Generating Features from Seismic Data for Overpressure Prediction

Georgy Peshkov[1], Anton Egorov[1], Nikita Bukhanov[1], Anton Voskresenskiy[1], Pavel Golikov[2]

[1]Aramco Research Center, Aramco Innovations LLC
[2]EXPEC Advanced Research Center, Saudi Aramco

Abstract

The knowledge of subsurface pore pressure distribution allows us to optimize the well planning, avoid accidents, and conduct the drilling in a safe manner. This work presents a methodology for the creation and selection of seismic attributes for an improved prediction of overpressure using machine learning-based data-driven approaches.

The proposed method takes the acoustic impedance cube as input within the target interval. The cube is then processed by an artificial neural network - an autoencoder - that learns to encode the unlabeled data, i.e., each seismic impedance trace. After encoding, each trace is turned into a code - a set of numerical values, the number of which is determined by the user (16 in our case). The code is fed to supervised machine learning models as features after performing recursive feature elimination. The labels for supervised learning might be either kick intensity in wells (a categorical variable) or pore pressure values.

The newly developed attributes provide more robust predictions of overpressure or kick intensity in well compared to the previously used acoustic impedances averaged between the horizons. Adding the spatial attributes, such as the surface depth gradient of the overpressured formation surface and seismic trace coordinates, also refines the overpressure zones predictions. The study also demonstrates that a special data augmentation performed by adding more traces from a finite region around the well to the training dataset improves the predictive power of the model. Two versions of the algorithm are created. The first one solves the regression problem and outputs the maps of the recommended mud weight. The second one performs classification and generates the maps with highlighted zones of different well kick intensity.

The developed approach to attribute generation and selection allows for effective extraction from acoustic impedance cube the hidden properties which are required for improved prediction of overpressure zones.