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The Limitation of 4D in Feasibility Study and Interpretation of Carbonate Field, a Case Study in Central Luconio, Sabah

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SUMMARY

4D seismic reservoir monitoring is a relative new technology consists of repeating 3D seismic survey in order to make time-lapse images of the fluid and pressure fronts as they move in a subsurface reservoir during hydrocarbon production. When successful, 4D seismic can locate areas of bypassed gas and or oil for new drilling opportunities, map out water flooded areas to avoid the costly mistake of drilling new wells into swept zones, and identify the geometry and nature of reservoir flow compartments that are the key to optimizing hydrocarbon recovery.
A successful 4D seismic is depends on repeatable acquisition and processing the monitor with base seismic 3D surveys to achieve detectability responds to production history changes. As the 4D seismic is commonly expensive,feasibility study is required to decide the value of business. we demonstrated a example of integrating Petrophysical and Seismic followed with 4D interpretation. Its limitation of using seismic amplitude differences was analyzed and qualitative “Two End Members” as a possible “Original and Current Hydrocarbon Contact” with its limitation was evaluated.
Finally, recommendation from qualitative to a quantitative 4D elastic inversion is proposed. Despite that its not tested yet, a successful case demonstrated in Norway using this kind of approach.

4D seismic reservoir monitoring is a relative new technology that consists of repeating 3D seismic survey in order to make time-lapse images of the fluid and pressure fronts as they move in a subsurface reservoir during hydrocarbon production. When successful, 4D seismic can locate areas of bypassed gas and or oil for new drilling opportunities, map out water flooded areas to avoid the costly mistake of drilling new wells into swept zones, and identify the geometry and nature of reservoir flow compartments that are the key to optimizing hydrocarbon recovery (David E'Lumley, The Leading Edge, 2004).

A successful 4D seismic is primary depends on conducting repeatable acquisition parameters and processing the monitor together with base seismic 3D surveys to achieve detectability differences amplitude image that responds to production history changes. As the 4D seismic acquisition including processing and interpretation are commonly expensive, prior the project start a proper feasibility study on technical and economical assessments are compulsory required to decide the value added of business objective. In this paper, we demonstrated a practical feasibility example of integrating components of Petrophysical and Seismic Modeling followed with a common fast track 4D interpretation after acquiring 4D seismic in Carbonate Central Luconia field. The Seismic Modeling was generated derived from geological or simulation model where Petrophysicist calculated the velocity, density associated with overburden pressure in building Seismic Forward Modeling scenarios. Its limitation interpretation on the basis of only using seismic amplitude differences responds was analyzed and a qualitative analysis "Two End Members" of 100% water and/or 100% hydrocarbon as a possible "Original Hydrocarbon Contact" and/or "Current Hydrocarbon Contact" with its limitation was also evaluated.

Finally, a possible practical recommendation to move from qualitative workflow to a quantitative 4D elastic inversion processing and interpretation is proposed. Despite the fact that in Malaysia field this work flow approach has not been popular tested yet, a successful history has been demonstrated in Norway, North Sea, on Jotun 4D time-lapse project using this kind of approach.

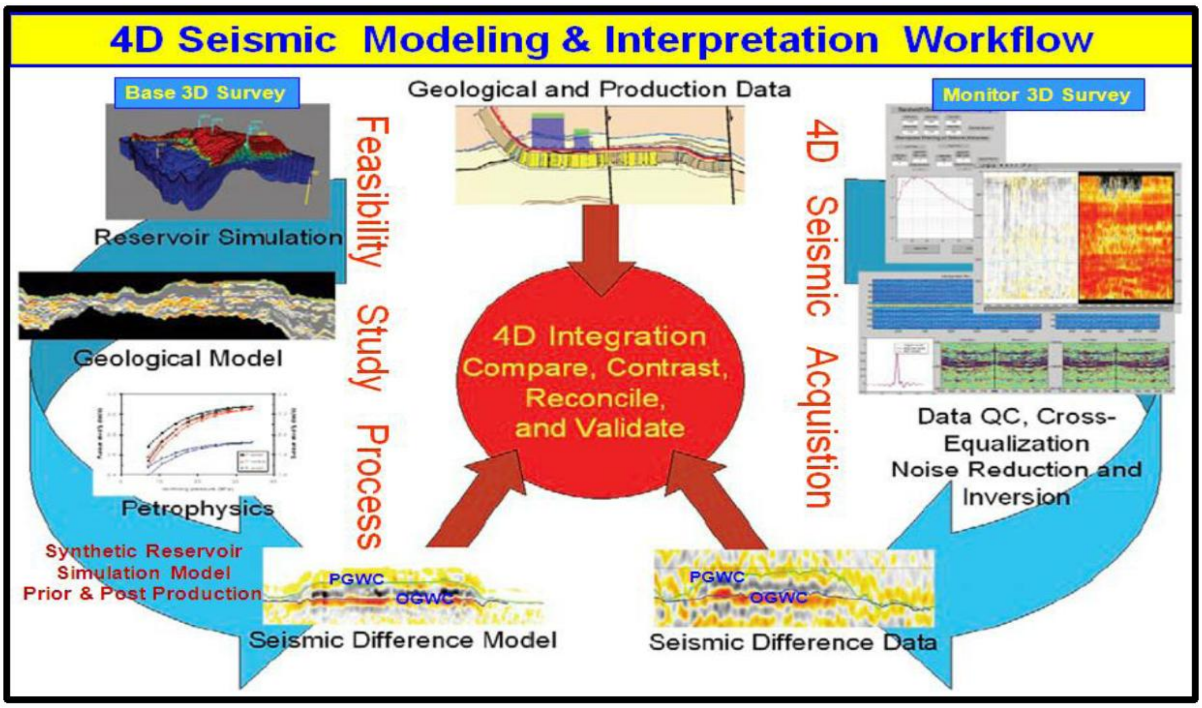

Figure 1 *Recommendation Approach of 4D Seismic Modeling and Interpretation Workflow(Wences P.Gouveia, David H.Johnston, Arne Solberg and Marten Lauritzen,Leading Edge, November 2004).*

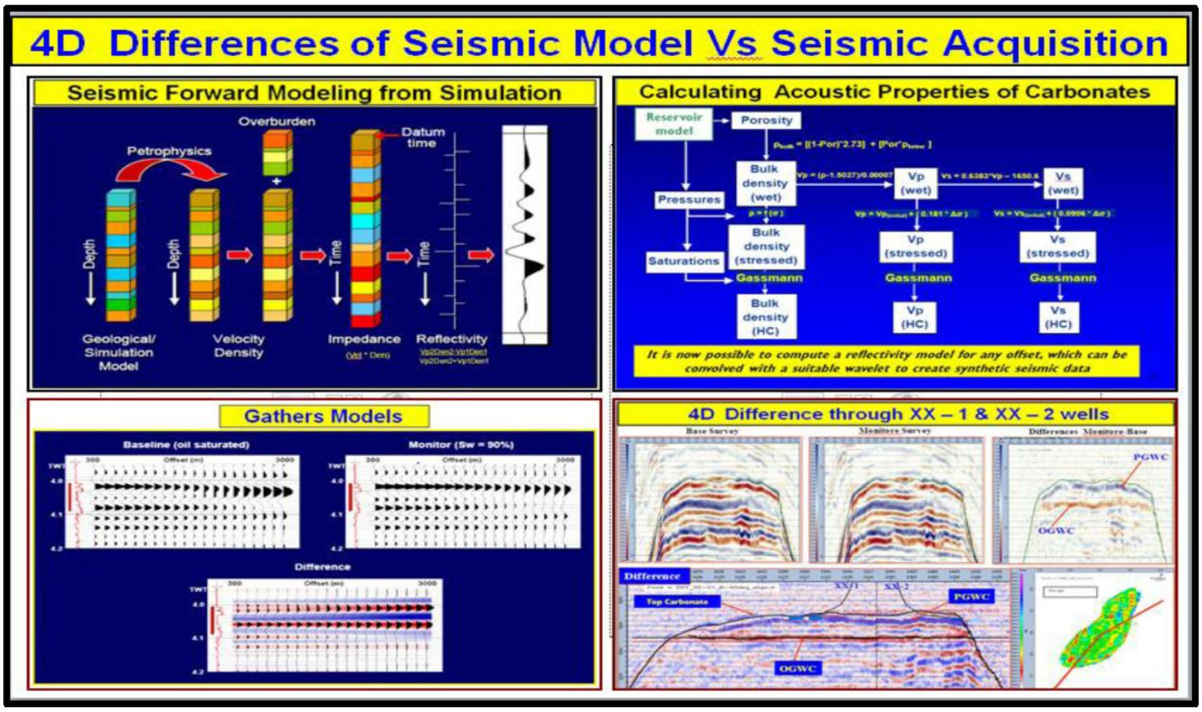

Figure 2 *Comparison 4D differences of Seismic Forward Modeling with Seismic Acquisition.*