

# Geological Control in Machine Learning based Seismic Facies Recognition

Sihai Zhang

Saudi Aramco

## Abstract

In complex depositional environment, it's common that one lithology develops in different facies or different lithologies in one facies. The inconsistency between lithology and facies increase the uncertainty of facies interpretation. During the early Permian, clastic sediments dominate in the intra-cratonic basin where the sandstones develop in both aeolian and fluvial facies.

Multiple seismic attribute analysis is implemented to recognize sedimentary facies and delineate geological features. However, the overwhelming number of seismic attributes results in a huge amount of data redundancy. Machine learning (ML) technologies such as Artificial Neural Networks (ANNs) are proposed to better resolve the challenge of how to integrate these multiple variables. Different lithologies of sandstone, siltstone and mudstone are identified through waveform classification by supervised ANNs. Aeolian dunes and fluvial channels are two different sedimentary facies, but the sandstones within them have roughly same physical properties which result in the similar impedance contrasts. Although supervised ANNs improve seismic facies recognition, seismic attribute based on impedance ( $\rho \cdot v$ ) contrast hardly differentiates dunes and channels due to the sandstone similarity in dunes and channels. To identify the depositional environment further, geological knowledge such as conceptual model is employed to distinguish dunes and channels on the lithofacies map according to their topographic characteristics. When the sandbodies are stripped and curved, they are possibly generated by fluvial channels. While the sandbodies are patchy and sinuous, they might indicate dunes.

Therefore, (1) seismic attribute analysis based on ANNs is an effective approach to identify the lithofacies. (2) To characterize the sedimentary facies, conceptual deposition model is employed to recognize aeolian dunes and fluvial channels according to their geomorphological characteristics.