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WAVE PROPAGATION IN FRACTURED POROELASTIC MEDIA

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Seismic wave propagation through fractures is an important subject in hydrocarbon exploration geophysics, mining and reservoir characterization and production. A dense set of horizontal fractures in a fluid-saturated poroelastic medium behaves as a 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. A major cause of attenuation in porous media is wave-induced fluid flow, which can take place at mesoscopic-scale heterogeneities, when the fast P-wave is converted into diffusion-type Biot slow waves. Wave anelasticity and anisotropy are significant in fractured poroelastic rocks due to this mechanism, which can properly be represented at the macroscale with an equivalent TIV medium. In this presentation we describe a set of compressibility and shear harmonic experiments on representative fractured fluid-saturated poroelastic samples to determine the five complex and frequency dependent stiffnesses characterizing an equivalent TIV medium to a fluid-saturated poroelastic medium containing a dense set of horizontal fractures. Each experiment is described by an associated boundary value problem formulated in the space-frequency domain, which is solved using the Finite Element Method. The numerical experiments show the aplication of the procedure to determine the equivalent TIV medium for different types of fractured samples and saturant fluids.