Applied Seismic Anisotropy: Theory, Background

submitted to *Geophys. J. Int.*

Fracture connectivity can reduce the velocity anisotropy of seismic waves *

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SUMMARY

The degree of connectivity of fracture networks is a key parameter that controls the hydraulic properties of fractured rock formations. The current understanding is that this parameter does not alter the effective elastic properties of the probed medium and, hence, cannot be inferred from seismic data. However, this reasoning is based on static elasticity, which neglects dynamic effects related to wave-induced fluid pressure diffusion (FPD). Using a numerical upscaling procedure based on the theory of quasi-static poroelasticity, we provide the first evidence to suggest that fracture connectivity can reduce significantly velocity anisotropy in the seismic frequency band. Analyses of fluid pressure fields in response to the propagation of seismic waves demonstrate that this reduction of velocity anisotropy is not due to changes of the geometrical characteristics of the probed fracture networks, but rather related to variations of the stiffening effect of the fracture fluid in response to FPD. These results suggest that accounting for FPD effects may not only allow for improving estimations of geometrical and mechanical properties of fracture networks, but may also provide information with regard to the effective hydraulic properties.

* Manuscript accepted for publication in Geophysical Journal International

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this subject is based.