

Characteristics and origin of Observed Strong Ground Motion at Near Fault by the 3 November, 2002 Denali, Alaska Earthquake

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The earthquake that occurred at Denali fault system, Alaska, USA on 3 November, 2002 caused no significant damages whereas its moment magnitude was 7.9 (USGS). Strong motion records were obtained through the National Strong Motion Program (NSMP) operated by the United States Geological Survey (USGS). Alyeska Pipeline Service Company has also obtained accelerograms at their pump stations along the Trans Alaska Pipeline and distributed them through NSMP. PS10 station (pump station #10) is located at the distance 3km from the near-distant surface rupture. This observed record is very important to investigate near source strong motion from M8 class events.

The maximum horizontal acceleration was about 350 gal at PS10, whereas the maximum horizontal ground velocity was more than 100 cm/s. We draw the locus of horizontal ground motion by double integrating accelerograms and applying them the low-pass filter at 0.5 Hz. The locus showed two major phases. The first phase was the motion to east (almost fault parallel) and the second was the fault normal motion. The latter phase could be explained as the forward directivity effect. However the former phase did not coincide with the motion predicted from the radiation pattern of strike slip fault.

Kikuchi and Yamanaka (2002) inverted teleseismic body waves and concluded that the initial rupture was reverse slip that was different from the total moment tensor solution showing right lateral strike slip. At first we synthesized the theoretical ground motion from the point source located at the epicenter, which was determined by the Alaska Earthquake Information Center (AEIC). We assumed the one-dimensional stratified underground structure referring the result of refraction and wide-angle reflection survey by Beaudoin et al. (1992). After this calculation, we made sure that the synthetic waveform obtained from the focal mechanism with reverse slip determined by the first motion of P-wave or Kikuchi and Yamanaka (2002) could explain the beginning of the observed waveforms at each station.

Next, we started to see the whole rupture process of this event. We calculated the Green's functions using the discrete wave number method (Bouchon, 1981) together with the reflection transmission method (Kennett and Kerry, 1979). The strike and dip near the hypocenter were assumed referring the focal mechanism and the moment tensor solution by Kikuchi and Yamanaka (2002). The strike and dip along the part of main rupture were assumed from aftershock distributions and the centroid moment tensor solution by Harvard University. We determined the seismic moment of each point source by least squares method with non-negative constraint. The result showed that there was a subevent that released large seismic moment near the PS10 station, and that this subevent contributed major phase shown in the records at PS10. We could verify that the existence of the nearest subevent from the station was important for the ground motion of a near fault area by a large inland earthquake.

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