An Integrated 3-D Surface and Borehole Seismic Approach to Better Understand a Complex Reservoir: Case History from West Kuwait

Tarek Nafie[1]*, Will Gowans*[1]*, and Pradyumna Dutta*[2]*. (1) Special Projects, WesternGeco, 26 Horreya St,Helioplis,Cairo-Egypt, Cairo, Egypt, TNafie@abu-dhabi.westerngeco.slb.com, (2) Senior Geophysicist, KOC, Al Ahmadi-Kuwait, Kuwait, Kuwait*

New technologies in borehole seismic and surface-seismic data acquisition and processing have allowed the integration of borehole information, such as Walkaway, Zero Offset VSP's and dipole sonic logs, with surface seismic data. The aim of this integration is to produce seismic images of superior resolution which can subsequently be optimally conditioned for inversion and reservoir characterization. This paper describes some of these new developments, and the results from a project in Minagish Field, Kuwait. The Minagish Field is located onshore West Kuwait. The main reservoir, Minagish Oolite, of Cretaceous age is around 120m thick. Secondary reservoirs are in the Upper Cretaceous and Jurassic layers. Apart from a series of normal faults running east-west through the centre of the field, there is evidence of a large number of small faults and lineations which could act as barriers for fluid movement. While the seismic data quality in the field is generally good, but the Minagish Oolite horizon is disturbed due to the karstification of the overlying Shuaiba formation in addition to inter-bed multiples from the shallow horizons. Integration of the borehole data with 3D seismic data was utilized for relative true-amplitude recovery, multiple suppression and anisotropic corrections. Relative true amplitude recovery was based on VSP-derived inelastic attenuation factors, anisotropic geometric-spreading corrections and transmission-loss compensation factors obtained from the Walkaway data. Anisotropy corrections accompanied velocity analysis, which was guided by the borehole velocity function, enabled accurate distinction of primary reflection events from multiple events. The final results of the processed seismic data were quantitatively appraised by the quality of the tie between the final migrated data, synthetic seismogram and VSP corridor stack from a number of wells. The integration of various data sets resulted in improving the seismic image, with overall higher resolution which enabled a robust and accurate inversion.