Introduction to the special section for the 2007 Noto Hanto earthquake

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(Received September 8, 2008; Revised September 29, 2008; Accepted October 1, 2008; Online published November 7, 2008)

A large shallow earthquake occurred in the Noto Peninsula on March 25, 2007. The Japan Meteorological Agency (JMA) estimated the hypocenter and origin time to be 136.685E, 37.220N and 09:41:57.9 JST, respectively, and the depth to be 11 km. The magnitude of the main shock is M_j (JMA scale) 6.9 and M_w 6.6, and the focal mechanism of the main shock is a reverse fault with right-lateral components. The strike, dip and rake are 58°, 66° and 132°, respectively, according to the National Research Institute for Earth Science and Disaster Prevention (NIED). The two largest aftershocks of M_j 5.4 occurred at the northeast and southwest edges of the aftershock area, at 18:11 on May 25 and at 07:16 on May 26, respectively. A maximum seismic intensity, 6 upper on the JMA scale, was observed at several stations situated in the source area. The earthquake caused severe damage on the Noto Peninsula and in the surrounding prefectures of Ishikawa, Toyama, Niigata and Fukui. The final report of the Fire and Disaster Management Agency reported one human fatality, 356 people injured and 29,349 houses completely and partially collapsed.

Although several moderate-sized earthquakes had occurred in the northeast and southern parts of Noto Peninsula prior to this event, there is no record of large earthquakes with $M > 7$ occurring in this area during the last 1500 years. In addition, events of M 6.0 $\sim$ 6.5 have never occurred in the source region of the March 25, 2007 earthquake, and even the seismic activity of small and micro-earthquakes has been very low for more than 25 years, based on the high-gain seismic-observations by the Kamitakara Observatory, Kyoto University (Ito *et al.*, 2007). Large active faults have not been identified on land in the source area. Nevertheless, some offshore faults in west off Noto Peninsula have nearly the same strike as that of the aftershock area, which may be related to the March 25, 2007 earthquake. Well-arranged high-density nation-wide networks have been constructed, and these provided abundant data for the sequence of the earthquake. In particular, strong-motion and high-gain earthquake records as well as the GPS data provided fundamental information on the earthquake sequence and related phenomena from immediately after the main shock. In addition, temporary dense seismic stations were deployed for aftershock observations with online and offline seismographs, including ocean bottom seismographs. Temporary GPS stations were also installed to detect after slips. Magnetoterullic and gravimetric observations as well as seismic surveys were also carried out with the aim of obtaining a better understanding of the structures in the source area. The data have been analyzed extensively, and interesting results have been presented in a number of papers of this session.

Since the 2000 Western Tottori earthquake of M_j 7.3, detailed surveys by dense observation stations have been conducted for moderate and large earthquakes. The results of some of these surveys can be found in various special sections of *Earth, Planets and Space*, including the 2000 Western Tottori earthquake (vol. 54, no. 8; Umeda, 2002), the M 7.1 and M 6.4 earthquakes in northwestern Japan (vol. 55, no. 12 and vol. 56, no. 2; Hasegawa, 2004), the 2004 Mid-Niigata earthquake (vol. 57, no. 5 and vol. 57, no. 6; Hirata, 2005) and the 2005 West Off Fukuoka Prefecture earthquake (vol. 58, no. 1; Shimizu, 2006). These special sections provide useful information that is valuable for improving our deep understanding of the inland earthquakes and facilitating the identification of the characteristics that these inland earthquakes have in common, as well as those that differ.

Fourteen papers appeared in the special section of *Earth, Planets and Space* dedicated to the 2007 Noto Hanto earthquake (vol. 60, no. 2, 2008). Now, 12 additional papers are being published in the special section (2) of this issue. The following paragraphs provide a short description of the papers appearing in this issue.

A highly resolved hypocenter distribution of aftershocks was obtained from the dense network data of earthquakes. The source process of the main shock was studied from strong motion records relating to the aftershock distribution; these records have enabled the study to be more precise than has ever been possible. A source model was also derived from a comparison of the crustal deformation data of GPS associated with the earthquake with the results from the inSAR technique, which has been developed in recent years and its use stepped up by the launch of the Advanced Land Observation Satellite (ALOS) in 2006. Many fissures and ruptures, but no earthquake surface faults, were found on land. Previously described geodetic surveys, however, revealed surface displacements of 20–50 cm. The displacements are in very good agreement with those derived from coastal ground level changes by a sessile organism. The maximum tsunami height was about 20 cm, but unusual oscillations of the tidal records on Toyama Bay were reported in relation to the change in sea level of Toyama Bay, suggesting the occurrence of submarine land slide on the steep sea floor on the western side of Toyama Bay.

A three-dimensional seismic wave velocity-structure in the source area was estimated from the dense network data. Gravity survey data were also used to derive the structure in the hypocenter area and its surroundings. Magnetoterullic surveys were also carried out onshore across and along the aftershock area, yielding structures of the resistivity in the upper and middle crust. These detailed structures were discussed with reference to the heterogeneous rupture process estimated from seismograms independently.

Reports relating to earthquake prediction or precursory phenomena are not presented in this section, with the exception of a new method for detecting changes in crustal structure by stacking ground noises. The JMA was testing an early warning system for earthquakes at the time of the March 25, 2007 earthquake. It was partly successful, but some problems remain. The March 25, 2007 earthquake provided information that is proving useful for improving the system. A new method was presented for onsite early warning, which is particularly relevant for inland earthquakes.

The March 25, 2007 earthquake occurred in a low probability area of the national seismic hazard map, similar to that of the 2005 West Off Fukuoka Prefecture earthquake. The map was created mainly on the basis of the large active faults, which have caused earthquakes with $M > 7$. Therefore, determining the relation between a large earthquake and the moderate ones is of great importance. Data collected on the March 25, 2007 earthquake may be useful in attacking the problem.

We hope that the studies reported in the special section will contribute to our acquisition of a clear image of the March 25, 2007 earthquake and to a deep understanding of the mechanism of onshore earthquakes.

Acknowledgments. We express our sincere gratitude to an anonymous referee, S. Ohmi and T. Iidaka for improving the manuscript. We also thank the editors of *Earth, Planets and Space* for editing the special sections.

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