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Sub-seismic geological facies mapping using the seismic volume for geocellular Modeling in Reservoir Characterization of a Producing Field

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Abstract

The objective of this study is to utilize the customized high definition facies templates in predicting sub-seismic geological facies between the wells using seismic data and rock physics measurements. This is a complex multi-scale data integration workflow with various data resolution from the reservoir properties scale (centimeter level) to the field scale (kilometer level). A new method of interpretation with synthetic core has been utilized in reservoir characterization of a producing oil field. Implementation of this unique technique in reservoir evaluation will help to achieve maximum extraction of the existing resources and reduce uncertainties in new exploration projects with a higher confidence level.

Predicting the sub-seismic scale facies were essentially needed to rely on well log data and core data with underlying interpretation of the depositional processes that controlled the facies distribution. Well data and core data provided high resolution (centimeter level) vertical information of the reservoir properties and seismic data became the most vital source of information in obtaining the spatial distribution of the reservoir properties in terms of the facies in between the wells. Seismic attributes were represented by the rock physics properties of the related facies and hence made the relationships with the observed properties in the wells and their lateral distributions. Rock physics, such as rock's bulk modulus and shear modulus were successful in establishing the facies-by-facies links between reservoir properties and their elastic responses.

A case study has been taken from the heavy oil bearing McMurray Formation in northern Alberta. A new approach to facies-template-based rock elastic property values have been utilized in this study with the goal of accurately predicting and mapping rock properties from a seismic volume. It resulted in better correlation and visualization between seismic attributes and sedimentary facies, which enabled the prediction of facies distributions between the wells. This method allows the geological, geophysical, petrophysical and geomechanical information to provide facies information to a geo-cellular model that enables quantitative analysis of reservoir properties and helps production evaluation.