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Fault Characterization using Convolution Neural Networks in Alaska's North Slope

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ABSTRACT

Seismic data analysis has been one of the most important tools to study the subsurface. In recent years the interest in the application of machine learning algorithms for seismic interpretation have significantly increased. Such technique can automate the identification of different geologic features in seismic data, such as channels, faults, and horizon interpretation. However, most of the studies only focus in the application of machine learning algorithms without analyzing in depth the results and using them to have a more detail analysis and interpretation of the subsurface. In this study, we use a Convolutional Neural Network to detect faults automatically from 3D seismic data and investigate the structural development of the Colville High in the North Slope in Alaska. The neural network considers the fault detection as a binary image segmentation problem of labeling a 3D seismic image with ones on faults and zeros elsewhere. After training only with synthetic datasets, the network automatically learns to calculate rich and proper features that are important for fault detection. To investigate this normal-fault system we focus on characterizing geometry, displacement, strain and different fault interactions. The fault network comprises two generations of faults: (1) north-northeast trending faults and (2) west-northwest trending faults. Understanding this fault networks is important because interconnected faults can provide pathways for fluid, allowing migration, and entrapment of hydrocarbons. They can also act as fluid barriers compartmentalizing reservoir. Fault interaction can be important when assessing reservoir quality and heterogeneity as they contribute variations in reservoir thickness.

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