Shear-wave studies of the near-surface at the CaMI Field Research Station in Newell County, Alberta

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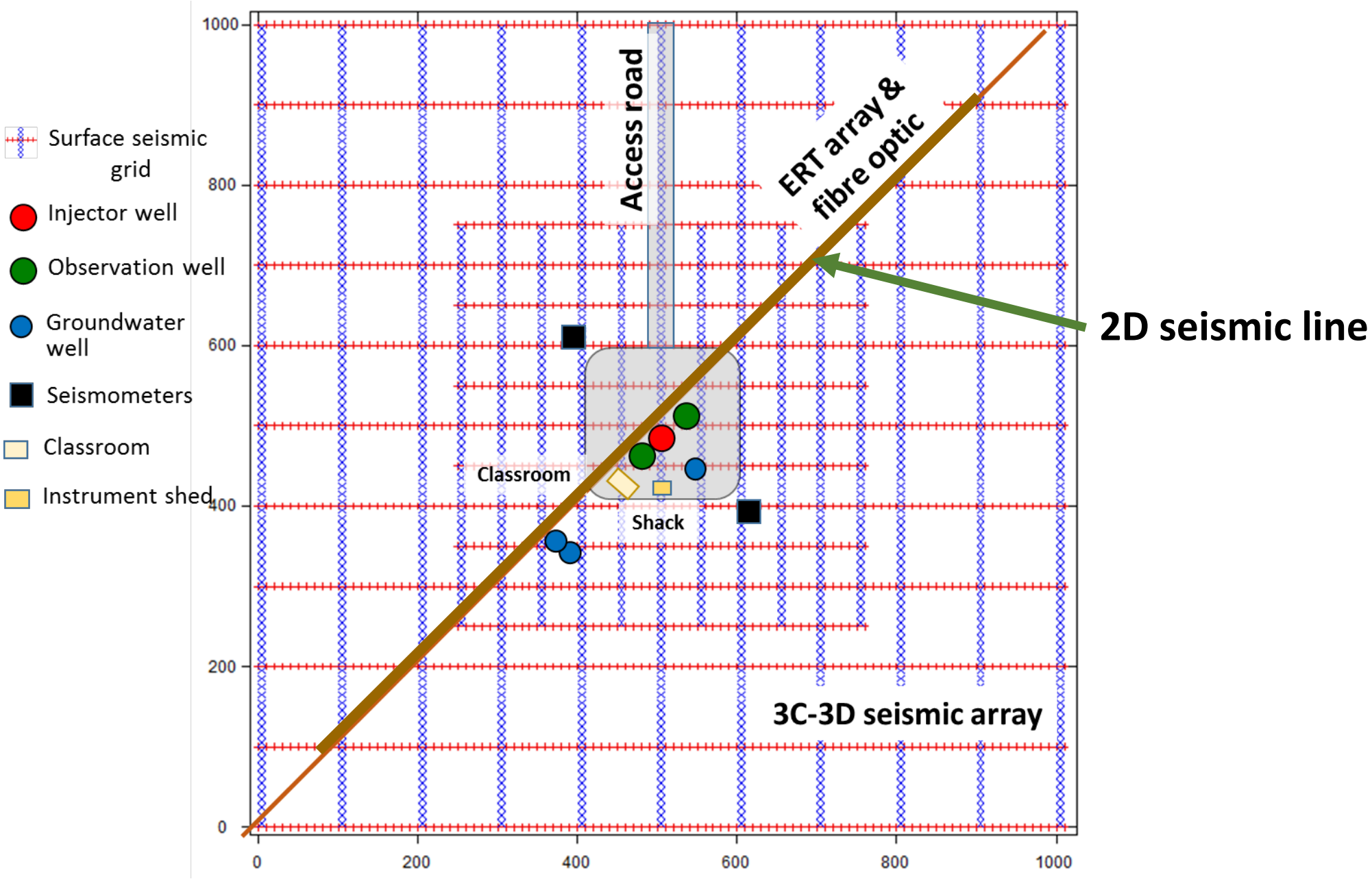
NSERC CRSNG
CMC Containment & Monitoring Institute
UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
Department of Geoscience

Objectives

Renewed interest in the S-wave velocity structure of the near-surface

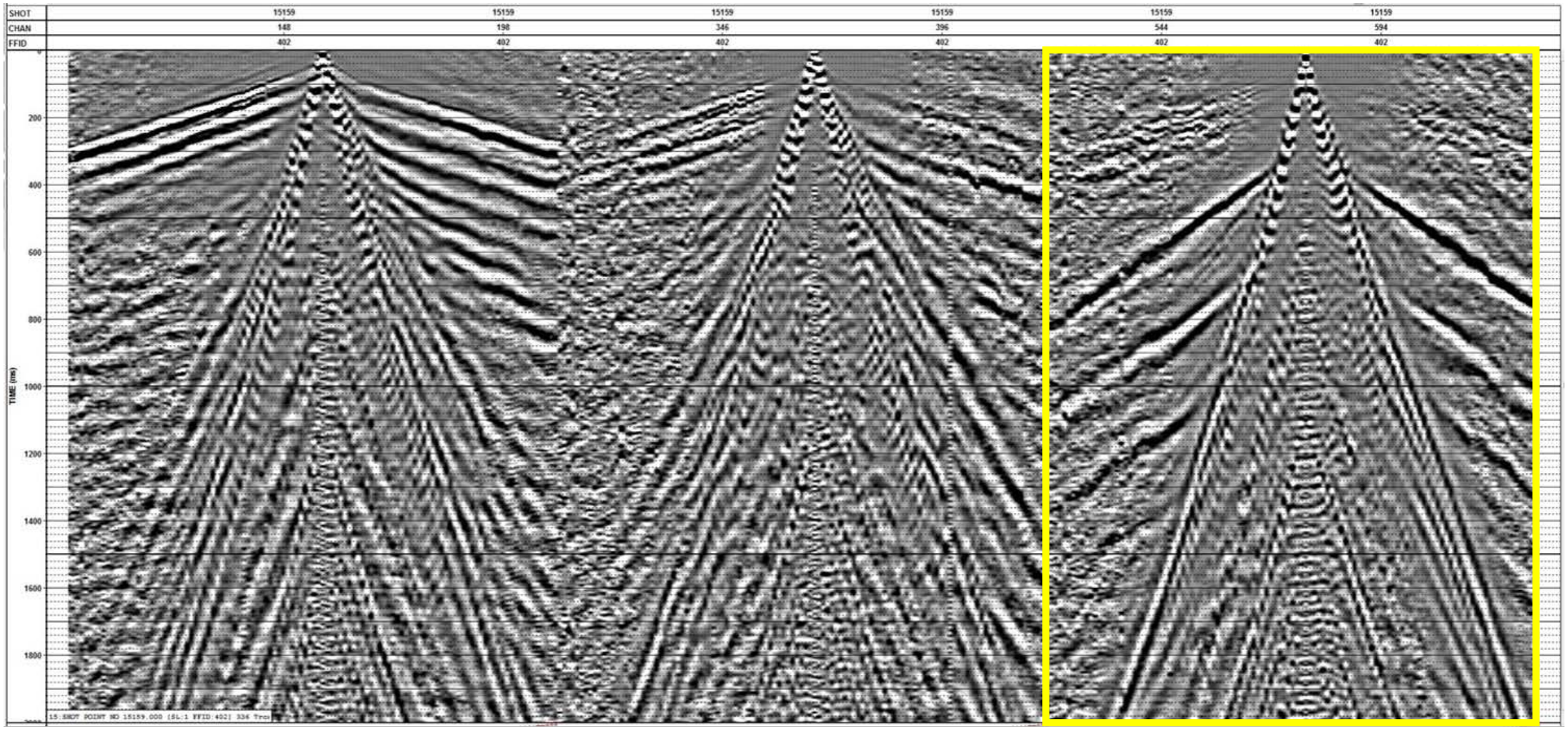
- S-wave statics for P-S surveys
- Near surface rock properties
- Focal-time method for microseismic hypocentre depths
- Constraints on the shallow part of the velocity model for land elastic FWI

CaMI Field Research Station



CREWES multicomponent thumper

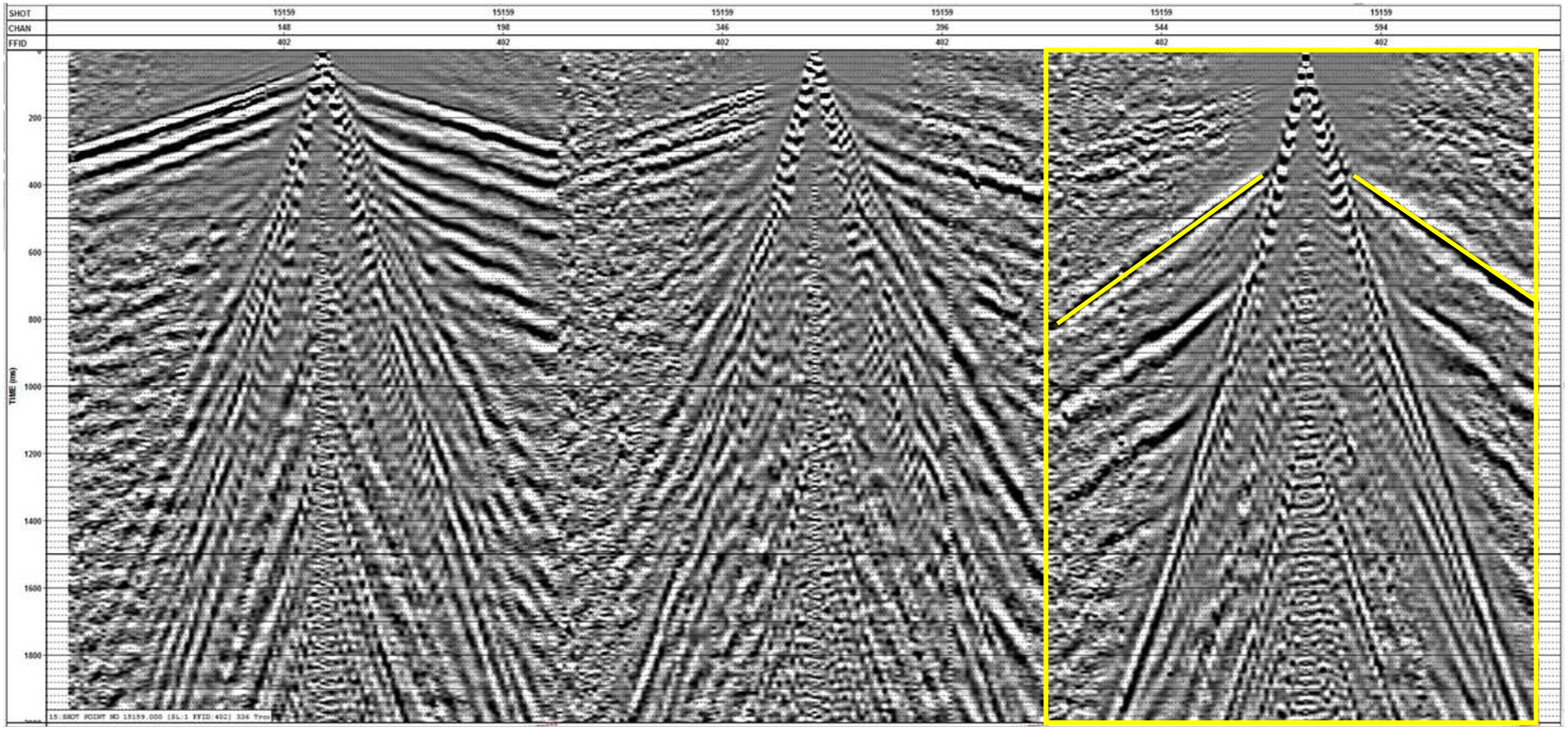
S-wave thumper shot record



Vertical Inline Crossline

10 m trace spacing

SH refracted arrivals



Vertical Inline Crossline

Echo Seismic towed multicomponent land streamer

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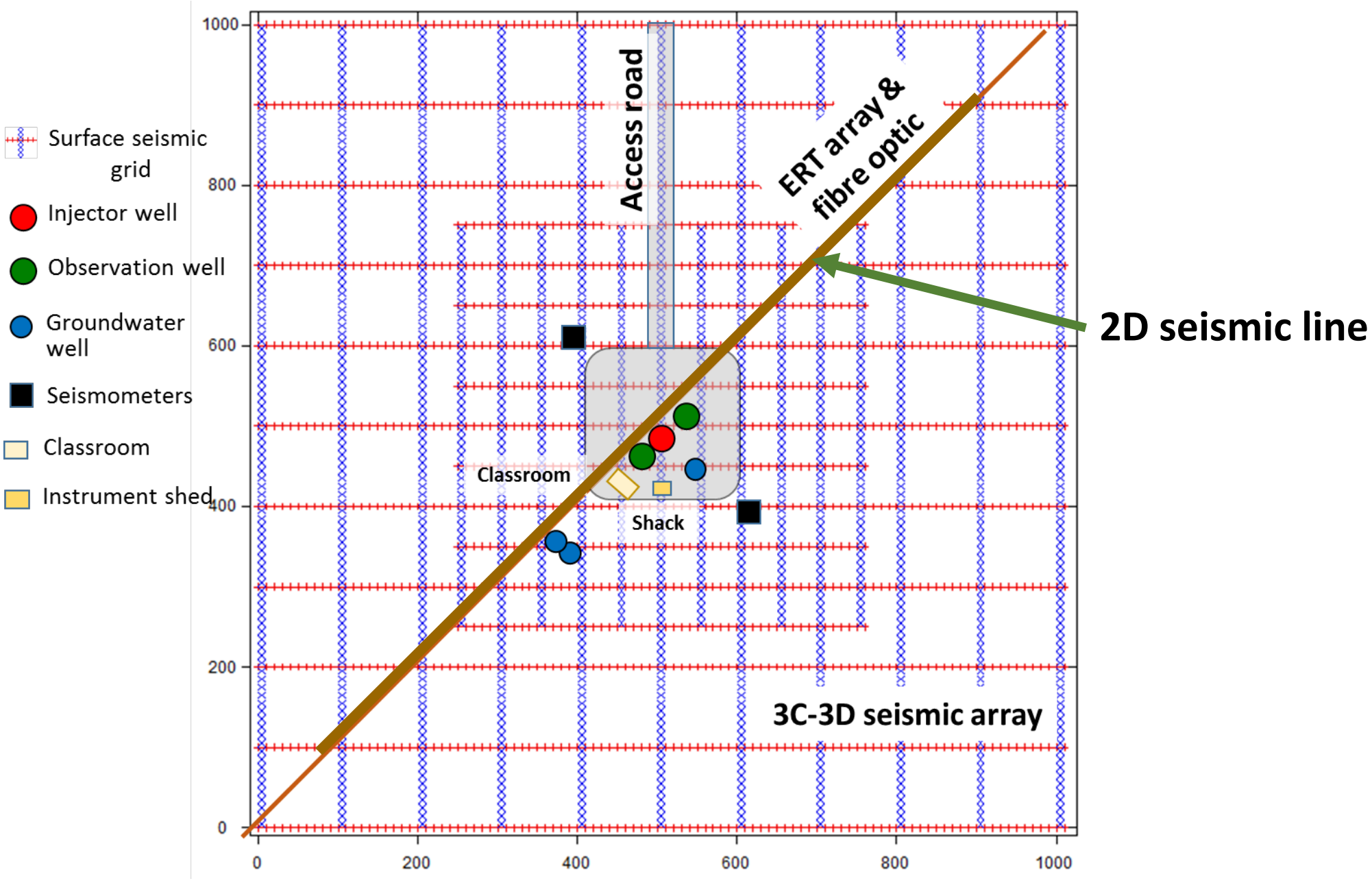
Towed streamer survey

CaMI Field Research Station



Surveys

Echo Seismic S-wave Envirovibe: 10 – 150 Hz over 8 seconds (1 sweep)

2018 fixed 3C array:

- 3C geophones at 10 m intervals over 1.1 km
- 20 m source interval

2018 towed 3C streamer:

- 72 x 3C geophones at 1 m interval
- 2 m source interval

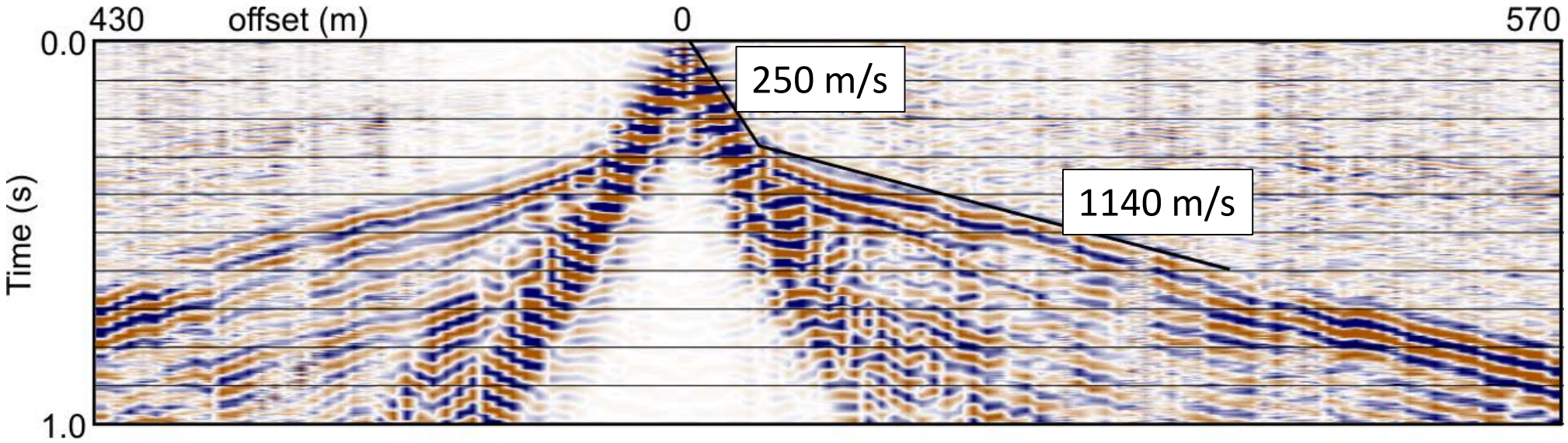
UofC P-wave Envirovibe: 10 – 150 Hz over 16 seconds (4 sweeps)

2017 P-S survey;

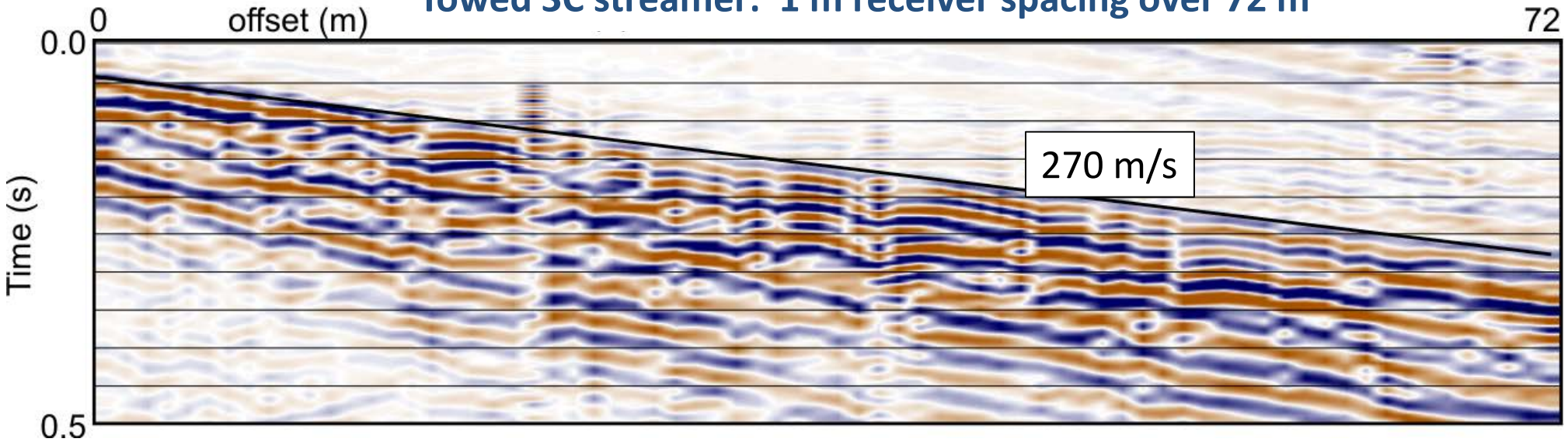
- 3C geophones at 10 m intervals over 1.1 km
- 20 m source interval

SH shot gathers

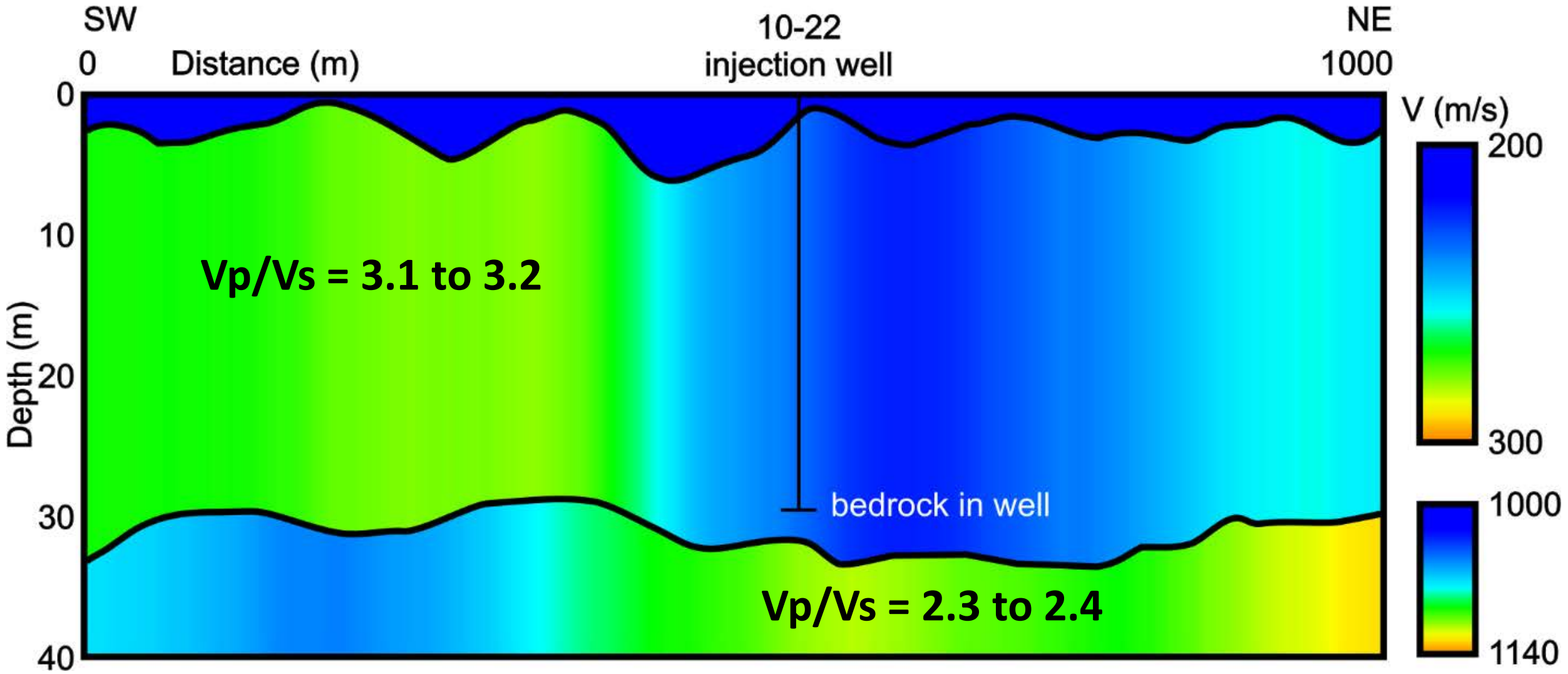
Fixed 3C geophone spread: 10 m receiver spacing over 1.1 km



Towed 3C streamer: 1 m receiver spacing over 72 m

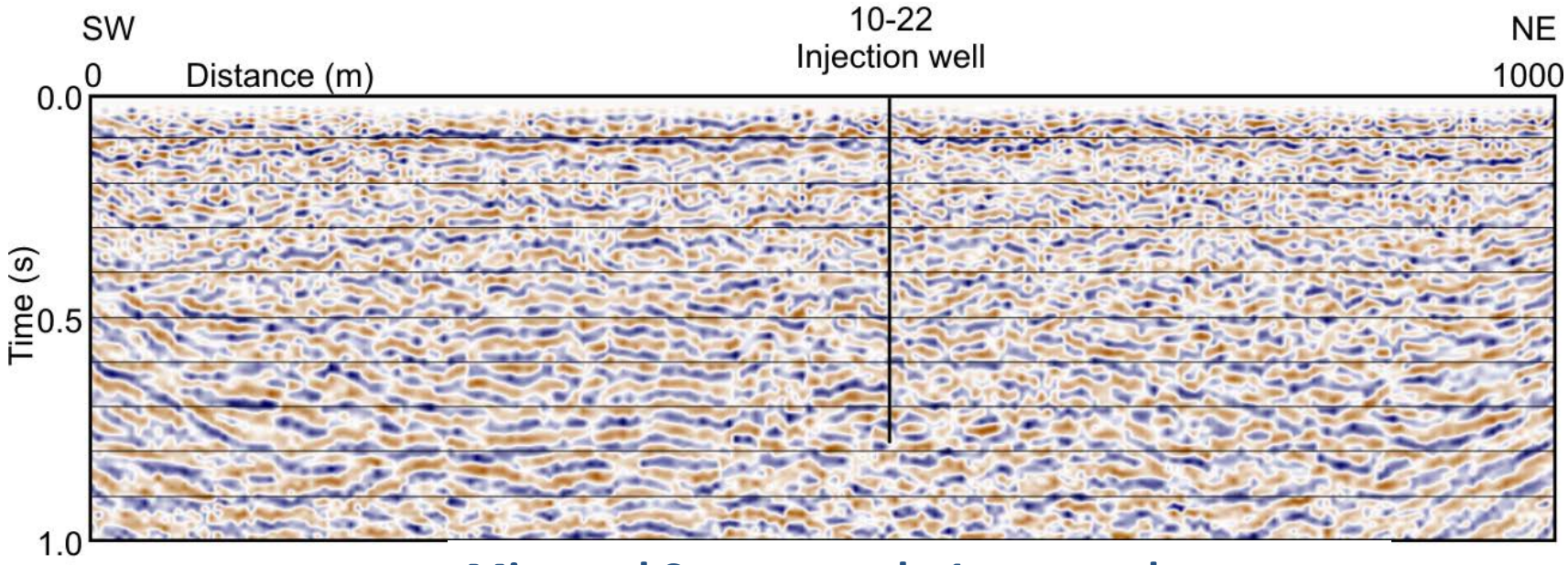


S-wave velocities Vp/Vs from 10 m fixed geophone spread

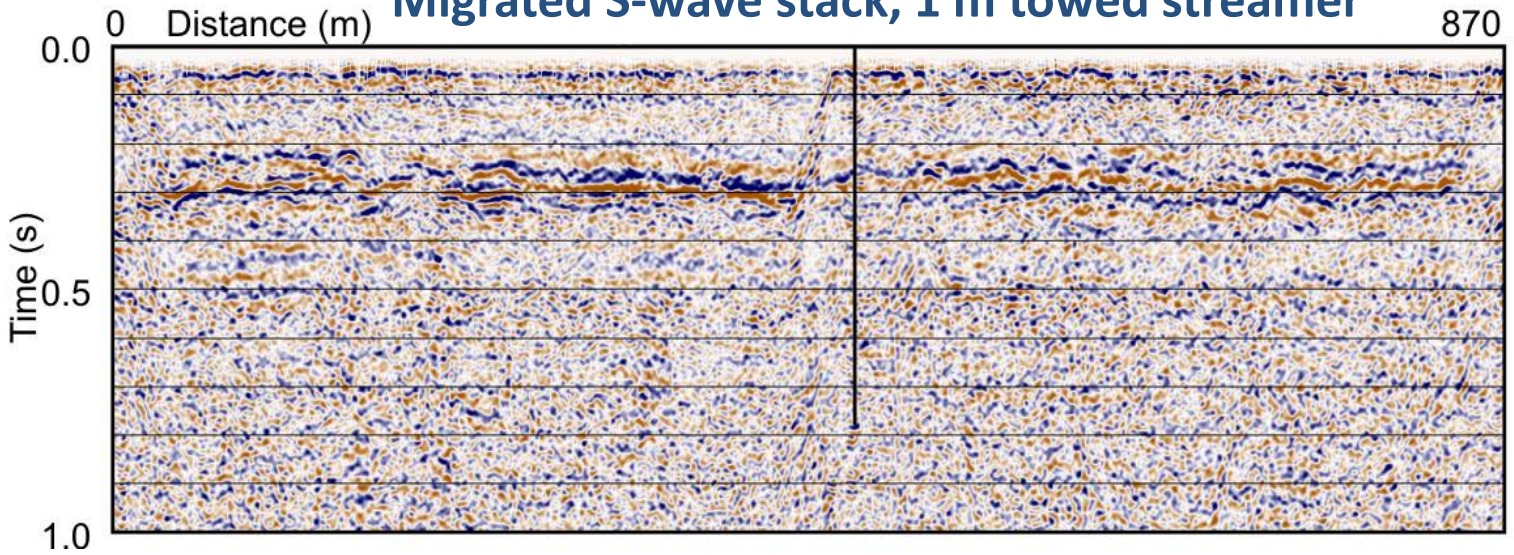


Migrated sections

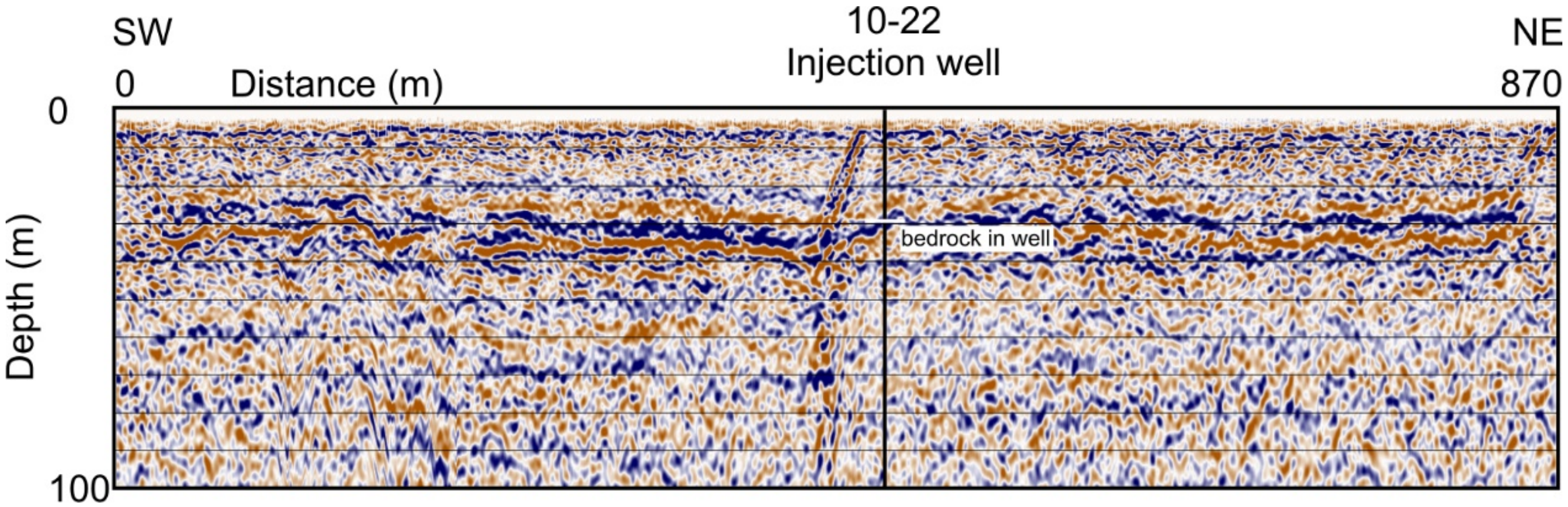
Migrated S-wave stack, 10 m fixed array



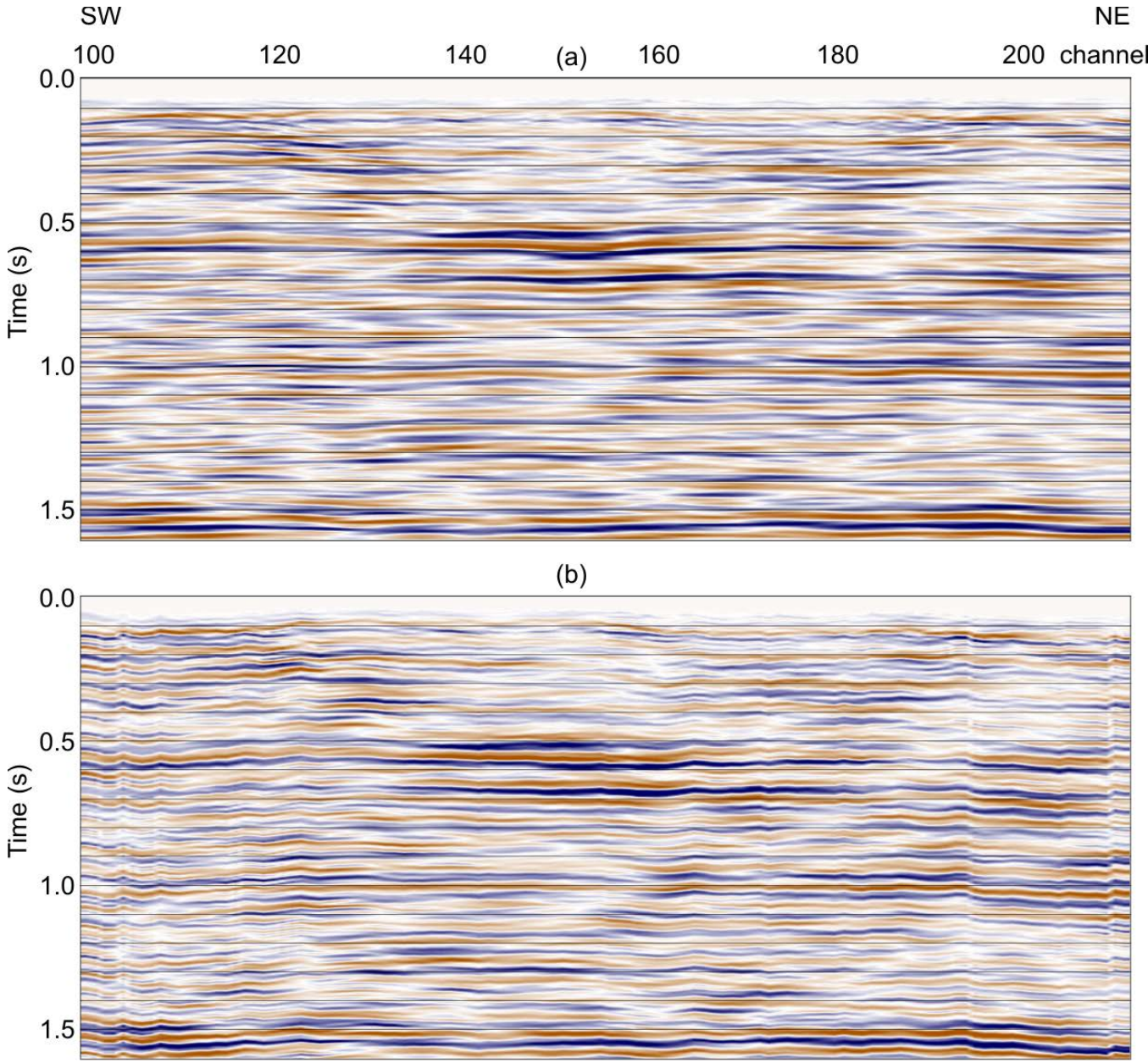
Migrated S-wave stack, 1 m towed streamer



Depth-converted S-wave migrated stack



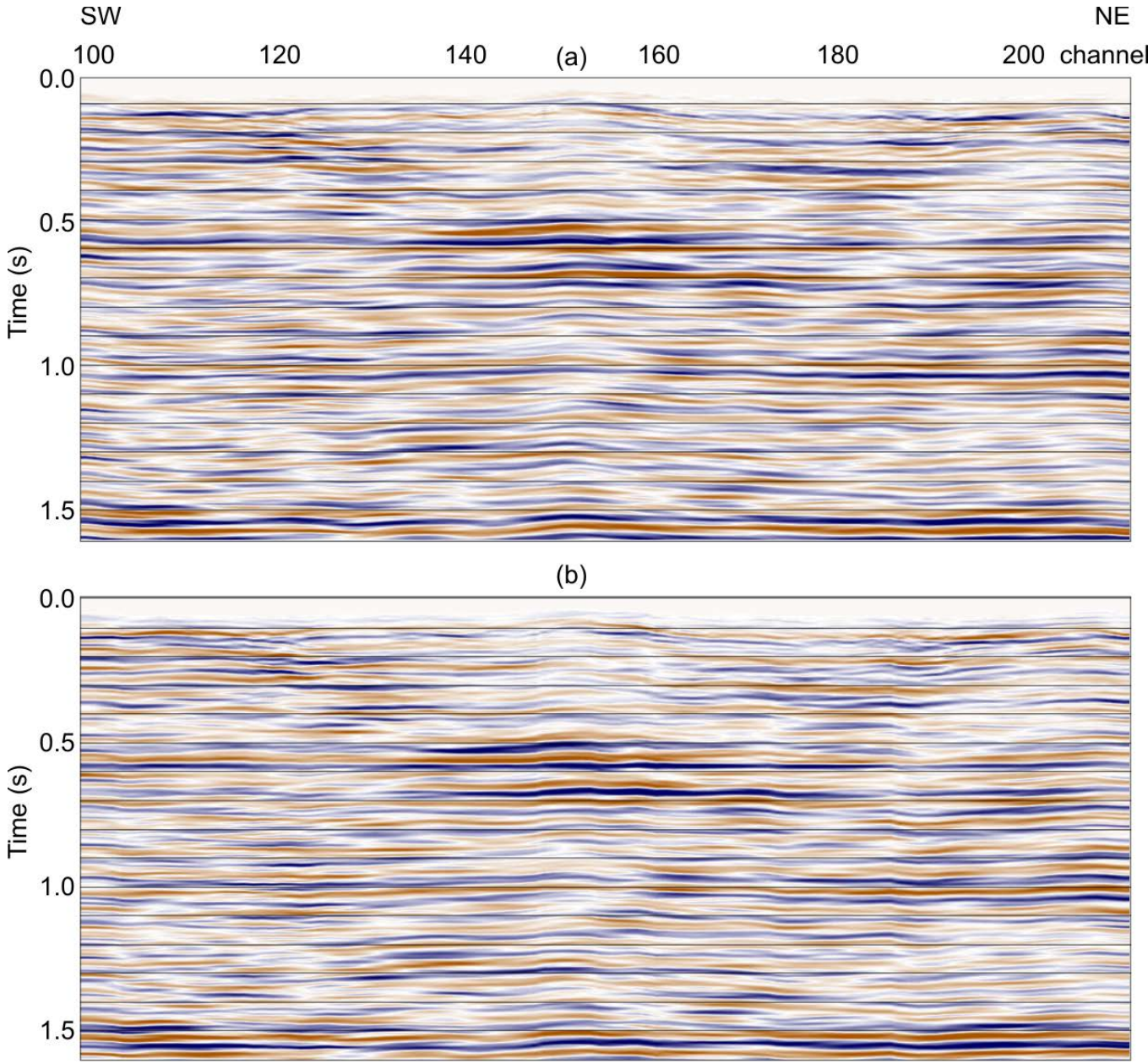
2017 P-S survey revisited; 10 m 3C geophones, 20 m source interval



Original receiver stack with elevation statics only

Receiver stack with elevation and 2018 receiver statics

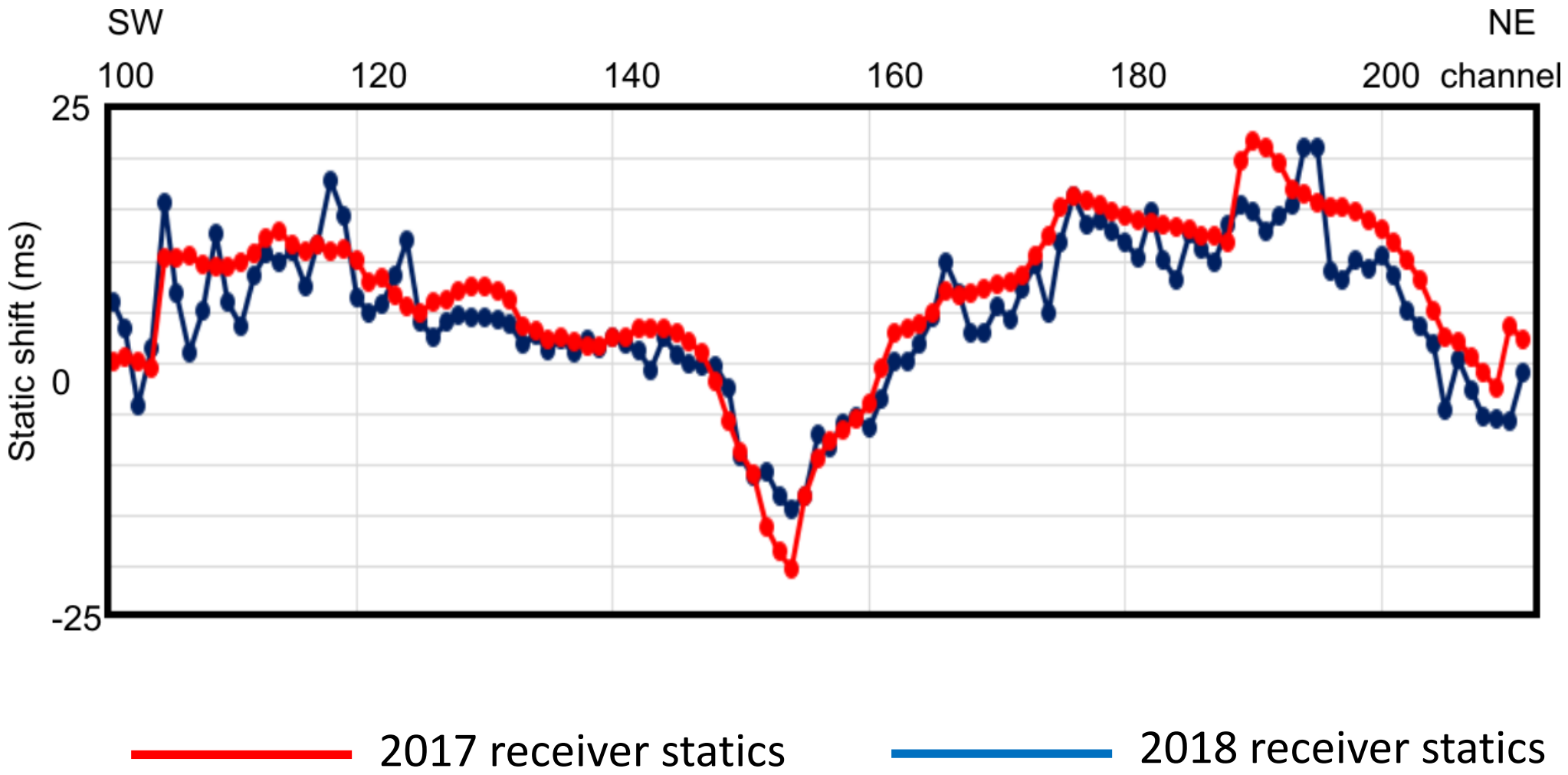
This is a new slide



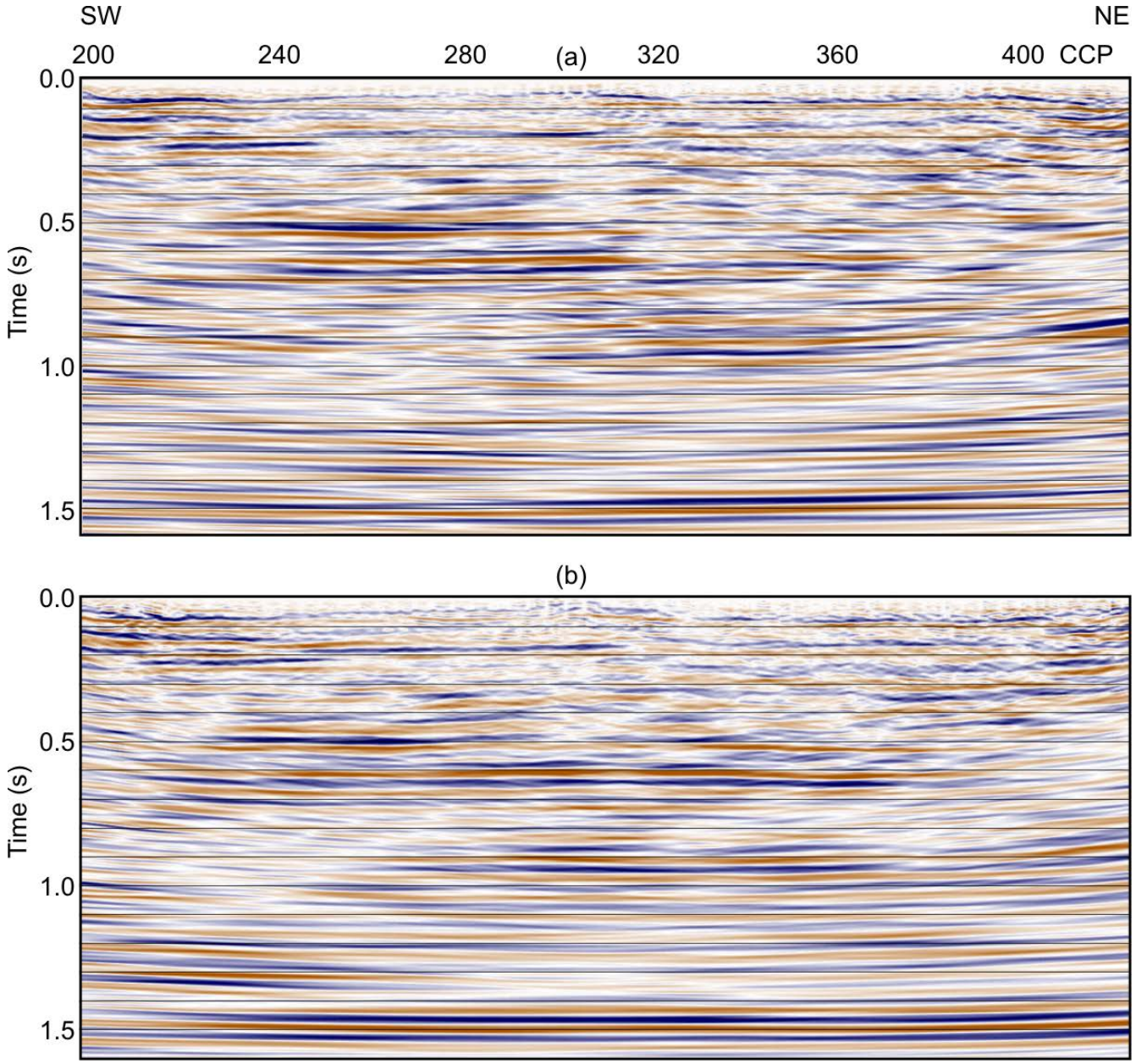
Original receiver stack with elevation statics only
flattened

Receiver stack with elevation and 2018 receiver statics
flattened

Final S-wave receiver statics



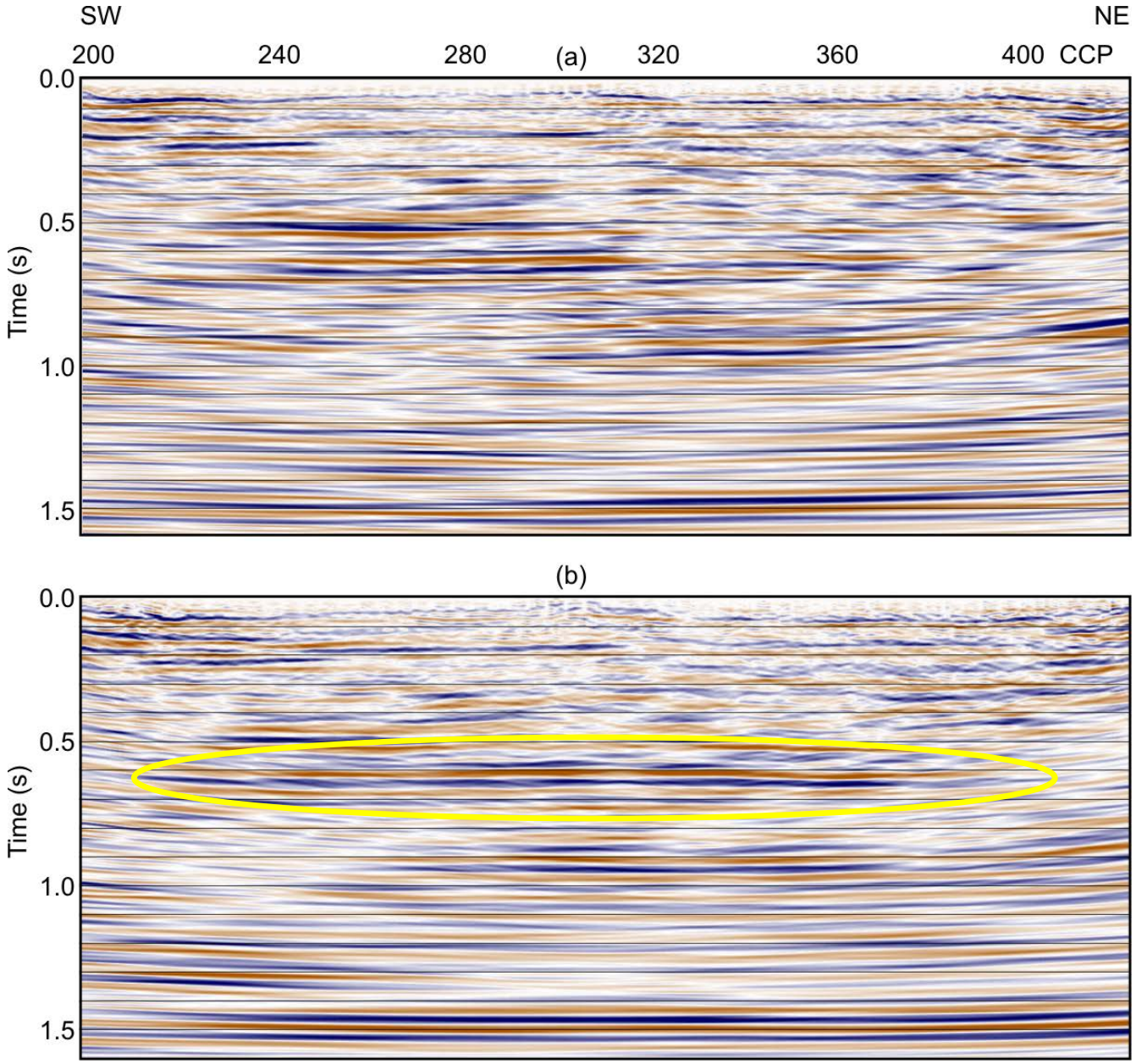
Migrated P-S sections



Original P-S migrated section, with elevation statics and flattened receiver stacks

New P-S migrated section with elevation statics, 2018 receiver statics and flattened receiver stacks

Migrated P-S sections



Original P-S migrated section, with elevation statics and flattened receiver stacks

New P-S migrated section with elevation statics, 2018 receiver statics and flattened receiver stacks

Summary

- S-wave Envirovibe into the fixed 10 m 3C geophone spread yielded good first breaks.
- S-wave refraction analysis yielded a 2-layer model with S-wave velocities averaging 220 – 280 m/s for the surface layer and 1045 – 1110 m/s for the bedrock at depths 25 – 35 m.
- Vp/Vs values were 3.1 to 3.2 in the surface layer, and 2.3 to 2.4 in the bedrock.
- Towed 3C streamer yielded a detailed image of the bedrock interface at depths consistent with the refraction interpretation.
- Improved P-S migrated section from the 2017 multicomponent survey

Acknowledgements

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- CREWES staff and students
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