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Direct probabilistic inversion under VTI conditions

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Summary

Probabilistic inversions allow for better vertical resolution and a more comprehensive statistical analysis of possible solutions to the AVO inverse problem. Here, we apply the anisotropic direct probabilistic inversion (DPI) introduced by Cova et al (2019) to data from offshore East Canada. DPI is a single-step inversion process which inverts pre-stack seismic data directly for geologic facies. It is based on the Bayesian probabilistic framework developed by Jullum and Kolbjørnsen (2016). In the case of VTI-DPI, Ruger's AVO approximation is used as the forward modeling operator to compute the likelihood function. The benefits of this approach are two-fold. First, the model space is expanded from three (AI, Vp/Vs, density) to five elastic parameters which now includes the two weak anisotropy Thomsen parameters ε and δ. This provides an opportunity for resolving elastic ambiguities that might not be resolved by using only three isotropic parameters. Secondly, the use of a more complete AVO approximation that accounts for common anisotropic effects helps to avoid the misinterpretation of hydrocarbon-related AVO signatures, which might result from the false positive effect of overlaying anisotropic shales above water-saturated sands. We illustrate these effects by testing this approach using a VTI wedge model and field data from the East Coast of Canada. In both cases, the results show how VTI-DPI minimizes the overprediction of hydrocarbon saturated reservoirs providing more realistic solutions. Moreover, the results show how VTI-DPI can accommodate facies models with a much higher vertical resolution than its deterministic counterpart. All of this makes VTI-DPI a more suitable tool for reservoir characterization under VTI conditions.