

Interactive comment on “Azimuth-, angle- and frequency-dependent seismic velocities of cracked rocks due to squirt flow” by Yury Alkhimenkov et al.

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Azimuth-, angle- and frequency-dependent seismic velocities of cracked rocks due to squirt flow

by

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The paper is focused on a numerical model aiming at calculating the frequency and
C1

anisotropic response of a saturated cracked rock for a passing seismic wave. The model provides a numerical calculation following the previous work of B. Quintal. The model considers two orthogonal thin cracks embedded in a homogenous background. Two situations are examined: the two cracks are either connected or disconnected. The numerical method has been previously used by Quintal (2016, 2019). It consists in applying relaxation tests to a viscoelastic medium. The CIJ constants are obtained by averaging.

Several remarks are the following. First the frequency dependent curves extend over a broad frequency range, for a unique crack aspect ratio. This implies that squirt flow would never be focused on a narrow frequency range (unless the system size plays a dominant role in the calculation). This remark is important for the geophysical implications: Fig. 4a shows that the width of the attenuation peak (at half amplitude) is about one order and half magnitude. Second, the model considers two cracks of 0.1 m in a cube of 0.24 m size. In terms of crack density, this means a very high crack density (close to 1). This is consistent with the large decrease of C22 and C33 in the dry case, compared to the original values of the intact rock (table 1). But such high values are not realistic. Third, Fig. 4c shows a negative 1/Q and a very high dispersion for C23. Probably, the negative sign (which is unphysical) is an error of convention. But the high value (almost 0.4 for 1/Q) should be related to the very high crack density (i.e. the size of the system) and the low value of C23. Four, although a precise comparison is impossible, it would be of interest to discuss these results against (effective medium) calculations published some years ago (Guéguen, Y. , and Sarout, J., 2009. Crack-induced anisotropy in crustal rocks : predicted dry and fluid-saturated Thomsen's parameters. *Physics of the Earth and Planetary Interiors*, 172, 116-124; and Guéguen, Y. , and Sarout, J., 2011. Characteristics of anisotropy and dispersion in cracked medium. *Tectonophysics*, 503, 1-2, 165-172.) In both cases, the goal is similar but the methods differ. In terms of anisotropic compliances dispersion, it seems (from a first check) that the predictions of GS agree with the present results. They give a prediction of dispersion for Sijkl in terms of the two crack density tensors alpha and

beta. Non-zero values are predicted only if the i,j,k,l index is 2 or 3 (given the cracks orientations in the present case).

In conclusion, this is an interesting paper.

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