Direct measurement of frequency-dependent phase velocities from Snowflake data

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Summary

- Analyzing the VSP datasets from the Newell County facility enhances the understanding of seismic data in the near-surface.

- Phase velocity estimates changes with the direction of wave propagation.

- Estimating the frequency-dependent phase velocities in the near-surface is integral to determining the Q-factor of seismic waves.

- These phase velocity estimates could be used as initial model for frequency-dependent velocity model.

Method

$$V_p(f) = \frac{L}{\Delta T(f)}$$

$$L = \sqrt{x^2 + z^2}$$

$$\Delta T(f) = T_M(f) - T_s(f)$$

FIG 1: Schematic diagram of the source and receivers locations.

FIG 2: Uncorrelated seismic traces
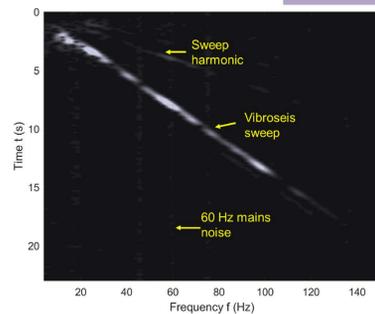

FIG 3: Source signal

Results

FIG 4: Gabor spectrum of a seismic trace
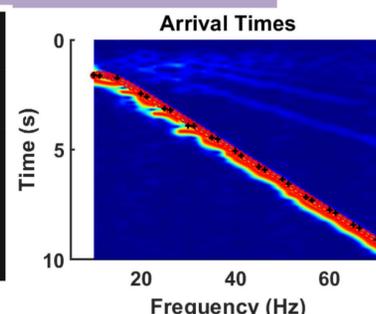

FIG 5: Picking of the arrival and departure times of the frequencies

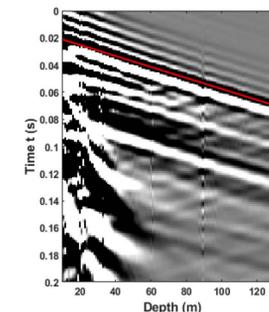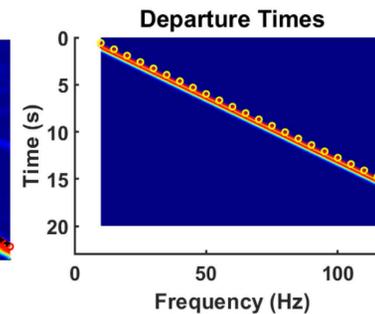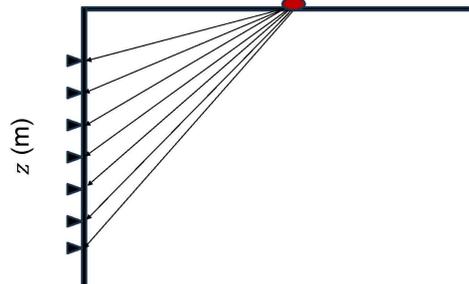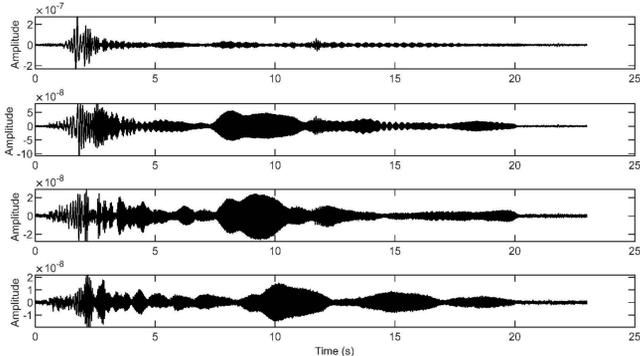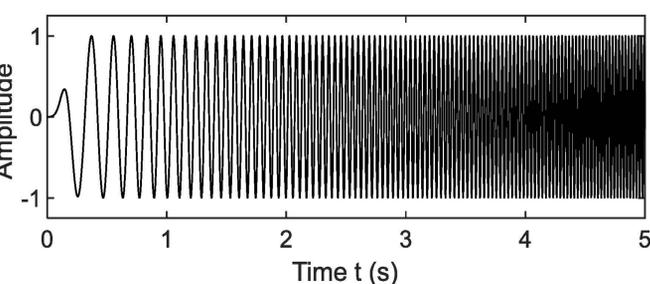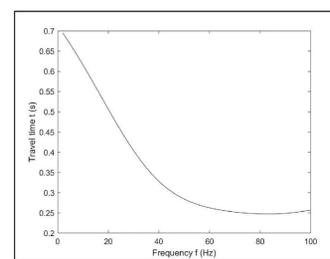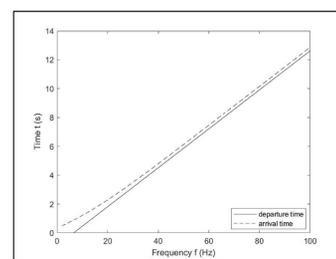FIG 8: Calculation of Tcal from the group velocity of the P-wave.

FIG 6: Travel time of the frequencies

$$V_{p(f)} = \frac{L}{T_{M(f)} - T_{s(f)} - T_{cal}}$$

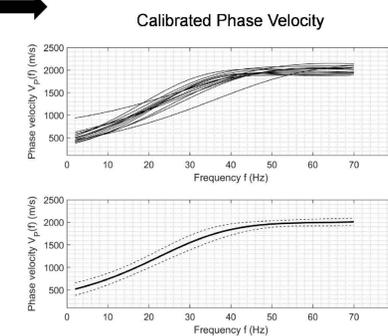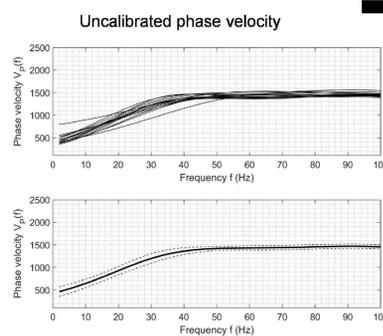Uncalibrated phase velocity → Calibrated Phase Velocity

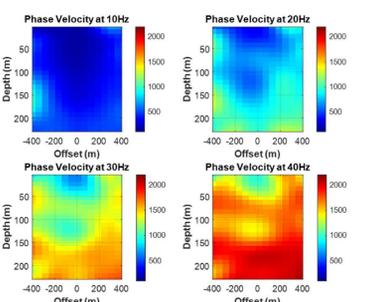FIG 7: Calibration of the raw phase velocities

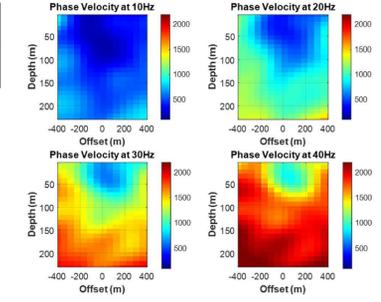FIG 9: Phase velocity maps at different frequencies along Line 1

FIG 10: Phase velocity maps at different frequencies along Line 5
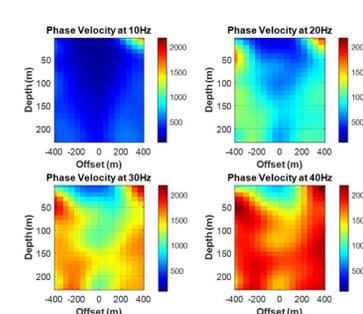

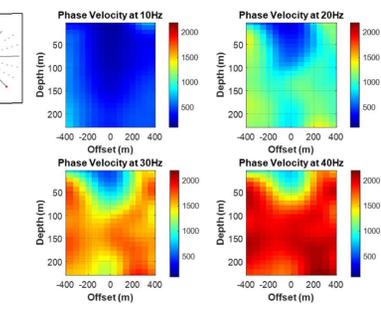FIG 11: Phase velocity maps at different frequencies along Line 10

FIG 12: Phase velocity maps at different frequencies along Line 12

Acknowledgements

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