10.11 Seismic imaging of stress-driven anisotropy

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ABSTRACT

We use lab data analysis to relate uniaxial stress to stiffnesses of anisotropy media. In this process, stiffnesses under different uniaxial effective stresses are calculated from measured velocities and densities. Moreover, the maximum likelihood method is used to deal with the uncertainty in lab measurements and ascertain strain energy constraints are satisfied. Furthermore, we utilize a power law to extrapolate this relation to higher stresses.

We then investigate the effect of stress on seismic data using seismic modeling of the stress-induced TI (transversely isotropy) media and the derived relations between stiffnesses and effective stress. In this stage, we use the principal stress profile of a sedimentary layer (a salt basin), modeled using evolutionary geomechanical approach. We assume this layer is a stress-induced TI media. Based on the relation of stress and stiffness from lab analysis, we obtain the stiffnesses of the layer. By comparing the synthetic seismic data from isotropy and anisotropy situation, we demonstrate imprints of stress effects in the form of anisotropic non-hyperbolic move-out and AVO.

CLICK ON IMAGE FOR LARGER VIEW

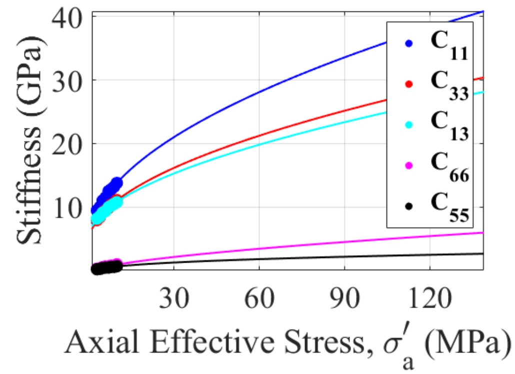


Fig. 1: Calculated stiffness from lab measurements and fitted curves to higher stresses.

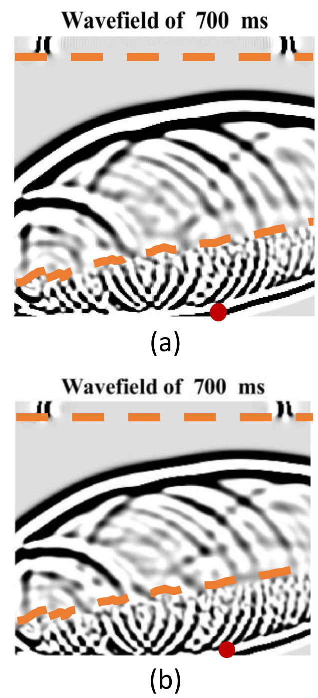
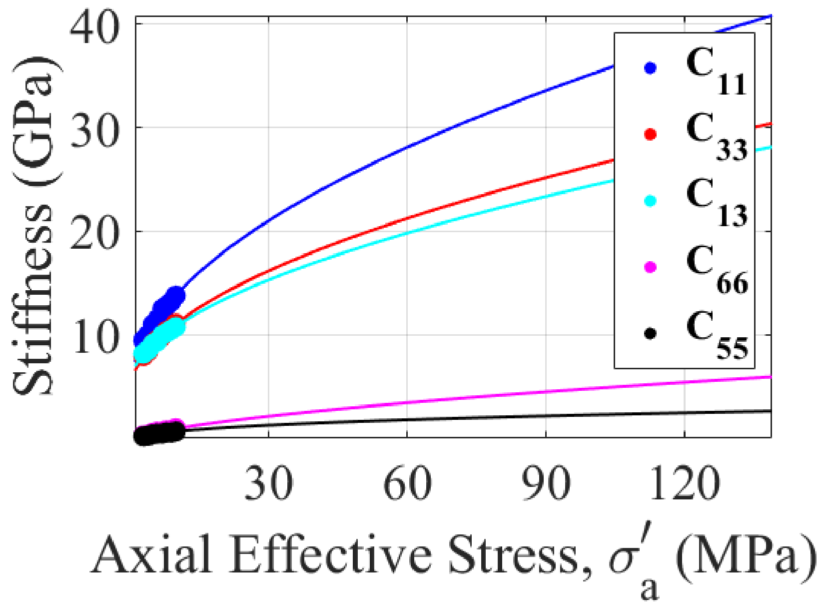


Fig. 2: Synthetic wavefield of the sedimentary layer. (a) Isotropy situation. (b) Anisotropy situation.



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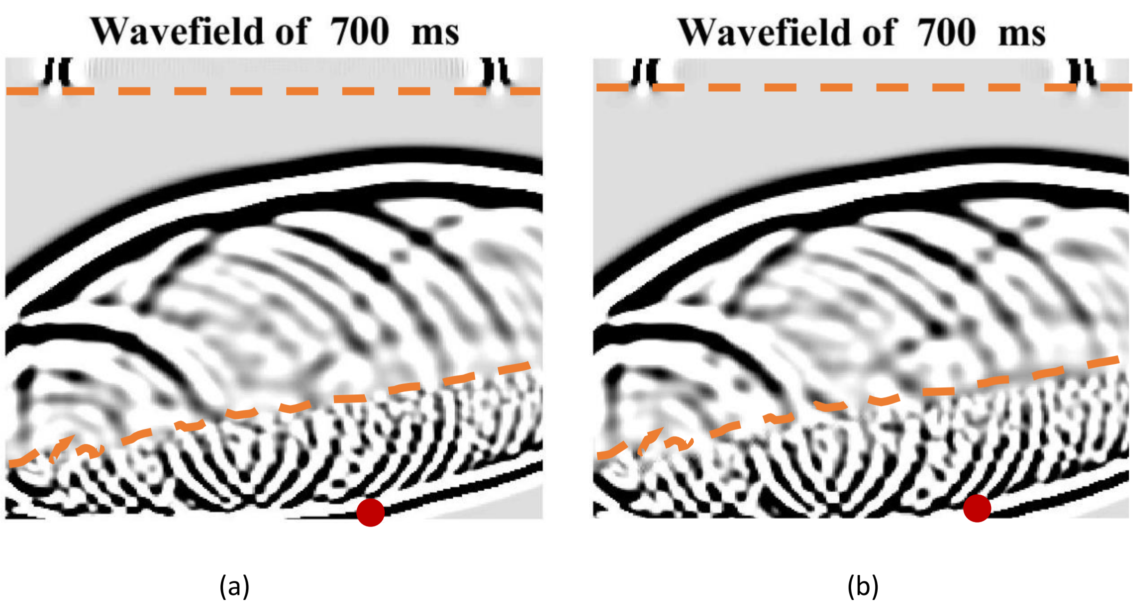

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