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Please fill in your author name(s) and company affiliation.

Given Name	Surname	Company
Raphael	Lencrerot	TOTAL SA
Cyril	Agut	TOTAL SA
Anne-Sophie	Barnola	TOTAL SA
Julien	Colonge	TOTAL SA
Christian	Rivera	TOTAL SA
Cyril	Ronot	TOTAL SA

Abstract

Objective

Acquiring advanced survey geometries, such as Ocean Bottom Survey, is mandatory when dealing with very complex overburden. Considering the investment that represents rich azimuth surveys, it is however crucial to optimize the design to ensure the objectives achievement for an optimal cost. Herein, we discuss about the use of advanced depth imaging techniques to define optimum cost effective rich azimuth geometry and to also assess the capability of our acquisition design to build the subsurface model.

Methods

Our proposed advanced feasibility study consists in four main steps:

1. Create a synthetic subsurface model that captures the main geological and geophysical features of our studied area,
2. Perform a seismic modeling using Full Wave Modeling (FWM) for different acquisition designs,
3. Define through prestack depth migration the optimal design yielding a correct illumination (and therefore a faithful migrated image) of our reservoir target, using at this stage the correct subsurface model.
4. Define the acquisition constraints allowing to improve the model building process. It implies the use of Full Waveform Inversion (FWI) and the production of surface-offset migrated gathers.

Results, Conclusions

Our target is a deep sub-salt reservoir in deep offshore Gulf of Mexico. We want to investigate if an Ocean Bottom Nodes (OBN) acquisition could correctly illuminate the reservoirs masked by massive salt bodies, but also could improve the model building process with respect to a previous Wide Azimuth acquisition. In such geological settings, classical ray-based methods are limited to simulate accurately wave propagation behavior due to their intrinsic limitations while considering sharp velocity contrasts, Wave-Equation based techniques become the only adequate solutions.

After studying the capability of different OBN designs to correctly illuminate the reservoir target, we push further the feasibility study to evaluate the possible acquisition designs to build the background velocity model. Relying on the use of FWM, depth migration and FWI, we assess the added values of different acquisition designs in different configurations. However applying a full depth imaging workflow for each design is not realistic and adapted shortcuts must be found. We propose to evaluate the designs through two main criteria: quality of the FWI update and the analysis of residual move-out (RMO) using a wrong model in the migration phase.

The originality of this feasibility study is to go through all the key steps involved in a depth imaging project using adequate engines of wave propagation. It implies some phases of FWI and the generation of surface-offset Wave-Equation migrated sections to select the most suitable acquisition design.