

Similarities and differences of the 1952 and 2003 Tokachi-oki earthquakes

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Along the Kuril Trench off the Pacific coast of Hokkaido, many destructive earthquakes have occurred. Among those, the 1952 Tokachi-oki earthquake (41.706°N, 144.151°E, depth: 52 km) and the 2003 Tokachi-oki earthquake (41.779°N, 144.079°E, depth: 45 km) were very close to each other and their magnitudes (M_{JMA} 8.2 and M_{JMA} 8.0) were also close to each other. Therefore, it is highly possible that these two earthquakes were characteristic plate-boundary earthquakes.

The source process of the 1952 earthquake was analyzed using strong-motion data (Yamanaka and Kikuchi, 2003) and tsunami data (Hirata *et al.*, 2003; Satake *et al.*, 2006). However, the slip distributions obtained by those studies were different from each other, because many strong-motion seismograms went off scale after the S-wave arrival so that sufficient data length was not available for the strong-motion data.

In this study, we performed joint inversions of teleseismic data which were recorded with enough lengths and strong-motion data to analyze the whole rupture process of the 1952 earthquake. We also analyzed the 2003 earthquake with the same methods to examine the differences and similarities of these two earthquakes.

For the dataset of the 1952 earthquake, we collected the copies of seismograms which were recorded by historical seismographs, and digitized them. For the dataset of the 2003 earthquake, we used teleseismic data from IRIS-DMC and strong-motion data from K-NET. When we selected the stations, we took care to include the stations which are identical to, or nearby, those of the 1952 earthquake.

We first compared the datasets of the two earthquakes. The results revealed that the 1952 earthquake was composed of two large events and the data from the first event look similar to the ones of the 2003 earthquake. In addition, the initial parts of data suggest that the 1952 earthquake was preceded by a small event.

Secondly, we performed joint inversions of the teleseismic and strong-motion data. The results showed that the 1952 earthquake was composed of two large events as shown in the above comparison. The rupture first propagated to the western part and then to the eastern part. The moment rate function of the western event was similar to the one of the 2003 earthquake and their rupture areas almost overlapped with each other.

In summary, the western event of the 1952 earthquake and the 2003 earthquake are characteristic great earthquakes, but the eastern event and the small event are specific only to the 1952 earthquake.

Keywords: source process, inversion, the 1952 Tokachi-oki earthquake, the 2003 Tokachi-oki earthquake, characteristic earthquake