New Approach Using Acoustic Impedance Modeling for Reservoir Sand Identification in Brown Field Area: A Case Study for Besitang Field, North Sumatra Basin, Indonesia

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The strongly increase of gas demand along with decreasing the oil and gas production in the North Sumatra Area are facing a big challenge to enhance the oil and gas production. The latest technologies which have not been fully applied over the area become a reason why hydrocarbon potential from the main objective of Besitang River Sand (BRS) not yet optimally developed. The Acoustic Impedance modeling is approached as the new innovation to overcome the reservoir problem.

Besitang field was discovered with BST-1 exploration gas well in 1977. Recently, only BST-14 that still can produce intermittent oil from 21 development wells controlled by submarine fan system. The study area is located at North Sumatra Basin toward to the north of Telaga Said Field which proved the presence of oil bearing in BRS.

Seismic interpretation and well correlation analysis are inadequate to characterize the reservoir distribution. Constrain Sparse Spike Inversion method is then chosen using several 2D post-stack seismic lines from Aru area acquired in 1989 and 2 well constrained for getting the low frequency component to build geological model.

Dry wells reservoir can be distinguished from producing wells by comparing the difference value of acoustic impedance anomaly.

The acoustic impedance modeling controlled by regional geology expected to be potential tool to enhance the confidence level in finding the proper position for infill drilling in mature area. Furthermore, the field still has a good opportunity to optimize the production from next infill development wells which will be drilled this year.

Innovation without Limits –Minas Infill Stratigraphy Project Development

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This paper will illustrate how the integrated cross functional team in Minas Field (Indonesia) conducted reservoir management process continuously to identify and produce bypassed oil thru Infill Project. Many candidates are identified based on structural and stratigraphy traps. The process covers two main themes; planning and executing. In the planning part, in addition to utilizing the high resolution seismic technologies along with improved geology concept, the Team also improves reserves calculation methodologies. In the execution part, the Team improves a communication process that is called POP coordination process to accelerate well put on production. Both improvement processes adding incremental reserves of 24% more than expected.

The Team uses technology that could increase our capability to accurately select economically viable locations to drill wells. The technologies used to help select drilling locations are the 3D high resolution seismic attribute study and detailed seismic sequence stratigraphy / morphology, an attempt to predict physical properties from seismic attributes. It was then combined with other approaches such as improving well selection criteria, project look back, and considering current production performance of surrounding wells. The uses of technologies are critical since Minas Field is structurally compartmentalized by faults and rapid stratigraphic changes, which are believed, are potential factors for bypassed oil. The result has been promising with improving the infill well's production performances.

Cycle time of putting the well on production has also been significantly improved. In 2004, we have achieved 15 days from complete drilling to POP well, 6 days better than target. This excellent continuous performance was achieved with stringent attention to safety due to good coordination among teams. As testimony to this, the project recently clocked up over 100,000 man-hours without a lost time incident.

Improving Seismic Interpretability by Integrating Well Seismic Data into Processing

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Construction of well-to-seismic ties and structural and stratigraphic mapping are the key tasks of an interpreter. In order to achieve the best results and see the most detail, great care must be taken during processing of the seismic data. Often, however, the standard processing flow is not sufficient to get good well ties and achieve the maximum resolution possible.

Valuable information from well seismic data (Vertical Seismic Profile – VSP) can be integrated into the processing flow, which is often not fully utilised. The application of the so-called Q factor to compensate for attenuation of seismic waves in the earth is very important. This can be directly based on VSP data, rather than a trial and error process, which is common practice. A Q factor of 100 is common to process the seismic data in Murphy Oil.

Through various examples in the Sarawak Basin, VSP-based time variant Q compensation function improves the interpretability of the seismic data by increasing the resolution and the continuity of events. This means that optimum Q application will provide the seismic interpreters with more data to be interpreted with higher confidence. Semblance between different stacks with various Q values applied and corresponding VSP corridor stacks was calculated to measure the similarity. Higher semblance was observed after applying time variant Q to the seismic data.

It was learned that a constant Q of 100 that have been used during earlier seismic processing would not be sufficient to compensate for both amplitude decay and time-variant phase shift.

Heuristic Validation of Probabilistic Neural Network in Reservoir Property Estimation from Seismic

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Interpreters increasingly rely on neural network methods to predict reservoir properties at locations far from existing wells. When it is done in a field with scarce well control the validity of the method becomes increasingly uncertain. Fortunately, the main application of neural networks in property estimation is minimizing error, while providing a more empirical observation of the error rather than purely mathematical. Observation of error measures how well the method predicts reservoir properties. Final validation however, should not depend on error statistics and coefficient correlations alone, but include geological reasoning. Probabilistic Neural Network is used in this work to predict reservoir properties from 3D synthetic seismic data. Reconstruction of the 3D synthetic data for this purpose minimizes uncertainty from the well-seismic ties. Once bias of well-ties is minimized, the main source of error comes from the input well parameters. Varying this input and adding a set of pseudo wells from the synthetic data enhances understanding as to the source of error. Observation of error as a function of the well location suggests uncertainty of the estimation if the well distance and stratigraphy vary with the input wells, and raises the issue of unreliability of high correlation coefficients as a result of using many wells with varying stratigraphy. Applying the result of this heuristic validation can improve property estimation in a field with limited wells, avoid misinterpretation of high correlation coefficients, provide multi-realizations of property models using pseudo wells, and rejuvenate new well development in mature fields.

Direct Hydrocarbon Indicators (DHIs) Derived from Analysis of Simultaneous Seismic Inversion Significantly Reduces Exploration Risk

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The Early Cretaceous Flag Sandstone has proven to be a prolific oil and gas producer within the Barrow Sub-Basin to the east of Barrow Island. The main trapping mechanism is four-way dip closed anticlines formed by drape compaction. The large structures have now been drilled and remaining prospects require the integration of data through the use of inversion technology. The variations in extracted seismic amplitudes at the Flag reservoir level are primarily related to variations in porosity or gas, and are therefore not seen as reliable indicators of oil charged reservoirs. Simultaneous inversion of three angle seismic stacks was applied to a 500 sq km area and a direct hydrocarbon indicator (DHI) attribute, fluid index, was derived as an exploration tool to minimize risk.

This presentation shows how the fluid index attribute was derived using a combination of well and seismic inversion data and summarizes the results of using fluid index (DHI) as a predictive tool based on the 2005/6 well results. The application of DHI technology to this mature hydrocarbon producing area has aided Apache and its joint venture partners in their assessment of remaining assets within their exploration permits.