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Wellbore instability analysis in highly fractured carbonate gas reservoirs

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A major challenge facing the oil and gas drilling operations is mitigating the encountered wellbore instability issues. Those can vary from loss circulations up to having stuck pipes or tools that may jeopardize well integrity and potentially lead to total loss of wells and assets. These problematic situations are even much more complicated in fractured reservoir environments where predicting the highly fracture zones is important. Analyzing such problems is critical for companies especially in developing offshore fields where one day lost time is in hundreds of millions of dollars. There are various data sources that help in determining the main culprit behind the loss circulation problems from core data, Image logs and well testing data. The field of rock mechanics emerged to connect those phenomena to reservoir rock properties and stress profiles. Coupling this with an intensive analysis of drilling parameters, logging, core testing and other existing wells data builds a work frame that helps in understanding the reasons behind wellbore failures and providing solutions to them. The field under investigation is a highly geo-pressured carbonate gas field. The field development called for drilling vertical and slightly deviated wells. During the field increments, sever loss circulation were encountered that resulted in lost drilling times estimated in millions of US dollars with rig cost up $ 200,000/Day. Other drilling failures includes, stuck drill pipe and difficulties with logging response and log interpretation. The objective of this study is to investigate the wellbore instability events during drilling operations and explain it as a function of rock properties, in-situ earth stress. The role of natural fractures will be highlighted using available data. During the course of the study, existing field's and drilled wells available data, seismic data will be analyzed in order to come up with methods to map the loss circulation events and recommendations will be made for future wells drilling programs as well as future work to be carried.

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Deriving permeability models from static 3D seismic attributes through artificial intelligence tools for conventional gas reservoirs

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Developing gas reservoirs and assets is playing major role in supplying consumers demand provided that those developments are optimized with the minimal capital cost investment. A major challenge in those reservoirs is the reservoir quality and the ability to target potential productive sweet spots. It is typical in any delineation or development program to account for potential dry holes which in some cases escalate the drilling requirements substantially to meet the delineation or development objectives. In the current reservoir characterization practices, well placement is mainly based on the derived porosity distributions from Impedance or other seismic attributes. Only actual drilling results will reveal the reservoir performance and its flow capacities. Nevertheless, the advancements in mathematical models with the introduction of Artificial Intelligence tools can help in correlating the seismic not only to porosity but also to permeability. The AI models are able to correlate the input data with the help of what is called training sets. After the model is created it is calibrated with the testing set. In this project, we will construct a reservoir permeability model from 3D seismic attributes using Artificial Intelligence tools. First, we will identify the relevant 3D seismic attributes and windows that will serve as the input data to the AI models. Secondly, several AI models which include Artificial Neural Networks, Fuzzy Systems and several types Vector Machines will be evaluated and optimized with several training and testing sets from two fields in Saudi Arabia with enough penetrations. The models will then be discussed and validated with some drilling results out of those two fields to check for validity and further recommendations for future work will be discussed.

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