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Using AVO inversion to assess seismic acquisition geometries

Maximo Rodriguez[1], Raul Cova[1], Bill Goodway[1], Peter Vermeulen[2], Andrea Crook[2], Wendell Pardasie[1]
[1]Qeye, [2]Optiseis Solutions Ltd

Summary

Seismic surveys are commonly designed to satisfy the minimum requirements for proper "imaging" of the target interval. Hence, acquisition parameters tend to be influenced by the requirements of migration algorithms. For land acquisition, some of these requirements have been relaxed after the development of 5D interpolation and regularization algorithms. Consequently, more attention is now being paid to the impact of acquisition parameters on the performance of seismic inversion algorithms. In this work, we present the AVO inversion results of ten pseudo-decimated acquisition geometries and analyze the performance of the inversion in each case. The results illustrate the sensitivity of each inverted parameter to offset/incidence angle distributions for each survey. The inversion results obtained for acoustic impedances are less sensitive to offset distributions, but it is strongly affected by the quality of the near-offset data which can be affected by the presence of acquisition footprints. The inversion of parameters like Vp/Vs are not only affected by the presence of footprint but the inverted values change depending on the near to mid-angles data sampling. Finally, the inversion for density values is most sensitive to the quality of the far offset data. We ranked each acquisition geometry based on the deviation of the results from the inversion results obtained with the undecimated data. This way we tried to identify which geometry would provide similar results to the fully sampled dataset but at a much lower source/receiver effort. Our analysis indicates that the key factor to optimal inversion results is consistent and uniform offset/incidence-angle sampling. Oversampling or subsampling certain offset ranges introduces biases in the AVO response of the data leading to suboptimal inversion results. In conclusion, AVO inversion tests can be extremely useful in the design of acquisition geometries.