Seismic response of fractures and induced anisotropy in poroelastic media

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Seismic waves in fluid-saturated poroelastic materials. I

- A planar fracture embedded in a fluid-saturated poroelastic – Biot - medium can be modeled as a extremely thin, highly permeable and compliant porous layer.
- A Biot medium containing a dense set of aligned fractures behaves as an effective transversely isotropic and viscoelastic (TIV) medium when the average fracture distance is much smaller than the predominant wavelength of the traveling waves.
- This leads to frequency and angular variations of velocity and attenuation of seismic waves.

Seismic waves in fluid-saturated poroelastic materials. II

- P-waves traveling in this type of medium induce fluid-pressure gradients at fractures and mesoscopic-scale heterogeneities, generating fluid flow and slow (diffusion) Biot waves, causing attenuation and dispersion of the fast modes (mesoscopic loss).
- A poroelastic medium with embedded aligned fractures exhibits significant attenuation and dispersion effects due to this mechanism.
- Due to the extremely fine meshes needed to properly represent these mesoscopic-scale fractures, numerical simulations are very expensive or even not feasible.