Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SSS027-P07 Room: Convention Hall Time: May 24 17:15-18:45

Tsunami Source of the 1960 Chilean Earthquake inferred from Tide Gauge Data

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We modeled the tsunami from the Chilean earthquake on May 22, 1960, Mw 9.5 (Kanamori, 1977, JGR), the greatest earthquake in the world history. Tsunami generated by this earthquake was recorded at many tide gauges located in and around the Pacific Ocean as reported by Berkman and Symons (1964, Coast and Geodetic Survey). Although the seismic moment of this event is still controversial, some source models were constructed by using the seismic or geodetic data. However, source model inferred from the tsunami data has not been reported. In this paper, we model the observed tsunami waveforms which we have digitized from the analog records at tide gauges, to estimate the tsunami source of this earthquake.
We first assume a single fault model with a uniform slip of 17 m (Barrientos and Ward, 1990, GJI). The size of the fault is 850 km x 130 km with the strike of N7E, dip of 20 deg, slip of 105 deg. The top depth of the fault is 4 km. Static deformation of seafloor is calculated for the rectangular fault model (Okada, 1985, BSSA) as an initial condition for the tsunami numerical computation. We adopted a constant rise time (or slip duration) of 3 min. In order to calculate tsunami propagation, the linear shallow-water, or long-wave, equations were numerically solved by using a finite-difference method (Satake, 1995, PAGEOPH). We used a 2 arc-minute grid resampled from GEBCO (British Oceanographic Data Centre, 1997, CD-ROM) for the bathymetry data.
The amplitudes of the synthetic waveforms generally agree with the observed ones, however, at some stations the observed phases of tsunamis are not well reproduced. Barrientos and Ward (199 0) also proposed the variable slip model which suggests that the slip on the fault is more complicated than the uniform slip model. In order to reveal the tsunami source, more detailed tsunami modeling with subfault model is required to estimate the slip distribution. In the presentation, we will discuss the source model by the tsunami waveforms inversion using the digitized tide gauge data.

Keywords: 1960 Chilean Earthquake, Tide Gauge Data, Tsunami Source, Tsunami Waveform Inversion