ESTIMATION OF SAND DUNES PROPERTIES USING TIME-DEPTH SEISMIC DATA FROM THE EMPTY QUARTER DESERT OF SOUTHEASTERN SAUDI ARABIA

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Many velocity models can be used to fit the time-depth seismic data but only some of them are related directly to the actual properties of the sand. A better understanding of the factors that affect the near-surface velocity can lead to better results of the compensation of its effect on various stages of seismic data processing.

We take the advantage of one analytical velocity-depth model V(z) to reveal more details of the subsurface. We used Al-Shuhail's V(z) to derive a new vertical one-way vertical time model that is a function of water saturation (Sw), porosity (φ), and volume fraction of clay (fc). The model is designed to work with sand dunes like those commonly encountered in the Empty Quarter Desert of Southeastern Saudi Arabia.

We found that, among the model parameters, (fc) is the most effective parameter. Fixing the values of (Sw) and (phi) at 0.3 and 0.38, respectively, we used the model to estimate (fc) by searching for the value of (fc) that result in a minimum sum of squared error SSE. The average value of (fc) from six datasets is 0.16 with an average SSE of 6.45×10^{-05}.

The sensitivity analysis of the synthetic data generated at the extreme values of (Sw) and (phi), shows that the minimization procedure can retrieve the input fc accurately with an average SSE of 1.99E-18 calculated from 8 different scenarios.

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