Broadband Source Modeling for the Himalayan Collision Zone

*Hiroe Miyake[1], Babita Sharma[2], Kazuki Koketsu[1], Soma Nath Sapkota[3]

1. Earthquake Research Institute, University of Tokyo, 2. National Centre for Seismology, Ministry of Earth Sciences, India, 3. Department of Mine and Geology, Nepal

The Himalayan collision zone is characterized by the significant tectonic setting. There are earthquakes with low-angle thrust faulting as well as continental outerrise earthquakes. Recently several historical earthquakes have been identified by active fault surveys [e.g., Sapkota et al., 2013]. We here investigate source scaling for the Himalayan collision zone as a fundamental factor to construct source models toward seismic hazard assessment. As for the source scaling for collision zones, Yen and Ma [2011] reported the subduction-zone source scaling in Taiwan, and pointed out the non-self-similar scaling due to the finite crustal thickness. On the other hand, current global analyses of stress drop do not show abnormal values for the continental collision zones [e.g., Allmann and Shearer, 2009]. Based on the compiled profiling of finite thickness of the curst and dip angle variations, we discuss whether the bending exists for the Himalayan source scaling and implications on stress drop that will control strong ground motions. Due to quite low-angle dip faulting, recent earthquakes in the Himalayan collision zone fit the upper bound of the current source scaling of rupture area vs. seismic moment (< Mw 8.0), and do not show significant bending of the source scaling. Toward broadband source modeling for ground motion prediction, we perform empirical Green’ s function simulations for the 2009 Bhutan and 2015 Gorkha earthquake sequence to quantify both long- and short-period source spectral levels [e.g., Miyake et al., 2017; Sharma et al., 2018].

Recent Himalayan events showed the upper bound of the current source scaling of rupture area vs. seismic moment (< Mw 8.0), and current plots well match with Somerville et al. (1999) without bending. However, re-estimates of maximum fault width may change the source scaling. We also found that Himalayan events less than M6-class follow crustal earthquake scalings for short-period ground motion generation. If M7-class sources are modeled to follow crustal earthquake scalings, simulated ground motions tend to be larger than GMPEs on rock. Short-period ground motion saturation will be validated after broadband ground motion modeling for more events (e.g., Gorkha aftershocks).

Keywords: Himalayan collision zone, broadband source model, scaling, 2015 Gorkha earthquake