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True-azimuth 3-D Multiple Prediction - A Step Change in Multiple Elimination - Method and Examples

R.G. van Borselen* (PGS Geophysical (Netherlands) BV), S. Barnes (PGS), R.F. Hegge (PGS) & P. Aaron (PGS)

SUMMARY

The paper shows the application of a new true-azimuth 3-D multiple prediction method capable of removing the most complex 3-D multiples from a Mediterranean data set, known for the challenging diffracted multiples that hamper interpretation.

In the Nile Delta, a thin but complex layer of partially eroded anhydrite and other facies, also known as the Messinian, has a highly irregular and laterally varying velocity structure. These large velocity contrasts are likely to act as multiple generating boundaries. As their geometry becomes more complex, the multiples they generate become more and more difficult to suppress because of their 3-D nature. Amongst them, diffracted multiples are the most difficult to suppress, because of their rapid lateral changing nature and their steep dips (see Keggin, 2006 and Rietveld, 2006).

In recent years, the industry has taken a significant step forward in the prediction and subtraction of such complex multiples. True-azimuth 3-D Surface Related Multiple Elimination (TA 3-D SRME) has emerged as a very effective method to eliminate these multiples.

SRME aims to predict and subtract free-surface related multiples from the measured hydrophone data, without using any a priori information about the subsurface geology. This is in contrast to other methods known in the industry that rely either on detailed knowledge of the main sub-surface reflectors (Wave-equation based multiple attenuation), an accurate velocity model (Radon or f-k demultiple), or assumptions regarding the statistical properties of the measured wavefields (Predictive deconvolution).

True-azimuth multiple prediction is accomplished when the original source and receiver locations of the measured data are honoured during multiple prediction. As a result, the accuracy of the 3-D multiple predictions is far superior compared to 2-D or 3-D zero-azimuth predictions which greatly benefits the adaptive subtraction of the most complex 3D multiples.

The example in Figure 1 shows the stacked sections before (left) and after (right) application of True-azimuth 3-D SRME to an outer cable of a deep water Mediterranean data set. Note the excellent removal of the first-order (sea layer) peg legs of the Messinian, and even low-amplitude second-order diffracted multiples.

References

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Acknowledgements

The authors would like to thank BP for permission to publish these results.

Figure 1: Full-offset stack of data shot in the Mediterranean sea before demultiple (left) and after True-azimuth 3-D Surface Related Multiple Elimination (right). Note the excellent removal of these multiples, where even the second-order diffracted multiples have vanished.