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AVO Quality for Reservoir Properties Estimation from 2D Broadband Seismic Survey, Offshore Newfoundland and Labrador

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SUMMARY

A large-scale long offset broadband 2D seismic program has been acquired in the slope and deepwater regions of offshore Newfoundland and Labrador, Canada. The survey was planned integrating well ties from the shelf, regional gravity data, and newly acquired satellite slick data to assess the hydrocarbon potential of under-/un-explored slope and deepwater areas. To accomplish the survey, Nalcor Energy, the state energy company of Newfoundland and Labrador, invested and partnered with TGS and PGS in the long offset GeoStreamer® seismic survey spanning from the Labrador Sea to the Jeanne d'Arc and Flemish Pass in the south as shown in Figure 1. The early data results from this 2011-2013 program (47,000 line km) have resulted in the identification and delineation of new basins, play types, and AVO supported leads. The evaluation of the data was in part initially focused on determining the quality and utility of using the new 2D broadband data for exploration prospect reservoir characterization purposes.

Introduction

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Figure 1 Survey location map showing offshore Newfoundland and Labrador, Canada.

Data Results

One of the goals of our early evaluation was to evaluate the quality of the gathers with a view to understanding the applicability of the dataset for AVO analysis leading to prospect reservoir characterization. An example of our evaluation is shown in Figure 2. Figure 2 shows a full stack seismic line from the program delineating a 2D expression of a previously unknown Labrador Sea broad Tertiary aged structure. A CDP gather (0-8km) is shown intersecting perpendicular to the section at the CDP location on the full stack. The gather shows a variety of seismic events with differing AVO character – some increasing amplitude with offset, some decreasing, and others having fairly flat AVO. The quality of the gathers and the AVO character suggests that the amplitude variation with offset being imaged is reflective of lithology/fluid content and not processing or acquisition effects. In addition, many of the reflection packages have clear top and base reflectors without significant side lobe effects allowing for improved interpretability.

Figure 2 Perspective view of a deepwater Labrador Sea seismic line showing a broad Tertiary aged structure and a CDP gather showing Class III AVO behavior in the upper portion of the structure.

With confidence established that the effects being imaged in the regional broadband dataset were likely lithology/fluid driven as opposed to acquisition or processing artifacts, we began to evaluate numerous AVO supported leads to gain a sense of the amplitude change with angle. One area that this broadband survey has consistently provided value is in the new identification of class II AVO leads and prospects. Figure 3 illustrates an example of a newly identified class IIp turbidite feature.

Figure 3 Far angle stack image of a newly identified AVO class IIp turbidite. The amplitude graph on the right hand side shows the consistent and physical amplitude trend of the top reservoir (yellow horizon) through the angle range which will enable more accurate estimation of reservoir properties. Reduced swell noise due to deep tow streamer and broadband wavelet has likely contributed to trend being identified in low amplitude near angle stacks.

Conclusions

The new regional exploration 2D broadband dataset offshore Newfoundland and Labrador, Canada has demonstrated early potential to be utilized for exploration prospect reservoir characterization. This will reduce geologic pre-drill uncertainty and lead to improved high-grading of prospects. The benefit of the reduced swell noise due to the deep tow streamer has been demonstrated in the newly identified class II AVO leads which consistently appear to have physically consistent amplitude trends through the low amplitude range. Ongoing work will utilize an in-progress regional rock physics study to estimate the causative reservoir properties of the seismic response of the newly identified leads and prospects throughout this frontier area.

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References

Carter, J.E., Cameron, D.E., Wright, R. and Gillis, E. [2013] New insights on the slope and deep water region of the Labrador Sea, Canada. *EAGE Conference and Exhibition*, London, June 2013, Extended Abstract.

Wright, R., Carter, J., Cameron, D., Neugebauer, T., Witney, J. and Hughes, D. [2013] Early insights and AVO supported leads from new long offset 2D seismic data, Labrador Sea, Canada. *SEG Annual Conference and Exhibition*, Extended Abstract, Houston, September 2013.