New research project for the next Nankai trough mega-thrust earthquakes, southwest Japan -Earthquake cycle simulation- (1)

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The subduction of the Philippine Sea plate along the Nankai trough, southwest Japan, has produced the great interplate earthquakes with the recurrence time of about 100 years. The next Nankai great earthquake is anticipated to occur in these 30 years, which causes the enormous disasters amounting to the national budget of Japan. According to a simulation study of Hori(2006), the rupture is expected to initiates off the Kii peninsula and propagate toward the eastern Tonankai and further the Tokai segment, and extend to the western Nankai segment, simultaneously as in the 1707 Hoei event or after some delayed times as in the 1854 Ansei or the 1944 and 1946 Showa events. Last year, we started a new project for the next Nankai mega-thrust earthquake in order to evaluate how the next earthquakes will occur, namely the simultaneous or delayed rupture of the eastern and the western fault segments.

In this report, we give the first year result of research group for construction of physical model of earthquake cycle simulation. In this research group, we construct the database both for the historical long-term Nankai earthquake sequences deduced from tsunami deposit and other geological data and for the recent 120 years slip evolution on the plate interface mainly from geodetic data. Then we construct the earthquake cycle simulation model based on the laboratory-derived rate and state friction law in which we infer the distribution of the frictional parameters on the plate interface, reproducing the historical and present data compiled in the database, to evaluate when and how the next Nankai earthquake will occur.

For the long-term earthquake cycle data, the core sampled at the Lake Hamana shows the tsunami events for Meiho and Hoei events. And the core sampled in the Tosa bay gives the tsunami sand layer for Hoei and Tenmu events. For the recent 120 years data, the newly corrected crustal deformation data are complied.

For the advanced simulation research, the code for 2-D thermal structure simulation is used to construct the thermal structure, and the X-FEM is introduced into the code of dynamic fault rupture simulation in heterogeneous elastic media, in which we can handle the discontinuity surface such as crack and faults in the ordinary FEM code. For the thermal pressurization effects, are examined the effects on the dynamic rupture and also on the earthquake cycle. The FEM is used to examine the effect of viscoelastic medium on the earthquake cycle in a 2-D model simulation. In a layered viscoelastic medium, the cell model is developed for the earthquake cycle including both the Nankai great earthquakes and the inland ones on active faults in southwest Japan.

The condition for the consecutive rupture between two asperities is examined in a simple model. A new frictional model for producing the large variation of recurrence times and the sizes is considered and then preliminarily applied to the earthquake cycle simulation in the Hokkaido, the off-Miyagi and the Nankai trough regions.