Supporting Information for

Moment Tensor Estimation of Event S1222a and Implications for Tectonics Near the Dichotomy Boundary in Southern Elysium Planitia, Mars

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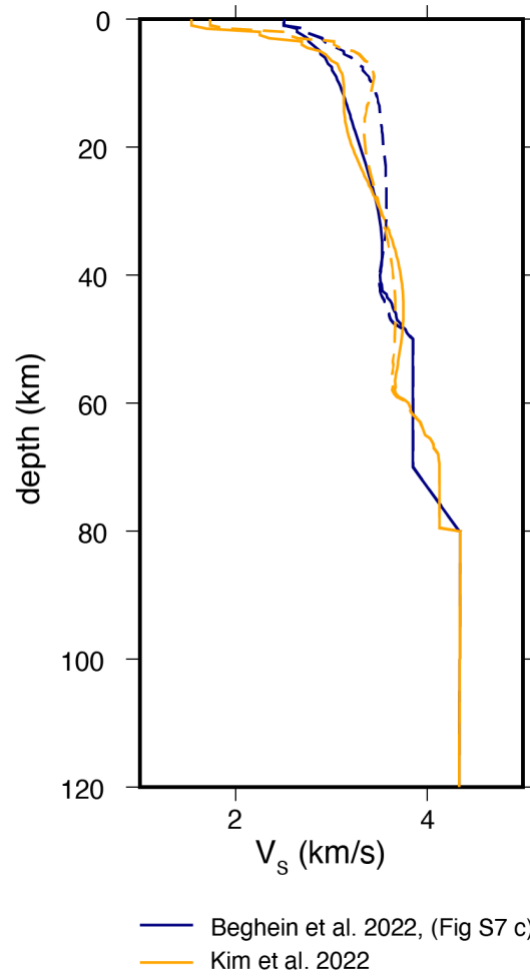## Contents of this file

Figures S1 to S6

Figure S1. Shear wave speed profiles used to calculate Green's functions, which are based off of studies by Beghein et al., (2022) and Kim et al., (2022b). Solid lines indicate V_{SV} and dashed lines indicate V_{SH}. The Mars model InSight_KKS21GP (Stähler et al., 2021) is used at depths of 80 km and below.
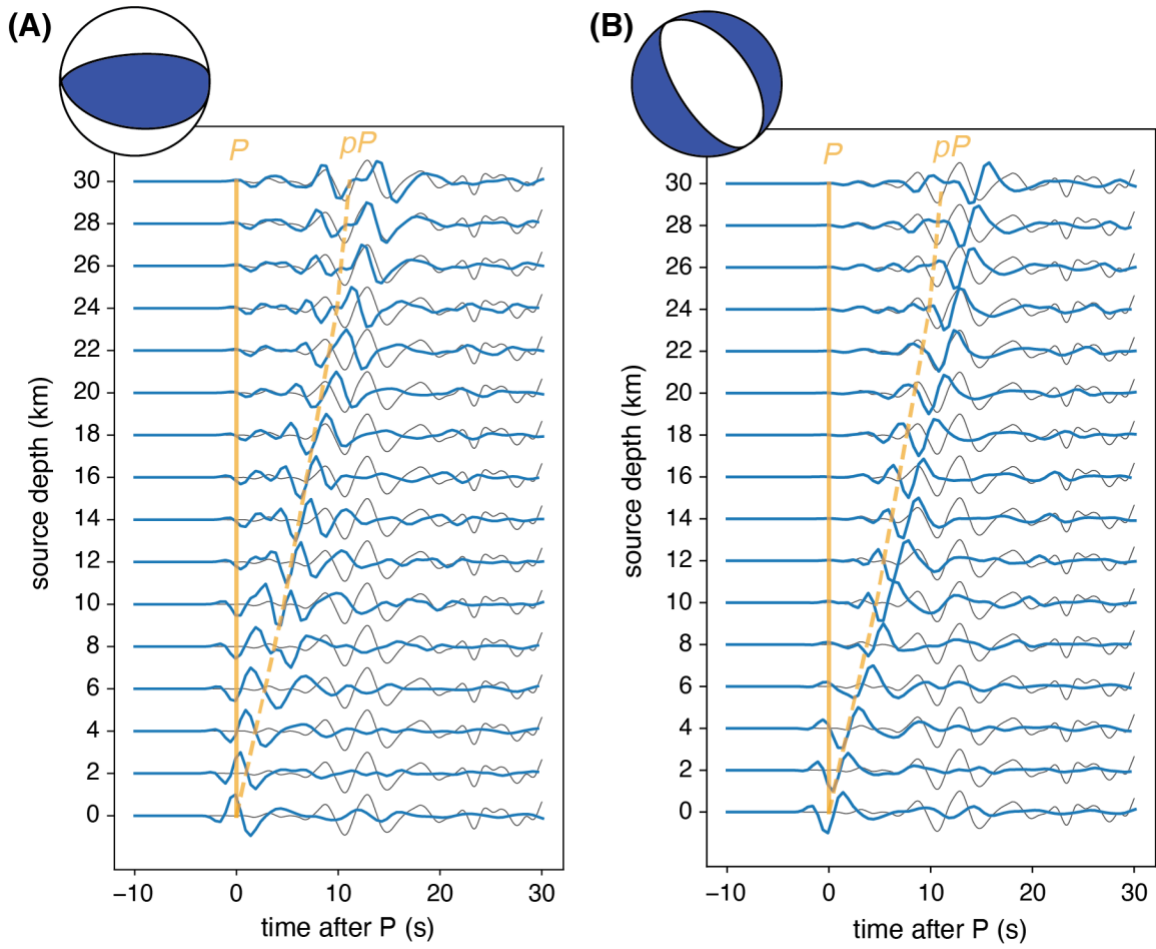
Figure S2. Vertical component synthetic P waveforms for two moment tensor solutions at source depths between 0 – 30 km. Predicted data are shown in blue and observed data are shown in black.

MW 4.40, Depth 0.0 km
strike, dip, rake: 266, 57, 83
body waves: 3.0 - 12.0 s, surface waves: 14.0 - 36.0 s

P_Z

Δ*t* = 5.50 s

P_R

Δ*t* = 5.50 s

S_R

Δ*t* = -2.75 s

S_T

Δ*t* = -4.70 s

$R1_Z$

Δ*t* = -0.90 s
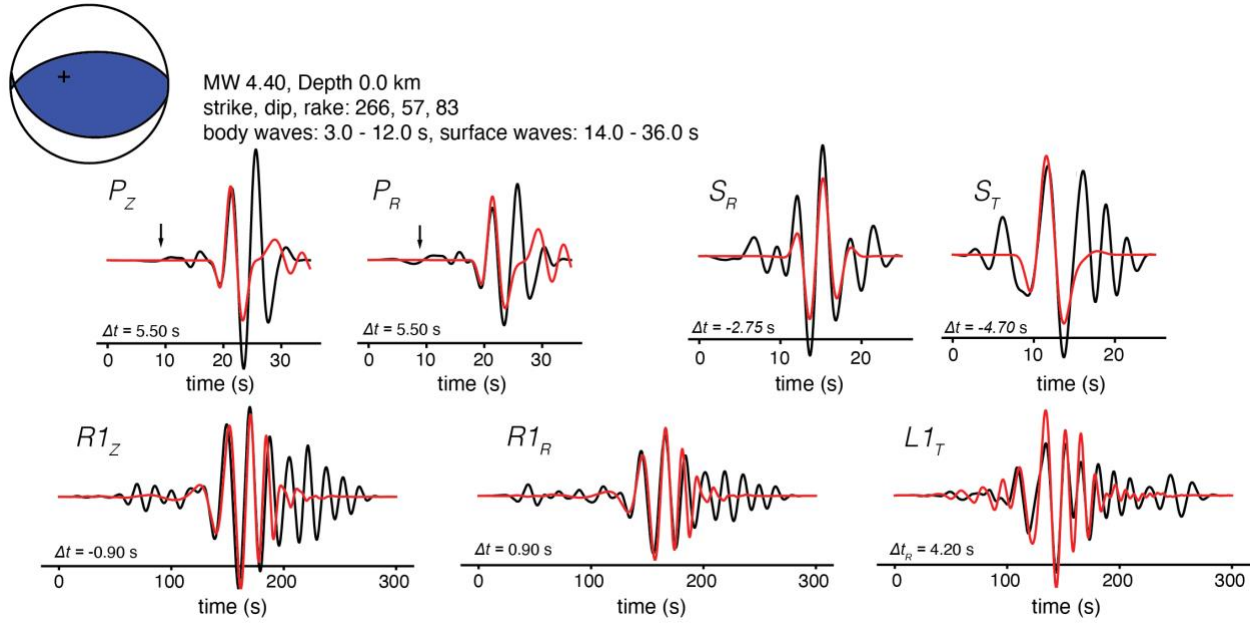
$R1_R$

Δ*t* = 0.90 s

$L1_T$

Δ*t_R* = 4.20 s

Figure S3. Waveform fits for an E-W striking thrust fault located at the surface. Observed data are shown in black and synthetic data are shown in red. The focal mechanism corresponds to the best-fitting moment tensor shown in Fig. 3B.
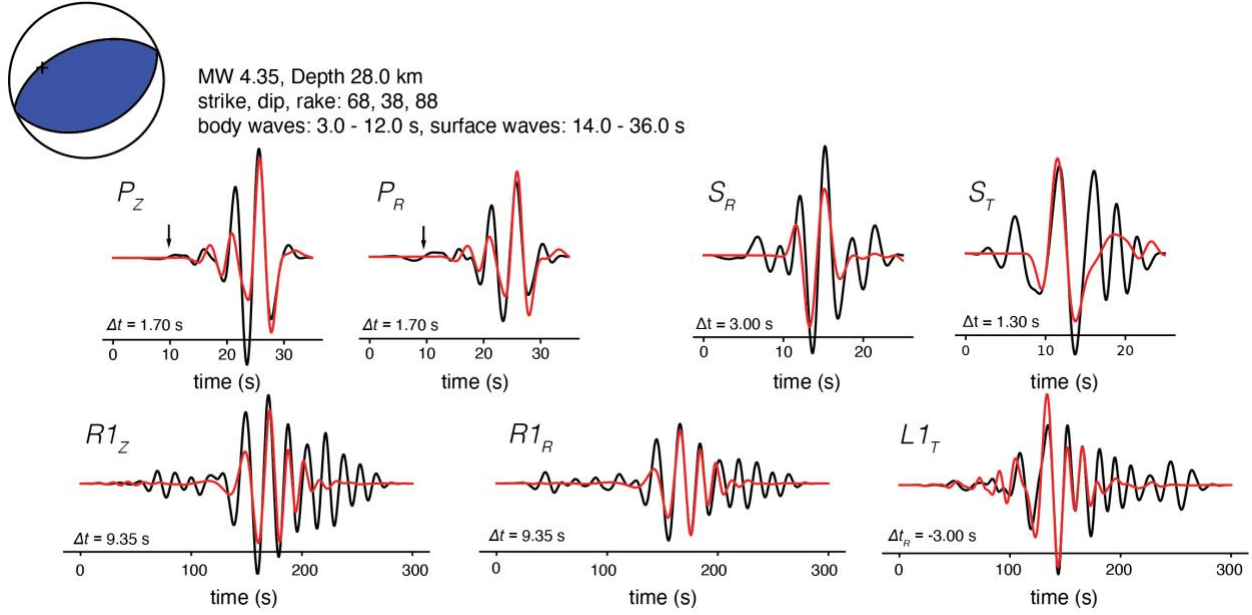
Figure S4. Best-fitting moment tensor and waveform fits for a source at 28 km depth using a heavily weighted early P-wave window. Observed data are shown in black and synthetic data are shown in red.
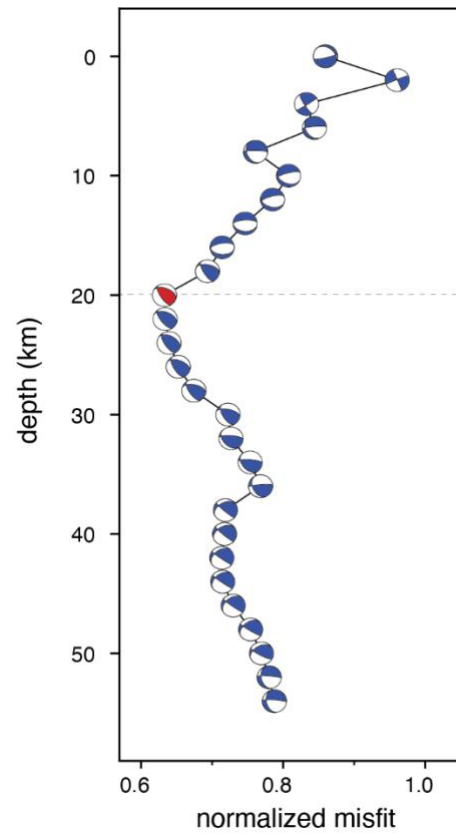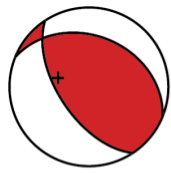
Figure S5. Inversion misfits using the model of Kim et al., (2022b). Best-fitting beachballs are shown for source depths ranging from 0 – 54 km. Waveform fits for the solution at 20 km depth are shown in Fig. S6.

MW 4.20, Depth 20.0 km
strike, dip, rake: 292, 36, 61
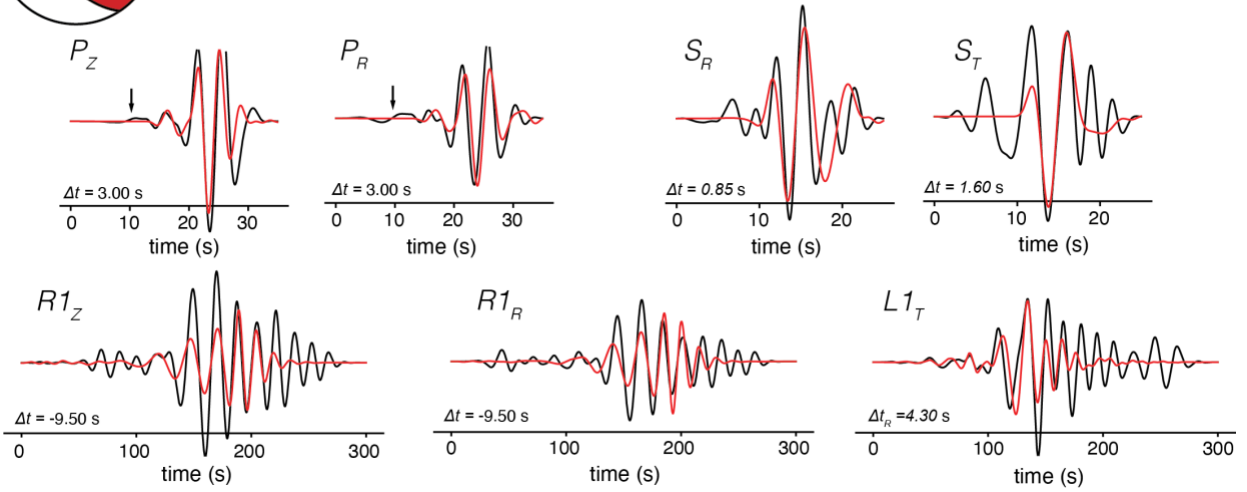body waves: 3.0 - 12.0 s, surface waves: 14.0 - 36.0 s

Figure S6. Waveform fits for the best-fitting moment tensor at 20 km depth, using the structural model of Kim et al., (2022b).