 2004).”

Page 5 line 6 The authors write: “This source-receiver combination reduces the converted waves”, this however is slightly incorrect. The reduction of converted waves is achieved by vertical stacking of opposite polarization of the SH data after cross-correlation.

Page 5 line 32 “Therefore the mean CMP-fold of the profiles results in 18 traces. . .”

Page 6 line 14 “. . .improve the signal-noise ratio, by. . .)

Page 6 line 23 “Besides the vertical stack the S/N ratio was improved. . .”

Page 7 line 28 “. . .that have vertical offsets of ca. 1 m. . .”

Page 8 line 29 “reflections observed in the seismic image” instead of “reflectors”

Page 9 line 13 “Section 3 reveals another 30m wide and 20 deep depression structure (Fig. 11b, c, S3), located 15 m south of the church.”

Page 9 line 16 “. . . in the near-surface, low velocity zones or significant diffractions.”

Page 9 line 21 “80 m”

Page 9 line 24 “. . .to asphalt, concrete or cobblestone streets.”

Page 11 line22 “. . . are shown to be associated with salt dissolution (. . .).”

Page 12 In section “Summary and Outlook” the planned LiDAR scans could be mentioned as well (or instead)

Figure 1 could be more clear and maybe simplified, especially the legend. The reference LBEG (2015) is not in the reference list. The caption is unclear. Also the borehole information used for interpretation of the shear-wave data differ a lot from the average stratification.

Figure 7 compares 4 shots of the different profiles in means of noise and surface conditions. Which processing steps were applied to these shots?

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