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AVO Scanning—Large Datasets and Little Time

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Abstract

AVO (Amplitude versus offset) analysis is an important tool in identifying hydrocarbons directly from seismic data and reducing drilling risk under certain conditions in some geologic settings. Properly acquired and processed seismic data shot across a basin where the reservoirs are porous enough (greater than ~20%), thick enough (greater than ~5-10 meters) and charged with light oil or gas can permit direct detection of hydrocarbons. Exploration around the world driven by “Bright Spot” detection and AVO analysis has had a huge positive impact on drilling success. The technology is increasingly employed in areas of poorer rock quality and heavier fluids - pushing the envelope on what can be extracted from (removed the word our) 3D seismic volumes.

Large 3D seismic datasets are a challenge to conventional interpretation and AVO analysis techniques. Interpreters typically focus their mapping on structural closures. Many of the best opportunities remaining in oil and gas basins around the world are in stratigraphic traps which may offer billion-barrel-potential. Unfortunately, it is often difficult to extract reliable AVO information from huge 3D volumes with changing data quality and changing geology. The combination of large datasets, limited time and limited staff increases the potential for missing opportunities. A systematic work-flow is required to identify prospects or geologic “leads” using a combination of processing technology and volume manipulation to more rapidly identify exploration opportunities. The “leads” highlighted can then be matured to prospects and risked using AVO analysis and other seismic amplitude anomaly characteristics.

Processing the seismic data for AVO analysis involves preserving small amplitude changes buried in the pre-stack dataset. These changes can be hidden by spatial differences in the seismic generally caused by variations in the overlying geology. Correcting for the overburden effects permits a more aggressive detection of anomalies using cross-plot and attribute stack comparisons. Anomalies identified from the above are then compared with a geologic model and ranked. The high-graded anomalies are then used to focus the exploration mapping and prospect analysis – ultimately saving time while still capturing unconventional (strat-trap) potential.

Introduction

Time is critical for executing an exploration program. Often by the time the acreage terms are agreed, data acquisition is planned and executed, and the data is processed…there’s little time for the critical technical work needed to assess the oil and gas potential. Add to this the massive size of some of the 3D datasets being shot around the world and the likelihood that excellent prospects will be missed increases to unacceptable levels. The following paper describes a workflow for minimizing missed potential though processing tools and interpretation techniques designed to flag opportunities and help focus the interpreters efforts. The discussion starts with an assumption that the data have been processed properly to provide a pre-stack time migrated gather set.