geoconvention
Virtual Event
September 13 - 15
2021

Case Study: Designing a Seismic Survey in an Area with Steep Dips

Andrea Crook, Shane Bossaer, Cameron Crook, & Stephanie Ross*
OptiSeis Solutions Ltd.

Omar Medina, Camilo Monroy, Mario Prince, & Paul Stephenson
Gran Tierra Energy

Case Study

When designing a new survey in an area with steep dips, there are three important considerations: survey geometry, source size, and survey area. The survey geometry must be designed to image the dips of interest at the desired frequencies without any aliasing, sufficient trace density is required to ensure a good signal-to-noise ratio, and, since steep dips result in longer ray paths, the offset/azimuth distribution of the recording patch must be selected with care to ensure the steeply dipping energy is recorded. Given the long offsets utilized on surveys with steep dips, the source size must be selected to ensure adequate energy at far offsets. Finally, the overall survey area may need to be larger than expected due to the far offset reflections. In order to acquire this type of data cost-effectively, equipment layout and movement through the field should also be considered.

The study area is located in the Middle Magdalena basin in Colombia, South America, and is within a Gran Tierra E&P lease. This intermountain basin is flanked by the Central Cordillera on the west and the Eastern cordillera on the east of the Colombian Andes. Several different structural settings are present in the basin, with the north central strike-slip system representing an important area for oil and gas exploration.

Previous 3D surveys in the study area were designed to image shallow structures with moderate dips up to 30 degrees. However, 2D lines to the south of the existing 3Ds had imaged some deeper complex targets with steeper dips. “Pop-Up” structures, such as the La Luna formation, were identified on legacy 2D (Fig. 1). High resolution 3D seismic is required in order to provide accurate imaging over this formation, which is a deep naturally fractured carbonate. New 3D seismic acquisition will be required to define the best drilling opportunities and is critical for successful well placement. Without good offset and azimuth distribution, it can be difficult to accurately prediction fractures.

In addition to the imaging challenges highlighted in Figure 1, the new 3D survey would be acquired in an area with varying surface conditions from farmlands to swamps with the overall extents limited by a large river system. This case study will review the data analysis and modeling that was conducted to determine the optimal offsets required for imaging the deep structures.

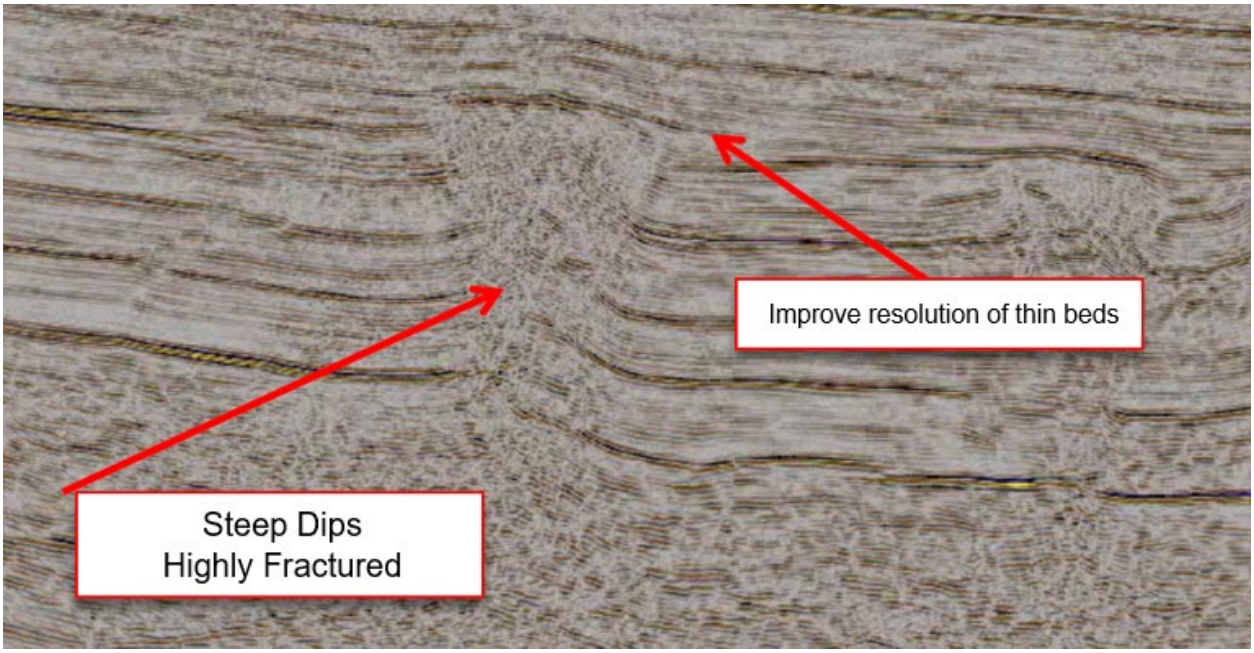

Figure 1: Legacy 2D illustrating challenges to solve in the new 3D design.

Acknowledgements

The authors would like to thank Gran Tierra Energy for permission to publish these results.