Seismic Driven Machine Learning Model for Well Circulation Losses Prediction

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Abstract

In most of the cases, the 3D surface seismic data are the single tools attainable in the areas with limited wells control, so it is the only source of data used for initial well planning and placement. Therefore, having a seismic driven losses prediction model can massively improve well locality placements by mitigating the risk of drilling in loss circulation zones. Since seismic frequency and resolution are very low compare to that of wells, the study focuses on losses caused by fractures or holes that are large enough to be detected and resolved by conventional 3D seismic datasets. In view of that, dissolution cavities and large faults or fractures are the main focus of this machine learning study for losses mechanisms. Thus, the primary objective is to create a machine learning model volume capable of predicting drilling losses derived from various set of 3D seismic attributes volumes to aid in well planning and well placement optimization. The losses data was constrained only to those formations that have loss circulation associated with dissolution cavities and large fractures or faults to ensure that losses occur by the same mechanism. On the other hand, formations related to other loss mechanism, such as drilling induced fractures, were excluded from the study application. To achieve our goal, more than a thousand drilled wells were used in this study employing Natural Language Processing (NLP). NLP is an artificial intelligence subfield used to establish interaction between human and computer languages that utilized to acquire losses data from the daily drilling reports. Moreover, multiple 3D structural seismic attribute volumes were extracted from 3D surface seismic data volumes that cover the area of interest. Additionally, with the exploitation of the pre-built seismic velocity model, the 3D seismic attribute volumes were converted from the time to depth domain. Seismic attribute values were extracted along the 1000+ drilled well trajectories used in this study in the formations of interest. Employing conventional machine learning model generation, a model was created using losses as a target and seismic attributes as features. The results of the machine learning model showed 50% accuracy for high risk areas (wells with losses) and 99% accuracy in low risk areas (wells with no losses). In conclusion, the aforementioned machine learning model potentially promotes de-risking well planning and drilling requirements by predicting intervals of losses along the well path thus reducing the time, efforts and optimize cost of the future proposed wells.