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Key questions to be addressed by seismic/geodetic measurements in the Nankai seismogenic zone drilling

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In this paper, I would like to discuss what aspects should be focused on by seismic and geodetic measurements using the downhole observatories installed by the Nankai seismogenic zone drilling. I raise the following four points essential to understand earthquake generation and fault rheology.

1) Define frictional properties of the drill sites

One of the most important themes of the Nankai seismogenic zone drilling is to understand what control seismic and aseismic natures along the subduction megathrust from differences in the core samples, logging and downhole measurements data obtained at the reference site in the shallow aseismic portion of the thrust and at the main deep hole reaching the seismogenic plate boundary. Although there are many studies to define the up-dip limit of the seismogenic part of the Nankai megathrust, including extensive researches currently going on, it is difficult to precisely predict whether the site to be drilled is in the seismic or aseismic parts. Downhole strain/tilt measurements will reveal whether the subduction thrust exhibit stable sliding or episodic creeping, or is completely locked. And also they allow us to locate silent earthquakes, taking places at the seismic/aseismic transition points.

2) Understand phenomena in the aseismic region

It may not possible to drill into the completely coupled plate boundary and to see what is the seismogenic plate boundary. But, instead, we can learn why the shallowest portion of the subduction plate boundaries necessarily be aseismic. From such point of view, it is important to understand how the relative plate motion is consumed in the aseismic area and the geodetic measurement data will provide definite answer. For example, do we observe stable sliding equivalent to the plate motion along the decollement ? Otherwise the relative plate motion may be partitioned into several different slip planes or as mass deformation of the accretion prism.

3) Clarify fine seismic structure of fault zone

Presence of a low seismic velocity zone is reported along almost all the active faults and it must be the case for subduction thrusts. Velocity contrast with the host rock, and thickness and velocity anisotropy, estimated by downhole seismometer arrays, bridge material composition and in-situ properties at the drilling points and seismic structure of much larger spatial scale obtained by surveys.

4) Role of the splay fault

The frictional properties and seismic structure of the splay fault is as important as those of the main thrust fault because the roles of the splay fault in the interplate earthquake generation and the evolution of the accretion prism are not known well. This problem is specific to the Nankai subduction zone. But understanding the role the splay fault is an imperative problem when we generalize the results of the Nankai drilling to the dynamics of faulting process.