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An additional meaning of Tokai slow slip event derived from numerical simulation and consideration of data analysis

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Tokai slow slip event (SSE) has been detected for 5 years. This is detected by analysis of continuous crustal deformation data observed using GPS by GSI. The analysis method is that the steady deformation calculated using the data before the event is removed from that after the event starts and the remains is considered as the deformation caused by the SSE.

We do numerical simulation of earthquake cycle using curving plate boundary model applied the rate- and state-dependent friction law derived by rock experiments. The model represents the plate boundary with the depth from 5 to 40 km and dip angle and strike at the depth from 5 to 25 km has constant while dip angle at 25-40km changes in the lateral direction and it makes the area with the dip angle of 10 degree (Area 1) and that of 25 degree (Area 2).

The simulation results are as follows. In the interseismic term, slip velocity in Area 1 increases to near the plate convergence rate and SSE occurs and after that the velocity decreases, while that in Area 2 increases earlier that Area 1 and after that the velocity becomes constant and it is different with SSE. After that, coseismic rupture starts at the different point to SSE area.

If we assume the slip velocity, after the slip velocity increases in Area 2 and just before that increases in Area 1, as constant and watch the velocity change, we can see SSE occur only in Area 1 and nothing seems to occur in the other area. Thus we cannot know what condition is in the plate interface except for that in the area of SSE.

In this simulation, the locking of plate interface starts to weaken before SSE occurs and coseismic rupture starts at the point far from SSE occurring area. In the real case, there is a question whether Tokai SSE triggers large earthquake along the Nankai Trough. If we apply the simulation results to this, we can regard SSE as only a phenomenon that strain accumulated in the area is released. Moreover the locking on the plate interface is getting weak when SSE occurs. Thus that off Kii Peninsula, where coseismic rupture likely starts, weakens earlier than the other area because dip angle of plate interface is larger and large earthquake may occur within the early time.

Thus the detection of Tokai SSE should be regarded as an indicator that shows the temporal change of the locking at the seismogenic zone rather than as that triggers large earthquake.