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A plate interface geometry off the southeastern coast of Hokkaido and its relation to source areas of large earthquake

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In the region off southeastern coast of Hokkaido, Japan, several large interplate earthquakes with magnitudes of 8 have occurred repeatedly due to a subduction of the Pacific Plate. The source regions of the earthquakes are spatially divided into several segments. Revealing a crustal structure in the region is essential to understand the distributions of source region. Seismic experiments using an airgun array and fifty-nine ocean bottom seismometers (OBSs) were performed along 4 profiles in 2006 and 2007. The profiles are located to cross the source regions of the earthquakes and an afterslip area following the earthquake. In this study we investigate relations between the source regions of large interplate earthquakes and an upper surface geometry of the subducting Pacific Plate. Combined the result from the wide angle seismic data with the previous seismic studies, we constructed a precise geometry of an upper surface of subducting Pacific plate in and around the source regions of large interplate earthquake. The depth of the plate interface geometry is not uniform along the trenches. A structure of the island arc crust and the plate interface geometry indicate a folded structure related to the arc-arc collisional tectonics of the Hokkaido region due to oblique subduction of Pacific plate. We found regions with high concentrated stresses on a fault based on the geometry of the plate interface. The areas are comparable with the source regions of the 1952 and the 2003 Tokachi-oki earthquake and the region where large slip was estimated during the 1952 Tokachi-oki earthquake from tsunami waveform inversion. In contrast to the stress concentrated regions, we found a region where the stresses are less concentrated. The afterslip of the 2003 Tokachi-oki earthquakes is distributed to the region. Therefore we suggest that the geometry of the subducting Pacific plate is strongly related to the distributions of source areas in the southernmost Kuril Trench. Due to the difference of the stress acting on the plate boundary, a wide variety of ruptures can occur for M 8 class earthquakes.

Keywords: subduction zone, megathrust earthquake, crustal structure, Kuril Trench, Japan Trench, arc-arc collision