Tectonic loading of inland earthquakes deduced from crustal deformation around active faults and remaining problems

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We have been conducting dense GPS observation around the Atotsugawa fault and the Itoigawa-Shizuoka Tectonic Line in order to understand tectonic loading process of inland earthquakes. We summarize our observations and our findings about tectonic loading process and lower crustal deformation, and discuss problems to be solved.

Around the Atotsugawa fault and the Gofukuji fault, we can reproduce the displacement pattern by introducing an elastic upper crust of 15 km width and a fault creep below the 15km depth. This interpretation can be applicable to many other active faults. This result may sound like supporting ductile deformation in the whole lower crust. However, it is more reasonable to suppose confined ductile deformation only in a narrow zone beneath active faults. One reason is that a rather large viscosity (decay time of more than 1,000 years) of the lower crust estimated from postseismic deformation. Another reason is based on the fact that we do not observe temporal changes in deformation pattern around active faults through their earthquake cycle. We still have a very limited number of examples for this argument and we simply need more observation.

Around the Atotsugawa fault, geodetic displacement rate is larger than the doubled sum of geological slip rates of nearby active faults. We may attribute this discrepancy to inelastic deformation of the crust. But this is still a remaining problem, which has important implications for seismic hazard estimation.