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The Attenuation of a Complex Multiple Wavefield Using 3D General Surface Multiple Prediction (GSMP) - A Case Study

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SUMMARY

In this case study, we show how a new implementation of 3D surface-related multiple elimination (3D SRME) can be used to successfully predict and attenuate complex multiples, including diffracted multiples, on a dataset from Egypt s Mediterranean Sea.

In this case study, we show how a new implementation of 3D surface-related multiple elimination (3D SRME) can be used to successfully predict and attenuate complex multiples, including diffracted multiples, on a dataset from Egypt's Mediterranean Sea.
Diffracted multiples have complex 3D propagation paths, resulting from irregularities at the seabed or in the near surface. Offshore Egypt, the seabed is characterized by rapid changes in water depth, steeply dipping channel features and complex near-surface geology (Figure 1). The survey extends into deep water where underlying primary data is obscured by high amplitude multiple energy which, if not removed, will also interfere with shallower prospective horizons after migration. In addition, the irregular top and base of salt also generates complex 3D multiples that are likely to have higher velocities than the primary reflections.
Because of the 3D nature of the multiples in this area, it is not possible to predict and remove them using 2D multiple attenuation techniques as the multiple raypaths lie outside the plane of the acquisition sail-line direction. A 3D multiple attenuation solution is needed. In this case study, we compare results using conventional zero-azimuth 3D SRME, and an advanced true azimuth implementation called 3D general surface multiple prediction (3D GSMP). Zero azimuth 3D SRME assumes that the azimuth of the target trace is equal to the nominal survey azimuth. For wide-towed streamer arrays, or in the presence of feathering, a true-azimuth technique is required to take the true raypath of the multiple into account. With both techniques, the resulting multiple models are adaptively filtered before subtraction from the input data.
The theory of 3D SRME was introduced by van Dedem and Verschuur (1998). Practical aspects of true-azimuth 3D SRME were described by Moore and Bisley (2005) and Dragoset and Moore (2008) described the 3D GSMP algorithm. This data-driven method provides a high-quality true-azimuth 3D multiple attenuation solution for surveys acquired in areas of complex geology, complex seabed topography and variable water depths. The method also takes into account feathering and irregular acquisition geometry. Applied to this complex multiple problem, 3D GSMP attenuates significantly more complex multiple and diffracted multiple energy than the conventional zero-azimuth 3D SRME.
Figure 2 illustrates the improvement achieved by taking the azimuth of the multiple raypath into account. Some residual multiple remains from the very steeply dipping multiple diffraction tails. This can be further reduced by applying customized noise attenuation workflows before migration.

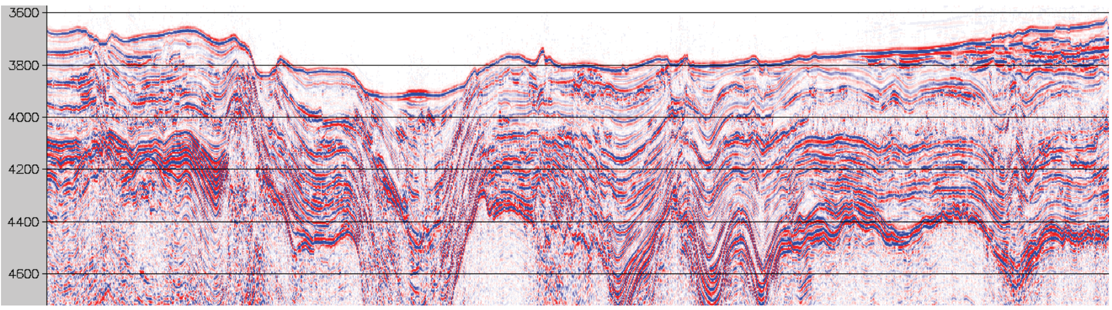

Figure 1. Rough seabed topography and complex near surface in this area generates multiple diffractions and scattered multiple energy.

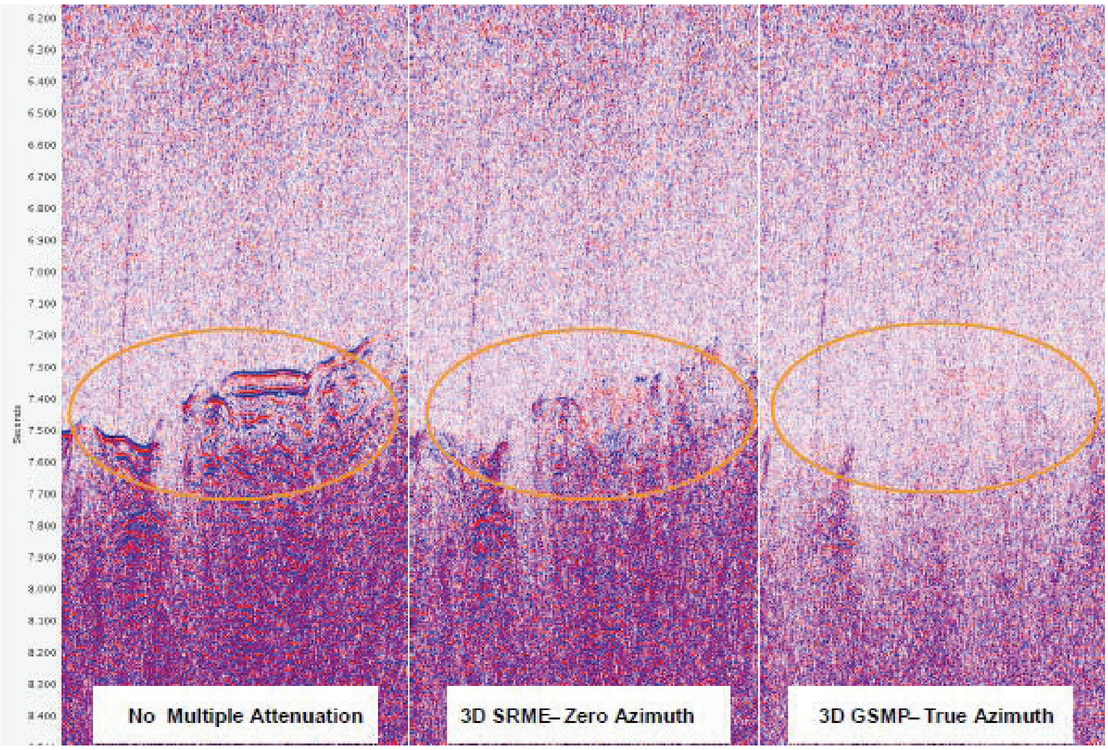

Figure 2. The area is characterized by a complex multiple wavefield (left). Zero azimuth 3D SRME (middle) attenuates some multiple energy. True-azimuth 3D GSMP (right) eliminates both simple and diffracted multiples.

Acknowledgments:
The authors thank WesternGeco and StatoilHydro Egypt and partners for publication permission.

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