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Integrated Reservoir Characterisation with Three Dimensional Modeling in Thin Bed Low Resistivity Natural Gas Exploration

YEN JUN LIM[1] & SHYH ZUNG LO[2]

Geoscience and Petroleum Engineering Department, Universiti Teknologi PETRONAS
32610 Seri Iskandar, Perak Darul Ridzuan, Malaysia
Email: limyenjun@gmail.com[1], loshyh.zung@petronas.com.my[2]

An attempt in hydrocarbon exploration is carried out on subsurface target at a depth of approximately 3km. This subsurface structure was drilled and declared a successful natural gas discovery with significant flow and volume but four consequent wildcat wells were drilled but ended up as dry wells (no hydrocarbon discovery). This issue is further clouded by the presence of existing low resistivity pay in first success well (absence of expected high resistivity log value from hydrocarbon zone). Band pass limited seismic data could not resolve the top and bottom of formation with thickness with an average value of 20m causes thin bed effect which hindered effective seismic interpretation. The failure of wildcat wells was hypothetically believed mainly from structural complexity, the formation was deformed extensionally and inversed throughout geological ages and different local and regional faults were formed and compartmentalised the formation. Dry wells interpreted from high water saturation values might originated from highly conductive mineral affected resistivity logging tools. Less understood petroleum system with different charge and migration pathways might be another factor for less successful hydrocarbon exploration. In order to validate hypothesis, an integrated reservoir characterisation based on seismic data, petrophysical data, geological research information, rock physics calibration, and machine learning technique were researched to obtain final three dimensional model. This model is able to visualise the subsurface formation deformities, compartmentalisation, lithological distribution, porosity distribution, and other crucial reservoir information. Many important technical process were carefully applied to obtain accurate subsurface geological model, some of the significant process were neural network facies classification, machine learning well correlation, and automated fault interpretation. With the final geological model produced from integrated reservoir characterisation, the reasons of unsuccessful exploration were well understood and alternate promising target is proposed.

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