Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SCG65-P01 Room:Convention Hall Time:May 19 18:15-19:30

Focal mechanisms around the northwest margin of the Kanto Plain (Kanto-heiya-hokuseien) fault and Tachikawa fault zones

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We investigated stress field around the northwest margin of the Kanto Plain (Kanto-heiya-hokuseien) fault zone and Tachikawa fault zone based on focal mechanisms of microearthquakes. Focal mechanisms have been determined from P-wave polarity data as well as body wave amplitudes for about 400 microearthquakes that occurred around those fault zones between June 2002 and December 2011. The main results are summarized as follows:

(1) Most of earthquakes show a reverse faulting mechanism, while earthquakes with strike-slip faulting components are also occurring throughout the region.

(2) A stress field suddenly changes across the Kanto-heiya-hokuseien fault zone. P-axes on the northeast side of the fault zone are oriented in the E-W direction, which is consistent with an overall stress regime in northeast Japan. In contrast, those on the southwest side are oriented in the NE-SW direction.

(3) The region with P-axis of NE-SW direction is estimated to extend to at least 50 km away from the surface trace of the Kanto-heiya-hokuseien fault zone.

On the basis of the above features, we discuss the relation of the present-day stress field with the geologically estimated slip sense of both fault zones.

Acknowledgements. The seismograph stations used in this study include permanent stations operated by NIED (Hi-net), JMA, and ERI. We modified a program coded by Satoshi Ide for estimating focal mechanism solutions.

Keywords: the Kanto Plain (Kanto-heiya-hokuseien) fault zone, Tachikawa fault zone, microearthquake, focal mechanism, stress field

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SCG65-P02 Room:Convention Hall Time:May 19 18:15-19:30

Stress and effective frictional coefficient estimated by micro-fault inversion method in Chi-Chi seisimogenic fault, Tai

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Introduction: Stress changes spatially and temporally in seismic cycles. Chelungu-pu fault is a seismogenic reverse fault that can be drilled from on land. In Taiwan Chelungu-pu Fault Drilling Project (TCDP) detailed structural data was obtained from drilled core. Additionally the surface rupture zone of the fault is well traceable in surface topography. In this study, we estimated paleo stress and effective friction coefficient from micro-faults, and then, discuss the relationship between spatial and temporal changes of stress and seismic cycles.

TCDP core: Deformation structures such as micro-fault, open crack, and fault rock were described from TCDP core observation. Slip data including displacement orientation and slip sence is obtained from slickenlines, rake and slickensteps. Calcite vein accompanies with some micro-fault or open crack.

Fault data from on land outcrops: In order to compare with slip data of TCDP core, we gathered slip data from a surface rupture zone on land. The surface rupture zone exposes 450m long along the river located at southern part of Dakeng Earthquake Park. Lithofacies is composed mainly by gray shale and slightly thick sandstone. Most of micro-fault which we could get slip data presented in range of 100m.

Grouping of slip data: We classified slip data into two, as the hangingwall side (T1) and footwall side (T2). The boundary is at 1153m. We have classified the micro-fault as that with vein, vein (T1c or T2c), without vein (T1n or T2n), fault zones (FZ), all of data (ALL) for TCDP data. Slip data from surface rupture zone is classified into 4 on the basis of resulted stress ratio (s1-s4). Stress ratio shown in phi=(sigma2-sigma3)/(sigma1-sigma3). Number of the slip data is following, ALL is 153, Fz is 10, T1c is 33, T1n is 65, T2c is 27, T2n is 31, s1 is 32, s2 is 26, s3 is 28, and s4 is 28.

Micro-fault inversion method: We used inversion method Hough transformed inversion method (HIM) (Yamaji et al., 2006) that uses Hough conversion. We estimated effective friction coefficient mu from minimum of the ratio of normal stress to shear stress on each micro fault.

Result: Direction of compressional axis for ALL, T1c, and T1n are WNW-ESE, NNW-SSE for FZ and EW for T2c and T2n. As a consequence, directions of compressional axis for T1 and T2 are different at the boundary of fault zone 1153m. Direction of compressional axis from surface rupture zone, for s2 and s4 are WNW-ESE, NNW-SSE for s1 and NS for s3.

Over all, stress ratio estimated from drilled core represent a small, about 0.008-0.274. The stress ratio from surface rupture zone is 0.0194-0.6448. Effective friction coefficient mu of core is 0.08-0.70 for ALL, 0.51 for FZ, 0.74 for T1c, 0.18-0.65 for T1n, 1.14 for T2c, 0.51-1.44 for T2n. Mu of surface rupture zone in 0.04 for s1, 0.08 for s2, 0.13 for s3, and 0.09 for s4. Mu of T1 is higher than that of T2.

Discussion: Compressional direction of T1 coincides with the direction reported in Lin et al (2010) which estimated the modern stress state by borehole breakeout. T2 direction, however, indicates slightly different from the modern state. s2 and s4 show almost the same direction as T1 direction. s1 is consistent with that in FZ. Lin et al (2010) also represented that compressional direction rotated about 90 degree from other place in vicinity of fault zone. Compressional direction of s3 is rotated but the rotation is only about 60 degree. High effective friction coefficient of micro-fault with veins suggests low fluid pressure along the fault. Micro-faults without vein are expected relatively high fluid pressure, which reduce effective frictional coefficient. Stress ratio for FZ shows one order lower than the others, suggesting that the fault zone was formed under large axial compression in seismic events.

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SCG65-P03 Room:Convention Hall Time:May 19 18:15-19:30

Distribution of fault plane solutions of smaller events associated with transcurrent movement of Kuril fore-arc sliver

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Using the method developed by Imanishi et al. (2006), Sugawara et al. (2010, 2011) determined fault plane solutions of smaller events to find the evidence of transcurrent movement of fore-arc sliver along the southern Kuril trench. They used P- and SH-waves amplitudes as well as P-wave polarity data and determined fault plane solutions of smaller events with magnitude range from 2.0 to 3.5 and the numbers of P-wave polarity data are 10 or greater. Especially, they focused on the fault plane solutions of events along the estimated boundary of the fore-arc sliver in Hokkaido. Hiratsuka et al. (2012) investigated the spatial distribution of P-axes and T-axes of those fault plane solutions determined by Sugawara et al. (2010, 2011) in more detail. As results, WNW-ESE trending P-axes are distributed along the volcanic front, which is consistent with transcurrent movement of Kuril fore-arc sliver. Under the Hidaka Mountains, ESE-WNW trending P-axes are distributed along the upper interface of subducted Pacific plate. P-axes sub-parallel to the Kuril trench is distributed in the western side of Hidaka Mountains, which is consistent with ongoing process of collision between Kuril fore-arc sliver and Northeastern Japan arc. Strictly speaking, azimuth of P-axes near the hypocenters of 1970 Hidaka earthquake (M6.3) and 1982 Urakawa-oki earthquake (M7.1) are oriented SW-NE direction, while in the surrounding region they are oriented WSW-ENE direction. These results may imply that at least three different stresses act on the vicinity of the Hidaka Mountains.

In order to estimate stress field in the vicinity of Hidaka Mountains, we applied the multiple inverse method (Yamaji, 2000; Otsubo et al., 2008) to the fault plane solutions of smaller events determined by Sugawara et al. (2010, 2011). On the basis of azimuthal distribution of P-axes, we assumed the existence of three different stresses and estimate the direction of their principle stress axes and stress ratio ((sigma2-sigma3)/ (sigma1-sigma3)). We discussed the origin of those stresses based on the calculation of stress field for a homogeneous half-space using the formulae developed by Okada (1992) and comparison with 3D seismic velocity structure inferred by Nakamura et al. (2008).

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