Stress heterogeneity on shallow decollement controls property of sediments and Very Low Frequency Earthquakes in Nankai Trough

*Yoshitaka Hashimoto[1], Haruki Kuchimoto[1], Shigeyuki Sato[1], Gaku Kimura[2], Masataka Kinoshita[3], Ayumu Miyakawa[4], Gregory F Moore[5], Masaru Nakano[6], Kazuya Shiraishi[6], Yasuhiro Yamada[6]

1. Kochi University, 2. TUMSAT, 3. ERI, University of Tokyo, 4. AIST, 5. Hawaii University, 6. JAMSTEC

Variable slips from slow to fast have been observed in subduction plate interfaces. Recently, slow slips and tremor, and very low frequency earthquakes (VLFEs) are observed in shallow portion of subduction plate interface in Nankai Trough. Such variation of slips can be controlled by a rheological heterogeneity, which will be expressed by both heterogeneities in stress and/or physical properties of sediments. Stress heterogeneity could be archived due to the roughness of plate interface reacted with the regional stress. Material heterogeneity could be expressed by the heterogenetic distribution of porosity or abnormal fluid pressure. This study investigates stress and material heterogeneities on the shallow decollement in Nankai Trough to see the relationship between the heterogeneities and its relation to the VLFEs' occurrences.

We used 3D seismic profiles acquired for IODP NanTroSEIZE in the Nankai Trough off Kii peninsula and produced a 3D surface of the shallow decollement. Dip angle and dip azimuth for each 50 m X 50 m patch of the 3D surface were obtained. With focal mechanisms of the VLFEs in the region, regional stress orientations and stress ratio were estimated. Normal and shear stresses normalized by differential stress on each patch were calculated by the relationship between patch orientations and the regional stress. Slip tendency (*Ts*) and dilation tendency (*Td*) were also calculated.

The decollement dips in the convergent direction with low angle 0–5 degree in average. Patches with slightly larger dip (10–25 degree) are identified, distributing in NE-SW direction. The regional stress estimated shows relatively horizontal NW σ_1 and relatively vertical σ_3 with 0.65 of stress ratio. *Ts* ranges 0.4–0.6 and high or low *Ts* areas distribute in NE-SW directions repeatedly. *Td* ranges 0.3–0.7 and the distribution of *Td* shows a good agreement with that of *Ts*.

In the reprocessing on the 3D seismic profiles, the velocity model was also improved using the up-dated technics. Velocity distribution on the shallow decollement was also examined. Velocity ranges 1500-3500 m/s increasing from shallow to deep in broad sense. It is, however, not a simple increase with depth but some high and low velocity areas with NE-SW directions are identified. Using the velocity-porosity-effective pressure relationship from laboratory experiments on the sediments from IODP NantoSEIZE expeditions, the velocity could be converted to porosity and to effective pressure. Porosity ranges from 0.5-5% and effective pressure ranges from 1600-2600 kPa on the decollement. Because the conversion from velocity to others is a kind of linear conversion, the distributions of porosity and effective pressure are the same with that of velocity; NE-SW trend in high and low values. Although the absolute values of these properties could have multiple errors in many procedures, the relative values in spatial relationships can be discussed.

The spatial relationship between *Ts* and *Td*, and porosity or effective pressure also represent a consistent distribution. High *Ts* and *Td* areas correspond to the areas with low porosity and high effective pressure (relatively low fluid pressure at a depth). Slips tend to concentrate in the area with high *Ts*. High *Td* area corresponds to that with high *Ts*, which implies that the slip zone could be a fluid conduit. Oppositely, low *Ts* area has low *Td* where the fault could be a barrier of fluid migration. In the area with low porosity and

high effective pressure, the sediments are relatively lithified than the sediments in the other area. In high *Ts*and *Td*areas enhance the fluid escape to make sediments lithified. The NE-SW directions of the distribution of high *Ts*and *Td*areas shows a good agreement with the direction of VLFEs' elongated distributions. This suggests that the *Ts*and *Td,*determined by the regional stress and the geomorphic features on decollement, may have close relation to VLFEs' occurrences.

Keywords: Slip and dilation tendencies, physical property of sediments, very low frequency earthquake, Nankai Trough

