Tectonic Loading Process in the Central and Northern Itoigawa-Shizuoka Tectonic Line Fault System

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We have been observing crustal movements around the central and northern part of the Itoigawa-Shizuoka Tectonic Line Fault System with a dense permanet GPS array as a part of the Comprehensive Research on Slip and Flow Processes in and below the Seismogenic Region supported by the Special Coordination Fund of the Ministry of Education, Culture, Sports, Science and Technology. Our result shows a concentrated WNW-ESE shortening within a narrow zone of a 30km width across the East Matsumoto Basin Fault near Omachi, and a broad as well as uniform strain distribution around the Gofukuji Fault. Based on these results, we discuss tectonic loading processes associated with these faults.

The concentrated deformation near the East Matsumoto Basin Fault requires a very small effective elastic thickness of the upper crust. If we assume the deeper extension of the fault is steadily sliding, such a sliding motion must extend to a shallow depth. This area was attacked by the 1918 Omachi earthquake (M6.5), which is considered to release the tectonic stress in the shallow crust. Probably Omachi area has a rather small capacity for elastic energy accumulation, and the 1918 Omachi earthquake is possibly the largest event in this area. On the other hand, if the model of steady sliding in the deeper extension of the fault is correct, we expect to observe significant uplift around the shortening area, which is actually not seen. Further modeling effort is necessary in this aspect.

Around the Gofukuji fault, although we observe a small geodetic strain rate, the geodetic displacement rate is consistent with the geological slip rate of the fault (Sagiya, 2002). Wide spread deformation can be explained by either a large elastic thickness, or a viscoelasitc relaxation at depths during a long time period since the last earthquake. In either case, the viscosity of the lower crust is considered to be rather large and the relaxation time should be as long as several hundred years. Modeling the Gofukuji Fault is difficult because the deep structure is still not well known. We can assume that the deeper extension of the fault may not be vertical, but dipping. The surface deformation pattern clearly shows left-lateral shear, and it is not likely that the deeper extension of the fault mainly has a dip-slip component. Rather, observed deformation pattern can be reproduced by a steady sliding parallel to the fault's strike on a nearly horizontal deeper extension. In any case, the Gofukuji Fault is considered to be loaded enough to cause a large earthquake. We will also discuss the time-dependent deformation pattern associated with the cyclic occurrence of inland earthquakes.