

# Analysis of the FWI workflow for accelerometer and DAS data from the 2018 CaMI VSP survey

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## Abstract

To develop methods for monitoring the growth of a  $\text{CO}_2$  plume maintained in Basal Belly River sandstone unit of Upper Cretaceous age at a depth of 300 meters, the CaMI-FRS in Newell County Alberta, which is part of CMC, carried out a baseline survey of 3D vertical seismic profile (VSP) (snowflake data) using three-component accelerometer and distributed acoustic sensing fibers (DAS). In this report, we mainly follow the processing and FWI workflow to inversion for the line 4 of the snowflake data to detect the anisotropy of the area.

## FIELD DATA PROCESSING

The DAS and accelerometer data, will follow a similar overall processing workflow, but due to inherent differences in the two sensor types, each dataset will require slightly unique processing steps (Figure 1). Figure 2 and Figure 3 shows the accelerometer data and DAS data after processing, respectively.

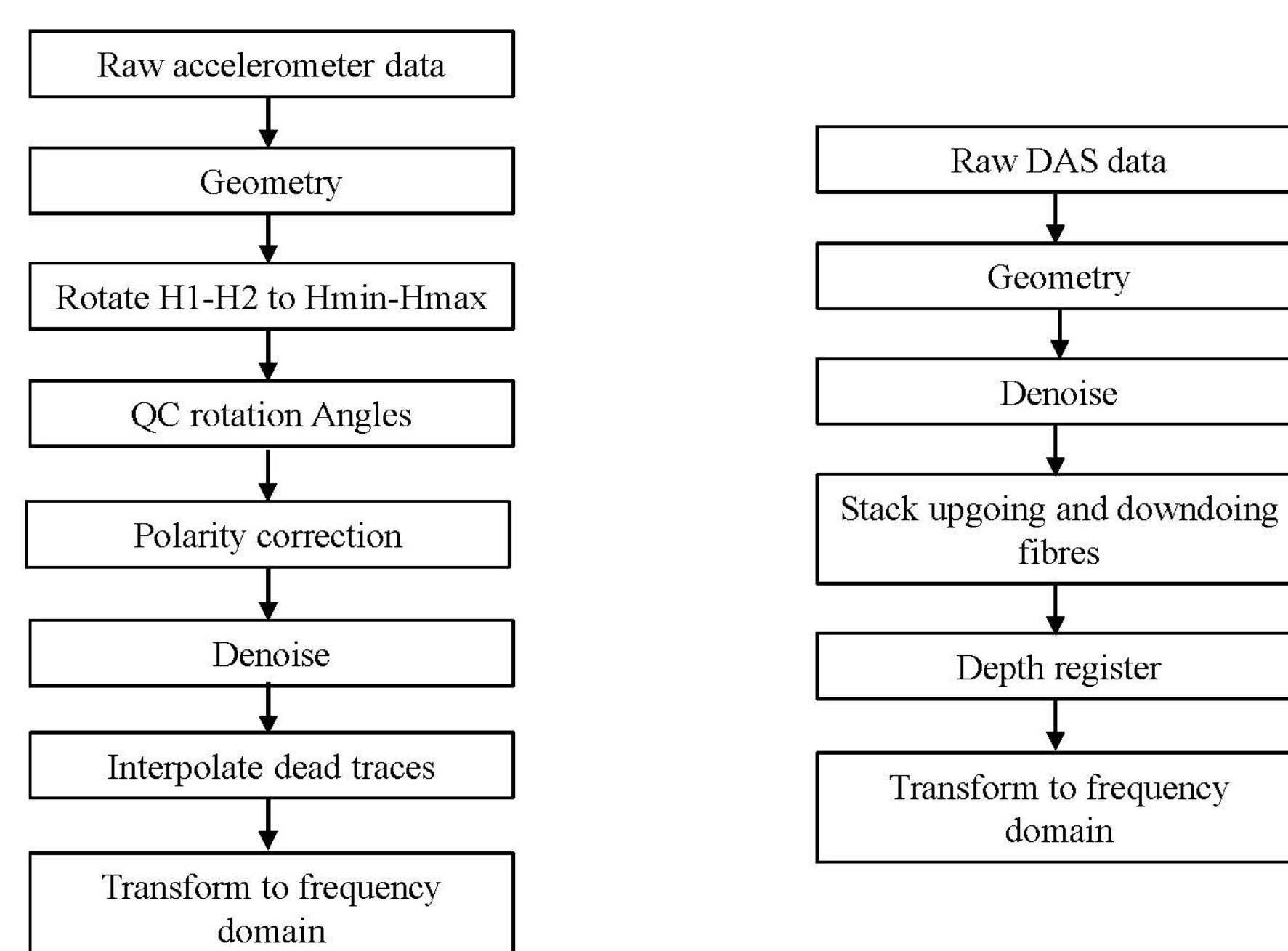


Figure 1: Preprocessing workflow of the accelerometer data and DAS data.

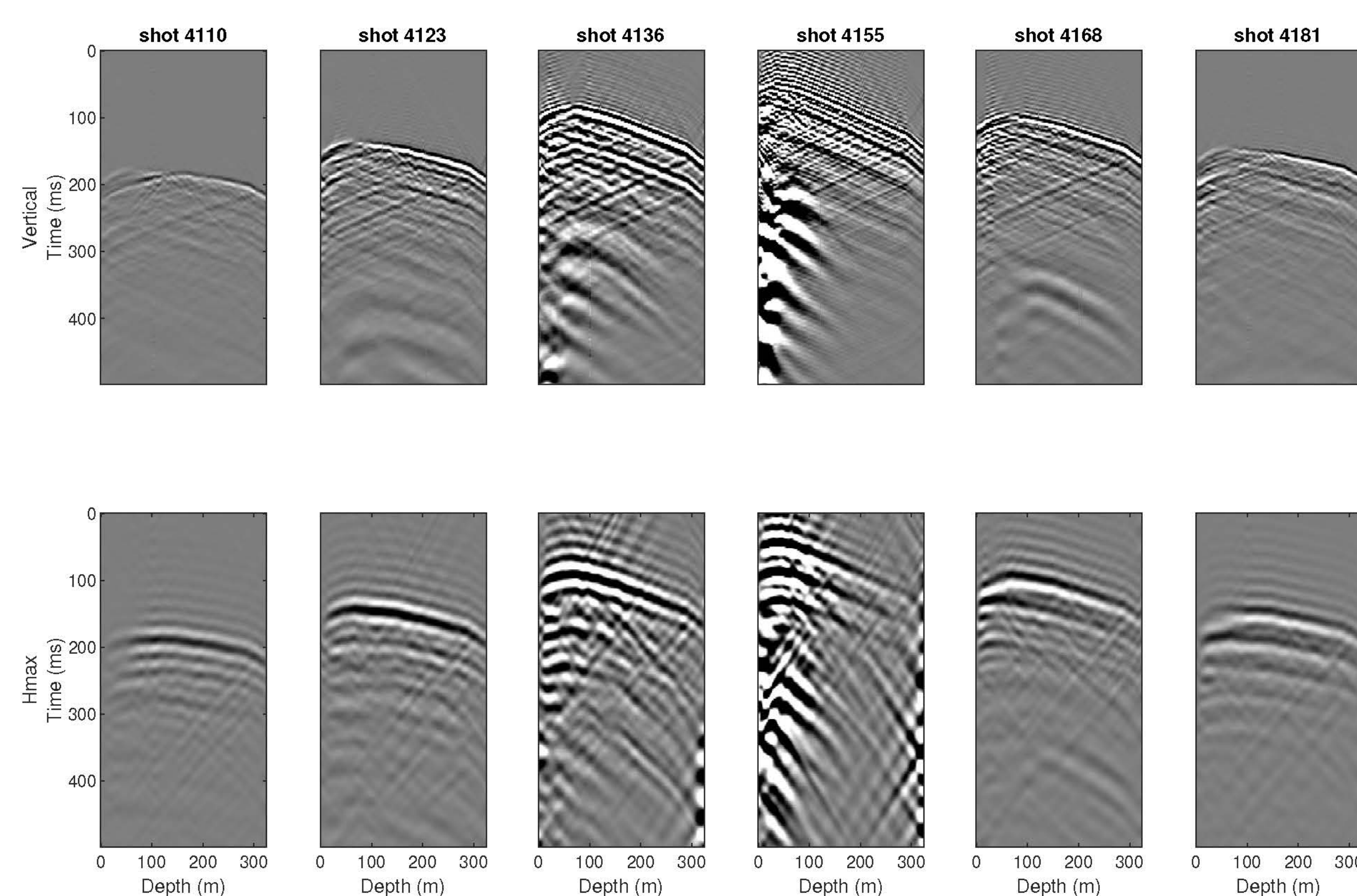


Figure 2: Accelerometer data after processing for every 13th shot point on source line 4. The top row plots the vertical component and the bottom row the Hmax component.

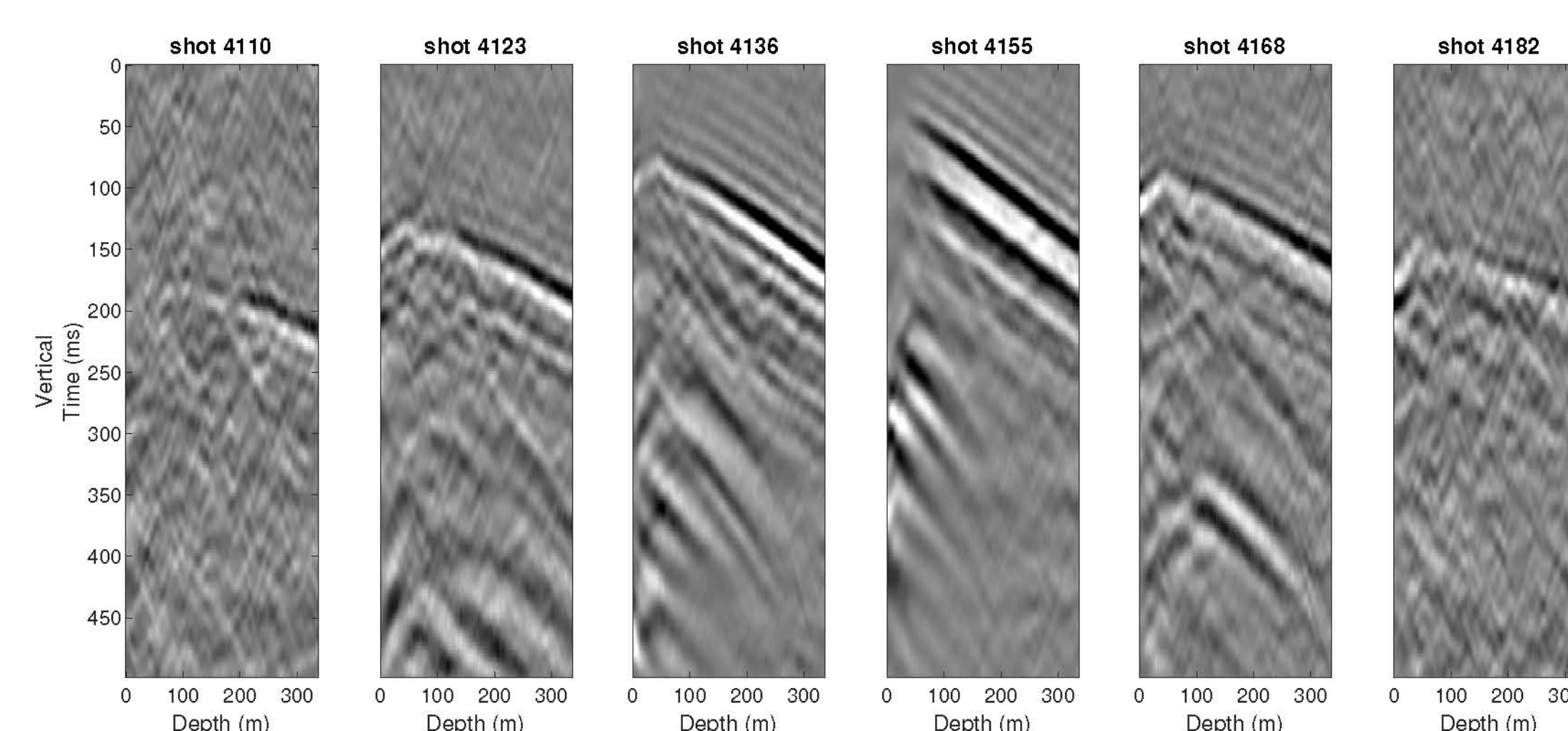


Figure 3: Straight observation well 2 DAS data after processing for every 13th shot point on source line 4.

## Depth registration

The depth registration can be divided into three step:

- First, as shown in Figure 4, the depth in channel 2 is known, we could calculate the depth of channel 1 using a start depth, a spatial interval and a time difference;
- Second, we find the 7 traces in channel 2 closest to the 7 traces in channel 1, and obtain the sum of the cross-correlation of the 7 traces of the two channels;
- Finally, we can get a maximum correlation coefficient and the corresponding time interval, starting depth and spatial interval, so as to get the depth of each trace of channel 1.

Here, we get the depth of DAS data from 0 to 335.52 m with an interval of 0.699 m. To demonstrate the accuracy of the DAS depth, we compared the first break time from shot 4170 for the accelerometer data and DAS data (Figure 5) .

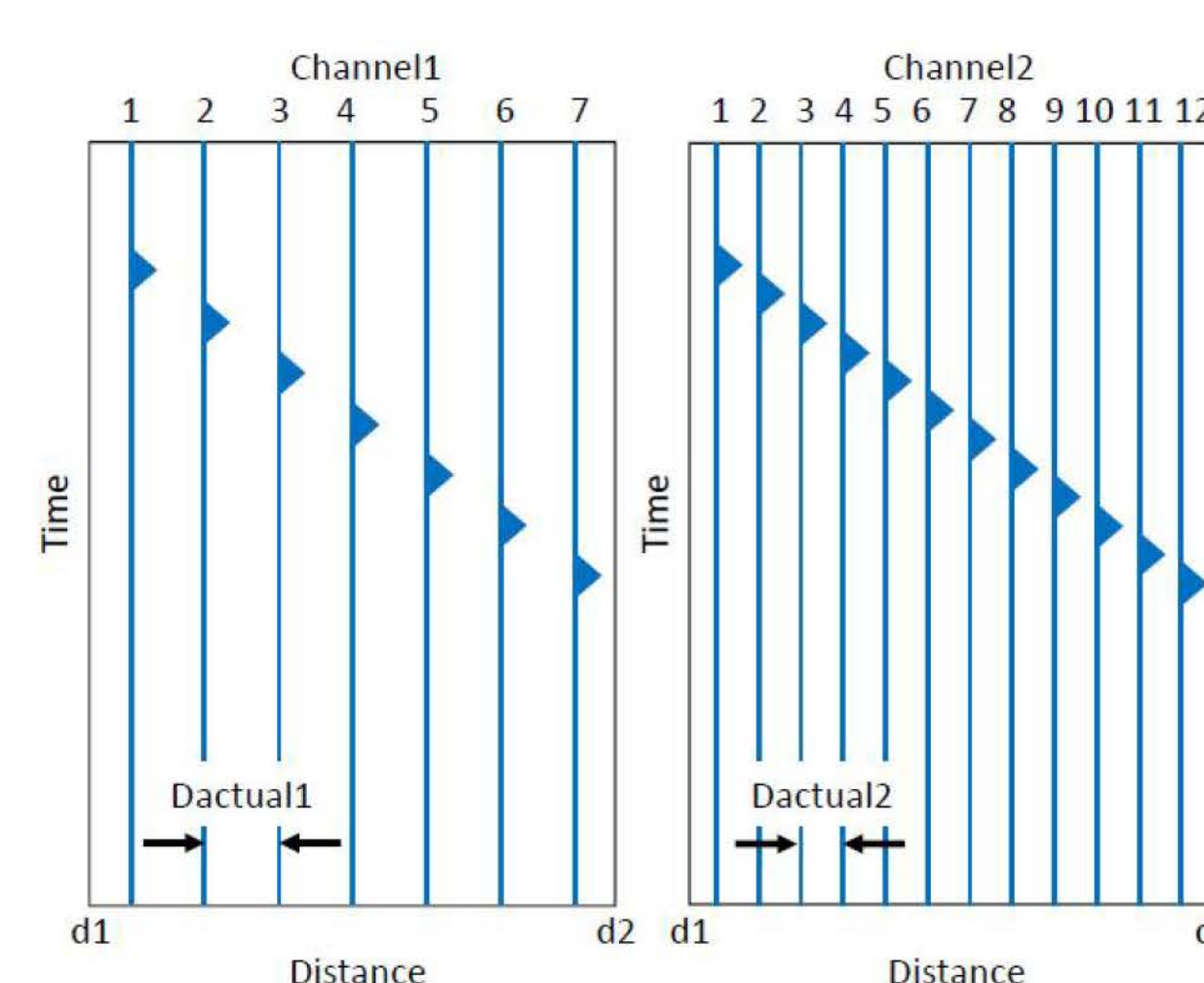


Figure 4: Proposed method to estimate depth in Channel 1.

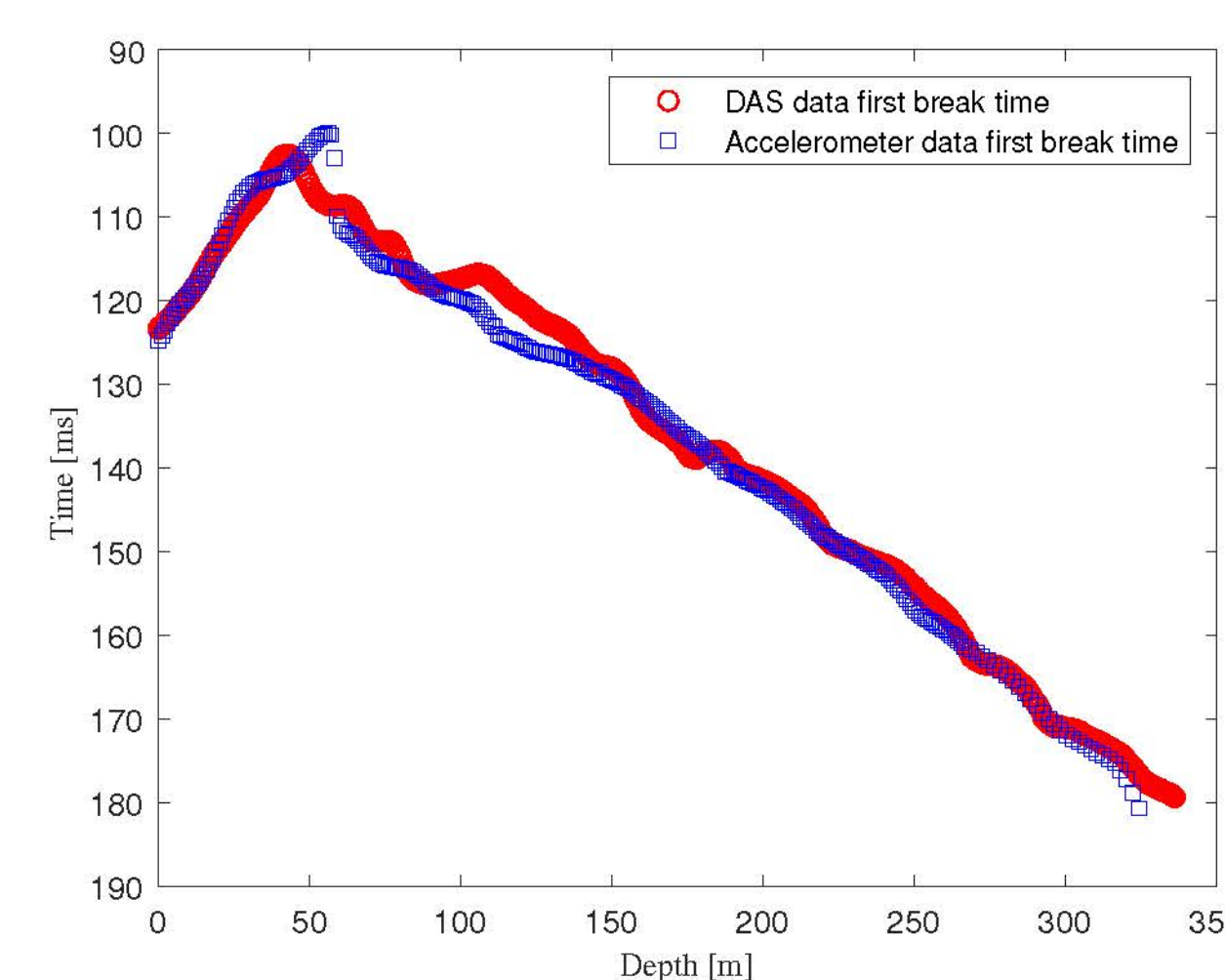


Figure 5: First break picks from shot 4170 for the accelerometer data (blue) and DAS data (red).

## FIELD DATA FWI

Here, we use P-wave velocity parameterization frequency-domain FWI and effective source estimation schemes to implement the elastic properties inversion. The Figure 6 shows the inverted models of  $V_p$ ,  $V_s$ , and  $\rho$  for the line 4 and line 1 of the snowflake data, where the line 1 have been processed by Eaid last year. Figure 7 indicates the comparison of the initial and inverted velocities models with the well logs data. From the Figure 6 and Figure 7, we can see that the anisotropy exists in the field data, but the anisotropy is not strong.

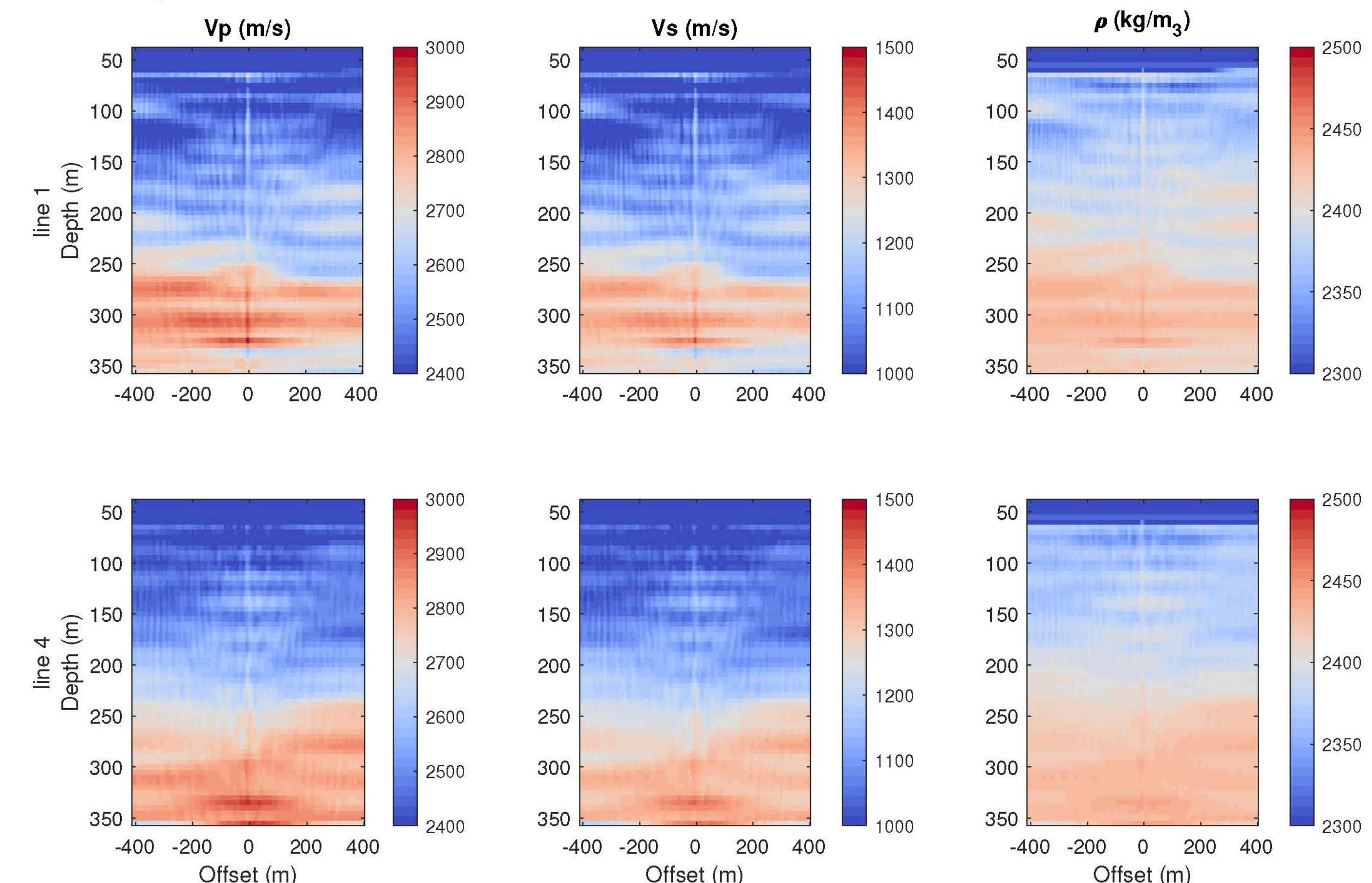


Figure 6: Elastic FWI for the Line 1 and the Line 4 of the snowflake accelerometer and DAS data.

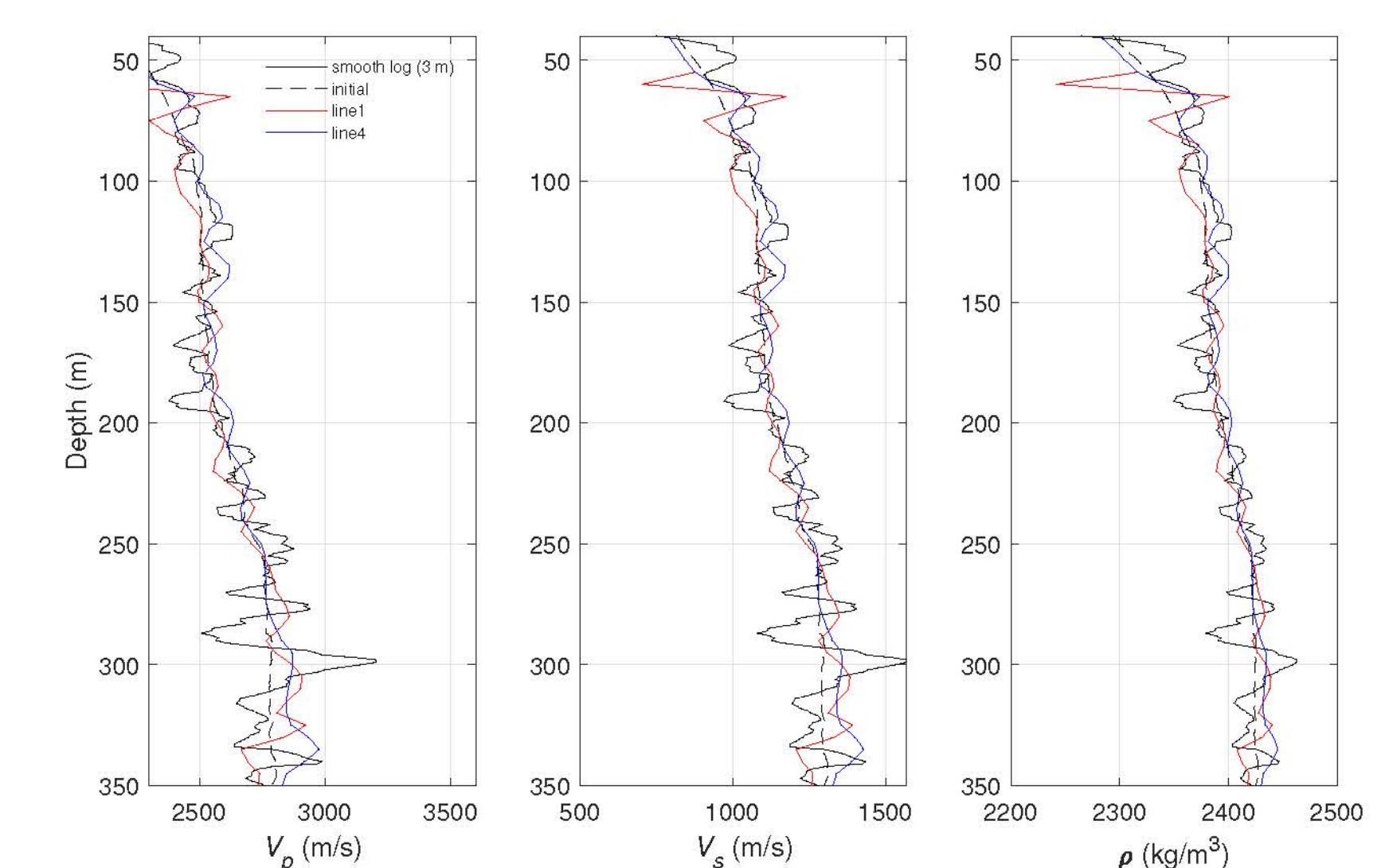


Figure 7: The comparison of the initial and inverted velocities models (line 1 and line 4) with the well logs data.

## Acknowledgments

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