Abstract

The 2011 March 11 Tohoku-Oki earthquake with moment magnitude of 9.0 east of Honshu, Japan, has been the fourth strongest event in the era of instrumental seismology. This thesis is focussed on a detailed analysis of earthquake distribution in time and space in the broader area of Honshu during the time interval of fifty years (1964 – 2013), and on correlation of seismological data with tectonic structure and surface morphology, including the sea floor.

The aim of the thesis is not to predict the earthquake retroactively but to put its occurrence into the context of the long-term development of seismicity, to identity differences in the seismic response to the process of plate tectonics prior, during and after the Tohoku-Oki earthquake and to delimitate the tectonic causes of areal limitation of the extent of the aftershock series.

The space-time analysis of the development of earthquake occurrence utilized relocated hypocentral parameters primarily identified by the International Seismological Centre (so called EHB data), focal mechanisms of the Global Centroid Moment Tensor Solution programme, surface morphology and bathymetry data, and eruptive history database of active volcanoes. A series of epicentral maps and vertical sections of focal zones were construced for the analysis of seismic activity in space and time.

No significant changes of the seismic regime of the affected area preceded the Tohoku-Oki earthquake. Significant elongated aseismic zones perpendicular to the plate boundary appear in the Wadati-Benioff zone prior the Tohoku-Oki earthquake, the position of which have correlates with the southern and northern limits of the aftershock zone. These aseismic zones probably correspond to structures that make the subducting plate segmented. The south-eastern limit of the aftershock epicentral zone correlates with the Kashima chain of seamounts. Subducting part of this structure probably stopped the propagation of the rupture of the Tohoku-Oki earthquake further to south. Significant is also the absence of intermediate-depth earthquakes in the WBZ of the Pacific plate beneath the fault/aftershock zone of the Tohoku-Oki earthquake. This observation suggests that the subduction of the Pacific plate was decelerated during the last fifty years beneath the segment of the Tohoku-Oki earthquake.