# Earthquake triggering and nucleation on an optimally oriented fault (Sumatra to Alaska)

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Seismic surface waves from large, distant earthquakes commonly trigger smaller earthquakes. However, delay times of hours to days between the surface waves and the triggered earthquakes weaken the causal connection. Furthermore, when there is no delay, the triggered earthquakes are typically too small or too obscured to obtain reliable source mechanisms. We present observations of instantaneous triggering of a strike-slip earthquake in central Alaska. Shear strain from the optimally-aligned teleseismic Love wave induced a 24 s exponential foreshock signal leading to the triggered earthquake. This nucleation phase, and the alignment of the triggered earthquake source mechanism with the teleseismic stress field, reveal the behavior of an existing fault under well-calibrated strain conditions. The Alaska earthquake provides the first observation of combined nucleation and triggering, and it suggests that transient stresses during nucleation may influence the subsequent earthquake rupture. Laboratory and theoretical studies of nucleation and triggering may help discriminate between different interpretations for the Alaska earthquake.

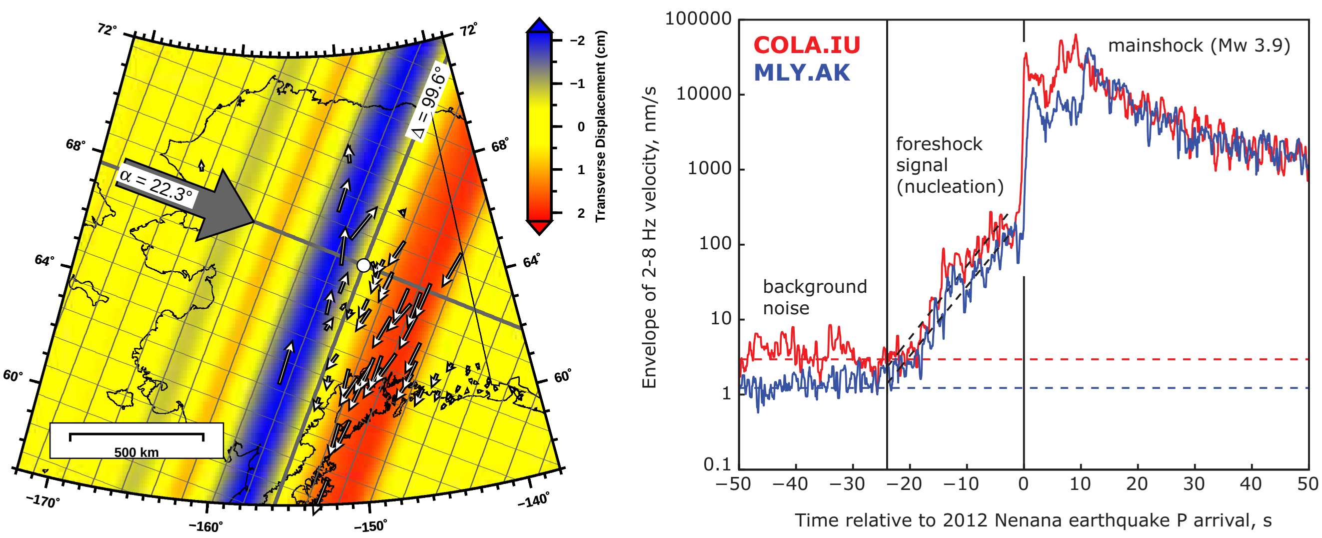


Figure 1: Nucleating and triggering a $M_\mathrm{w}$ 3.9 earthquake in central Alaska from Love waves of the April 11, 2012 $M_\mathrm{w}$ 8.6 Sumatra earthquake. (a) Horizontal displacement field in Alaska at the origin time of the $M_\mathrm{w}$ 3.9 Nenana earthquake in central Alaska. The epicenter of this event is marked by the white dot at the center of the thick gray lines. The large gray arrow denotes the wave propagation direction from Sumatra. The grid lines represent increments of 1° in $\alpha$ and 1° in $\Delta$ from the Nenana epicenter. (b) Envelope of velocity seismograms for two representative stations. The amplitudes are plotted on a log scale so that the noise level, foreshock signal, and mainshock are all visible. The linear slope of the foreshock signal represents an exponential growth in amplitude.