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Please fill in your manuscript title.	Multicomponent Seismic-While-Drilling Data Analysis without Pilot Records

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Abstract

Objective and scope:

In most seismic-while-drilling (SWD) applications, the pilot sensors are required to predict the drill bit source function (Rector and Marion, 1991). The interferometry method could recover the subsurface response without pilot records with the requirement of sampling the drill bit from the stationary source locations (Vasconcelos and Snieder, 2008). In this abstract, we propose a novel processing workflow to extract elastic wave pseudo-shot gathers from multicomponent SWD data without pilot records and restrictions on the drill bit location.

Methods, Procedures, Process:

To recover the subsurface response from multicomponent SWD data without pilot records, we reconstruct the drill bit source signature and utilize cross-coherence method. The workflow mainly contains three steps: (1) Apply a directionally constrained migration method to locate the source (2) Estimate the source signature by backward propagating the recorded multicomponent data to the source location (3) Apply a cross-coherence method to generate multicomponent pseudo-shot gathers. Here cross-coherence is used to compute the time difference between the geophone data and the estimated source function to avoid being contaminated by the complicated amplitude spectrums of the input traces.

Results, Observations, Conclusions:

The SWD field data is acquired by a 3D seismic array of three component (3C) geophones in a large offset. The drill bit signal is weak and it suffers from a noisy background. We first demonstrate that the cross-coherence can improve the signal detectability by suppressing the imprint of the source signature and the amplitude variations between receivers. Next, we perform a series of preprocessing steps that enable us to clearly detect P- and S-waves on the 3C pseudo-shot gathers. These pseudo-shot gathers have

a similar configuration as the shot gathers in reverse vertical seismic profile. The visible move out of direct P- and S-waves on these gathers provides rich velocity information after traveltime tomography, which is complementary to surface seismic velocity analysis. Moreover, these signals can be used to locate the drill bit relatively on the surface seismic image and form the structural image ahead of the drill bit. The reflection image using retrieved Green's function from the SWD data matches the surface seismic reflection image very well.

Novel/Additive information:

The P-waves can be clearly identified on the pseudo-shot gathers without using pilot records. The S-waves are detected from the multicomponent SWD field data. It can add more information about the elastic properties of the subsurface. Using S-waves, we can potentially provide different illumination on the targets ahead of the drill bit.