also be bandlimited or relative. But Interpreters need absolute impedance, density for quantitative interpretation like porosity, saturation etc. therefore,
Low frequency modelling is an important part model based seismic inversion. These low obtained from seismic velocity and well data.
In addition, this process enhances the resolution of the inversion output and helps to propagate the elastic properties of well logs. Low Frequency model (LFM) was generated using horizons, well log data by using the inverse square distance technique to populate the data. Fig. 6 depicts modeled P-impedance consistent with log P-impedance.

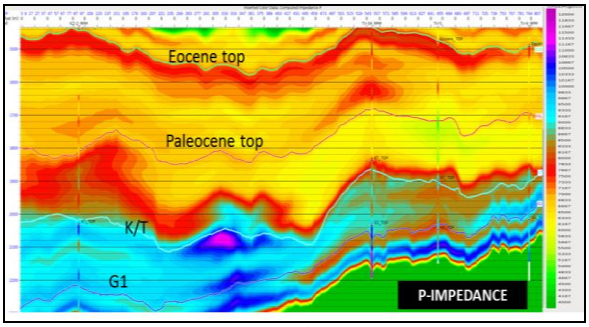

Figure 6: Low Frequency Model of P-Impdeance.

Analysis of Inversion Results and Reservoir Characterization

Paleocene Kamalapuram sands are known as the channel fills in K/T canyon cut while Nannilam sands are mostly deposited as slope fans, slumps, debris flows and as channels.
The generated Vp/Vs volume has found to be in good match with well data especially for the major Paleocene (PS) and Nannilam sands (NS) (Fig. 7a). Using polygon filter (ranges of Vp/VS <2.0 for Brine and Hydrocarbon sands) in the cross-plot between P-impedance vs Vp/Vs, extracted geobodies are effectively explaining the drilled wells in both Nannilam and Paleocene sands (Fig. 7b).

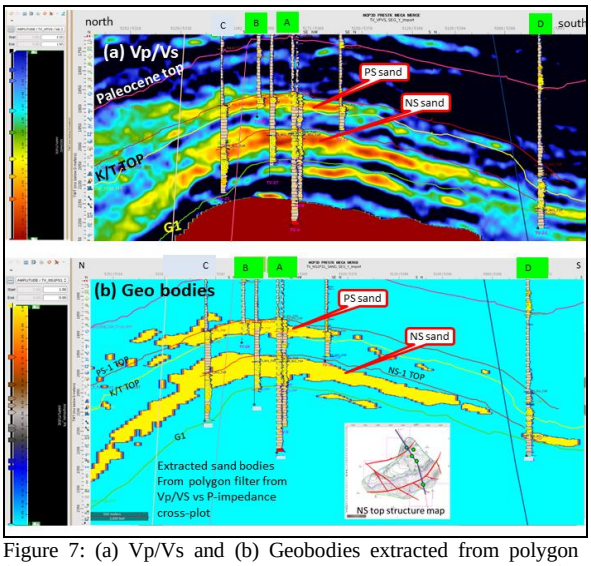

Figure 7: (a) Vp/Vs and (b) Geobodies extracted from polygon filter in Vp/Vs vs P-impedance shows the prominent geobodies for NS and PS in both sections and are matching with well data. Wells A & B are hydrocarbon producers from both NS & PS sands while Well D is hydrocarbon producer from NS sand.

In addition to the vertical sections, stratal slices extracted for Paleocene sand (Fig. 8a) and upper Nannilam sand (Fig. 8b) from Geobody volume to visualizes areal extension of facies. This supports the presence of low Vp/Vs sands in the main producing field (central area) and validating the geological model of sand dispersal. Sand provenance is from NW (adjacent Karaikal high).

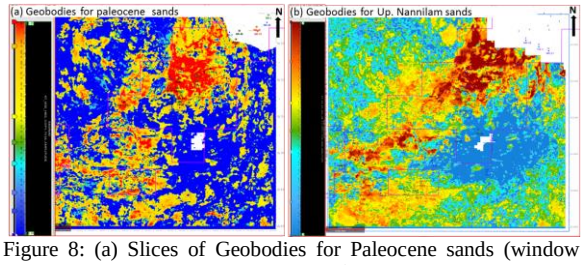

Figure 8: (a) Slices of Geobodies for Paleocene sands (window 50ms above to K/T), (b) Geobodies for Upper Nannilam sands (50ms below to K/T).

Geobodies for PS sand (15ms below from PS sand top) shows the distribution of better reservoir facies PS (Fig. 9a), while it also gave presence of two additional sand bodies at west and southern areas (shown by circles in fig. 9a). Extracted Geobodies for Nannilam sand (25ms below from NS sand top);

justifies all producing wells in the central part (Fig. 9b). The wells D & E drilled further east are in separate fault block and are hydrocarbon producers from NS sand. The results are justifying these wells along with an additional sand body is present in the adjacent fault block (shown in circle in fig. 9b).

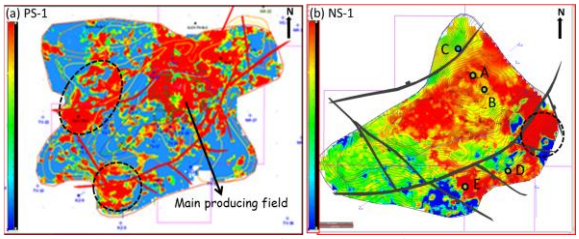

Figure 9: (a) Geobody extracted from polygon filter in Vp/Vs vs P-impedance for PS sand (PS top+15ms) shows the presence of tow additional sand bodies shown in circles apart from main field. (b) Geobody for NS sand (NS sand top + 25ms)

An effective fluid indicator can be found on cross plot of poisson's ratio and Vp/Vs in the area. Hydrocarbon zones possess low poisson's ration (< 0.25) as compared to brine sands. Shalier zones bearing relativily higher poisson's ratio (> 0.3) than sands. Sweetspots can be established by using the relatioship between Poisson's ration and Vp/Vs subsequently brine and shale zones can also be identified. The selected polygon on the cross plot captures hydocarbon zone (red) and brine zone (blue) at well-A and Well-B (Fig. 10).

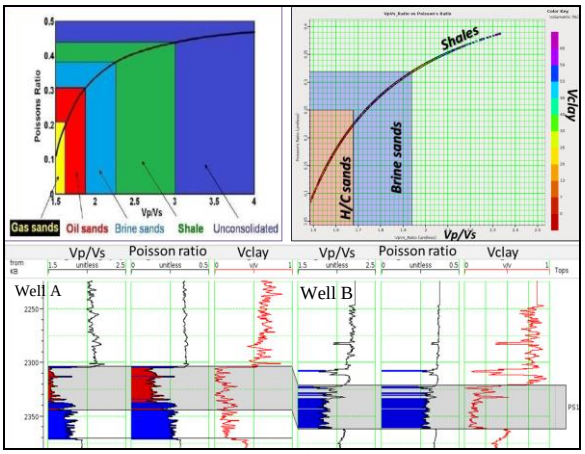

Figure 10: (a) Guideline plot of Vp/Vs vs Poisson ratio (Per Avseth lecture notes). (b) Cross-plot of Vp/vs vs Poission ratio coloured with Vclay. (c) Log motif is showing paleocene sand; highlighted in cross-plot.

The impedance logs and volumes were converted to Lame's parameter to estimate other geophysical parameter which also discriminates fluid and lithilogies. Fig.11 shows that hydrocarbon bearing sands possess high μρ because of sand's rigidity and low λρ because of less incompressbility of fluid content within the sandstone (Waffa El-shahat,2014). The selected polygon on the cross plot captures hydocarbon zone (red) at well-R (Fig. 13). The results confirmed that this process may also be used to charchterize the reservoires and to separate hydrocarbon bearing sands form water bearing sands and shales.

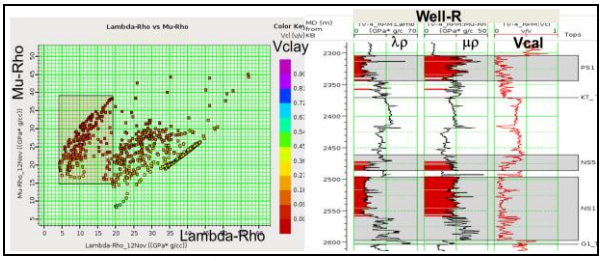

Figure 11: Cross-plot of λρ vs μρ coloured with Vclay along Log motif showing hydocarbon zones; highlighted in cross-plot.

Conclusions

This study is an integrated work to characterize the Paleocene and Nannilam sands through elastic attributes

Since the well logs can differentiate the hydrocarbon zones from surrounding geology. So the Prestack seismic inversion is also a useful product for interpretation as expected.

The attributes of Acoustic impedance, Shear Impedance, Vp/Vs, Geobodies, Poisson's Ratio and Lambda-Mu-Rho are good tools to discriminate lithology and fluid content within reservoir.

Geobodies bodies are captured from the polygon filter between Vp/Vs and P-impedance. The geometries of captured facies "bodies" are consistent with well control and geological information. The presence of additional Geobodies might be valuable in future for play extension and field growth

It is recommended to record shear-wave (DSI) at more no of wells to increase the level of confidence in reservoir characterization.

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The views expressed in this paper are solely of the authors and do not necessarily reflect the view of ONGC.