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Abstract

Heterogeneities in the shallow sedimentary overburden are definitely a challenge for seismic imaging. Debris flows, paleo-channels, presence of salt and gas are the most common difficulties justifying for a depth imaging processing. Nevertheless, building an accurate depth velocity model in such a geological context requires the implementation of various techniques. Case studies will be described where complementary methods were utilized, including reflection tomography, acoustic and elastic FWI as well as interpretation driven model refinement.

Strong non hyperbolic move-out is generated by short wavelength anomalies in the overburden. This prevents the reflection tomography alone to provide accurate velocity models for imaging. Provided the initial model is acceptable for long wavelengths, a 12 to 14Hz acoustic FWI converges to an optimal solution validated by well information. Well calibration is then performed before additional updates of reflection tomography. Interleaving reflection tomography and FWI updates is systematically conducted for sub-salt imaging. The use of acoustic joint Vp/Ip FWI and elastic FWI enabled to better delineate the salt geometry and provide optimum sub-salt images where reflection tomography usually fails.

The case studies described include a feedback loop with seismic interpreters to provide valuable and important input to seismic imaging. Thanks to this approach, adequate effort is put to testing different interpretative scenarios within large velocity contrast domains such as with salt-sediment interfaces, leading to more geological constraints applied to velocity model building. Push-downs due to slow velocity paleo-channels are adequately corrected using acoustic FWI, non-hyperbolic move-out are largely simplified for further reflection tomography update. Reflection tomography is also helped by signal processing techniques that reduces residual multiple noise on the input traces thereby leading to more accurate residual move-out picks. Using state-of-art seismic migration algorithms such as Reverse Time Migration (RTM) with surface offset gathers computation, combines the best of both worlds: waveform modeling in addition to asymptotic simplification, especially in complex geological basins. Providing optimum seismic images to seismic interpreters allows them to better qualify and quantify the geological uncertainties around their subsurface reservoir objectives, whether it is within exploration, delineation or reservoir exploitation contexts.