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ABSTRACT

FALSE POSITIVE SEISMIC "BRIGHT SPOTS" AND DISCRIMINATION BETWEEN GAS AND BRINE SATURATION, USING AVO ANALYSIS IN THE COLUMBUS BASIN, OFFSHORE TRINIDAD

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Exploratory drilling in the Tertiary Columbus Basin, offshore Trinidad has targeted high amplitude anomalies or "bright spots" in stacked sections with the expectation that these high amplitude reflectors will be gas-saturated sands. Many of these "bright" reflection events are brine-saturated sands or tight, un-commercial gas-saturated silts. Thus, they are often characterized as "False Bright Spots".

This study investigates the use of Amplitude Variation with Offset (AVO) techniques to discriminate bona fide gas-saturated "bright spots" from false brine-saturated "bright spots". Three AVO analysis techniques utilizing well log data and 3-D seismic data were applied to 4 different study areas within the Columbus Basin: Intercept (A) and Gradient (B), Elastic Impedance (EI) inversion and Lambda-Mu-Rho (LMR) inversion. A total of 20 prospective intervals were evaluated. The three AVO analysis techniques were all successful in discriminating gas saturation from brine saturation in the vast majority of the case studies.

The AVO methods correctly identified the fluid saturation in an average of 90% of the cases compared to a 45% success rate with the “bright spot” analysis. Figure 1 shows an example of the differentiation of gas- and brine-saturated “bright spots” using LMR inversion

Application of all three AVO techniques is recommended as a means of cross-validating results and increasing the reliability of results and interpretation. In addition, the EI and LMR inversion methods demonstrated potential to be lithology indicators between sandy and shaly lithologies. The Rock Physics and AVO analyses presented in this study provide a reliable method to discriminate gas-saturated and brine-saturated sediments including “False Bright Spots”, and contribute to the overall geophysical understanding and characterization of the Columbus Basin. Further, this is also a new case study of LMR inversion involving younger Tertiary sediments, as many of the documented examples of LMR inversion applied to real seismic data are on well-consolidated Lower Cretaceous sediments. As part of this study, a new “mudrock” line with coefficients relative to the Columbus Basin has been developed for estimation of seismic shear wave velocities from conventional sonic log data.

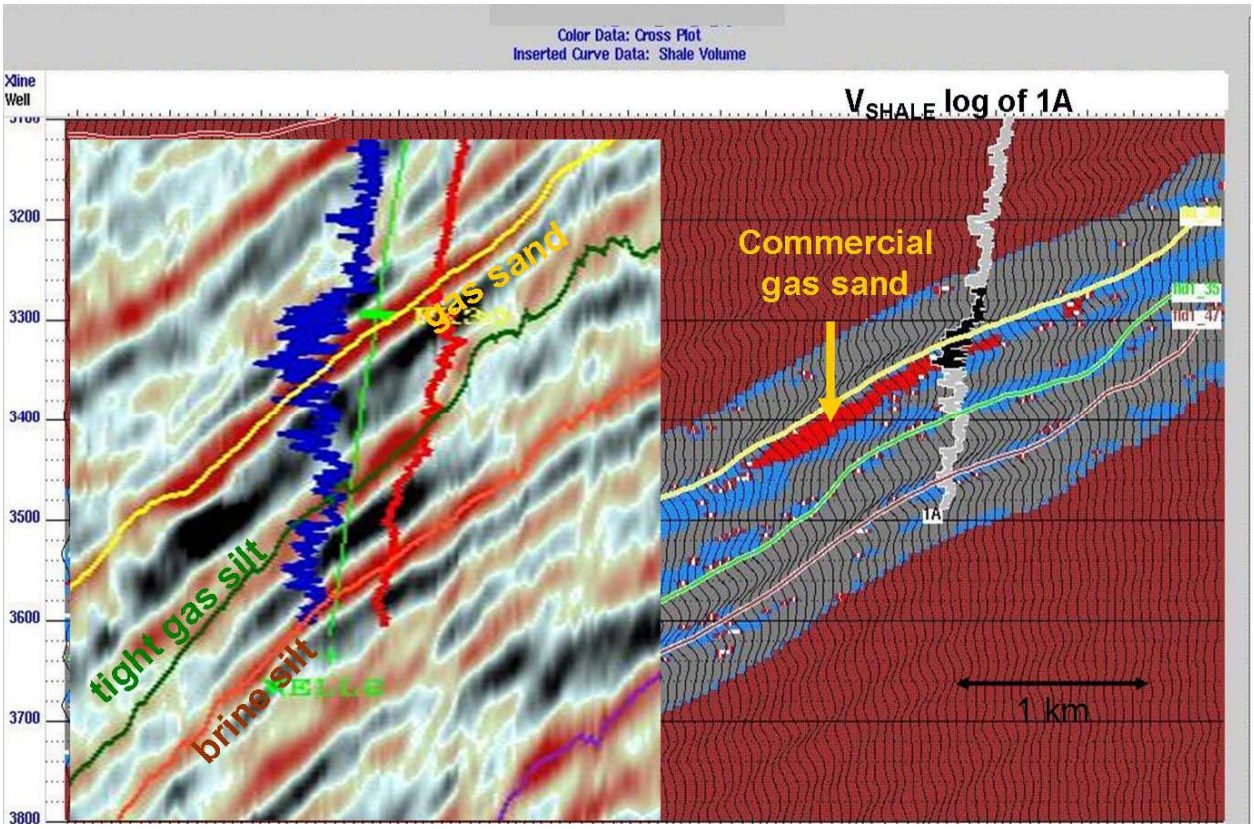

Figure 1 – Results of LMR Cross plotting for Field 1. The stacked seismic section on the left shows 3 “bright spots” indicated by the tracked horizons. Only the shallowest yellow horizon is a fully gas-saturated sand, while the green horizon is a tight partially gas-saturated silt (which was deemed un-commercial) and the brown horizon is brine-saturated. The LMR inversion result shown on the right highlights and differentiates the good, commercial quality gas sand (bright red) from the other false “bright spots” , which are categorized as background lithologies (blues and greys).