# Rupture initiation of deep-focus earthquakes

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As part of the deep-focus earthquake mechanism puzzle, the initiation mechanism, which needs to be spontaneous, is particularly important and enigmatic. Once rupture is initiated, various feedback mechanisms, such as shear heating/melting, can potentially be triggered and promote further slip. However, accurate characterization of the initiation phase is difficult due to the limited data resolution and complex high-frequency Green's functions. Here we develop a new method to jointly invert teleseismic and regional P waveforms for a Haskell-style model, assuming unilateral rupture with constant rupture speed. Small aftershocks' waveforms are used as Empirical Green's functions when available. We apply this method to large deep-focus earthquakes to zoom in on their first 2~3 seconds of rupture. We found that their initiation phases often show relatively high, sometimes supershear rupture speeds, depending the fracture modes. For example, the 2015 M7.9 Bonin Islands earthquake shows a supershear initiation, and the 1994 M8.2 Bolivia earthquake's initial rupture speed is also higher than its later stages. The observed high-speed initial ruptures may suggest a more efficient initiation mechanism than the later rupture propagation mechanism(s).

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