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Salt Around the World - Similarities and Differences

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SUMMARY

Introduction

Subsalt imaging is seen as one of the most difficult imaging challenges in seismic processing. Although that is a discussion in itself, no one will question the fact that processing seismic for subsalt exploration is very complicated due to the structural complexities associated with salt, the complex multiples, as well as the associated velocity contrasts.

When people discuss subsalt imaging challenges, they almost immediately associated these with the deepwater Gulf of Mexico issues. However, each salt basin has its own characteristic set of problems.

In this paper we will discuss and illustrate different salt ‘types’ in different parts of the world, each of which has a specific set of issues and potential seismic solutions. We will discuss differences and similarities.

Summary of salt related seismic issues

The most common salt related seismic issues are multiples and lateral velocity contrasts. Because of the relatively large velocity contrasts associated with sediment/salt interfaces, these are generally strong multiple generators. The large reflection coefficients at top and base salt, resulting in low transmission coefficients, make subsalt reflections appear weaker than extra-salt ones. Those weaker reflections combined with a strong and complex multiple train, sets up a tough multiples problem. Although 3D demultiple methods are becoming increasingly better and more viable, especially multiple diffractions are still very difficult to suppress effectively. Also, in shallower water, like the Gulf of Suez, where missing near offsets hamper some of the more advanced demultiple methods, waterlayer reverberations and interbed multiples are still a huge problem.

The large velocity contrasts generally associated with salt, mean that multi-pathing becomes an issue for subsalt imaging as well. These complex wavefronts result in complex illumination at target level. Although this is considered the most difficult issue, recent work has shown that salt inhomogeneities, caused either by salt intrusions or by salt-shale layering (Gulf of Suez), can cause far more complex wave propagation than we have so far been willing to deal with. Detailed velocity model analysis, including TTI and potentially Q, are necessary to resolve the associated issues.

Seismic Quality and subsalt imaging

An underilluminated issue in subsalt imaging is related to the reservoirs that we are targeting. Where in the Gulf of Mexico, at least for exploration, we are looking for large low relief structures at depth, in Angola we are chasing channelized systems draped over steep structures. The Gulf of Suez looks for subsalt rotated fault blocks and the Mediterranean has patchy illumination underneath a difficult to describe complex salt/shale/sand sheet-like Messinian layer, the targets being complex channel systems. Each of these requires a different level of seismic quality, hence put different emphases on seismic acquisition and processing.

The paper

In this paper the issues describe above will be illustrated with data examples, and potential seismic solutions with respect to acquisition and processing will be discussed.