

Over/under Towed Streamer Data Acquisition, a Novel Method For Offshore Hydrocarbon Exploration

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Abstract

We have introduced a nearly novel technique for marine seismic operation called over/under towed streamer technology. In spite of its high cost compared to other conventional techniques; however, due to many advantages that this technology has, it has become a common method for marine seismic exploration. The main idea of this technology is to use two concurrently towed streamers at two different depths which must be kept fixed in a vertical plane. Using two concurrently streamer is to overcome a typical problem in marine seismic operation caused by downward reflection of our desired upgoing wavefields from the sea surface. These undesired downgoing reflected wavefields from the sea surface is well-known as "ghost". One benefit of this technology is that we can acquire seismic data at depths deeper than conventional acquisition depths. This technology enables us to acquire data that has the high-frequency characteristics of conventional data recorded at a shallow towing depth and the low frequency characteristics of conventional data recorded at deeper towing depth. The advantages of this technology are presented and this technology is compared with other conventional methods. Over/Under data acquisition is also investigated. To prove the reliability of the technology some case histories briefly are studied show the superiority of the technology to other conventional technologies. The new developments of this technology as well introduced and their advantages in comparison with the premium technology are explored too.

Key words: over/under, streamer, wavefield, notch frequency, upgoing, downgoing, ghost, triple

Introduction

By increasing in the rate of world's daily consumption of fossil fuels and also the growth of oil and gas price, hydrocarbon supplies around the world, especially offshore supplies found of great importance; hence the demand for a reliable and robust offshore exploration method has become manifested. Meanwhile marine seismic methods as trustworthy geophysical exploration methods have their essential values. Recently the numbers of marine seismic operations which use over/under towed streamer technology have increased. Because this method has many advantages compare to other conventional methods, many companies are being motivated to use this technology, in spite of its higher cost. The main idea is to tow two streamers at two different depths in a vertical plane using positioning and steering. In conjunction with these paired cables, it is possible to acquire data with paired sources at two differing source depths. Ideally, in favor of prevention ghost effect the single streamer should be just below the sea surface in all conventional towed streamer methods, however, due to environmental noise we have to tow the streamer at a predefined depth below the sea surface and this solution has its own main dilemma which is "ghost generation". By adding another streamer to the single streamer and combining their recorded data, it is possible to compensate for the ghost effect of free surface using wavefield separation methods. Since the technology uses two streamers at both shallow and deep depths the data acquired have both high frequency and low frequency characteristics at the same time. Significantly broader signal bandwidth with low-frequency content gives deeper penetration, and therefore, improved imaging beneath basalt, salt and other highly absorptive overburdens. Moreover, the bandwidth extension to lower frequencies makes seismic inversion less dependent upon model-based methods. A simpler signal wavelet with the bandwidth extension to higher frequencies gives enhanced resolving power and allows for a more detailed stratigraphic interpretation.