Modelling & Migration using Acceleware's AxRTM API

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Outline

- Who Acceleware is
- Motivation
- AxRTM and AxWAVE
- Features of AxRTM
- Hussar Well logs
- Forward and RTM examples
- Examples from Hussar velocity profile
- Conclusions

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Who is Acceleware?

- Acceleware limited is CREWES' in-kind sponsor
- They provide Parallel Computing software solutions to the Oil & Gas markets.
- Acceleware's software products utilize a variety of parallel computing hardware platforms.
- Hardware platforms include compute GPUs and multi-core CPUs.

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Motivation

- Research based. My research focuses on FWI (IMMI) of real data. To achieve this, there is need for computational speed and power.

- AxRTM and AxWAVE provide computational speed and power as the codes run on GPU's and CPU's and offer parallel processing.

- Since AxRTM is a Reverse Time Migration engine, it will provide an opportunity to compare results with other types of FWI workflows.

AxRTM & AxWAVE

A high-performance finite-difference library for isotropic & anisotropic forward modeling and Reverse Time Migration.

Both Support 2D and 3D

Acoustic Finite-difference computational engine Isotropic, VTI and TTI media 2nd order time, 4th to 12th order space.

Option for absorbing and reflecting boundaries, arbitrary source and receiver locations

Forward modeling and RTM modes

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AxRTM & AxWAVE

Library with a C-language and Matlab interface

Disk I/O

Multi-core CPU and NVIDIA GPU support

Multi-node support for large simulation sizes

Code examples for forward modeling and RTM modes

Code example for multi-node usage

VTI and TTI: use Thompson parameters ε and δ

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Features: Reverse Time Migration

Disk storage minimized:
- Forward source propagation
- Reverse receiver and source propagations

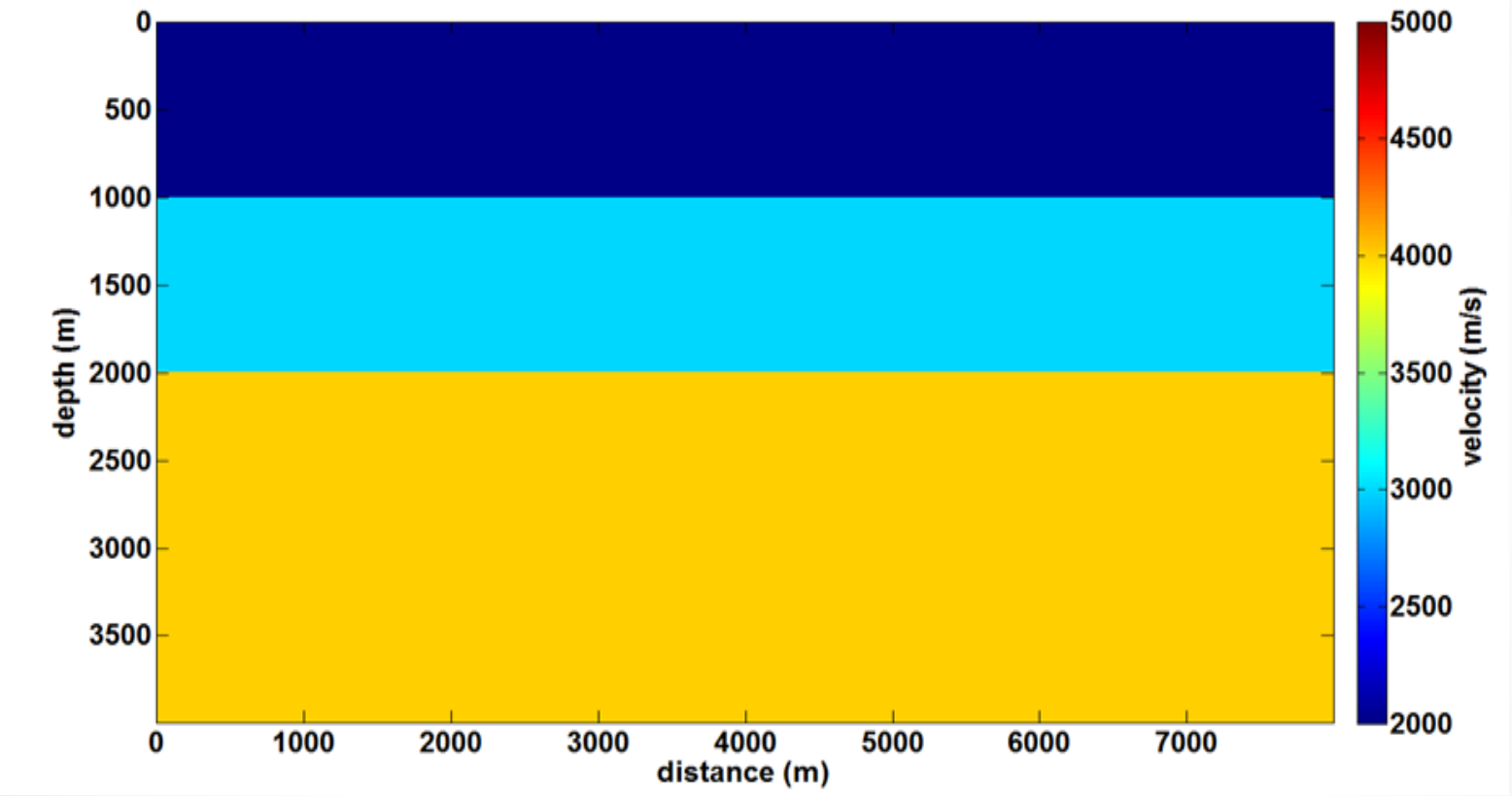
Imaging conditions
- Cross-correlation between source and receiver wavefield

Image filters
- Low-cut filter
- Laplacian filter

Source Illumination output

AxRTM library can be used “as is” to perform FWI using cross-correlation imaging condition

Some examples



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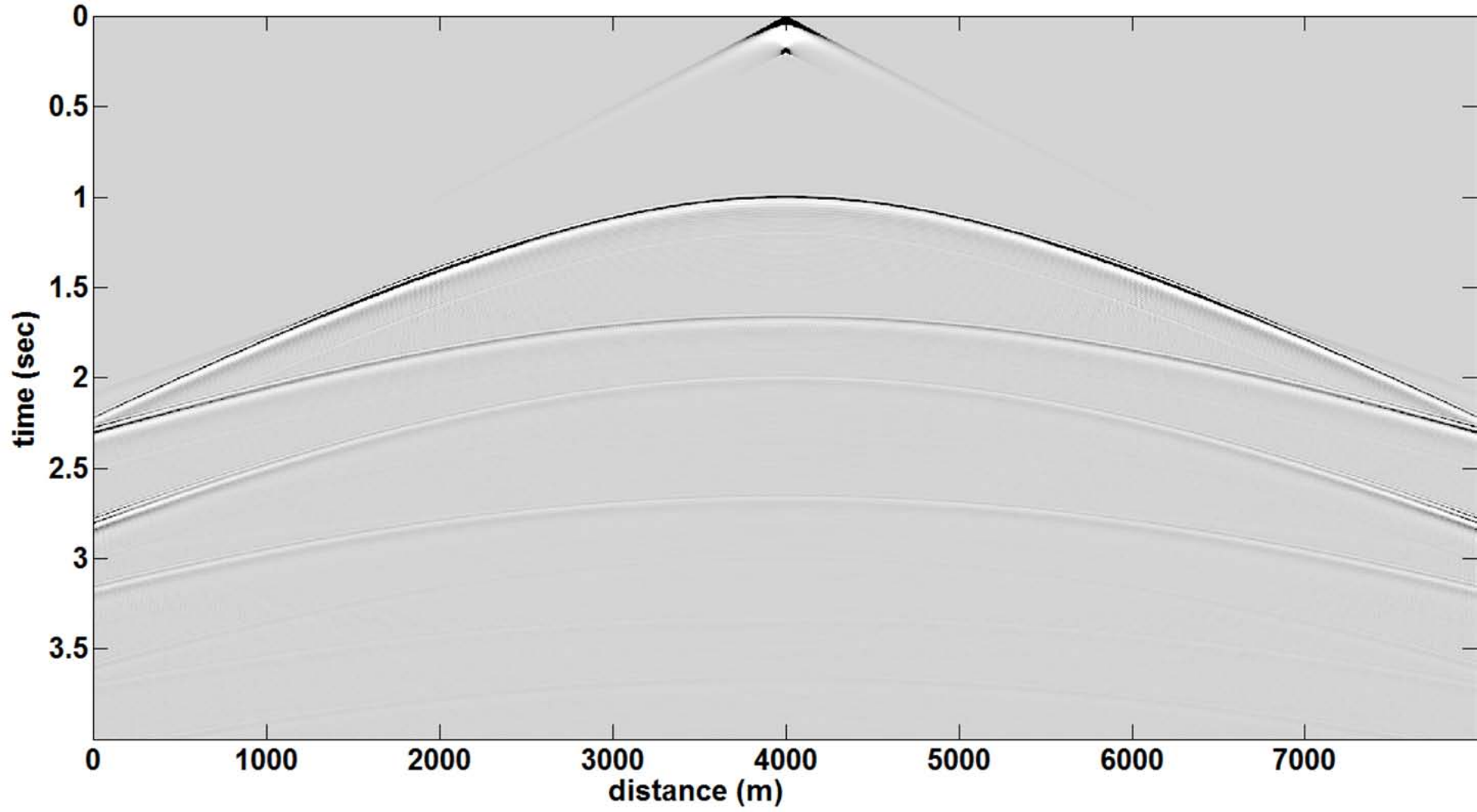
Shot record from AxRTM



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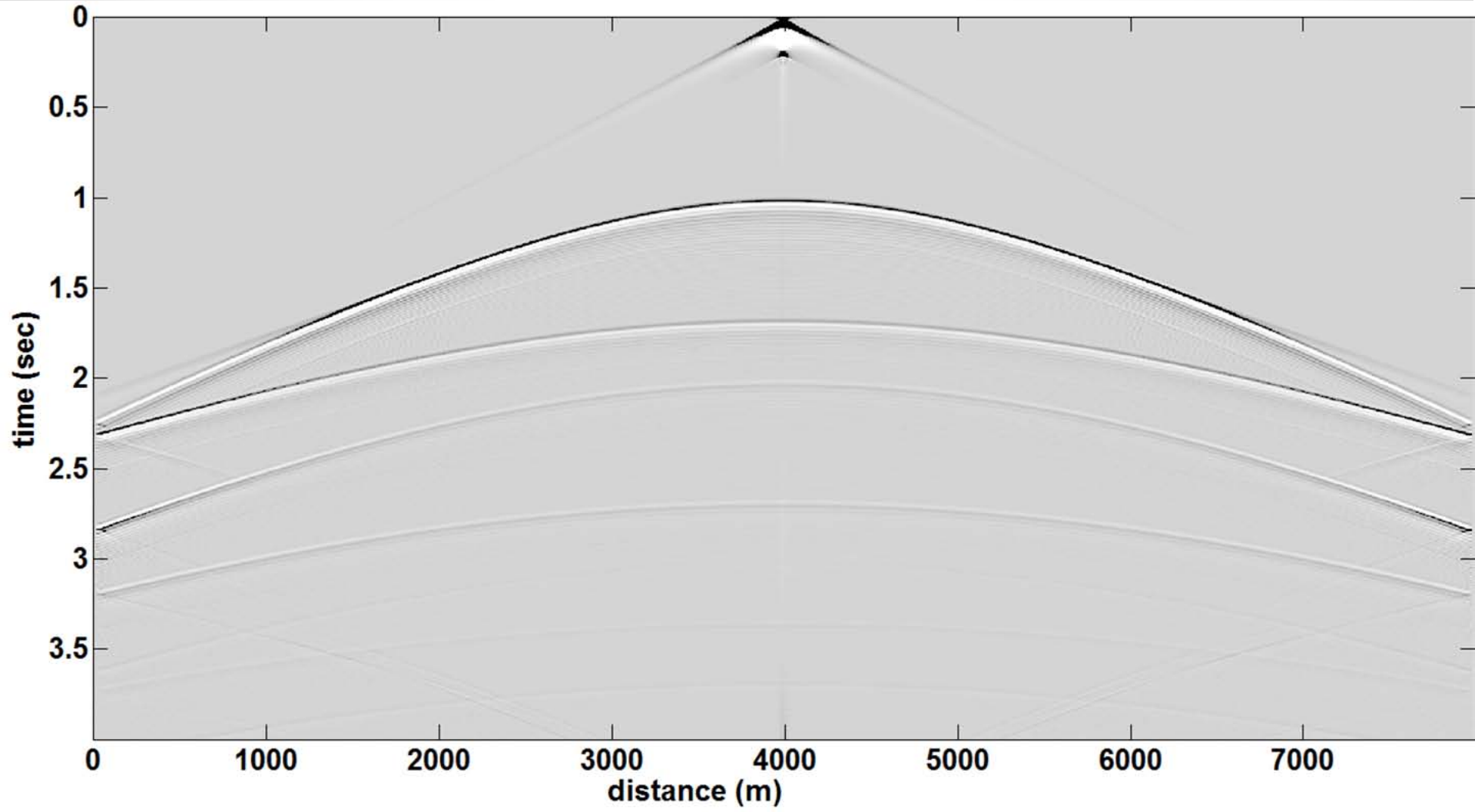
Shot record using Afd_shotrec_alt from CREWES toolbox



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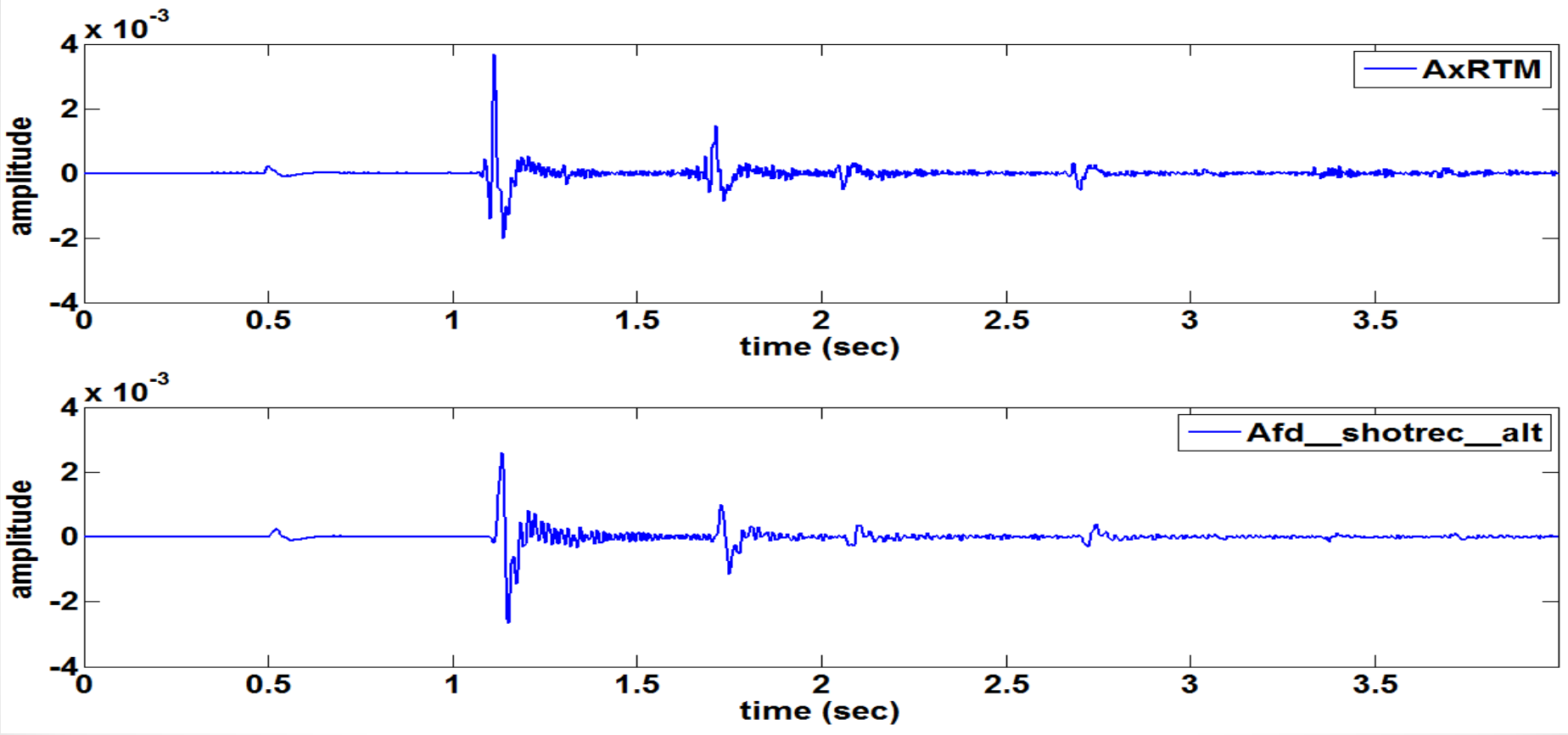
Trace at 500 meters



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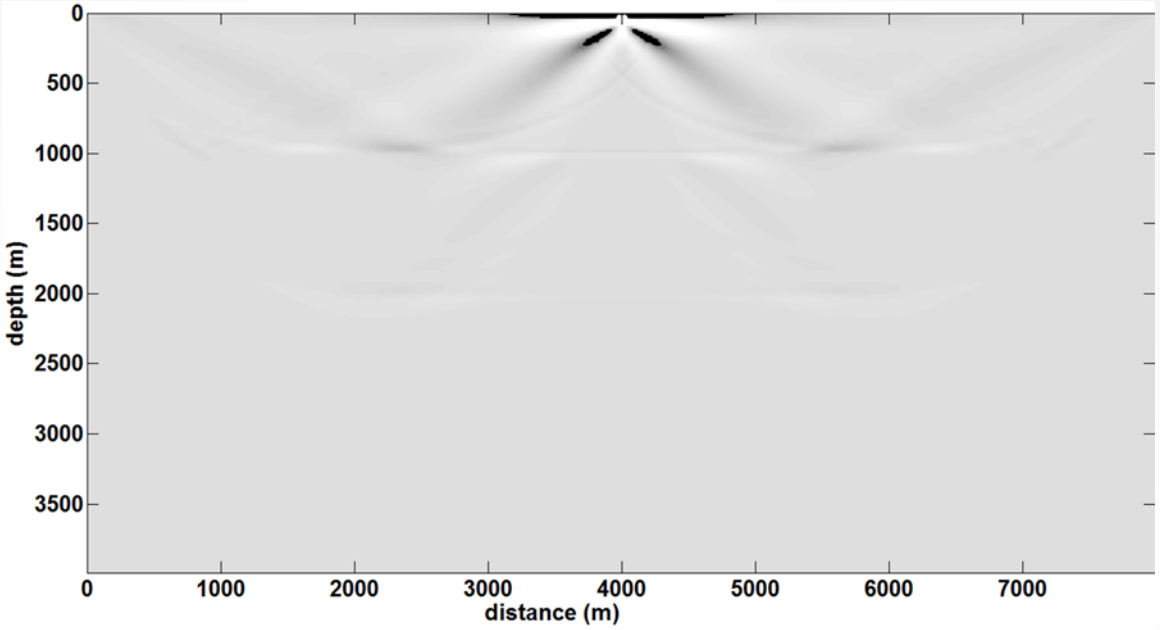
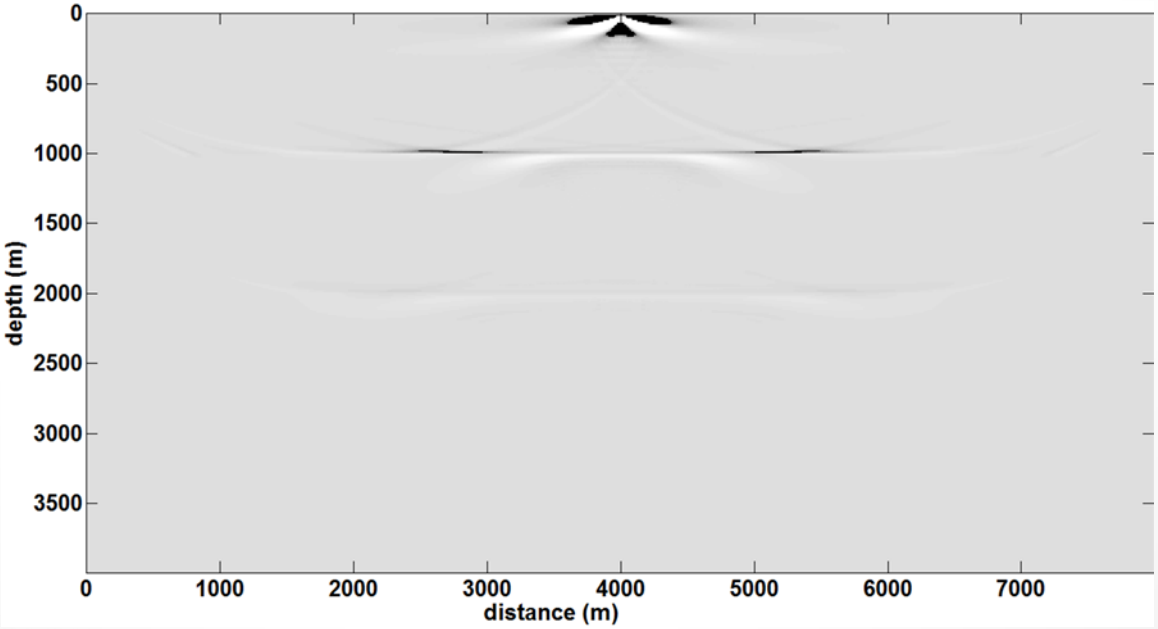
Migrated image
AxRTM, C.



Migrated image.
PSPI, Matlab.



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Recall on acquisition parameters-Hussar

- 2D seismic line from Hussar, central Alberta.
- About 4.5km long running from Southwest to Northeast.
- Seismic source is dynamite; shot spacing 20m Number of shots 269.
- Number of receivers is 448 with a receiver spacing of 10m.

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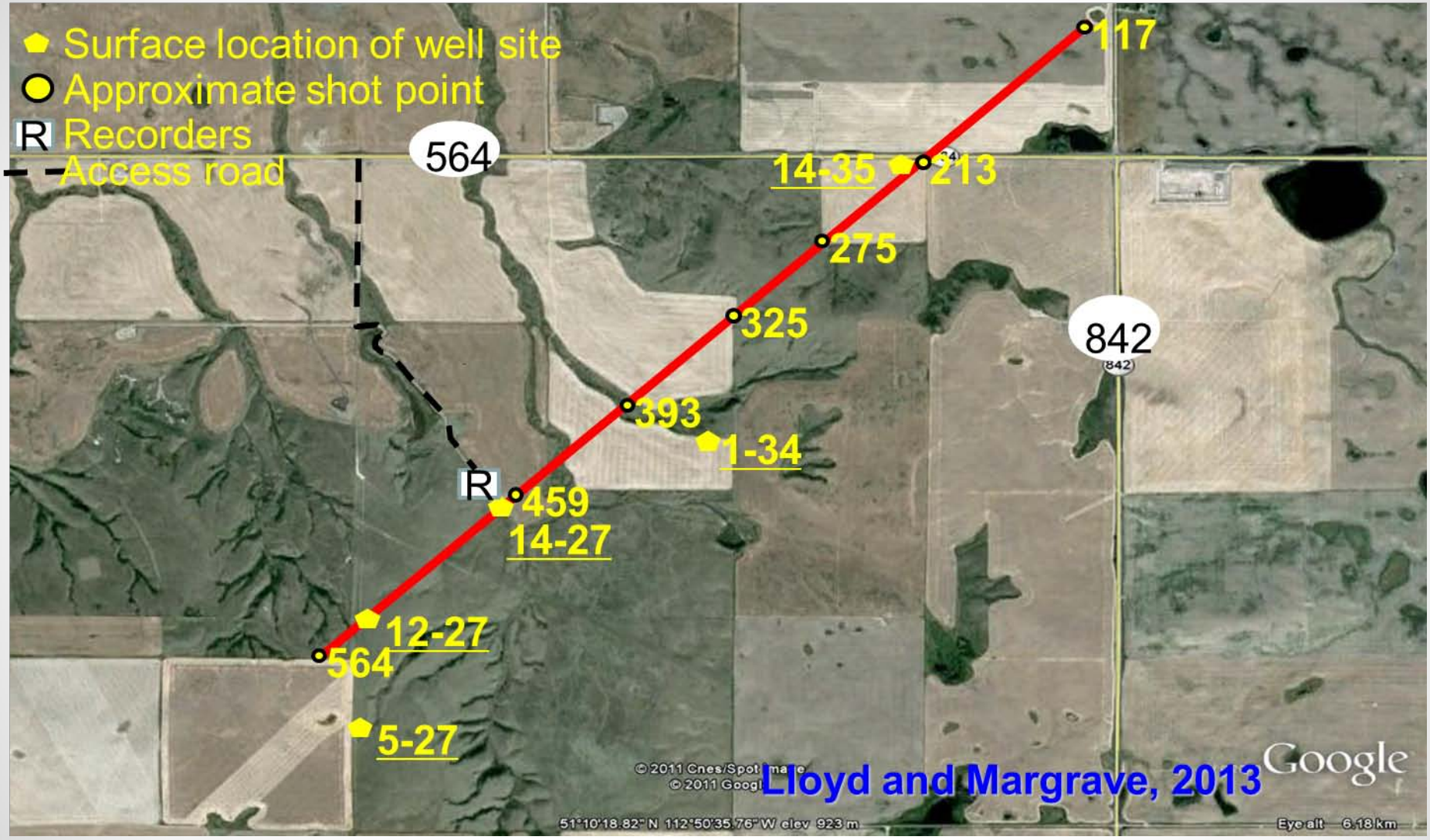
Hussar Central Alberta



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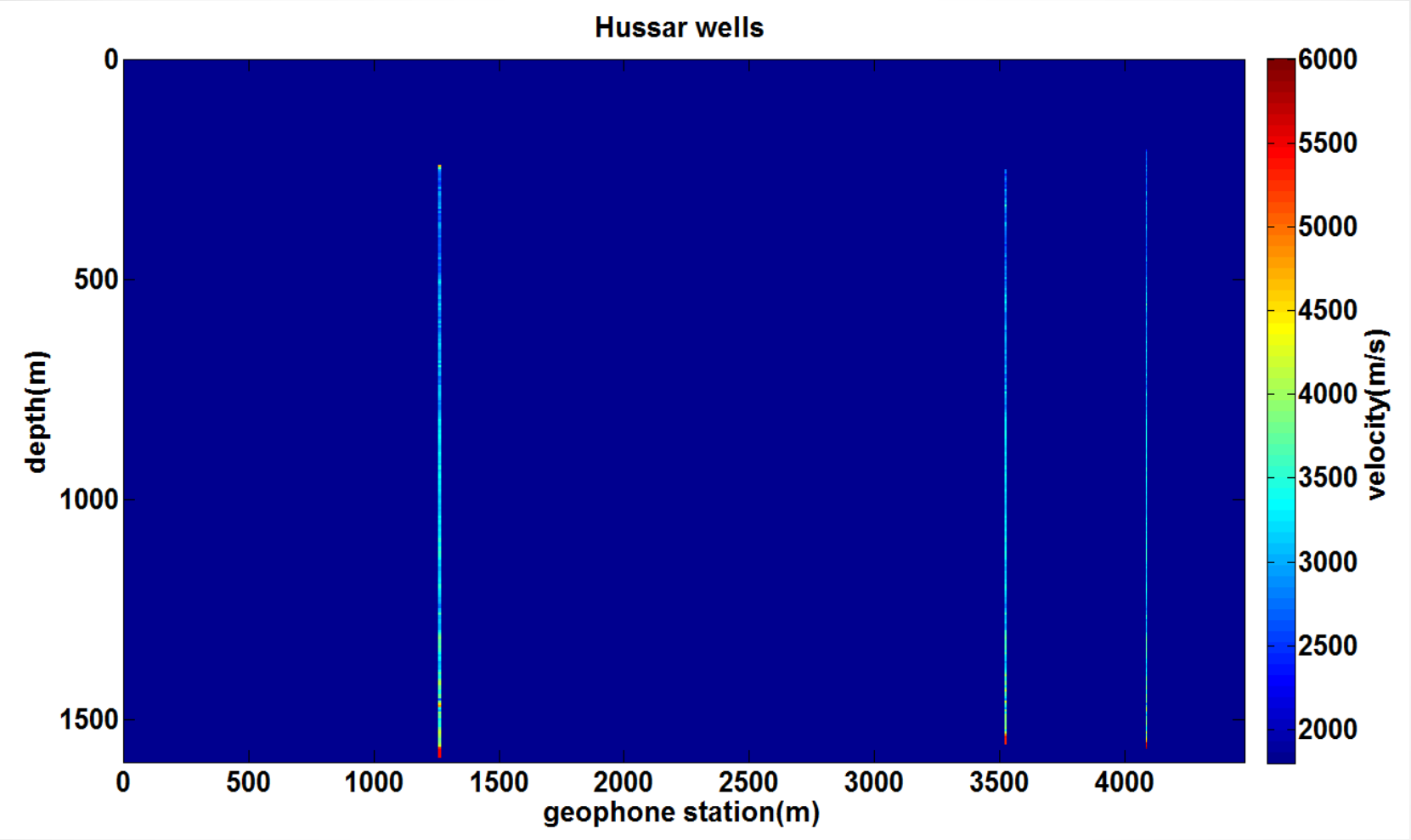
Subsurface picture of Hussar wells.



AxRTM, C-language.

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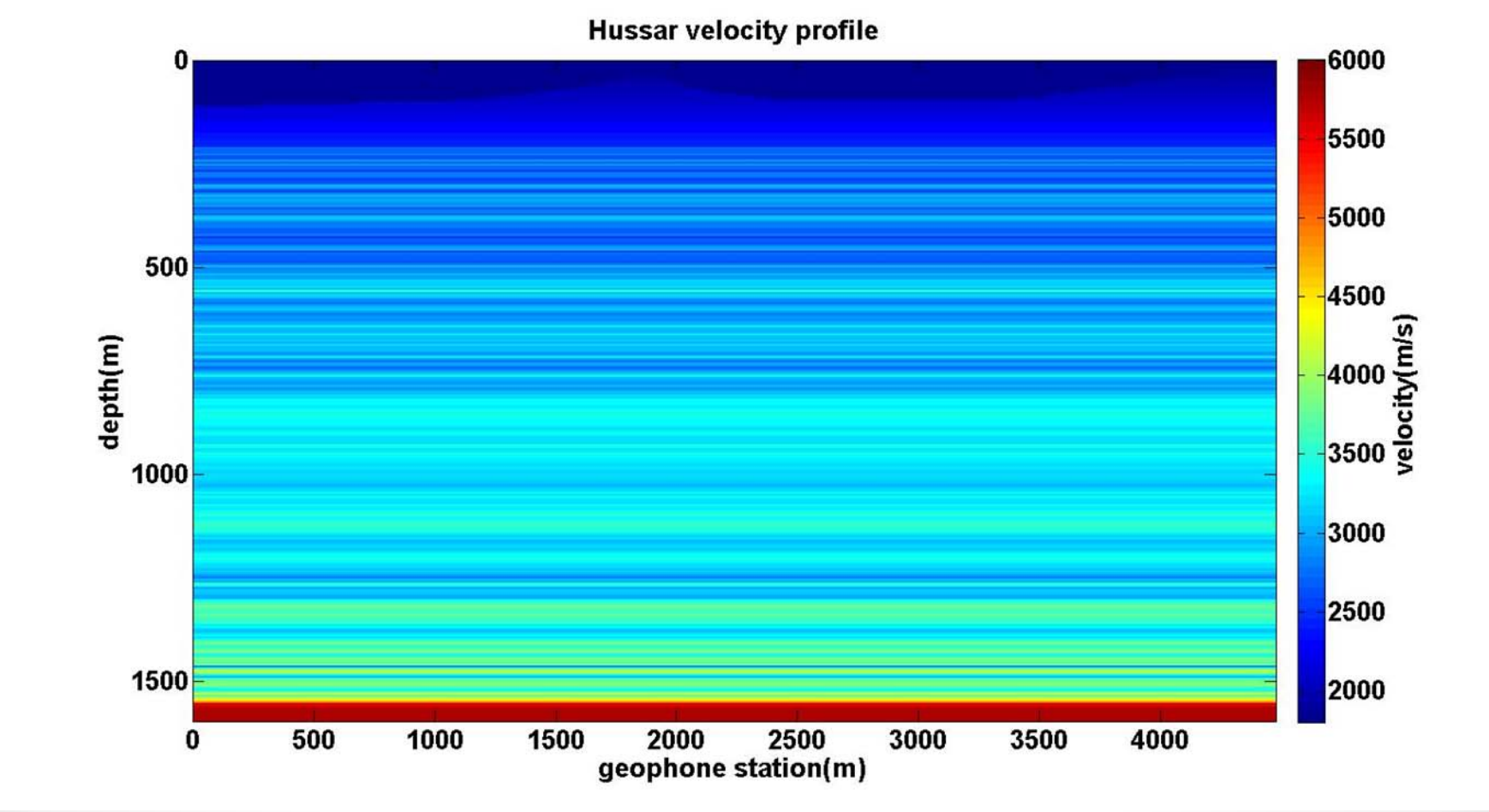
Velocity profile. well 12-27 with drift correction



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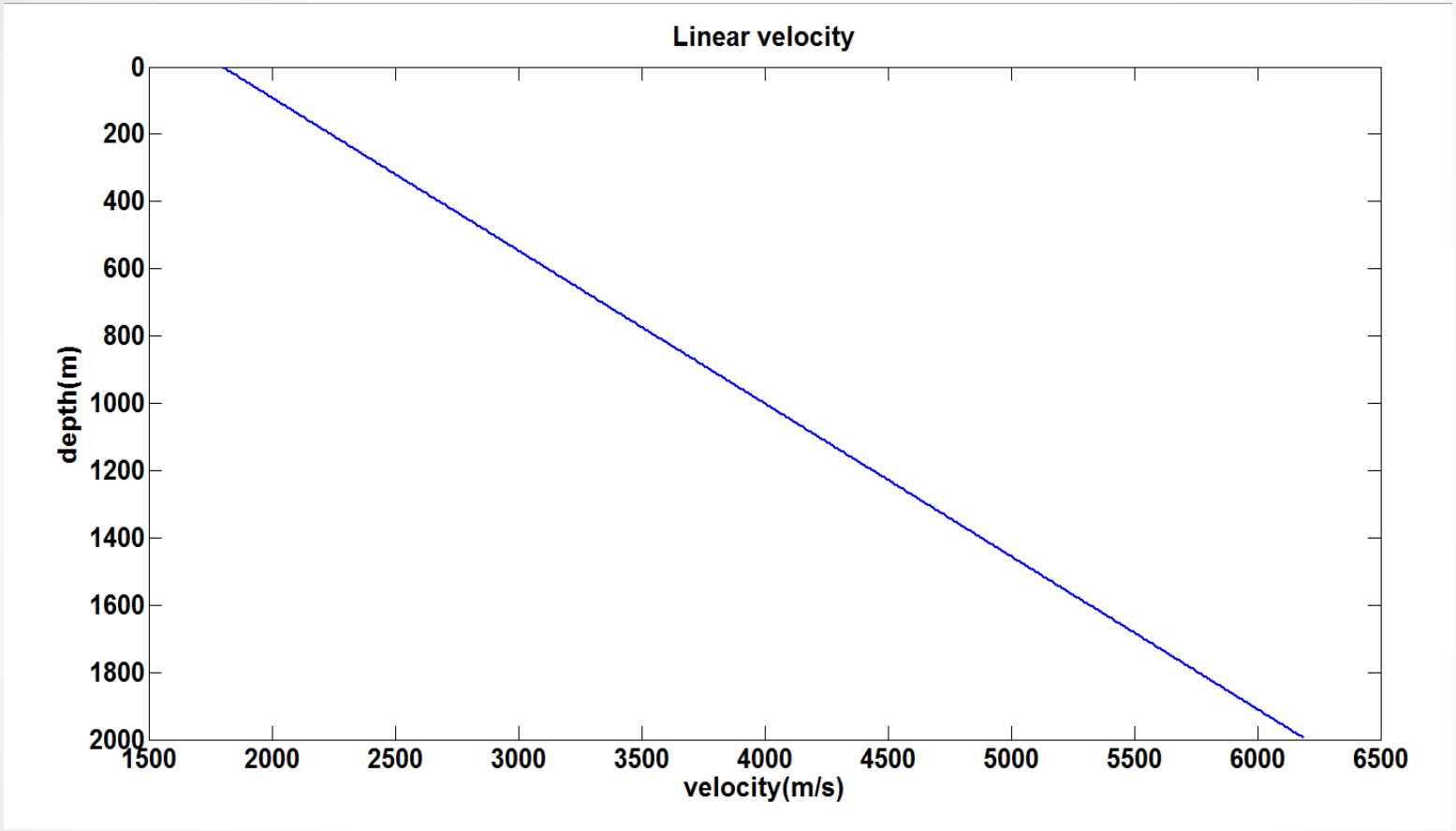
Linear velocity; $V=V_0+cz$



c~2.2m/sm, V_0=1800m/s

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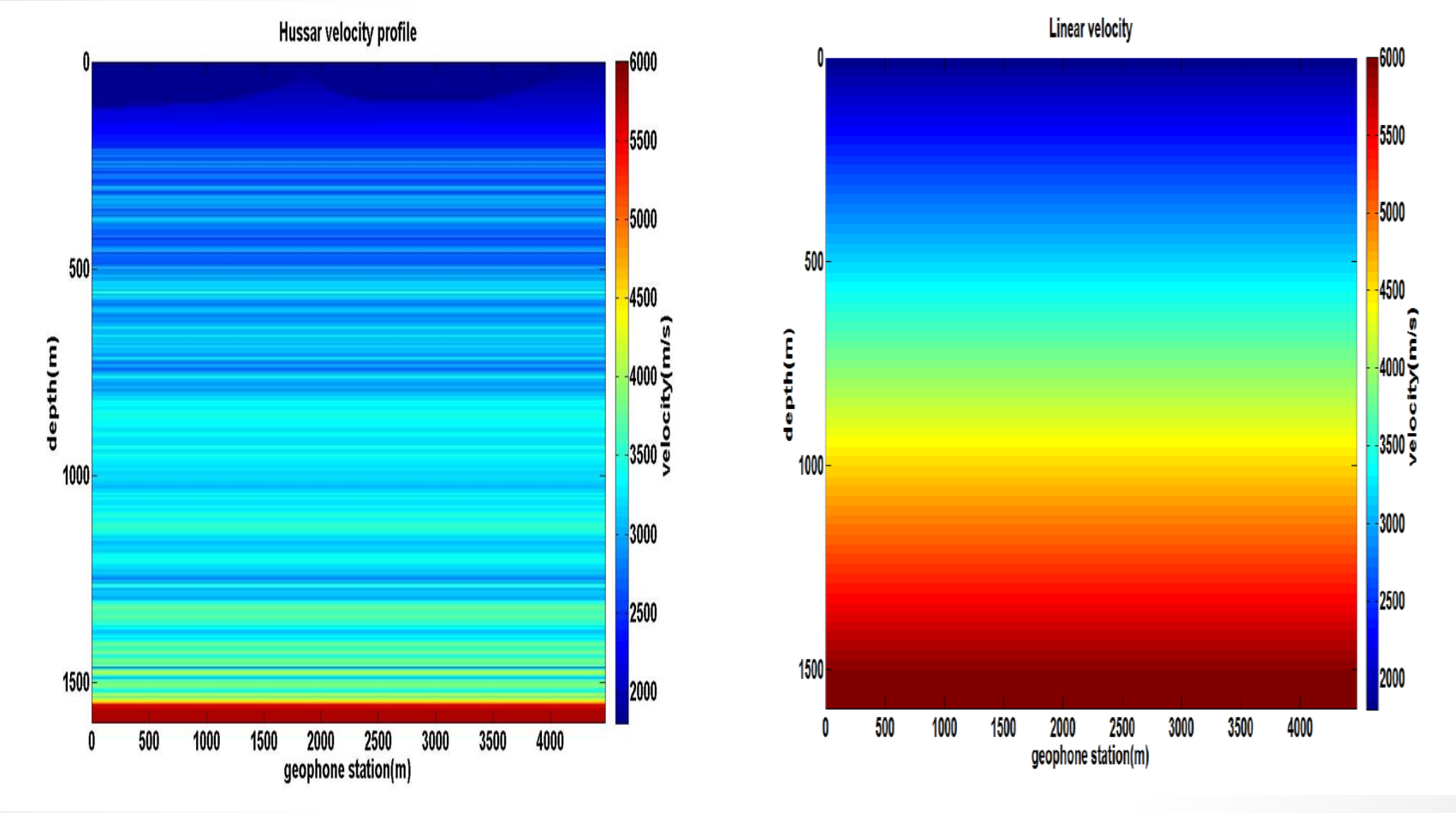
Velocity profile. well 12-27.



Match is very poor below 700m. c~2.2/s could be too high. Could change V_0. Least-squares fit.

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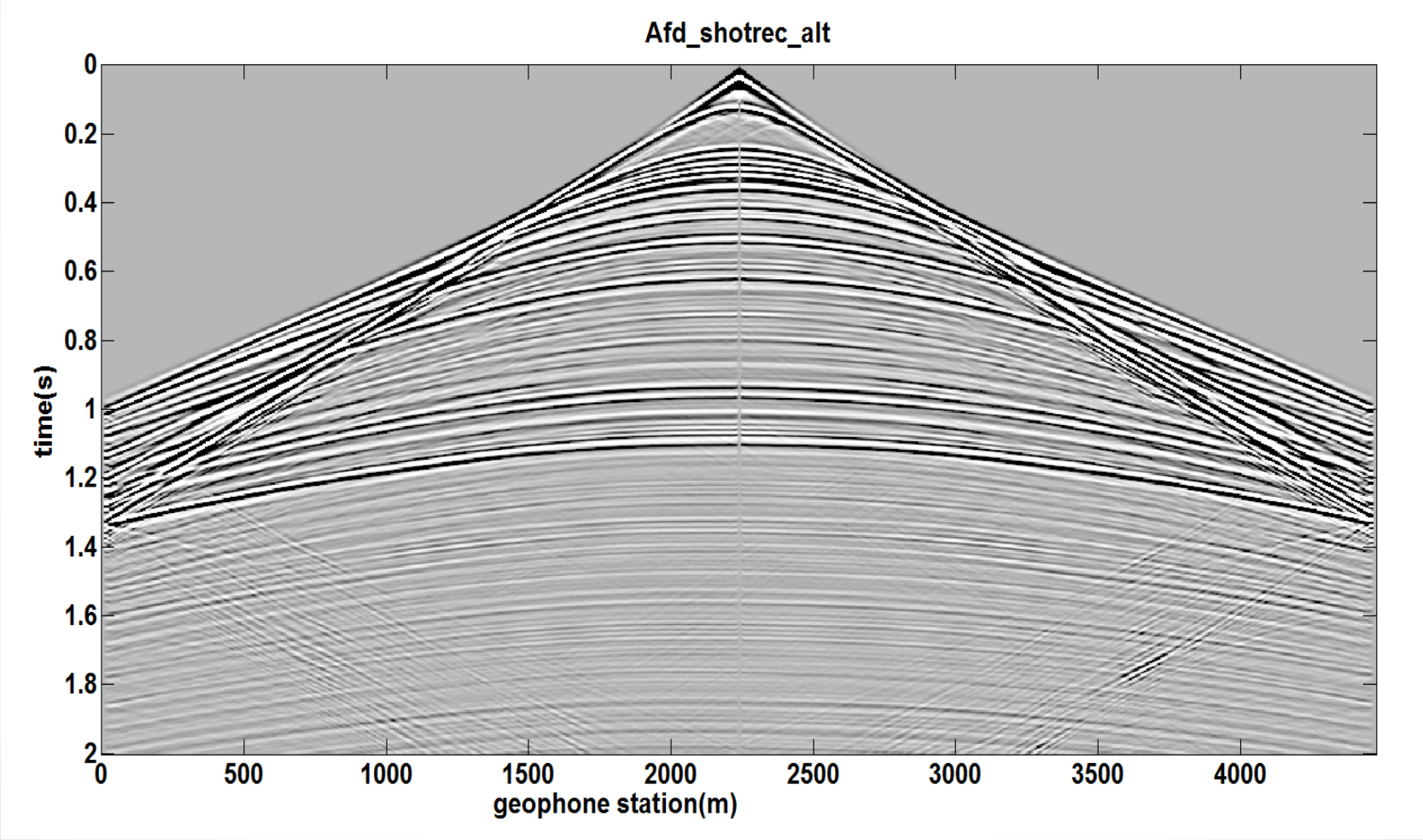
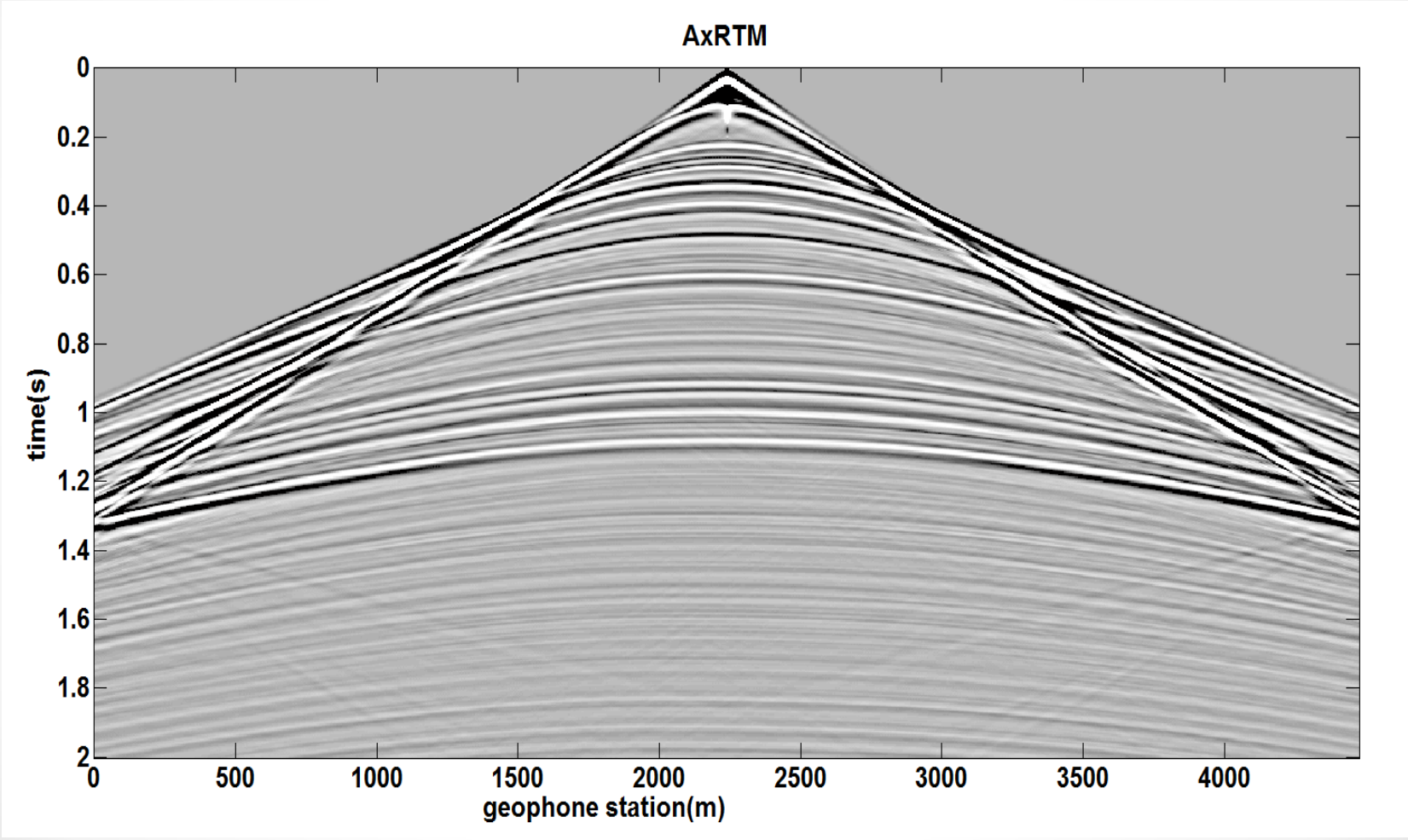
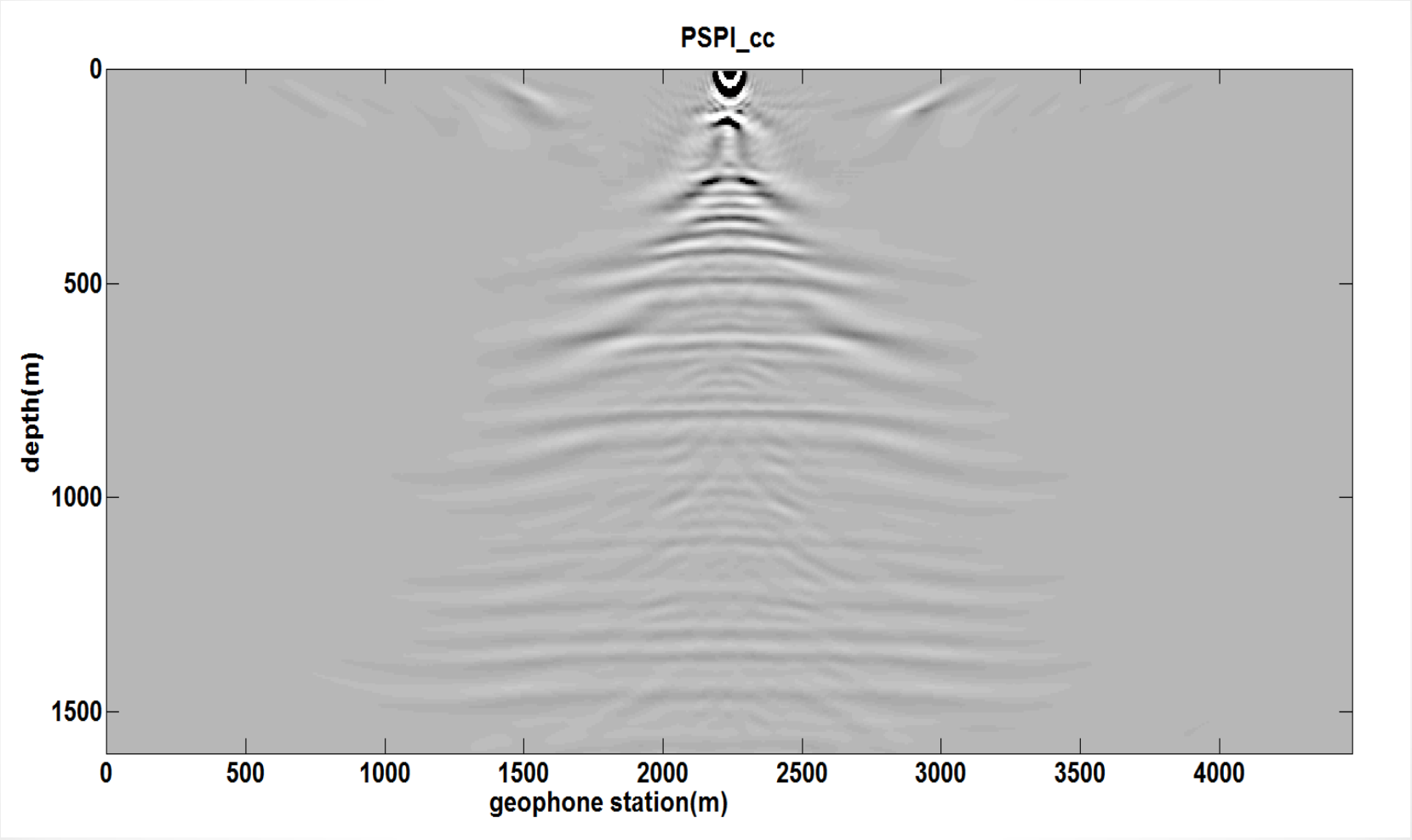
Shot record using Hussar well velocity profile



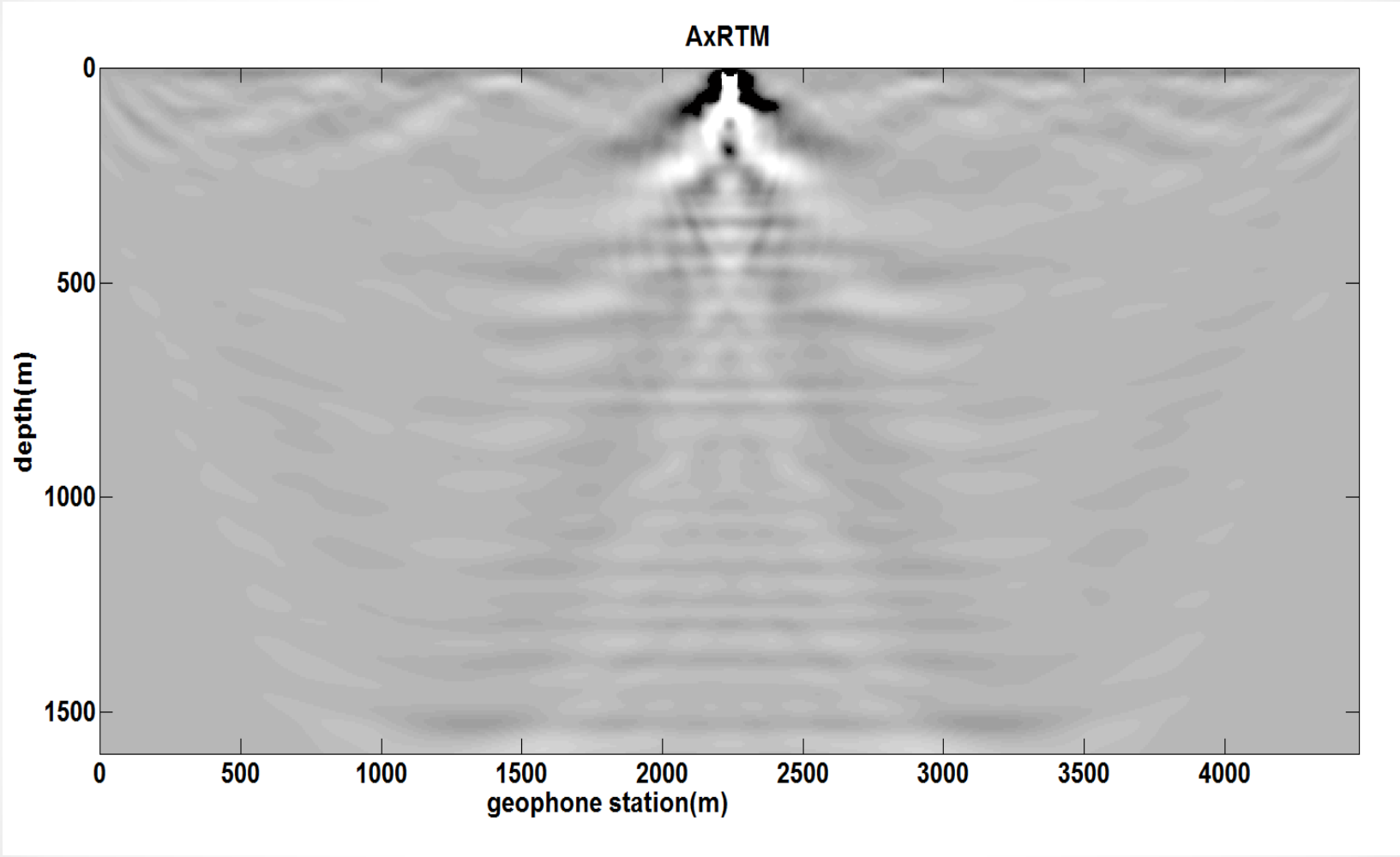
Shot record using Hussar well velocity profile



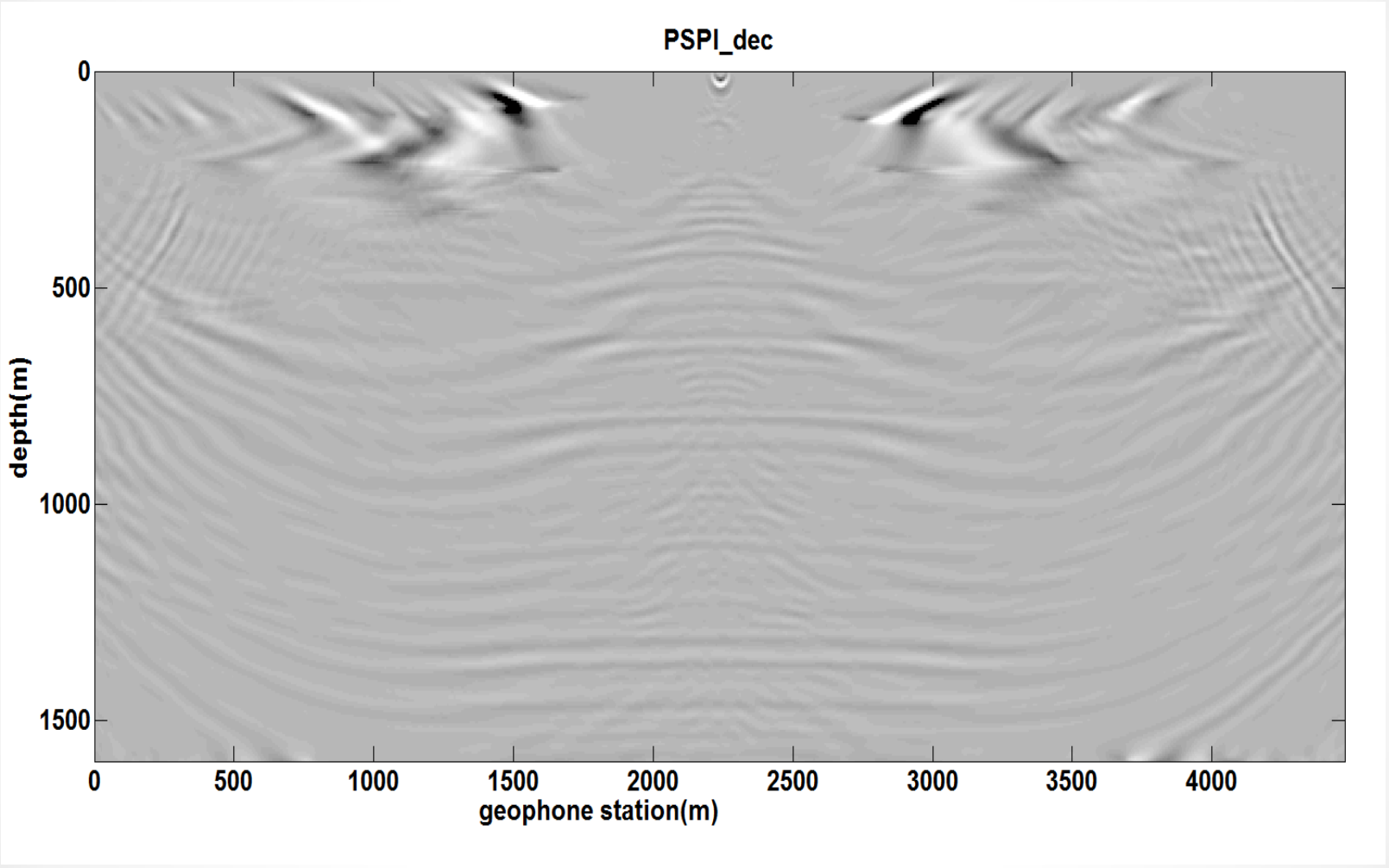
PSPI image, cc IC



AxRTM image, cc IC



PSPI image, dec IC



Conclusions

- We have been able to show that AxRTM API from Acceleware can be used for modelling and migration (RTM).

- The results from AxWAVE and AxRTM are comparable with the results from the forward modelling and migration codes from the CREWES toolbox. However, from the examples presented, the migrated image from AxRTM suffers from RTM artefacts, nonetheless the package comes with the flexibility of applying a spatial filter to the migrated image.

- For the forward modelling, we observed that AxWAVE runs about 20 times faster than ‘Afd_shotrec_alt

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