Source Parameter Variability of Intermediate-Depth Earthquakes in Japan Estimated from Empirical Green's Functions

*Shanna Chu[1], Gregory Beroza[1], William L Ellsworth[1]

1. Stanford University

The mechanism of intermediate-depth earthquakes occurring within subducting slabs remains controversial. Two proposed mechanisms for these earthquakes are dehydration embrittlement and thermal shear instability. By analyzing the stress drops and radiated energies determined from the recorded waveforms of these earthquakes, we can constrain the radiated efficiencies of the events and hence determine to what degree the mechanisms causing them are dissipative. We use the method of empirical Green’ s functions (eGfs) and spectral ratios to obtain stress drops for moderate to large (M4.0 and greater) intermediate-depth earthquakes since 2006 in the Kyushu and Hokkaido regions of Japan using data from the Hi-Net, F-Net, and Kiban seismic networks. With events at intermediate depth, the quality of small events usable as eGfs is a major limiting factor of the spectral ratio method. We examine the robustness of stress drop estimates determined from different source models, varying falloff rate and number of corner frequencies to better constrain the uncertainty in these estimates. We also look at the effects of near-source heterogeneities on the eGf waveforms, as in practice the data for intermediate-depth earthquakes often does not allow us to select smaller events within one source radius of the larger event. We are able to constrain the source parameters for the larger events, and can place bounds on them for the smaller events. The two loci of intermediate-depth earthquake activity differ in the character of the subducting plate, in that the Kyushu events occur in a plate that is younger and warmer. While we find generally larger stress drops and lower radiated efficiencies than shallow events in both regions, the difference is not as marked as has been found in previous studies of regions with anomalously high intermediate-depth activity, such as the Bucaramanga Nest in Colombia.

Keywords: intermediate-depth earthquakes, instraslab earthquakes, source parameters

