# Seismic Attribute Optimization for Deep-Water Facies Classification in SOM Analysis

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## Abstract

Machine learning has many applications within the geosciences, from predicting seismic facies to automatic fault detection. A variety of machine learning algorithms are commonly employed, among these principal component analysis (PCA) and self-organized maps (SOMs), which provide a fast organization of data in groups that aid in geological interpretation. It is, nevertheless, interesting to note that parametrization choices during algorithm initiation could create a range of reasonable output model responses. To quantify the effects of parametrization, a case study is performed for facies classification in a deepwater setting. The goal of PCA is to reduce a multivariate space down to a computationally more manageable size of relatively independent variables. But this method relies primarily on the mathematically calculated eigenvectors and does not consider the a priori knowledge of the interpreter. The main motivation of this research strives to investigate the impact of a user-controlled selection of attributes to perform SOM for facies classification versus a machine- derived result. Using the Pipeline 3D seismic dataset, in the southern Taranaki basin of New Zealand, results are presented that improve the understanding of how input parameter choices affect the output seismic facies classifications using a multi-dimensional, multi-attribute SOM algorithm. A variety of attribute classes are systematically examined, including geometric, instantaneous, and textural attributes, in mixed combinations with one another, to understand how input variability alters the resultant SOM classification for deepwater architectural elements and facies characterization. The findings reveal that an appropriate combination of geometrical, textural and instantaneous attributes with a clear interpretation objective enhances the SOM results and facilitates the

interpreter understanding of the output classes especially if attributes are previously selected or tested. On the other hand, PCA provides insightful information regarding the contribution of attributes that may not have been initially considered by the interpreter. This study reveals that while machine learning techniques are a powerful tool for geological interpretation, user control on initial input attributes and testing of different parameters remain necessary for an optimal interpretation.

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