Adeolu Aderoju
Oyelowo G. Bayowa
Olatunbosun A. Alao

Hydrocarbon Exploration Using Unconventional Interpretation Techniques

Reflection Seismology

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DEDICATION

This beautiful piece is strictly dedicated to my heavenly father; the owner of the universe, the author of my life, the one who knows my destination.

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ABSTRACT

Technology has been predicted as the last card in combating the ever increasing demand of our commodity; oil and gas. Modern approach to Seismic acquisitions and interpretation is of prime essence. A powerful

Interpretation tool; Spectral decomposition, has been used to visualize (in 3 – D) a thin sandstone reservoir in "X – Field" Niger Delta, Nigeria. The study aimed at mapping thin sandstone beds which have been considered sub seismic or un-mapable.

Well log data were acquired and qualitatively and quantitatively interpreted using RocDok software and correlated across four wells; Tmb 01, 02, 04 and 05. The interpreted well logs were presented in Tables. Seismic data were also acquired. Thin sandstone bed markers were identified from well logs and consequently mapped on the seismic data. The data were interpreted using the OpendTect software for frequency analysis which was presented in form of maps.

Two thin sandstone beds were delineated from the well log these are; TB 01T and TB 03T. TB 01T had an average thickness of 4.16m and cuts across three wells (Tmb 01, 04 and 05) but was not delineated in Tmb 02. TB 03T was extremely thin. Its average thickness could not be estimated but cut across the four wells. Frequency analysis from seismic sectional view revealed the portion of the thin pay sandstone as the markers were engulfed by high amplitude. The plan view seismic analysis also showed high amplitude across the region of the thin sandstone.

The study concluded that the high amplitude represented on the seismic views characterize the thin sandstone pay. However, other regions on the seismic views with high amplitude could be new prospects.

CHAPTER 1

1.1 Introduction

Over time, beds of relative thicknesses between 10 - 30m or thin reservoirs have been deemed un-mapable or probable to interpreters using conventional interpretation techniques. This is caused by various factors, such as: the reservoir's thinness, discontinuous occurrences, high degree of vertical and lateral variability in net sand thickness, weak impedance contrast at sand interfaces, high impedance of bounding overlying layers and the limited bandwidth of seismic data.

In geological settings where there are successive intercalations of rocks such as the Niger Delta basin of Nigeria, mapping of such thin reservoir may seem more challenging using the conventional Technology. This project is set to map such thin pay zones using a 3-D visualization and spectral decomposition attributes which in turn will help to define the thickness, heterogeneity, rock property changes, depth thickness and the lateral spread across oil wells in the selected locale of the Niger Delta, Nigeria.

The Research problem

The term "All the easy oil has been found" is no more a novel term, it has grown popular. In the 1900s it was not uncommon to search for oil tucked beneath structurally simple anitclinal traps. However, geoscientists have to work much harder today to discover economic reservoirs. Searching for hard-to-find stratigraphic traps is common as we reexamine mature plays to uncover missed hydrocarbons. In modern times, simply relying on the full-stack amplitude response as a direct hydrocarbon indicator is not enough; typically, advanced reservoir characterization techniques and seismic attribute analyses are needed to evaluate a reservoir properly.

Most Seismic datasets contain higher frequencies near the surface; all frequencies attenuate as the wave front propagates deeper into the subsurface. Many of the Pays lie in depths where they are primarily imaged by frequencies as low as 10 to 20 Hz. This means that thin beds, beds that are 16 to 82 ft (5 to 25 m) thick are sub-seismic in nature (i.e., they cannot be resolved by the seismic wavelet and are considered to be below the tuning thickness). These are the type of thin stringer sands that are encountered on usual basis in seismic datasets. Given the low frequency content of these datasets, advanced attribute analyses techniques are required to properly evaluate these deposits. The processes helped to supplement the thin sandstone beds exploitation and to uncover the data that traditionally goes undetected.

1.2 Aim of Research

To map thin pay zones using 3-D visualization and spectral decomposition attribute.

1.3 Specific Objectives of the Study

The specific objectives of the study are to

1. Carry out interpretation of well data to determine possible thin reservoir sand, including the sand Reservoir in the study area.
2. Carry out conventional seismic interpretation over the study area, mapping faults and interpreting horizons
3. Overlay the well log data interpretation on the seismic interpretation to determine a lateral continuity of the thin sand.