

Source depth and characteristics of the DPRK's nuclear tests [2006, 2009, 2013, 2016J (01/06/2016), 2016S (09/09/2016) and 2017] using regional and teleseismic data

North Korea conducted underground nuclear explosions on October 9, 2006 (mb 4.3), May 25, 2009 (mb 4.7), February 12, 2013 (mb 5.1), January 6, 2016 (mb 5.1), September 9, 2016 (mb 5.3) and September 3, 2017 (mb 6.3). We estimated source depths at 2.12 km, 2.06 km, 2.05 km, 2.06 km, 2.05 km and 1.97 km respectively based on the azimuth averaged spectral minima using $pP+P/sP+P$ and $pPn + Pn/ sPn+Pn$ including spectral holes of the fundamental-mode Rayleigh wave amplitude spectra. It is also noticeable that the synthetic spectral nulls of P-wave spectra at the near-field and at the far-field including Rayleigh waves are in a good agreement with those of observations. We show particle motions of surface waves which represent the generations of Rayleigh and Love waves depending upon the different raypaths. The raypath through the subduction zone of the Pacific slab shows poor Love waves indicating that the low Q with high attenuation generates little Love waves in addition to the less trapped SH waves in the explosions. In particular, we should also note that the possibility of the over-burial detonation would affect magnitudes and seismic yields for North Korean underground nuclear tests.

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