グローバルＣＯＥ地球惑星科学

特別講義

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日　時　：　2011 年 10 月 24 日(月)　10:00 – 12:00

場　所　：　地震・噴火予知研究観測センター　別館　第一会議室

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Bridging the gap between science and practice in seismology –Lessons from the 2011 Tohoku-oki earthquake-

講義内容：

The 2011 Tohoku-oki earthquake (Mw=9.0) caught most seismologists by surprise mainly because no great earthquake was known to have occurred in the region for several hundred years. Also, occurrence of great earthquakes is considered less likely here where an old plate is subducting. The 1933 Sanriku earthquake (Mw=8.4 to 8.6), the largest outer-rise earthquake ever recorded, is considered a manifestation of weak plate coupling. This concept led to the idea that the Sanriku is a transitional zone from Kuril (strong coupling) in the north to the Bonin-Marianas to the south (weak coupling), and is characterized by a patchy distribution of asperities. Corollary to this are relatively large aseismic slip, tsunami earthquake, repeating earthquakes, and infrequent great earthquakes in the region. Recent GPS studies indicated, however, strongly coupled zones, suggesting the potential for large mega-thrust earthquakes. However, it was inevitably difficult to constrain the EW-wise locations of the strongly coupled zones with the land-based GPS network. Also, studies of historical and old earthquakes suggest evidence of large earthquakes in the offshore region of Tohoku and elsewhere with a similar geophysical environment (e.g. Sumatra). While seismologists were pondering on the implications of all these findings, the 2011 Tohoku-oki earthquake occurred with the devastating consequence. With the extensive networks of seismographs, GPS, tsunami gauges, and other ocean-bottom instruments, scientific results came out very quickly. In less than 30 min after the occurrence, it became clear that the event was a mega-thrust with Mw~9 located close to the Japan trench. This information alone was good enough to recognize that this was an extraordinary event with extremely grave tsunami hazard that would require immediate action to minimize its impact. Within a few weeks, the overall character of the event became clear. The most unusual was a large slip, over 30m, in a zone, 100x50km^2, very close to the trench. The slip in this zone is relatively slow without strong excitation of short-period seismic waves, a characteristic of tsunami earthquakes. In contrast, strong short-period radiation occurred from a down-dip portion of the mega-thrust. Tomographic studies using the data both before and after the 2011 earthquake indicate a high-velocity structure which coincides approximately with the zone of large slip near the trench. In retrospect, we believe that our understanding of the overall geophysical framework of the region is correct, and the seismological research in this region has been in the right direction, but the inevitable lack of information on the details of plate boundary structure near the trench prevented us from recognizing the severity of the threat. The efforts to utilize the research products in practice need to be significantly enhanced to protect our society from this type of rare and devastating event. Seismology has made a good progress in determining what has happened very rapidly, and can provide a good geophysical framework. Thus, an effective approach to hazard mitigation is to take advantage of these strengths of seismology. Unfortunately, seismology cannot make precise predictions of what will happen on short time scales, at least at present.

主　催　：　東北大学　グローバルCOEプログラム
『変動地球惑星学の統合教育研究拠点』
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