Reviewer #2 comments:

Page 2.

1. (a) *I think the following reference would be relevant here:*
Masson, Y. J., and S. R. Pride. "On the correlation between material structure and seismic attenuation anisotropy in porous media" Journal of Geophysical Research: Solid Earth 119.4 (2014): 2848-2870.

(b) In this part of the manuscript we cite studies on fracture-related fluid pressure diffusion effects on the effective seismic anisotropy of fractured rocks. In the proposed reference, the study shows attenuation anisotropy effects associated with the presence of spheroidal inclusions that could be thought of as idealized fracture or cracks geometries. We have added the corresponding reference as suggested.

2. (a) *Please cite the former work:*
Masson, Yder J., and Steven R. Pride. "Poroelastic finite difference modeling of seismic attenuation and dispersion due to mesoscopic-scale heterogeneity. "Journal of Geophysical Research: Solid Earth 112.B3 (2007).

(b) In this part of the manuscript we mention studies related with seismic attenuation and velocity dispersion in fluid-saturated fractured media that numerically solve Biot's (Biot, 1941, 1962) poroelasticity equations. The suggested reference has been added here.

3. (a) *Numerical simulations based on experimental data have been conducted on fractured rocks, maybe it would be interesting to mention that:*
Masson, Yder, and Steven R. Pride. "Mapping the mechanical properties of rocks using automated microindentation tests. "Journal of Geophysical Research: Solid Earth 120.10 (2015): 7138-7155.

(b) In this part of the manuscript we cite studies related with the definition and modeling of fractures. The citation referred by the reviewer presents evidence of the geometry of fractures at the mesoscale on a sandstone sample. Since the suggested reference is relevant for our study, it has been added here.

Page 3.

1. (a) *I think this reference should be added here:*
Masson, Yder J., and Steven R. Pride. "Poroelastic finite difference modeling of seismic attenuation and dispersion due to mesoscopic-scale heterogeneity." Journal of Geophysical Research: Solid Earth 112.B3 (2007).

(b) The suggested reference has been cited in our manuscript (page 6, line 4) but not here as we are specifically referring to oscillatory tests which consider the application of a harmonic displacement as boundary condition.

2. (a) *I think Morency and Tromp also used a u-p formulation. Morency, Christina, and Jeroen Tromp. "Spectral-element simulations of wave propagation in porous media." Geophysical Journal International 175.1 (2008): 301-345.*

(b) We have checked the suggested reference and conclude that Morency and Tromp do not employ the ***u**-p* formulation. Moreover, their study focuses on wave propagation (dynamic equations) while our work considers quasi-static Biot's equations. Thus, we didn't include it in the manuscript.

Page 6.

1. (a) *Aren't you comparing two different things ? One big fracture vs 4 smaller fractures? Why not use numerical simulations only then ?*

(b) All the curves included in Figure 3 of the manuscript correspond to the effective seismic responses of models containing a periodic distribution of aligned horizontal fractures. Blue and red curves correspond to the models of Figure 2 that have four square contact areas within the fracture and their seismic responses are computed numerically. Dashed lines correspond to the analytical solution of White et al. (1975) for periodically layered media. Since here we aim at illustrating the impact of the presence of contact areas in the fracture, we believe that it is a pertinent comparison and it is representative of effects of including contact areas in a fracture. We modified Figure 2 for increasing clarity by removing the text "open regions" since the descriptive information of the fracture geometries is included in the caption.

2. (a) *There is no significant volume effects? i.e. what happens when you double the fracture's aperture ? Maybe it would be interesting to discuss this.*

(b) This is a very interesting comment. We have verified that there are not significant volume effects. In order to demonstrate thus, we have reduced the fracture aperture in the analytical solution (White et al, 1975) by 20%, which makes its fracture volume equal to that of the fractures with contact areas. We included the corresponding curve in Figure 3 of the manuscript. As we can see in the new Fig. 3, such volume reduction only causes a 3.6% and 4% reduction of the P-wave modulus values at the low and high frequency limits, respectively, with respect to the fracture with 20% more volume.

We appreciate the reviewer's comment and, hence, in addition to the above-mentioned change in Figure 3 of the manuscript, we have included the following description: "We compare these results with the analytical solution of White et al. (1975) for a fracture represented as a thin layer of constant thickness filled with the same soft material but without contact areas. Two models are considered, one of a thin layer having constant aperture of 0.4 mm and another one having equal total volume of open regions (that is, removing the volume occupied by the contact areas) as in the models shown in Fig. 2. We observe that the presence of contact areas reduces seismic attenuation, as they increase the fracture stiffness. For a thin layer with the same volume as the open regions of fractures of Fig. 2 (i.e., a constant thickness of 0.32 mm), we observe minor changes in the seismic response with respect to the thin layer having 0.4 mm of aperture. This means that the contact areas effects on the mechanical behavior of the fracture are more significant than the effects of reducing the open regions volume."

Page 7.

1. (a) *What is stress shielding? A definition as well as a discussion of its effect would help. Also, changing the geometry (i.e. regular vs random) will change the frequency at which the attenuation peak occurs and how broad it gets. Wouldn't that be sufficient to explain the differences between the two attenuation curves ?*
Also, it should have an effect on the attenuation levels.

(b) A definition as well as a short implication of the stress shielding have been added to the text: "The interaction between contact areas in the pseudo-random case results in a stress shielding, which means that the proximity of the contact areas caused a reduction of the stresses on them (Zhao et al., 2016). From Eq. 8, and given that the overall strain in the sample is the same in both cases, it follows that a reduction in the overall stress of the sample translates into a decrease of the effective P-wave modulus in comparison with the regular distribution."

2. (a) *It would be interesting for the reader to have a little more information on the stratified percolation model, and, why it is appropriate to model fractures.*

(b) More detailed information about the stratified percolation algorithm, including an explanation of the model generation work-flow can be found in the Appendix A. The use of such algorithm for appropriate modeling of fractures has been shown by Montemagno and Pyrak-Nolte (1999). The reference is included in the text, however this part has been re-phrased: "The consideration of such aperture distribution as realistic is based on the comparison with the imaging of the aperture distribution of a natural fracture network presented by Montemagno and Pyrak-Nolte (1999)"

Page 8.

1. (a) *I find this very confusing. First I think there is a typo, a regular distribution should be analogous to a correlated distribution. What "dispersion of distances" stands for ? Also approximately low is very vague... This should be rephrased.*

(b) The following detailed explanation about the definition of correlation length and its analogy with the models presented in Figure 2 of the manuscript has been added to text: "After generation of fractures, the correlation length of contact areas is calculated following the approach of Blair et al. (1993), also used by Pyrak-Nolte and Morris (2000), which represents an approximation to their mean length. Consequently, for a given contact area

density, as the correlation length decreases, the fracture exhibits more contact areas with smaller sizes and a narrower distribution of distances between them. Thus, increasing the correlation length of contact areas produces an increase in the mean distance between contact areas, that is, the mean length of the open regions. Using this kind of fracture models, Pyrak-Nolte and Morris (2000) discussed the effects that contact area distributions produce on the mechanical properties of a fracture (i.e., specific stiffness) and they showed that uncorrelated distributions of contact areas produce stiffer fractures than correlated ones. This is in agreement with the results presented in Fig. 3 since a regular distribution of contact areas is analogous to an uncorrelated distribution considering that both have a narrow distribution of distances between contact areas."
Also, some parts of the text have been rephrased for clarifying purpose.

2. (a) *Maybe computing the sample's dry stiffness using the same method would worth it to discriminate between poroelastic/elastic effects.*

(b) Model's dry stiffness are an essential component of our study and have been calculated in Section 3.3 to obtain fracture equivalent elastic properties (bulk and shear moduli). Indeed, the differences in effective compliance under dry conditions are given in Table 2 of the manuscript. The relative differences between the considered fracture models have helped us to interpret their poroelastic behavior.

3. (a) *Fig 4 isn't an explanation, "can be understood by looking at Fig 4?"*

(b) The review's proposed modification to the text has been made.

Page 18.

1. (a) *All the examples considered are planar fractures with variable aperture, in this respect the geometry dosen't change much, maybe it would worth it to say a word about general fracture distributions.*

(b) Following the reviewer's comment, "highly different geometries" has been replaced by "highly different aperture distributions".

2. (a) *Would that still hold for materials having arbitrary correlation functions ? i.e. frractal materials ?*

(b) On the basis of the excellent agreement between the seismic responses of the linear slip model and the more complex fracture models with variable aperture distributions, we expect that the results we found would be valid also for fractal materials. That is, provided appropriate equivalent fracture properties are used, the aperture variability of the fractures does not produce any additional seismic effects compared with modelling fractures as thin-layers with constant aperture.