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Please fill in your manuscript title.	Application of Deterministic Seismic Inversion for Well Planning: A Case Study from Bongkot Well Result, the Gulf of Thailand

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Abstract

In 2020, PTTEP has conducted the deterministic seismic inversion study in Bongkot area, Gulf of Thailand, to reduce the uncertainty of drilling delineation and development wells in the area. A total of 600 sq.km. of 3D seismic data and well log data from six wells were used and inverted to investigate the high potential of gas-bearing reservoirs in a shallow zone (Mid-Late Miocene).

Based on rock physics analysis, the key deliverables of 2020 deterministic seismic inversion can be used for lithofacies and fluid classification, mainly identifying gas sand, wet sand, and shale. Nonetheless, low saturated and high saturated gas sands cannot be separated based on their elastic properties.

One of Bongkot drilled wells was planned by using the deterministic seismic inversion to increase the chance of discovering gas-bearing reservoir distribution in the shallow zone (Mid-Late Miocene), especially high-gas related reservoirs in Middle Miocene.

The objectives of this study are to give feedback, to identify uncertainties of this deterministic seismic inversion by comparing the inversion model and the actual well result, and to analyse all related aspects that causes the mis-match between the actual well result and inversion model.

After receiving the actual well result, the comparison was performed to analyze the accuracy of seismic inversion model. The comparison shows that the prediction from deterministic seismic inversion model matches very well with water-bearing sand both individual and several thinner stacked sands with thickness greater than 10m. However, the reservoirs in Middle Miocene show the difference between model prediction and actual well result. In this interval, the prediction from most probable lithology cube suggests the high probability of being a gas reservoir, and the gas probability cube also indicates high gas related but the actual well result shows interbedded coal layers with water-bearing sand (low saturated gas sand, Sw=97%).

Correspondingly, depth trend of Vp/Vs which is related to lithology, pore fluid, and degree of fluid

saturation is showing that the of Ton Moke well has slightly higher than the other input wells. However, the rock properties in this area are consistency,also, depth trend of acoustic Impedance (AI) which is related to rock properties shows similar trend among these wells

In addition, the limitations in seismic resolution are also considerate, seismic amplitude responses are the combination of coal layer interbedded with water sand (low saturated gas sand), deterministic seismic inversion cannot be inverted to represent the elastics properties of each single layer, this could be one of the key uncertainties of the mis-match between the actual result and inversion model.

Another possible uncertainty may cause by the insufficiency of input well data. Only three out of six wells have shear sonic log, and the nearest distance from the input well to Bongkot drilled well is 20 km.

To improve the accuracy of the seismic inversion model, the method that can highlight coal response is needed to be applied such as geostatistical seismic inversion. Geostatistical seismic inversion also has higher resolution and integrated well data in modeling which is able to cover all litho-fluid classes in this area. In addition, to deliver the valid analysis of the high potential gas-bearing reservoir, the integration of subsurface information such as trap integrity, reservoir characteristics, depositional environment need to be taken into account.