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Interactive comment on "Coherent diffraction imaging for enhanced fault and fracture network characterization" *by* Benjamin Schwarz and Charlotte M. Krawczyk

Anonymous Referee #2

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General comments: The authors has presented two diffraction imaging approaches based on the assessment of coherence to detect geological features with small-scale complexity. One of the techniques is coherent focusing in which wavefield coherence is assessed in image space. Whereas in the second one, which is called coherent projection, first data coherence is evaluated, then the back-projection is conducted. Inspired from the field of optics, the proposed methods use intensities to evaluate coherence and reconstruct the image. The authors have declared that the coherent projection approach is not practical due to difficulty in separating wavefield components as well as being computationally heavy. Hence, they tested the focusing method on few real data including a multichannel and a single channel seismic data, a 3D seismic data,

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and a GPR data for imaging the upper crust. The results confirmed the success of the technique to detect faults and fracture networks, which later on can be implemented in qualitative interpretation. Generally, the article structure is clear and the content is rich. The concepts and techniques, presented in this paper, are novel, and they are supported with enough successful real data examples.

Specific comments: Please find my comments and suggestions below:

1. In page 3, line 86, the authors claim that since diffractions do not follow Snell's law, and they always have similar shape, therefore, diffracted signals are often an order of magnitude weaker than their reflected counterparts. Please elaborate on this matter and explain why the diffracted signals are often only an order lower than the reflected signals?

2. Page 6, figure 2: please check the section numbering. I recommend to add a section referencing in the figure caption, for instance: While projection-type imaging schemes start directly in data space (refer to section 3.3), focusing techniques typically are image-centred (refer to section 3.2).

3. What is the criteria to define the n-th order of the beam energy and the semblance? Does the algorithm utilize any optimization procedure to find the optimum order? Please elaborate on this matter in the last paragraph of page 8.

4. Page 10, figure 4: please explain whether augmentation is applied on the phase reversed semblance, or on the semblance directly? Besides, the explanation in the text about the algorithm and order of applying both phase reversing and augmentation is not clear.

5. Do the diffraction images, obtained via the coherent focusing technique, have the capability to be employed for future quantitative interpretation purposes?

6. Page 17, line 347: what do the authors mean with "a high degree of structural completely"? Please check the sentence.

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