Quick Look Prospect Sizing — Mississippi Canyon

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ABSTRACT

Exploration and development of hydrocarbons in the deepwater Gulf of Mexico relies heavily on seismic expression of the targets and the resulting interpretation. Numerous seismic attributes can be extracted from the seismic data in order to assess the economic viability of a given prospect or discovery. Attributes are derived from a seismic wave's response as it travels through the subsurface. The objective of this study is to determine the location and attitude of these reflections to infer geologic structure, stratigraphy, presence and extent of hydrocarbons, as they apply to estimating the range of Original Oil in Place (OOIP).

A recent discovery in the Mississippi Canyon area was used as the test area to evaluate the utility of "quick look" analog data for initial prospect sizing/screening in the Tertiary amplitude play of southern Viosca Knoll — northern Mississippi Canyon areas. A Monte Carlo simulator provided for the distribution of OOIP estimates using inputted P10, means, and P90's. Sensitivities, a product of the simulator, indicated that thickness and area were the drivers in initial OOIP estimates. The hydrocarbon accumulations in the study area occur predominantly in Middle Miocene turbidite deposits. Publicly available open hole well data and 3D seismic data provided the base information for the study. Petrophysical analysis of the well data, in the form of gross and net oil pay, provide the ground truth for comparison to seismic attributes. Basic seismic attributes included trough and peak amplitudes, composite amplitude, isochron, and the isochron/ composite amplitude product. These attributes were cross-plotted with the well data. Several strong correlations were apparent, with the net pay — isochron*composite amplitude being the highest having a .84 correlation coefficient (Fig. 1). Data for cross correlation were obtained from selected wells from Petronius, Tahoe, and Ram Powell Fields and were compared with seismic attributes over the discovery area. Well data from the discovery area were then compared to the predictive model in the order that they were drilled, revising the predictive model with subsequent wells as they were introduced. The tracking of OOIP estimates from the initial first look to the fourth well indicated significantly decreased variation in OOIP estimates with additional well data. The results of the study provided insight into future model refinements as well as appraisal strategies.

The seismic survey utilized was part of a non-exclusive 3D survey using a 6000 meter cable length, 50 meter line spacing, 25 meter group intervals, and an eight second record length. The basic processing steps included spiking deconvolution, NMO, DMO, and inline/cross line migration. The majority of the open hole log data included the following digital information: gamma ray, resistivity, neutron and bulk density, and sonic logs. Additional data included sidewall core data and reservoir fluid information.

The primary information extracted from a cursory petrophysical log analysis was net and gross sand thickness in the pay zones, which provided a basis for study of the region and comparison to seismic data. Further petrophysical attributes were analyzed and their range of uncertainty evaluated. However, those attributes were determined, by sensitivity analysis, to be of secondary importance at this stage of prospect sizing (Fig. 2). These petrophysical properties included changes in porosity, water saturation, grain size, cementation, and others. Reservoir fluid properties, such as gas/oil ratio, pressure, and formation volume factor, were also considered but were not determined to be vital to the sensitivities. From the seismic data, the peak amplitude, trough amplitude, and isochron thickness were recorded and analyzed for comparison. Tuning effects in the seismic data were investigated as part of the seismic issues associated within the analog fields and test area.

Cross-referencing log (geologic data) with seismic data is essential for interpretation of reservoir potential in the Gulf of Mexico where class 1 amplitude anomalies are common, especially in some of the deepwater basins. Integrated reservoir studies require core descriptions, petrophysics, log interpretation, reservoir geophysics, reservoir flow simulation, and reservoir economics (Johann, 1997). In this area of the deepwater Gulf of Mexico seismic attributes, such as anomalously high amplitude, are reliable and a cost effective method of predicting subsurface lithology, reservoir continuity, and fluid composition. To this end, it is important to be aware of unusual lithologies that may cause anomalous amplitude responses such as condensed sections and ash beds by emphasizing the well to seismic tie.

The ultimate goal of this study was to provide greater insight into initial prospect sizing/screening for field development and exploration. A Monte Carlo simulator provided the distribution of Original Oil in Place (OOIP) estimates. The predictive model was established using wells from regional fields and then applied to test area in the region to assess the method and the uncertainties involved with estimating OOIP. Once the regional data was

acquired and a correlation to seismic data was made, a blind test was performed to insure the validity of the analysis. For this test, the two areas of greatest sensitivity were used, those being thickness and area of the reservoir. In this test area the areal footprint of the suspected reservoir was relatively constrained due to its seismic signature, in comparison to the uncertainty in thickness. Here, the net average pay thickness of the reservoir had the greatest uncertainty due to the lack of well control in the region.

This study was important to assess the methods involved in a quick look into the area. The effects of the study show that assessing the major sensitivities and addressing them in a field is the most important first step to a field study. It also shows that no matter how accurate a predictive model from seismic may be, there is still a level of uncertainty that is involved (Fig. 3). The learning curve about any field cannot be discounted when assessing any field's value. For that reason, as the application of the blind test became more developed, so did the overall information about the field and thus so did the confidence about the predictive modeling. In retrospect, the study accomplished its goals of a "quick-look" for the short time frame of the study, but the results are applicable on a broad level. Further analysis would have to be made based on the data acquired in this study to proceed in the hydrocarbon development process.

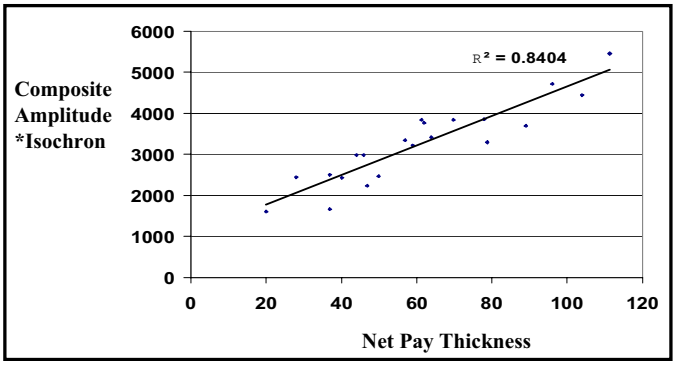

Figure 1. *Cross correlation between well derived net pay thickness and seismically derived composite amplitude*isochrone.*

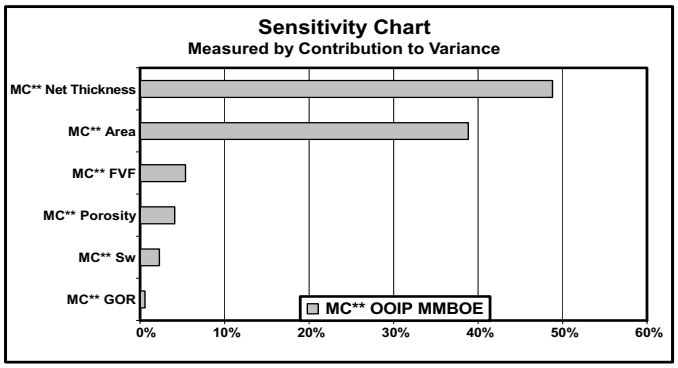

Figure 2. *Sensitivity analysis of OOIP and reservoir input parameters.*

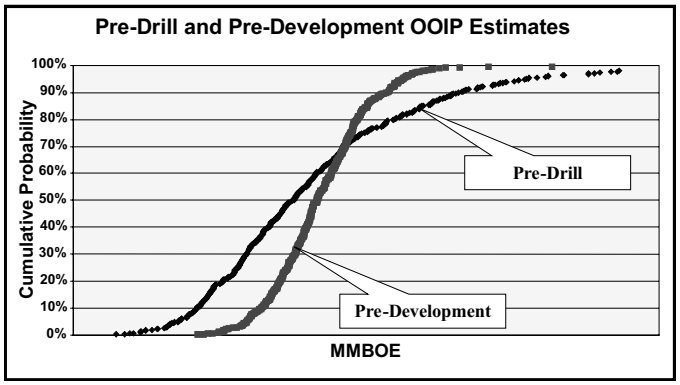

Figure 3. *OOIP distribution — pre-drill and pre-development.*

REFERENCES CITED

Johann, P. R., 1998, 3-D Seismic stratigraphic inversion; a lithology-based approach for seismic reservoir characterization in the deep water Campos Basin, AAPG Bulletin, 82 (10), 1883.