Detailed analysis of strain rate field on the Atotsugawa fault system and NKTZ, based on GPS observational data

Youichi Ooi[1], Kazuro Hirahara[2], Masataka Ando[3], Yoshinobu Hoso[4], Yasuo Wada[5]

[1] Earth and Planetary Sci.,Nagoya Univ., [2] Environmental Studies, Nagoya Univ., [3] RCSV, Science, Nagoya Univ., [4] RCEP, DPRI, Kyoto Univ., [5] Disa. Prev. Res. Inst., Kyoto Univ.

Recent deployment of GEONT by GSI, Japan, has revealed a concentrated deformation zone, NKTZ, in central Japan. The Atotsugawa fault is located in the NKTZ. Only on this fault in Japan, a surface creep with a rate of 1.5 mm/y has been detected by repeated EDM measurements in the central portion of the fault. To investigate the details of strain accumulation around this fault, we established a dense cross-fault GPS array and have observed since May in 1997. Moreover in 1999 we set three single frequency GPS receivers surrounding the fault creep portion to reveal detailed fault creep motion.

To evaluate the fault parallel and normal components of the Atotsugawa fault, we produce the velocity profile along a line perpendicular to the fault. In the parts far from the Atotsugawa fault to the northwest and southeast, we recognize rigid motion in each component. And there is a concentrated deformation zone due to NKTZ. We notice the differences of deformation styles in fault normal and parallel components. In fault parallel component, the width of deformation zone is narrow and the slop is abrupt. On the other hand, in fault normal component, the width is wide and the slop is gradual. Moreover the sites, on this zone, have high shear strain rates, which are 4.7*10E-7/yr and 6.4*10E-7/yr, respectively. These two rates are remarkably high values in the high strain zone NKTZ.

We use three-dimensional FEM model to explain the obtained velocity profile by GPS. The upper mantle and the lower crust below NKTZ are assumed to be a Maxwell viscoelastic body with a relaxation time of five years. The upper crust below NKTZ is assumed to be an elastic body with a low rigidity. This weak upper crust may be caused by the repeated failures due to the inland earthquakes here. And the other crust is purely elastic. We give the constrained displacements as boundary conditions deduced from GPS observations. The computed displacement rate profile well simulates the rigid motion and high strain zone. In addition, we give dislocations on the Atotsugawa and the Ushikubi faults as creep motions. This additional model explains high shear strain rates on both faults. However in the zone sandwiched by the two faults, we cannot explain the observed fault-normal components. This discrepancy suggests a possibility that another tensional force on the Ushikubi fault, which may be related to the water injection from deep portions.