Investigation of Source Characteristics of Subduction Zone in Chile Region

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1. Introduction
The September 16, 2015 Mw 8.3 earthquake occurred as the result of thrust faulting on the interface between the Nazca and South America plates in Central Chile and a number of seismic records were observed above the source region. Rupture process during the 2015 Illapel, Chile Earthquake were complicated, high-frequency radiation sources distributed at the deeper zone of the fault plane, large slip were located at shallow zone (Okuwaki et al. 2016; Melgar et al. 2016). In this study, we use spectral inversion methods and estimate Q value, source characteristics and site amplification characteristics. We investigate the relationship between seismic moment and the amplitude of the acceleration source spectral level (short-period level) , the stress drop and the focal depth.
2. Data and Methods
Observation datas were downloaded from CSN (Centro Sismológico Nacional; http://evtdb.csn.uchile.cl/). In addition to the main shock event, 31 plate boundary events near the source region and 386 observations of 27 sites were gathered. These data are records with Mw 5.0 to 7.0, distance 200km or less, PGA 200cm/s/s or less.
First, the Q value, the seismic source characteristics and the site amplification characteristics were evaluated from the observation records excluding the main shock using the spectrum inversion analysis. The constraint condition is equivalent to Kanaya et al. (2006). Based on the assumption that the seismic source spectrum of a small earthquake fit well to the ω-squared model, a reference earthquake was selected and a correction function to eliminate the trade-off between source characteristics and site amplification characteristics was evaluated. In addition, with reference to the velocity structure model used for the study of Okuwaki et al. (2016), the source spectrum was evaluated by setting the S wave velocity and density according to the focal depth of each earthquake. The seismic moment was fixed at the value of the Global CMT Project and only the corner frequency was searched. The target frequency of fitting was set to 0.2 to 5 Hz.
Next, the source spectrum of the main shock was evaluated using the estimated Qs-value and the site amplification characteristics. Because the seismic scale is large and the fault plane is wide, it is considered that the error increases by using a distance from the starting point of rupture. Therefore, two cases were examined, one using equivalent hypocentral distance Xeq calculated based on the inhomogeneity of the slip based on Okuwaki et al. (2016) and one using distance from the point where the short-period component was excited based on the fault model of Melgar et al. (2016) estimated from the analysis including the strong motion records.
3. Result
The estimated Q value was about $Q(f)=200^{0.8}$. There was almost no difference in the estimated source characteristics of mainshock from two distances. Calculating the short-period level from the estimated corner frequency and investigating the relationship with the seismic moment, the short-period level of the 2015 Illapel, Chile Earthquake is the average level of the Dan et al. (2001). In addition, stress drop of the main shock calculated by Brune (1970) was estimated to be 6.0 MPa and for other earthquakes it was estimated to be around 0.2 to 5.0 MPa. As a result of investigating the relationship between the stress drop and the focal depth, the dependence of the depth was slightly observed although the variation was large. Tomozawa et al. (2017) conducted a similar study in the Mexico region, and the depth dependence

of the stress drop was extracted as a common tendency in both regions.

Keywords: 2015 Illapel Chile earthquake, spectral inversion methods, acceleration source spectral level, stress drop , Q value

