Characteristics of long-period motion in the Kathmandu Valley during the 2015 Gorkha Nepal earthquake sequence

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On 25 April 2015, a large M_W 7.8 earthquake occurred along the Himalayan front. The epicenter was near the Gorkha region, 80 km north-west of the Kathmandu Valley, and the rupture propagated eastward from the epicentral region passing through the Kathmandu Valley and reached Sindhupalchok region. The largest aftershock (M_W 7.3) occurred on 12 May 2015 at Sindhupalchok region, 74 km east of the Kathmandu. The Kathmandu Valley is formed by drying of a paleo-lake and consists of thick soft sediment below the center of city. Hence, the Kathmandu city has been damaged not only by near field earthquakes but also far field earthquakes in the past. As for the mainshock, there are 6 strong motion stations (one rock site and five sedimentary sites in the valley (Takai et al. 2016, Bhattarai et al. 2015, USGS 2015) that recorded the data. Long- period ground motions were recorded on sedimentary sites during the mainshock and aftershocks. We will examine the long-period (2-10 sec) motions in the Kathmandu Valley during the mainshock and aftershocks (M_W > 6).
Mainshock: The velocity waveforms observed at the rock site KTP show the typical velocity pulse ground motions (5 sec), and there are no clear later phase. The fault parallel component velocity waveform shows a double-sided pulse, while the fault normal and vertical components show a single-sided velocity pulse. The Kathmandu Valley is located at a very close distance (~10 km) to the rupture area and the estimated large slip areas exist near the valley (Galetzka et al. 2015). Therefore, the observed velocity pulses may be effected by this fault rapture process. The vertical component ground velocities at the sedimentary sites are nearly the same as that observed at the rock site KTP. On the contrary, the horizontal ground velocities at the sedimentary sites have a long duration with conspicuous long-period oscillations. We tried 1-D amplification simulation for sedimentary sites using with KTP record as input motion to examine the cause of this long period motion (Bijukchhen et al. 2016) and we could know the importance of examining the effect of 2,3-D valley basement structure.
Largest Aftershock: We could recognize peaks around 0.1 Hz in the Fourier velocity spectra for all stations. Therefor we applied low-pass filter (0.2 Hz) for the velocity waveforms and plotted particle motion. Including rock site KTP, we observed retrograde motion just after initial S-wave motion from these particle motion. These motions should have been controlled by propagation of Rayleigh wave; the Rayleigh waves were also observed in the other shallow aftershocks (Δ~80 km). We examined this phenomenon by the Discrete Wave Number method (Takeo, 1985) with 1-D velocity structure (Monsalve et al. 2006) and GCMT source mechanism. The simulated waveforms have good fitness with observed records and we could grasp the excitation of Rayleigh waves.
In this examination, we recognize the difference in excitation and propagation of long-period ground motions during the mains hock and aftershocks. We will study the excitation and propagation of surface wave in the Kathmandu basin in detail.

Keywords: The 2015 Gorkha Nepal earthquake sequence, Kathmandu Valley, Strong motion records, Long-period motion

