GEOPHYSICS POSTER 1

4D EFFECT FROM SATURATION VARIATION DUE TO FLUID MOVEMENT USING 4D SEISMIC ACOUSTIC IMPEDANCE INVERSION METHODS FOR RESERVOIR MONITORING

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SUMMARY

Inversion method is the process of extracting the acoustic impedance (AI) profile for each seismic trace. The AI property is related to the layer properties of the reservoir-density and velocity. Meanwhile, velocity and density data can be obtained from well logs. Therefore the impedance inversion relates the seismic data with the well log data. The purpose of this study is to understand the changes in reservoir properties that could be predicted from the changes in P-impedance between the two surveys (base and monitor) and to obtain a time-lapse impedance model that can predict changes in fluid distribution that is due to production of hydrocarbons and also due to water injection (EOR) over the well X.

All inversion algorithms suffer from non-uniqueness because there could be more than one possible geological model consistent with the seismic data. However, we can include the low frequency model (LFM) to constrain the final result and give a reliable and accurate inversion output. Low frequency information can be derived from well logs information or from the stacking velocities.

The benefits of seismic inversion are numerous such as the broader bandwidth of the impedance data maximizes the vertical resolution and minimizes the tuning effects, interpreting volumes rather than surfaces is geologically more meaningful, removes the effects of the wavelet from the seismic bandwidth, reservoir properties are separated from the overburden, may provide quantitative predictions on the reservoir properties and possibility of extending the layer features beyond the seismic bandwidth.

Figure 1 is the inversion fundamental concept of inverting the seismic data to impedance data. Figure 2 shows the result of inversion on Base (left) and Monitor (right) within the A sand

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reservoir. The purple colour indicates the low impedance area (reservoir) and the red indicates the high impedance area (non-reservoir). The A sand reservoir was highlighted in the ellipses.

Figure 3 display the Difference (Monitor-Base) result within the A sand reservoir in percentage value of 0-18%. The purple colour represent the low changes value(less than 4%) while the green represent the highest changes value (more than15%). The red arrows are the injector wells and the yellow are the producer well that show changes in the impedance between the surveys.

From the study, 3D Seismic Acoustic Impedance Inversion is sensitive to the fluid changes in the reservoir and the AI differences at the production wells are possibly indicative of production (pressure\saturation changes), whereas at the injector wells, these inversion AI difference may be the result of water injection for the EOR program in A sand reservoir. These inversion results can help to make decision on where to place better injector and producer wells locations in the future.

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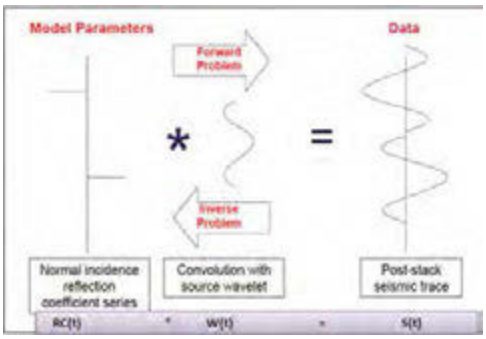

Figure 1: The fundamental concept of Seismic Acoustic Impedance Inversion.

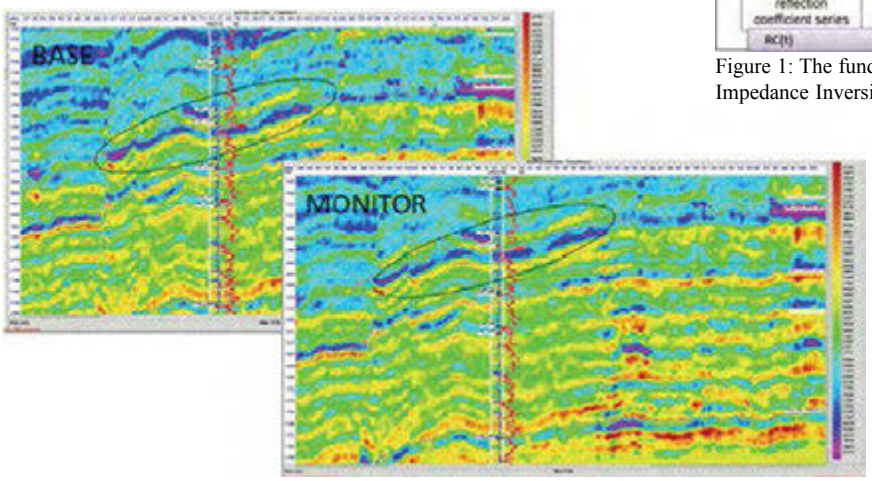

Figure 2: The inversion result on Base (left) and Monitor (right) seismic data.

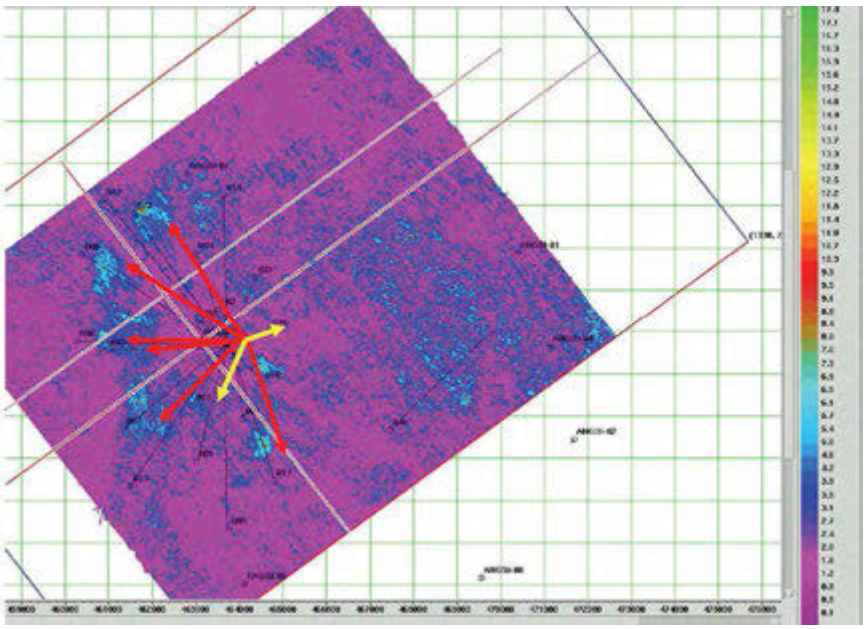

Figure 3: The Difference (Monitor-Base) result within A sand reservoir.