Please fill in the name of the event you are preparing this manuscript for.	2020 International Petroleum Technology Conference
Please fill in your 5-digit IPTC manuscript number.	IPTC-19629
Please fill in your manuscript title.	Advanced Noise Removal Technique for Seismic Data Processing

Please fill in your author name(s) and company affiliation.

Given Name	Surname	Company
Ferhan Y.	Ahmed	Saudi Aramco
Constantine	Tsingas	Saudi Aramco
Mohammed	Almubarak	Saudi Aramco

Abstract

Objectives/Scope: Separation of signal and noise is a challenging process in seismic processing, particularly in a land environment, where the near-surface is complex and seismic data suffers from backscattering. Conventional seismic noise attenuation techniques fail to properly model the complex noise. Advanced algorithms are needed to address these challenges. In this paper, we present a multiscale method, the seislet transform, along with a novel orthogonalization technique to attenuate the random noise from field seismic data.

Methods, Procedures, Process: Conventional transforms, such as the Fourier or the wavelet transform, have a number of limitations in representing complex seismic wave fields as they operate on a one-dimensional scale. The seislet transform is an effective multiscale wavelet-like transform specifically tailored for optimal representation of seismic data. The transform computes multiscale basis orthogonal functions aligned along the varying dips of seismic events. To further separate signal and noise from the input data, we apply an innovative and recently developed signal-and-noise orthogonalization technique to recover the leaked signal energy and restore it back to the original data.

Results, Observations, Conclusions: The seislet transform, along with orthogonalization techniques, has been successfully applied to several field data examples. We have achieved significant improvement in the signal-to-noise ratio, increased the frequency bandwidth of the data, and enhanced the image quality for subsequent seismic data processing and interpretation. We have demonstrated several applications of the seislet transform using pre- and post-stack seismic data examples from both marine and land environments. We will illustrate with a number of synthetic and real data field examples to show the effectiveness of the seislet transform along with the signal and noise orthogonalization scheme in suppressing random noise, increasing the frequency bandwidth and enhancing the image quality for accurate seismic interpretation. Both applications proved to be effective in removing complex random and backscattered noise that is difficult to remove using conventional seismic noise removal techniques as shown in Figure (1) and Figure (2).

Novel/Additive Information: The paper presents successful application of these new and novel approaches of seismic noise attenuation in a desert environment. We were able to effectively remove the seismic noises, which are otherwise challenging to attenuate using the conventional transforms due to the limitations mentioned above.

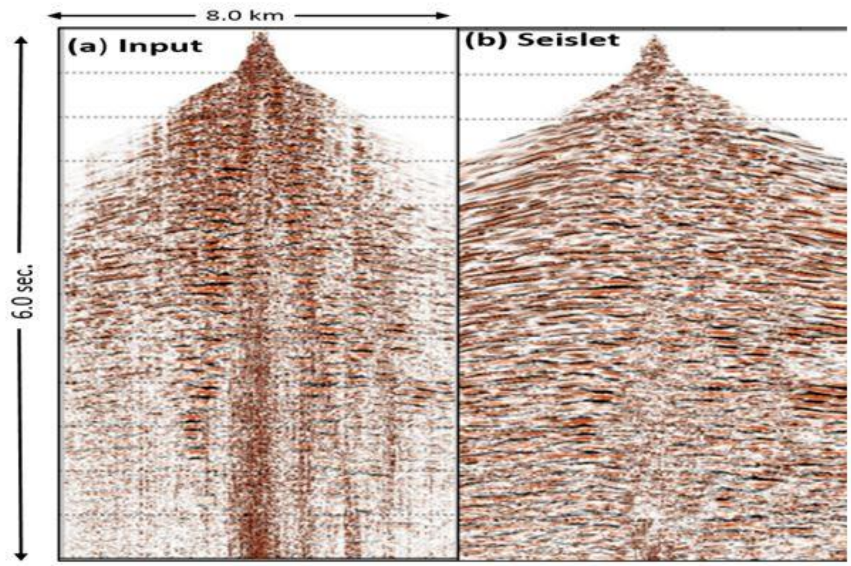

Figure (1) Seismic prestack input gather (a) before applying the seismic transform, (b) after applying the seislet transform to remove the noise.

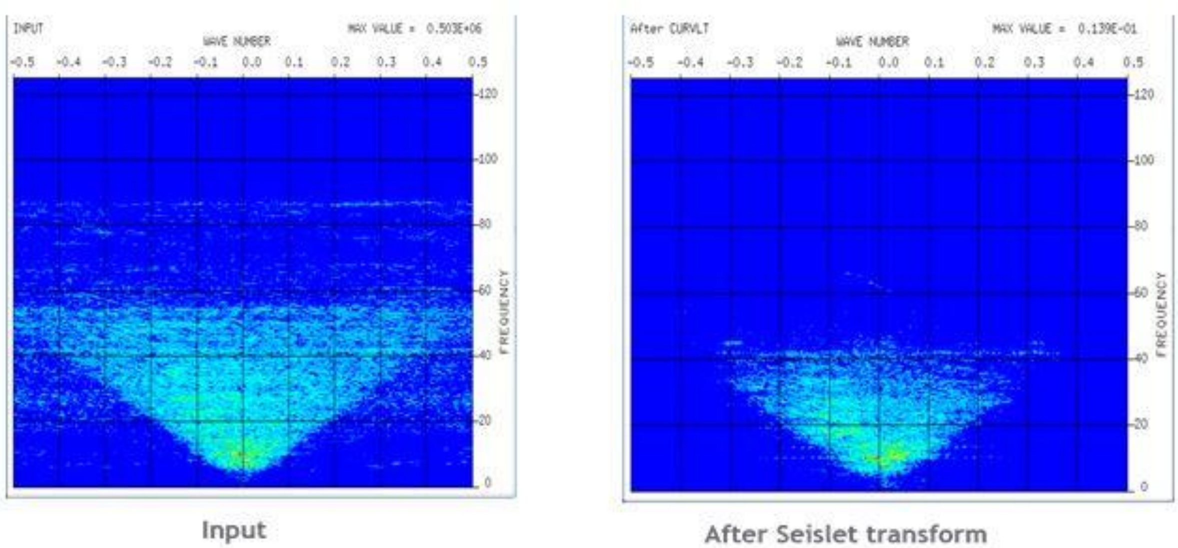

Figure (2) Comparison of the F-K spectra (left) before and (right) after seislet-based noise attenuation using the input data from Figure 1. The F-K section on the right shows significant noise suppression.