

Seismic full moment tensor analysis of nuclear explosions in North Korea

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We estimate seismic full moment tensors and their uncertainties for seven events at the North Korea nuclear test site, consisting of six declared nuclear tests and one event, interpreted as a cavity collapse, that occurred 8 minutes after the declared test. We also analyze two earthquake events that occurred to the south and were recorded by the same set of stations. We perform a grid search over the six-dimensional space of moment tensors, generating synthetic waveforms at each moment tensor grid point and then evaluating a misfit function between the observed and synthetic waveforms. For each moment tensor we characterize its uncertainty in terms of the variation in waveform misfit on the eigenvalue lune, a probability density function for moment tensor source type, and a confidence curve for the probability that the true moment tensor lies within the neighborhood of the best-fitting moment tensor. We find that the moment tensor source types are clearly separated for the six declared nuclear test events, the collapse event, and the two earthquakes. Moment tensors for the six explosion events can be represented as a sum of a double couple and a crack tensor whose plane is near horizontal.

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