The strategy of hydrocarbon prediction (DHI) in deepwater exploration area

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Abstract

In deepwater area around world, it is not true that high amplitude anomalies with AVO response on stacked seismic must be reservoir due to complex lithology (shale, calcareous shale, volcanic rock, tight carbonate, etc.). Low gas saturation hydrocarbon and wet sandstone or carbonate also cause high amplitude anomalies on stacked seismic or AVO response on CRP gather data. The strategy of hydrocarbon prediction in deepwater exploration area is reservoir prediction first and hydrocarbon prediction next based on quantitative pre-stack elastic inversion without well.

Introduction:

In past decade, traditional stacked amplitude analysis and traditional AVO anomaly analysis for hydrocarbon prediction (DHI) face great challenges in deepwater area around world.

Many high amplitude anomalies, which are caused by non-reservoir, brine or low gas saturation hydrocarbon, are not caused by gas sand (Subir Das et al, 2010; Naina et al, 2008).

Some features related to hydrocarbon prediction in deepwater exploration area

Multiple non-reservoir lithologies lead to high amplitude anomaly on stacked seismic

In deepwater Mahanadi Basin (India), high amplitude zone with Class III AVO response on stacked seismic were proved to be limestone streaks. Another high amplitude zone on stacked seismic were proved to be channel with clay filled in (Subir Das et al, 2010).

In deepwater Borneo (Sabah) basin (Malaysia), High amplitude zone were proved to be abandoned clay channel (Joseph M. Reilly, David Pitcher, Deva Ghosh, 2008).

In deep water B Sag in the northern South China Sea, multiple exploratory wells failed in exploiting gas due to lack of good sand (Xiong Pang, 2014).

In Santos Basin and Campos Basin, high amplitude anomaly may be caused by the presence of salt caprocks and stringers, volcanic intrusions, carbonates (Hovland and Judd, 1988;Sheriff, 1991; Cartwright et al., 2007).

Wet sand and low gas saturation hydrocarbon also can cause high amplitude anomaly on stacked seismic

In deep water of the Krishna Godavari basin (India), stacked seismic high amplitude zone with Class III AVO response indicates wet sand (Naina et al, 2008).

There is no well in deepwater exploration area usually

In deepwater exploration area, there is no well or there are few wells usually. Even if exploratory well exists, it is very difficult to build correct low frequency model for inversion due to sharp variation of reservoir.

The strategy of hydrocarbon prediction in deep water exploration area

Reservoir prediction first

Quantitative hydrocarbon prediction based on pre-stack elastic inversion without well next (Figure 1)

Conclusions

Stacked seismic amplitude analysis and traditional AVO analysis are ambiguous, complicated and dangerous for hydrocarbon prediction. The strategy of hydrocarbon prediction in deepwater exploration area is reservoir prediction first and hydrocarbon prediction next based on quantitative pre-stack elastic inversion without well.

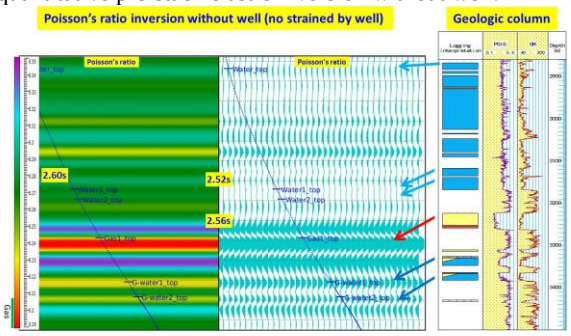

Figure 1: Quantitative Poisson's ratio inversion without well based on synthetic CRP gather (left and middle) and geologic column (right). Brine sand and low gas satturation hydrocarbon exhibit high Poisson's ratio behavior (>0.22), and high gas saturation hydrocarbon exhibit low Poisson's ratio behavior (<0.21)