

Supporting Information for

Fault Zone Imaging with Distributed Acoustic sensing: Body-to-Surface Wave Scattering

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Introduction

This file includes three figures and a table that supplement the main text. Figure S1 is a dispersion curve generated using a grid search of backprojected images computed at different velocities, the methodology of which is described in the main text, for the scattered wavefield of the earthquake shown in Figure 1. This figure served as partial verification that the scattered waves in this study are surface waves. Figure S2 is a dispersion curve generated using the same methodology as that of Figure S1, but using the sythetic wavefield shown in Figure 4. This figure helped us ensure there was a first order match between the synthetic wavefield and the observed wavefield. Figure S3 is a fit to the spatial decay of the ensemble of peaks associated with peaks α and β in the study. These fits use the relationship $Q_\mu = cV_s$ where we vary c . This plot was used in determining the attenuation relationship for the synthetics used in this study. Table S1 shows all the model parameters for the fault zone models used to make Figure 5. These models were important for evaluating the constraints and sensitivity of the model fits presented in this study.

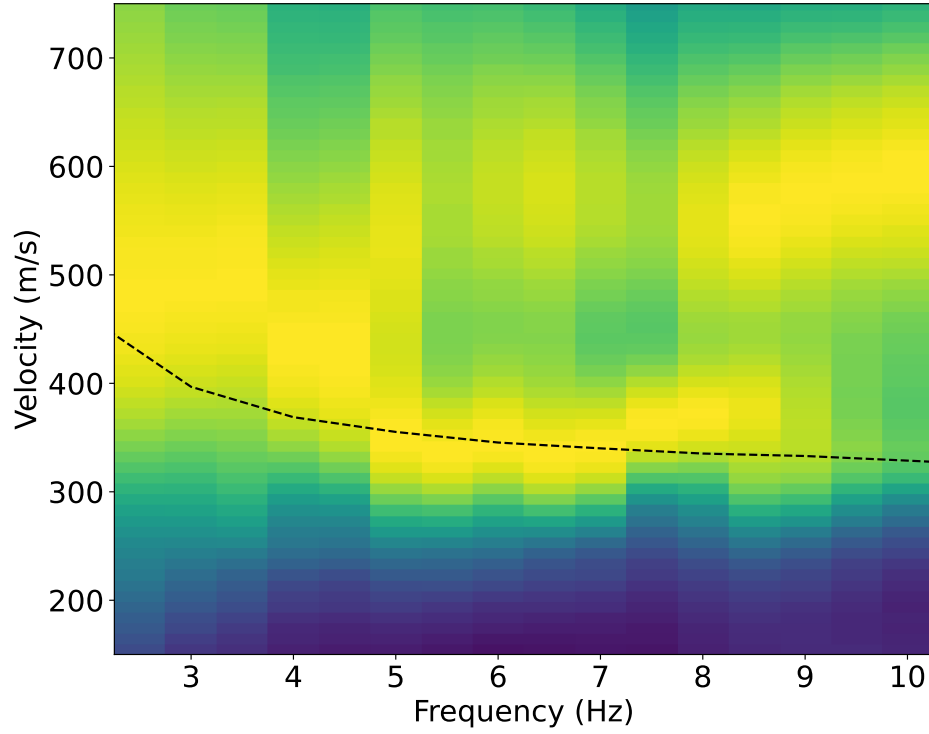
Figures

Figure S1. Dispersion curve generated using the backprojection framework to perform a grid search at velocities in narrow frequency bands on the earthquake wavefield shown in Figure 1. Black dotted line is the 1D average of the velocity model from Yang et al. (2022)

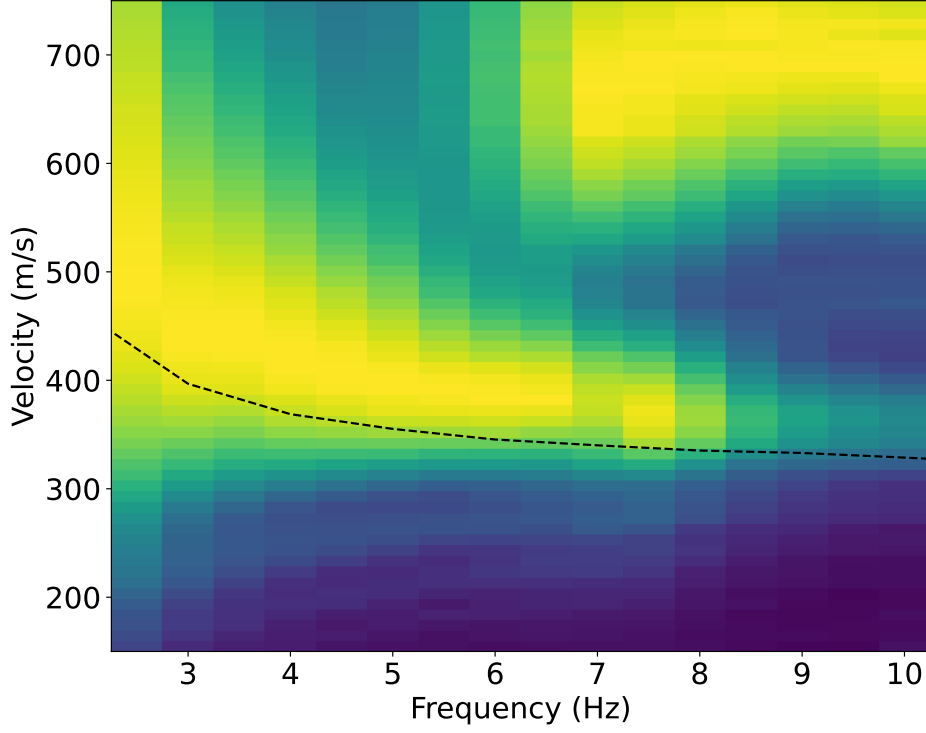


Figure S2. Dispersion curve generated using the backprojection framework to perform a grid search at velocities in narrow frequency bands on a synthetic shot gather with an emplaced fault model. Black dotted line is the 1D average of the velocity model from Yang et al. (2022)

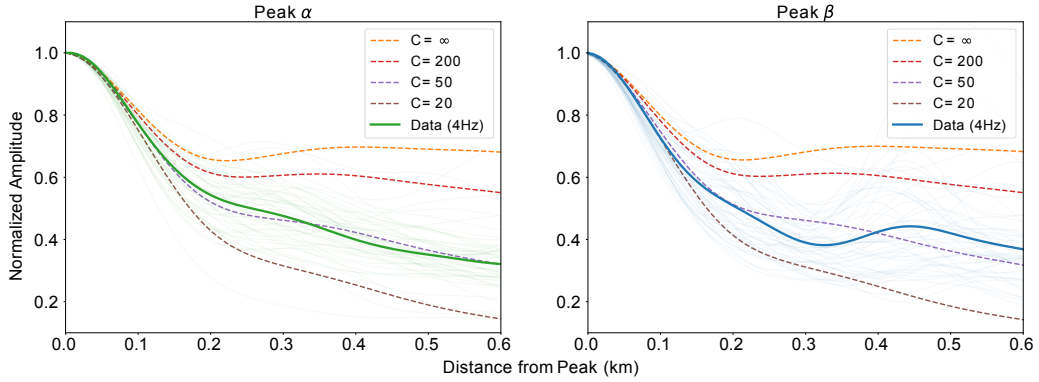


Figure S3. Peak decay functions of peaks α and β for ensemble of profiles shown in Figure 3. Light green and light blue lines are decay functions of individual profiles for peaks α and β , respectively. Dark green and dark blue lines are mean peak decay functions for peaks α and β , respectively. Dotted lines are peak decay functions for synthetics generated using different attenuation regimes defined using constant of proportionality c .

Tables

Model Parameters				
Model #	Burial Depth (m)	Maximum Depth (m)	Width (m)	Velocity Reduction (%)
Model 1	10	60	50	30
Model 2	10	30	20	30
Model 3	0	50	50	30
Model 4	0	100	50	10
Model α	10	60	20	30
Model β	0	50	50	10

Table S1. Model parameters for each of the models shown in Figure 5. Fault model is rectangular, where the burial depth is the depth of the top of the rectangle, the maximum depth is the depth of the bottom of the rectangle, the width is the lateral extent of the rectangle, and the velocity reduction is the applied velocity perturbation. All fault models are vertical.

References

- Yang, Y., Atterholt, J. W., Shen, Z., Muir, J. B., Williams, E. F., & Zhan, Z. (2022, January). Sub-Kilometer Correlation Between Near-Surface Structure and Ground Motion Measured With Distributed Acoustic Sensing. *Geophysical Research Letters*, 49(1). Retrieved 2022-01-11, from <https://onlinelibrary.wiley.com/doi/10.1029/2021GL096503> doi: 10.1029/2021GL096503