ESTIMATION OF FRACTURE PARAMETERS AFTER REMOVING ANISOTROPIC OVERBURDEN EFFECT

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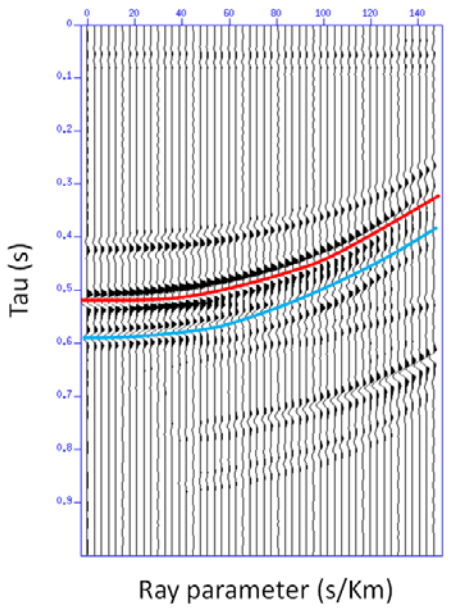
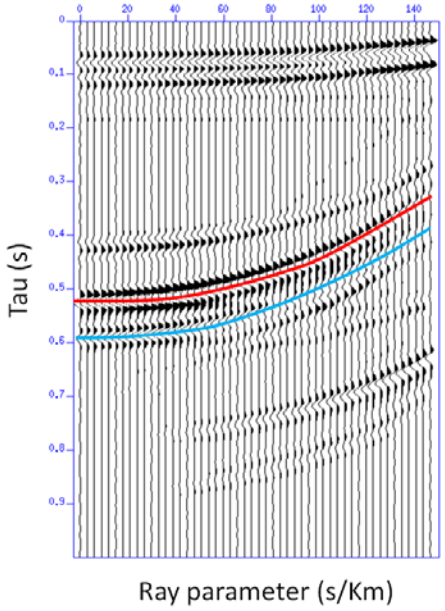
ABSTRACT

Estimation of reservoir fracture parameters such as fracture orientation and density or fracture normal and tangential weakness (ΔN and ΔT respectively) from seismic data is often difficult because of one important question: Is the anisotropy caused by the reservoir interval alone or by the effect of the lithologic unit above the reservoir? Often hydrocarbon reservoirs represent a small portion of the seismic section and inversion of reservoir anisotropic parameters can be easily obscured by the presence of anisotropic overburden. In this paper, we show examples where we can clearly observe imprints of overburden anisotropic layers on the seismic response of the target zone. Then we present a simple method to remove the effect of anisotropic overburden to recover reservoir fracture parameters. It involves analyzing amplitude variation with offset and azimuth (AVOA) for the top of reservoir reflection amplitude and for a reflector below the reservoir. Seismic gathers are transformed to delay-time slowness (tau-p) domain. We then calculate the ratio of the amplitudes picked at the reservoir top and for the reflector beneath the reservoir. The ratio is then used to remove the transmission effect of the overburden. The methodology is applied to two sets of models: one containing a fractured reservoir with isotropic overburden and the other containing a fractured reservoir with anisotropic overburden. Conventional analysis in the x-t domain indicates that the anisotropic overburden has completely obscured the anisotropic signature of the reservoir zone. When the new methodology is applied, the overburden effect is significantly reduced. Inversion of fracture parameters is applied to both conventional AVOA curves and the new amplitude ratio attribute. We show that the fracture parameter ΔN is estimated accurately whereas ΔT parameter is not stable and could not be recovered using only P-to-P reflection data.



(a)



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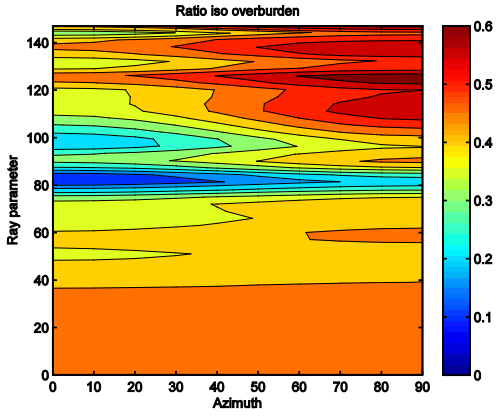
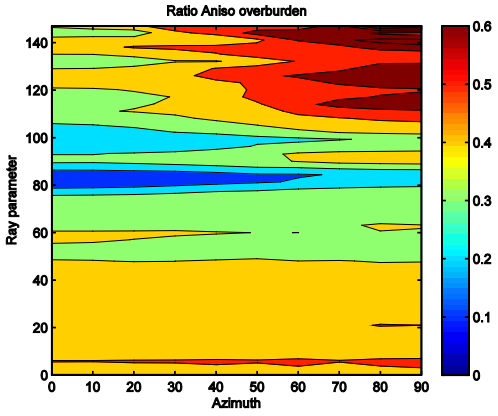


(c)



(d)

Transformed CDP gathers in the tau-p domain of two models - one containing a fractured reservoir with isotropic overburden (a) and the other containing a fractured reservoir with anisotropic overburden (b). The new introduced method involves analyzing amplitudes in the tau-p domain for the top of reservoir reflection amplitude and for a reflector below the reservoir (red and blow lines in (a) and (b) respectively). We then calculate the ratio of the amplitudes of both horizons. The ratio is then used to remove the transmission effect of the overburden. The amplitudes ratios for both models are shown in (c) and (d). They have almost the same amplitude ratio values where overburden effect is believed to be removed.