

The great 1933 Sanriku-oki outer-rise earthquake: Relocated aftershocks, recent seismicity and fault scarp morphology

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The 1933 Sanriku-oki earthquake is the largest earthquake that occurred outer trench-slope region of the northern Honshu, Japan. Recent observations and analyses on earthquakes, such as 2006 and 2007 Kuril earthquakes, 2004 Sumatra earthquake suggest the interactions between outer-rise and interplate thrust earthquakes. Thus it is important to examine the mechanisms of the aftershocks of the 1933 earthquake that encompass a wide area including the inner trench region according to the JMA location. In this study, we examined the data quality of the 1933 earthquake based on smoked paper records and relocated the earthquakes by using phase data from regional stations and modern relocation methods. Relocations by the double-difference method show about 170 km long aftershock area under the outer trench slope that is separated from the seismicity under the inner trench slope. The earthquakes under the inner trench slope were located where recent activity of interplate thrust earthquakes is high. Separation of aftershock activity between outer trench-slope and inner trench slope was also confirmed by an examination of recent earthquakes that are accurately located based on OBS data at the study area. Earthquakes under the inner trench slope immediately after the 1933 Sanriku-oki earthquake are consistent with earthquake location discrimination based on waveforms and S-P time data (Umino et al. 2007). These two regions of seismicity suggest stress triggering of interplate earthquakes by the deformation from the 1933 outer-rise earthquake. We also relocated pre March 11th, 2011 seismicity near the trench region. The result show the present seismicity at the outer trench-slope region of northern Honshu can be divided into several groups of earthquakes along the trench; one group roughly corresponds to the aftershock region of the 1933 earthquake. Comparison of the 1933 rupture dimension based on our relocations with the morphologies of fault scarps in the outer trench slope suggest that the rupture was limited by the region where fault scarps are trench parallel and cross cutting seafloor spreading fabric.

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