

Nodal Seismic Acquisition in Cook Inlet, Alaska

Mike Yates, Apache Corporation, Houston, Texas, USA

mike.yates@apachecorp.com

And

Steve Adiletta, Apache Corporation, Houston, Texas, USA

Introduction

In 2010, Apache Corporation began acquiring exploration leases in Alaska's Cook Inlet – a compressional fore-arc basin with current hydrocarbon production, known reserves, and according to U.S. government agencies, significant reserves yet to be discovered. In order to effectively explore for these remaining reserves, thought to lie deeper than many of the fields already in production, a regional seismic dataset would be needed that surpassed any previously acquired in that area in terms of extent, offset, and sampling, in order to image these deep structures.

To prove the viability of such a regional 3D program, and to evaluate equipment and parameters, a test program was carried out in early 2011. This test program, which proved successful, was followed by full-scale 3D seismic acquisition starting in the fall of 2011, continuing through the winter of 2011/12 and into the summer and fall of 2012.



Figure 1 - Test Line Layout, West Foreland

2D Test Program

The first step in the program was the design, acquisition, and processing of an 18-mile 2D line just west of the West Foreland, in Redoubt Bay, that spanned upland and coastal plain onshore, the inter-tidal or transition zone (TZ), and offshore into water depths of up to 150 feet.

The line was laid out with two recording systems in parallel in order to compare data and performance from a conventional cable-telemetry recorder and an autonomous nodal system with two types of node, one for onshore and one for offshore/TZ operations.

Onshore, groups of shots were drilled at 660' intervals along the line with 8 combinations of charge size and hole depth in each group. These were recorded and subsequently processed independently to compare the performance of each combination of hole depth and charge size. Offshore, multiple sizes of marine source array were used in separate passes in order to perform the source comparison in the marine environment.

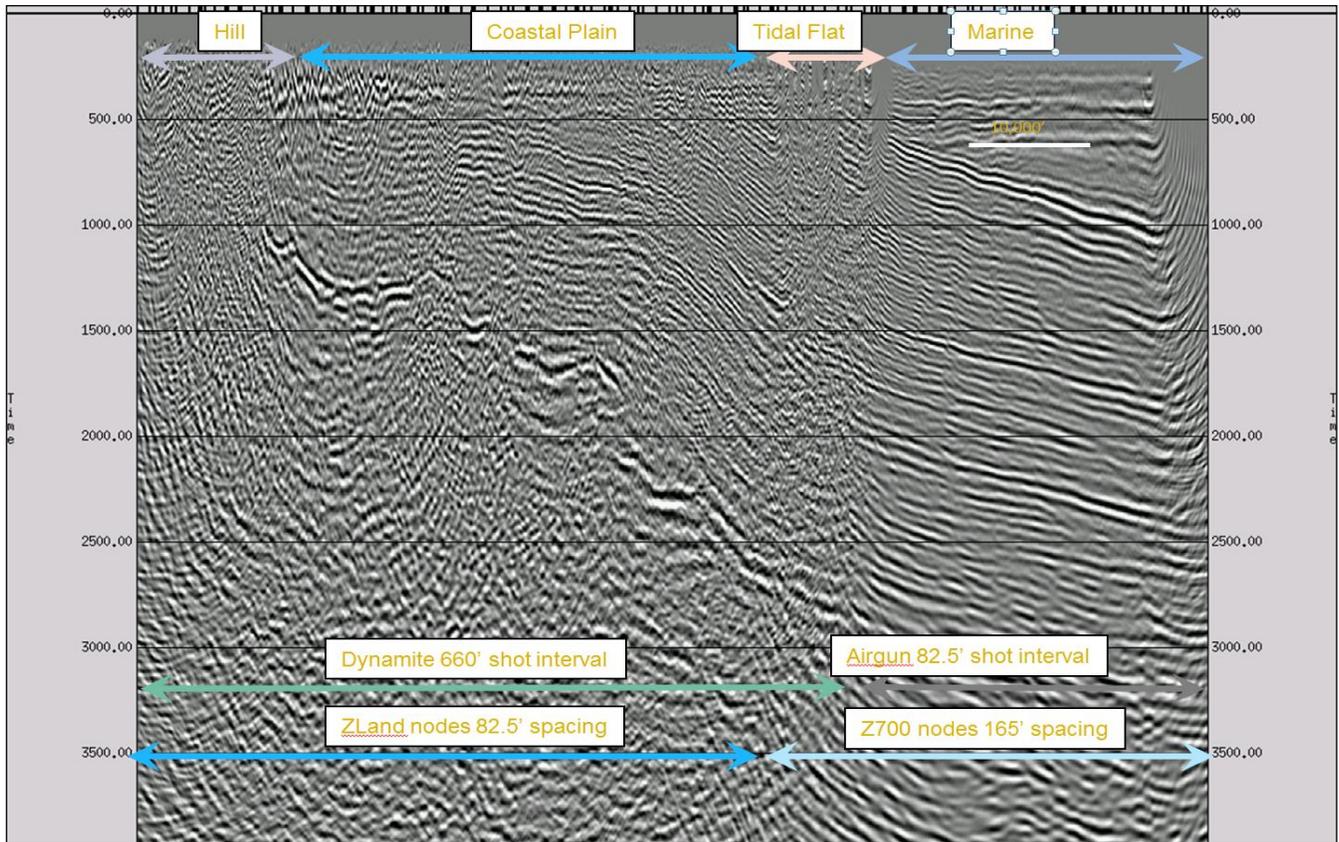


Figure 2 - Migrated 2-D Test Line

The onshore source testing showed that a 4-pound charge at 35' depth out-performed the traditionally-used 2-pound at 25' depth, and also showed that deeper holes that might offer better shot coupling were uneconomical in large numbers due to gravel-related hole stability problems. Offshore, the larger arrays were superior to smaller arrays, leading to the selection of a 2,400 cubic inch array for production recording. The results from a 1,760 cubic inch array were comparable, but the larger array was selected to maximize the energy recorded out to the longest offsets and boost signal to noise as much as possible.

The nodal recording system proved more reliable than the cable system in all environments, with no node-system-related downtime. The results of the test line served multiple purposes in terms of acquiring permits, establishing on- and off-shore source parameters, required offsets, and subsurface sampling requirements. Processing and migration of the collected data showed that the deepest targets of interest could be imaged without significant degradation beneath the coastline and TZ.

3D Acquisition

Starting with mobilization of land survey crews, a 12-month multi-mode 3D was started in the fall of 2011, onshore on the west side of Cook Inlet, close to Tyonek and Granite Point. This was followed by heli-portable shot-hole drilling and recording. The land crew worked through the winter, with the heaviest snowfall on record in south-eastern Alaska, achieving 110 square miles of onshore coverage by May 2012. Following six weeks of transition zone work to undershoot the coast, the marine program started in earnest in June 2012, recording 210 square miles of full-azimuth 3-D data in a single season, achieving 2 square miles a day at peak production. These two phases combined created 320 square miles of contiguous full-offset, full-azimuth data, spanning Cook Inlet from Granite Point to Nikiski.



Figure 3 – 320 Square Miles of Contiguous 3-D Coverage (Pale Green)

Conclusions

The successful 2-D test program established the necessary acquisition parameters, proved the viability of the nodal recording system, and gave sufficient confidence to commence the large-scale regional 3D program. Despite weather and permit challenges, a 12 month 3D seismic campaign followed the successful 2D test line, recording approximately 320 square miles of contiguous 3D coverage, the largest survey recorded to date in this challenging region.

Acknowledgements

Apache Corporation, Apache Alaska Corporation,
Mike Reblin, Blake Knoll and Gary Streff,
SAExploration and subcontractors.