Physical evaluation of large earthquake potentials in a seismic gap region south of the 2004 Mid-Niigata earthquake

Ikuo Cho[1]; Kazutoshi Imanishi[2]; Makoto Hoshino[1]; Yasuto Kuwahara[3]; Tetsuya Takeda[4]

[1] AIST; [2] GSJ, AIST; [3] GSJ,AIST; [4] NIED

1. Introduction

A seismic gap region between two focal regions of the 2004 Mid-Niigata earthquake and the 1846 Zenkoji earthquake is considered to have a potential of a large earthquake. We have conducted temporal seismic observations immediately after the occurrence of the 2004 earthquake in order to obtain the information on the seismic activities, the velocity structures and the stress field in that region. We have also been constructed a three-dimensional geological structure model to compile all the obtained geological and geophysical information. This report describes current status of the evaluation.

2. Contents

1) Geological structure

We constructed a three-dimensional geological-structure model, based on geological maps, deep borehole logging data and gravity data, with constraints of the geotectonic history. The Neogene layers, characterized by strong foldings aligned in the NNE direction, were successfully modeled (Cho et al.,2006).

2) Hypocentral distribution

We obtained a hypocentral distribution indicating possible deep geometry of the Muikamachi and the Tokamachi faults (Imanishi et al., 2006). In the western part of the interest, there appeared three clusters of hypocenters aligning in parallel along the anticlines.

3) Velocity tomography

We found a belt of low velocity along the west of a curved sequence of active faults from the Muikamachi to the Western Nagano-basin faults (Takeda et al., 2005; Hoshino et al., 2006). We also found differences in velocity structure between the north and south parts along the west side of the Shibata-Koide tectonic line, which possibly indicate the deep fault geometry.

4) Focal mechanism and regional stress

Reverse-fault type with a compression axis in the ESE direction dominates in the south of the aftershock areas. Consequently, a similar type of regional stress tensor was inverted. A type of the focal mechanism changes from reverse to strike-slip fault type beneath the southern edges of the Muikamachi and Tokamachi faults where the strong bends of the fault traces from the SSW to the west (Imanishi et al.,2006).

5) Shear-wave splitting and anisotropy

The leading shear-wave polarization directions were found to be dominantly ESE. The details of data and analysis are presented in this conference by Cho et al. Results of this analysis are consistent with those of 4) if we regard the LSPDs as the direction of a compression axis based on a crack model.

6) Simulation for earthquake cycles in this region

We preliminarily made numerical simulations for earthquake cycle (Kato&Hirasawa,1991) for a simplified model of the Muikamachi fault to which a rate-and-state dependent friction law was applied. A geometry of the Muikamachi fault was estimated by a alanced-section method with an assumption of a fault-related folding system (Okamura&Yanagisawa, 2005). Earthquake cycle of pre-slip, seismic slip and after slip is found to be repeated with irregular time intervals and with various magnitudes.

3. Future works

We will make earthquake cycle simulation with various model parameteres referring the above results of an interaction of multiple faults, a stress perturbation by the 2004 earthquake, and heterogeneity in velocity structure. Statistical quantities useful to increase the accuracy of the potential evaluation are expected to be obtained.

Acknowledgements

We used seismic data from NIED, JMA, Tohoku Univ. and Tokyo Univ. A simulation of earthquake cycle was done with a Fortran code of Naoyuki Kato.

References

Cho et al., J. JAEE, 6, 74-93, 2006; Hoshino et al., Abstracts of SSJ, C58, 2006; Imanish et al., EPS, 58, 831-841, 2006; Kato & Hirasawa, PEPI., 102, 51-68, 1997; Okamura&Yanagisawa, no.607, 13-17, 2005; Takeda et al., Abstracts of JGU, S101-007, 2005.