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

SSS36-P01 Room:Convention Hall Time:May 21 18:00-19:00

Active fault earthquakes triggered by mega thrust earthquakes on plate boundaries

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Crustal movement and seismic waves caused by the 2011 off the Pacific Coast of Tohoku Earthquake (Tohoku Earthquake) effects on the generation the inland active fault earthquakes. For example, earthquakes on Nagano-Niigata prefecture boundary (M6.7), eastern Shizuoka (M6.4) and Fukushima Hamadori (M7.0) are triggered earthquakes of Tohoku Earthquake. Fukushima Hamadori Earthquake impacted on active fault study by the reason of not only the appearance of significant surface faults with displacement up to 2.1 m, but also the reactivation of the normal faults under the E-W compressional stress field. HERP reported that the Tohoku Earthquake increased the probabilities of earthquake occurrence on some active faults, such as Gofukuji, Tachikawa and Miura Peninsula faults. It is important to realize the relation between mega-thrust earthquakes on plate-boundary and intra-plate active fault earthquakes. Triggered earthquakes by Tohoku Earthquake and other plate-boundary earthquakes in Japan and other region are also discussed.

Keywords: active fault, triggered earthquake, plate boundary earthquake

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Estimation of ground movement by the 2011 Earthquake in Hamadori, Fukushima Prefecture on April 11, from the Geomorphic

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In the previous work, authors developed the new method to estimate the ground deformation of 1m order quantitatively and easily used high resolution periodical DEM, applied the technique of the image matching analysis - Patent No.4545219. And we showed the result of measurement of displacement of the mass movement due to the earthquake with high accuracy by using this technique. In the present study, we applied the same technique to the area where the surface rupture appeared due to 2011 Earthquake in Hamadori Fukushima Prefecture on April 11, and tried the extraction of wide area ground deformation. The topographical data used in this research is two times of 2mDEM by the airborne laser survey immediately after the disaster in 2006 and 2007, and April 26 in 2011. The slope angle map where the angle of gradient in the grid point had been shown by gray- scale was used for the digital geomorphological image used for the image matching analysis. The software improved to use MPIV described with MATLAB for three dimensional analyses was used for the image matching. When 2mDEM is used, the displacement magnitude that can be extracted by the digital geomorphological image matching is about the 1/10 grid size or more.

As a result of the investigation, tendency to the relative subsidence on the west side area of Idozawa Fault was found in the entire region, and the surface earthquake fault was found along the West segment of Idozawa Fault. In northern part of study area, some surface earthquake fault has corresponding possibility to the boundary of the moving mass movement. The horizontal displacement near the surface earthquake fault is small in the central part of the West segment of Idozawa Fault. Moreover, in the mid zone of the west segment and the east segment of Idozawa fault, the direction and the magnitude of surface displacement is different in each small area, and southward transitional displacement and right-lateral movement stepped over the fault was found. In the previous study, there is no evidence of clear surface rupture in the mid zone of two segments. However it is possible that the sites where the small ground surface displacement was found by existing investigations are corresponding to the places where the direction and the magnitude of displacement of the ground change suddenly. In the future, an unconfirmed surface deformation may be discovered in the area where a big distortion is assumed.

Keywords: active fault, DEM

Japan Geoscience Union Meeting 2012
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SSS36-P03 Room:Convention Hall Time:May 21 18:00-19:00

Characteristics and paleoseismic history of the surface rupture of the April 11, 2011 earthquake at Iwaki City

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A large normal faulting earthquake (Mw6.6) occurred on April 11, 2011 in Iwaki City, Fukushima Prefecture due to east-west crustal extension associated with the March 11 mega-thrust earthquake. Clear surface ruptures appeared along the previously mapped Yunodake and Itozawa faults. We mapped the surface ruptures in the field and found that 1) the surface ruptures with predominant normal sense of slip along the Yunodake and Itozawa faults are both ˜15 km long and 2) the maximum displacement on the Yunodake fault is ˜80 cm and that on the Itozawa fault is ˜2.2 m. Paleoseismic trenching across the Itozawa fault revealed that the penultimate faulting event occurred sometime during 13000 and 16500 cal yrBP, indicating that the fault was not reactivated during the 869 Jogan earthquake.

Keywords: Fukushima-ken Hamadoori earthquake, triggered earthquake, normal faults, surface rupture, trenching

Japan Geoscience Union Meeting 2012
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SSS36-P04 Room:Convention Hall Time:May 21 18:00-19:00

Investigation of fault activity was induced by Tohoku district Pacific offing earthquake

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We investigated the activity history of the fault.
I collected information in order to perform examination about the relevance of inland active fault and massive earthquake.
Announcement that day reports some details.

Keywords: Idosawa Fault, Yunodake Fault, Surface earthquake fault

Japan Geoscience Union Meeting 2012
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SSS36-P05 Room:Convention Hall Time:May 21 18:00-19:00

Shear zones and fault rocks developed along the coseismic normal fault zones of the 2011 M 7.0 Fukushima earthquake

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The 2011 Mw 9.0 Tohoku (Japan) earthquake generated a violent tsunami and unexpected high tsunami wave that caused great substantial damage and more than 23,500 fatalities along the east-northeast coast of Honshu Island of Japan. Seismic inversion results reveal a maximum thrust slip of up to ~50 m on a 500-km-long fault plane (e.g., Yagi and Nishimura, 2011; Ide et al., 2011). Following this huge earthquake, several large earthquakes of M >/= 7 occurred in the east-northeastern Honshu Island, which are considered to have been triggered by the drastic change of crustal stress caused by the Mw 9.0 earthquake in the east-northeastern Japan. The 2011 M 7.0 (Mw 6.6) Fukushima earthquake occurred on April 11 in Iwaki City, ~250 km southwest of the epicenter of 2011 Tohoku earthquake, is considered to be one of such post-seismic events. Field investigations and InSAR data reveal that the Fukushima earthquake produced two sub-parallel ~15-km-long surface rupture zones with a normal slip sense along the pre-mapped faults: the Itozawa and Yunodake faults striking NNW-SSE and NW-SE, respectively (Tsutsumi et al., 2011).

In this study, to better understand the nature of seismogenic faults, we focused on the internal deformation structures of coseismic shear zones and on fault rocks within the Itozawa and Yunodake faults that triggered the 2011 M 7.0 Fukushima earthquake, and discuss the seismotectonic implications. Field investigations and structural analyses of the coseismic Itozawa and Yunodake fault zones and fault rocks show that i) the main coseismic shear zones consist of a fault core that includes a narrow fault gouge zone of <10 cm in width (generally 1-2 cm) and a fault breccia zone of < 50 cm in width, and a damage zone of ~5-50 m in width that is composed of cataclastic rocks including fractures and subsidiary faults; ii) the foliations developed in the fault core zone indicate a dominantly normal fault slip sense, consistent with that indicated by the coseismic surface rupture; and iii) veinlet cataclastic rocks composed of unconsolidated fault gouges and fine-grained materials are developed within the fault shear zones as simple veins and complex networks. These structural characteristics of the coseismic fault shear zones and cataclastic rocks indicate that the locations of coseismic slip zones associated with the 2011 Fukushima earthquake were controlled by pre-existing shear zones of the Itozawa and Yunodake faults that have repeatedly moved as normal faults of seismogenic source since the formation of cataclastic rocks.

Keywords: 2011 Mw 9.0 Tohoku (Japan) earthquake, 2011 M7.0 Fukushima earthquake, coseismic surface rupture, Itozawa fault, Yunodake fault, fault shear zone and fault rocks

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SSS36-P06 Room:Convention Hall Time:May 21 18:00-19:00

Wideband magnetotelluric survey over Iwaki region

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Magnetotelluric measurements were carried out around Iwaki area where high seisimicity with normal fault mechanism has been observed after the 2011 Magnitude 9.0 Tohoku-Oki Earthquake. We mamde 24 magnetotelluric measurements over the area in order to reveal the three-dimensional distribution of fluids which may be responsible for the high seisimicity. In this presentation, we will show the preliminary results of the survey.

Keywords: Iwaki, seismicity, resistivity, fluid, fault

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Seismic Activity around the Border of Fukushima and Yamagata Prefectures

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1. Seismicity

Seismic activity has been observed around the border of Fukushima and Yamagata prefecture (around the border of Kitakata city, Kitashiobara village and Yonezawa city) since March 2011. These earthquakes are located at the depth of 5 - 10 km. The distribution of the epicenters had spread northeast and southwest, and formed 4 clusters (center, west, northeast, and southwest) until the beginning of August. At the end of December 2011, the earthquakes mainly occured in the center, west and southwest clusters.

The seismicity retained very high until the end of April 2011, and became lower after that. Until the end of December 2011, more than 1700 earthquakes which magnitudes are 2.0 or over occurred. The largest earthquake of this activity (M4.6) occurred on May 7th, in the west cluster. After the occurrence of this earthquake, the seismicity of the west cluster became lower.

2. Focal Mechanism

Three fault zones are known around the area of this seismic activity; the western marginal fault zone of Nagai Basin (the northeast of this activity), the eastern marginal fault zone of Aizu Basin (the south of this activity), and the western marginal fault zone of Aizu Basin (the southwest of this activity). According to the Headquarters for Earthquake Research Promotion, these three fault zones run in north-south direction, and are reverse faults.

Most of the earthquakes occured in this activity are of magnitude under 3.0, so it is difficult to determine their focal mechanism. 24 mechanisms are determined by JMA as of the end of December 2011. Almost all the obtained focal mechanisms are reverse fault type, and their P-axes are oriented in the east-west to northwest-southeast direction, in accordance with the known fault zones.

3. b-value

We calculated b-values using 150 earthquakes which magnitudes are 2.0 or over, shifting 100 earthquakes in turn. high b-value (1.5 - 1.6) is exhibited until the end of April 2011, coincide with high seismicity, and lower b-value (1.0 - 1.3) after that.

4. JMA's treatment

The activity occured relatively shallow, so people felt them though they were relatively small. We also report reactions of the local residents to this seismic activity and JMA's community relations performed for them.

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Application of GPR to a near-surface structure study for damaged zones of the 2011 Naganoken-Hokubu earthquake

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After the Tohoku-off Pacific Ocean earthquake, the Naganoken-Hokubu earthquake occurred along the active fault zone in an area bordered between Nagano and Niigata Prefecures. In Aokura and Mori areas, many houses were damaged by this induced earthquake, while in Kamigo area, Tsunan Town, surface breakages took place along a pre-existence flexure of the Miyanohara active fault. Accordingly, we investigated subsurface structures in the three areas using the ground-penetrating radar (GPR) unit and two 100 MHz antennas on August of 2011. The GPR data were processed to accentuate geologic features by high pass ?ltering, low pass ?ltering. The time pro?le changed to a depth pro?le by the wide-angle measurement. Judging from the GPR results and observation, we conclude that a soft ground with saturated water exists in Mori area, because there is a layer of weak reflected signals on the GPR section. The distribution of the soft ground is almost consistent with that of the remarkable house damages in Mori area. Secondary, in Aokura area, there is also a water-saturated soft ground, based on an analysis of the GPR data. The soft ground layer is bounded by strong reflected signals on the GPR section. This boundary is assumed to be a fault. Thirdly, in Kamigo area, Tsunan Town, anomalous detection, showing a discontinuity of reflected signals, was found on the GPR section. This discontinuity on the GPR section is considered to be the Miyanohara active fault.

Keywords: Naganoken-Hokubu earthquake, ground-penetrating radar (GPR), flexure scarp, Miyanohara fault

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Distribution and activity of active faults in the northern segment of the Fujikawa-kako fault zone, central Japan

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Fujikawa - kako fault zone is an active fault zone that extends from south to north at the mouth of Fuji river at Fuji, Shizuoka, which is considered the landward boundary of the plate. Therefore, which is included in the source region of expected earthquakes along the Nankai Trough in the called Tokai, Tonankai and Nankai . Most previous studies are the fault has been approved by the indirect information such as borehole surveys, studies have confirmed the fault surface is less direct. Moreover, most of which are conducted mainly in central and southern segments, the Nebara segment was not confirmed the presence of active faults.

This paper is to determine the distribution of active faults in the study area due to terrain analysis, and field observations conducted based on it. Analysis of terrain by aerial photographs, and 1:25,000 topographic maps and the DEM has resolution 10m.

This study revealed active faults have not been confirmed so far in central and southern segments. The surface of older lava, Fuji volcano in the Nebara segment (11,000-8,000 y. a) has a few tens of meter high cliff successive are sloping toward the east or southeast, at surface younger lava, Fuji volcano (2,200 - y. a) has the number of meter of low cliffs slope down toward the southeast. These cliffs slope and the lava flow direction are inclined in the opposite direction. From the above, these cliffs are considered to be formed by active faults and it is considered that the accumulation of displacement. Moreover, fault outcrop found in the southern segments and Nebara segment. Continuous cliff have been the location of the northern limit from previous study area, which can be found intermittently about 10km further north, the entire length of the Fujikawa - kako fault zone is likely to be about more than 36km. And the height of the cliffs can be seen in the older lava in the Nebara segment is up to approximately 70m, the average vertical velocity of the Fujikawa - kako fault zone about 7mm/yr reached maximum, and this fault zone displaced the younger lava, most recent activity is considered to be 2,200 years ago that is later.

Keywords: Fujikawa-kako fault zone, active fault, terrain analysis