OTC 18549

Case Study: A Large 3D Wide-Azimuth Ocean-Bottom Survey in the Deepwater Gulf of Mexico

Richard Clarke, Ganyuan Xia, Nurul Kabir, Laurent Sirgue, and Scott Michell, BP

This paper was prepared for presentation at the 2007 Offshore Technology Conference held in Houston, Texas, U.S.A., 30 April–3 May 2007.

Abstract

We present the P-wave processing and imaging of a large 3D ocean bottom node survey, consisting of 1628 node locations, in deepwater Gulf of Mexico over the Atlantis field. The data quality is good, and the preliminary imaging results using both the primary reflections and the receiver ghost appear promising.

Introduction

In the fall of 2005 Fairfield Industries was the primary contractor of a large, wide azimuth survey (Ross and Beaudoin, 2006) for BP over the Atlantis field in the deepwater GOM. The water depth in the area varied from approximately 1400 metres to 2300 metres. The survey used 902 four-component ocean bottom nodes (Mitchell and Grisham, 2006), which BP commissioned Fairfield to build. The purpose of the survey was wide azimuth, sub-salt imaging using P-waves (Beaudoin and Michell, 2006).

The shot coverage was also on a hexagonal grid with a 50m spacing over an area of about 730km^2. The survey was acquired in two patches, with approximately 1700 node placements in total. The time between shots was 11.2 seconds, with a 12 second trace length, although the nodes actually recorded continuously.

The nodes were placed on the seafloor using an ROV. A dual Hydroacoustic Aided Inertial Navigation (HAIN) system (Marc et al, 2006) provided a positioning accuracy of approximately 0.5% of water depth (about 10m in this case). The node spacing was ~400m in both the x and y directions, using a hexagonal grid (Bardan, 1997) and covered an area of about 250 km^2.

Once placed on the seafloor the nodes were completely autonomous. The battery life and memory capacity were sufficient for about 28 days of continuous recording at a 2ms sample rate. The geophones were fixed (non-gimballed) and orthogonal, and the nodes were placed as much as possible on horizontal ground, such that one component was approximately vertical.

Discussion

The preliminary processing of the data to date has all been performed on common receiver gathers. Each gather is well sampled, and contains approximately 160,000 traces per component. The processing flow was very basic: node positioning, noise removal, quality control, geophone orientation, PZ summation and difference, and common receiver wave equation depth migration.

The overall positioning accuracy of the nodes was very good (Figure 1). Using the direct arrival to determine the node locations confirmed the positions derived from the HAIN system to within 10 metres for 95% of the nodes, and to within 20 metres for over 99%. About a third of the nodes had a bulk time shift due to a clock synchronization error, but this was easily detected and corrected.