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The Atlantis OBS Project: OBS Nodes—Defining the Need, Selecting the Technology, and Demonstrating the Solution

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Abstract

The goal of the Atlantis ocean bottom seismic (OBS) node project was to deliver improved 3D structural images of deepwater subsalt reservoirs by enabling the implementation of a wide-azimuth seismic acquisition system. Such a system will enable more cost-effective appraisal and development of reserves in complex structural environments, including subsalt. Achieving this goal at an accelerated pace required establishing and communicating the value of improved subsalt reservoir images, identifying a technical solution, evaluating and selecting a technology, deciding on a partner, managing the development process and planning and executing an at-scale field trial.

This paper focuses on the early definition and selection stage of the project. Previous investigations indicated that the acquisition of wide-azimuth seismic data promised significantly improved structural imaging of deepwater subsalt reservoirs. Such reservoirs constitute many of the recent deepwater development projects in the Gulf of Mexico.

Technology evaluation and selection centered on comparing three types of acquisition methods: multi-boat towed streamer seismic, ocean bottom cable (OBC), and ocean bottom seismic (OBS) nodes. All three technologies are capable of acquiring wide-azimuth seismic data in deepwater. The key difference is the efficiency of such a wide-azimuth acquisition at the appraisal and development scale (100-250 km^2). The large areal extent that can be covered by OBS nodes at any one time over what OBC systems offer provided a crucial advantage to nodes. Multi-boat towed streamers have advantages for larger survey sizes but do not appear to cost-effectively scale down to this appraisal and development range.

The Thunder Horse node sea trial in 2001 highlighted an environmental concern that influenced partner selection. Existing deepwater OBS nodes are designed for research purposes and include the use of non-retrievable anchor weights. Permits for seismic activity that left thousands of weights on the seafloor would not likely be granted. Second-generation OBS nodes, in which autonomous nodes are deployed on and retrieved from the sea floor by a remotely operated vehicle (ROV), held the greatest promise for achieving the project's business and technology goals despite being technologically unproven in deepwater. Selection of an industry partner to provide this deepwater capability concluded the selection stage.

Introduction

This paper is one of a group of papers that collectively describe the development of a novel deepwater ocean bottom seismic (OBS) acquisition technology that has been successfully applied at a commercial scale over the Atlantis field in the Gulf of Mexico. Taken together these papers present a case history in how a staged development process, rigorously managed, can substantially accelerate the pace of E&P innovation. This case history records the development of this technology from definition of the problem to execution of an "at-scale" field trial.

OBS nodes are autonomous seismic recording units that are placed in an array on the sea floor. They record seismic data continuously as seismic sources near the ocean surface shoot into them from any desired direction. These two characteristics, autonomy and the recording of seismic data from all directions of the compass, are the critical capabilities required to enable the solution of an urgent industry problem in the appraisal and development of deepwater subsalt reservoirs.

Many of the new deepwater subsalt Gulf of Mexico developments are challenged by imaging "holes" caused by the complex nature of the salt overburden. Current risks to well placement and efficient reservoir development can be reduced by combining the emerging technologies of wavefield imaging and wide-azimuth seismic acquisition to achieve a significantly higher quality of structural imaging. The primary objective of the deepwater OBS node project is to deliver a true 3D deepwater wide-azimuth seismic acquisition system that will enable more cost-effective appraisal and development of reserves in complex structural environments such as subsalt.

The petroleum industry today is engaged in a concerted effort to decrease the time between initial discovery of hydrocarbons and first oil. This goal is particularly