Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS30-01 Room:302 Time:May 24 15:30-15:45

Precursory migration of anomalous seismic activity prior to the 2011 Tohoku, Japan, earthquake

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For revealing the precursory process of the 2011 Tohoku, Japan, earthquake and its related statistical feature, we applied a modified version of the Pattern Informatics method (PI method) (Wu et al., 2011) to the earthquake data east of the northeastern Japan region including the hypocenter of the 2011 Tohoku earthquake. We especially focused on the spatial distribution of PI hotspots, which show the areas of anomalous seismic activities (seismic quiescence and seismic activation), and its migration pattern. By means of the modified PI method, we found that the area with anomalous seismic activities got closer to the epicenter of the 2011 Tohoku earthquake with time since 1997 prior to the occurrence. A similar tendency was also found since 2001 in the area off the Boso peninsula, where the existence of seismic quiescence is reported. Our result shows that the preparatory process of the 2011 Tohoku earthquake involved anomalous seismic activity that took effect since 1997 and implies that the same process is in progress in the area off the Boso peninsula since 2001.

Keywords: Pattern Informatics method, Seismic quiescence, Seismic activation, Seismic activity, Earthquake migration, The 2011 Tohoku earthquake

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SSS30-02 Room:302 Time:May 24 15:45-16:00

Triggering sequence of seismicity over Japanese Islands by dynamic stress changes from the 2011 Tohoku-Oki earthquake

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Early post-seismic events triggered by the 2011 Tohoku-Oki earthquake systematically propagated over Japan in a southwestern direction, associated with the strong seismic waves from the source. The propagation front was consistent with the arrivals of large amplitude surface waves traveling at 3.1 to 3.3 km/s and extending to a distance of 1,350 km. There were no observations of triggered earthquakes in the northern direction. Dynamic stress changes toward the north were comparable to or smaller than those necessary for triggering in the southwestern direction. Static stress changes were one to two orders smaller than dynamic stress changes at remote distance, indicating that static stress was not the main mechanism of the triggering. The value necessary for the dynamic triggering is more than about 500 kPa in stress or about 10^{-6} in strain. The early post-seismicity has a different spatial pattern compared to the later post-seismicity that occurred across Japan over the next days to weeks. Also the detection of seismic events triggered by the first arriving P-wave is examined by using a spectral method. P-wave triggering was found in the regions, where non-volcanic tremor was been observed triggered, and some seismic and volcanic regions. The triggering strain due to P-waves is on the order of 10^{-8} to 10^{-7}, which is 1 to 2 orders of magnitude smaller than the triggering strain necessary for the surface wave triggering.

Keywords: 2011 Tohoku-Oki earthquake, Dynamic triggering

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Tidal triggering of earthquakes in Iwo-jima island

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Tidal triggering of earthquakes clearly appears in Iwo-jima volcanic island, 1250 km south of Tokyo. This tidal earthquake occurs only in the northern area of the island although the seismicities in the northern and southern are the similar for the 7-year record. In the statistical analysis, the maximum of the number of low- and high-frequency earthquakes per an hour in the northern area coincides with the minimum of sea level and probably with the maximum of the volume strain, respectively. We speculate that the low- and high-frequency earthquakes triggered by the ocean and solid-earth tides is caused not by the tidal stress but by the cavitation of groundwater containing gas at the fault and the stress drop due to the groundwater intrusion into the fault, respectively

Keywords: Seismicity, Triggering, Tide

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SSS30-04 Room:302 Time:May 24 16:15-16:30

Detailed analysis of hypocenters and mechanisms of the M5.4 Eastern Yamanashi Prefecture earthquake on 28 January, 2012

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An M5.4 earthquake occurred in the eastern part of Yamanashi Prefecture, central Japan, at 7:43 on January 28, 2012. Intense aftershock activity followed the main shock. The main shock was located beneath Tanzawa Mountains where the Izu Bonin arc that belongs to the Philippine Sea plate (PHP) has been colliding into Honshu island. The ordinary seismicity around the focal area is particularly high. In order to elucidate the tectonic meaning of the activity, we precisely determined hypocenters and focal mechanisms of the pre- and aftershocks as well as the main shock.

We used data from the permanent online stations operated by the Hot Springs Research Institute of Kanagawa Prefecture, National Research Institute for Earth Science and Disaster Prevention Hi-net, the Japan Meteorological Agency, Tokyo University and MeSO-net. We located the hypocenters based on the double-difference relocation method (Waldhauser and Ellsworth, 2000). We determined the focal mechanism using the absolute P- and SH-wave amplitudes besides the P-wave polarities.

The aftershocks near the main shock are distributed along a plane inclining to the southeastward with a high dip angle. The focal mechanism of the main shock is a reverse fault type with the P-axis oriented to the NW-SE direction. One of the nodal planes of the main shock is coincident with the trend of the southeastward dipping plane where the aftershocks are distributed. This result suggests that the nodal plane dipping to the SE direction corresponds to the fault plane of the main shock. On the other hand, the largest aftershock occurred at a site about 5 km to the north from the main shock hypocenter, making two distinctive earthquake clusters in the main shock - aftershock sequence. The aftershocks near the largest aftershock are distributed on a plane with a strike of the EW direction. The focal mechanism of the largest aftershock contains some of a normal fault component.

The main shock occurred within the cluster of the western side in the ordinary seismic activity under Tanzawa Mountains (Yoshida, 1990; Yukutake et al., 2012), and the hypocenter was located beneath the upper boundary of the PHP estimated by Tsumura et al. (1993). The geometry of the main shock fault inferred from the aftershock distribution is not consistent with the configuration of the upper boundary of the PHP. These results indicate that the main shock occurred within the PHP, not on the plate boundary. The difference of the focal mechanisms found between the main shock and the largest aftershock suggests heterogeneity of the stress field within the PHP in the region.

Keywords: Tanzawa Mountains, Tectonics, Izu collision zone

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Source process of an east-Mino earthquake (12/14/2011; M5.6) in Gifu prefecture, Japan

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An east-Mino earthquake (12/14/2011; M5.6) occurred in the Philippine Sea slab (PHS) beneath the Mizunami city, Gifu prefecture, Japan. The Tono Research Institute of Earthquake Science (TRIES) has deployed about 60 seismic stations above the hypocenter of the earthquake. We relocated hypocenters of the earthquake and 14 aftershocks, and estimated focal mechanisms by the TRIES seismic network and the High Sensitivity Seismograph Network Japan (Hi-net).

The east-Mino earthquake occurred at 49 km depth which appears to be about 9km beneath the upper surface of the PHS. Aftershocks occurred along an east-dip rupture plane of the mainshock. Focal mechanisms featured normal faults as a fault's type with the T-axis to the E-W (margin-parallel) direction and the P-axis to the slab-normal direction. Upper surface of the PHS seems to be convex downward in this region. These features suggest that compression to the slab normal direction and extension to the margin-parallel direction are dominant in the PHS. The PHS seems to contact with a mantle wedge in this region. Cause of the vertical compression in the PHS has remained controversial.

Keywords: the Philippine Sea plate, slab earthquake, focal mechanism, hypocenter distribution, fault plane, stress field