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Characteristics of regional seismic waves from large explosive events including Korean nuclear explosions

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Three North Korean underground nuclear explosion (UNE) tests were conducted in 2006, 2009 and 2013. Discrimination of explosions from natural earthquakes is important in monitoring the seismic activity in the Korean Peninsula. The UNEs were well recorded by dense regional seismic networks in South Korea. The UNEs provide unique regional seismic waveforms with high signal-to-noise ratios. However, the continental crust in the Korean Peninsula changes abruptly into a transitional structure between continental and oceanic crusts across the eastern coast. The complex geological and tectonic structures around the Korean Peninsula cause significant variations in regional waveforms. Outstanding question is whether conventional discrimination techniques can be applicable for explosions including the North Korean UNEs. P/S amplitude ratios are widely used for seismic discrimination. To understand the regional shear-energy composition, we analyze the frequency contents of waveforms. The shear-energy contents for the UNEs are compared with those for natural earthquakes with comparable magnitudes. The result shows that the UNEs are successfully discriminated from earthquakes in the Korean Peninsula. We also analyze the explosive events from North Korean not UNEs to test the applicability of the discrimination technique. The result of high frequency Pn/Sn regional discrimination in the explosions show that as magnitude of event is smaller, available distance of discrimination is decreased particularly in high frequency range. The poor signal to noise ratio of Pn phase in the explosions, and inefficient propagation of Sn phase in the Western part of the peninsula frustrate Pn/Sn discriminant, while the UNEs show good performance using both discriminants because of propagation path effects in the eastern part of the peninsula.