AAPG Datapages/Search and Discovery Article #90254 ©2016, GEO-2016, 12th Middle East Geosciences Conference & Exhibition, Manama, Bahrain, March 7-10, 2016

Improving Temporal Resolution of Land Seismic Data with a Stabilized Inverse Q-Filter

Abdullah M. Alshangiti[1], Peter Pecholcs[2], Rienk Lakeman[1], Mohammad Bannagi[3]

[1]SAUDI ARABIA
[2]BBIntegratedSolutions, Guadalajara, MEXICO
[3]Saudi Aramco, Dhahran, SAUDI ARABIA

ABSTRACT

Seismic wave attenuation, quantified by the seismic quality factor Q, results in an exponential decay of amplitudes, distortion of wavelet phase and decrease of spectral amplitudes, especially at high frequencies. This leads to poor resolution and low signal to noise ratio (SNR) at large travel times.

Q-values can be measured from surface seismic and/or VSP data. These values can then be used to inverse the effects of attenuation on seismic data. Often, inverse Q-filters produce undesirable artifacts, including a large reduction in the SNR. This explains why these types of filters are not often used in conventional processing flows. If the filter is applied on a selected range of frequencies and travel times it can produce data with improved resolution and SNR. This can be done by applying a damping operator for the undesirable scalars produced at large travel times and/or high-frequencies. By selecting the correct damping parameters, a stabilized inverse Q-filter can be designed and applied on the seismic data to improve resolution and enhance the SNR.

In this study, an investigation using an inverse Q-filter with and without stabilization on synthetic and 3D land seismic data was carried out. The noise free synthetic data test showed that the lost amplitudes were fully recovered and the phase distortion was corrected. When random noise of 2% was added to the synthetic data, only part of the lost signal was recovered with a significant increase in the noise level. When a stabilized inverse Q-filter was applied to the synthetic data, the resolution of the signal was enhanced without adding artifacts or amplifying noise. This stable filter was then applied on 3D land seismic data from Saudi Arabia in which Q-values were derived from zero-offset VSP data. The application of the stabilized inverse Q-filter improved the resolution, coherency and continuity of the target horizon without amplifying the noise.