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Supplementary Materials for

Earthquake rupture below the brittle-ductile transition in continental lithospheric mantle

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- fig. S1. Temperature modeling for the Randolph, UT earthquake.
- fig. S2. Comparison of estimated *S* wave corner frequencies and the best-fitting source model obtained from the STF stretching approach.

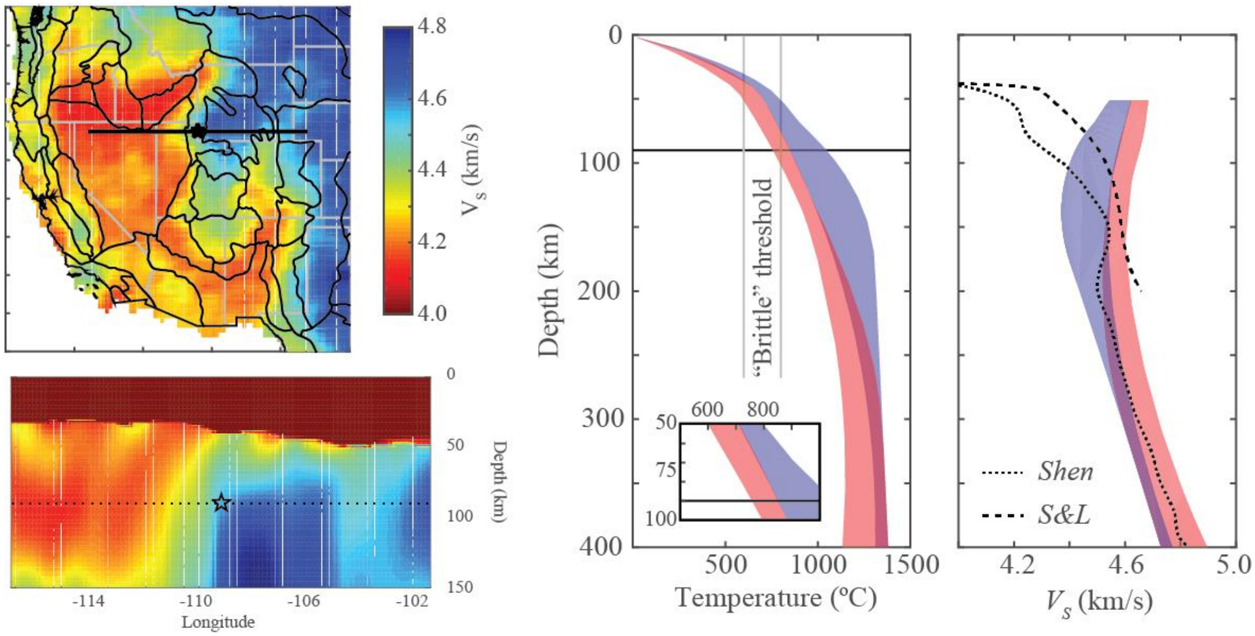

fig. S1. Temperature modeling for the Randolph, UT earthquake. (**A**) The V_S model from *Shen et al (24)* in the western US at 90 km depth and EW cross sections showing the location of the Randolph, UT earthquake (star) within the strong velocity gradient (**B**). Geothermal models (left, inset shows a zoom around the hypocenter) and predicted shear-wave velocities using the approach of *Faul and Jackson* (*23*) that best fit the V_S tomography models of *Schaeffer and Lebedev (25)* (blue area) and *Shen et al.(24)*, (red area) in the right panel. The geothermal models assume a crustal thickness of 45 km (50 km for the Wyoming earthquake) and produce surface heat flows between 40 and 60 mWm^{-2}. The range of temperatures at the hypocentral depth predicted is between 760-1000ºC, mostly above the brittle to ductile transition. Our modeling is not capable of reproducing the strong positive velocity gradient between 50-80 km depth, suggesting shear wave velocities are affected by factors other than temperature.

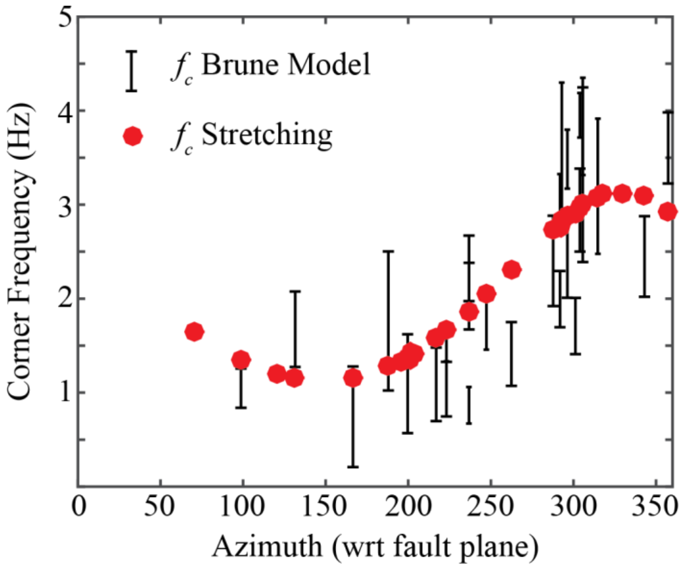

fig. S2. Comparison of estimated *S* wave corner frequencies and the best-fitting source model obtained from the STF stretching approach. We fit the spectral ratios obtained in the EGF analysis to obtain corner frequency and uncertainties corresponding to 5% decrease in variance reduction following (44), black lines. We then calculate the corner frequencies corresponding to the source durations of the best-fitting model of the STFs (V_R=1.3 km/s), red circles. The uncertainties in the corner frequency measurements reflect the limited bandwidth of the spectral ratios, and the underlying assumption of a simple circular rupture. Larger corner frequencies are observed around azimuth ~ 300, as predicted by the STF stretching model. The slow rupture velocity predicts well the azimuthal variations of corner frequency ranging between 1.5 and 2.5 Hz.