Stress condition during rupture propagation as new index for fault characterization

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To characterize the seismogenic fault, this paper proposes paleo-stress analysis for fault drilling project. During the fault rupture propagation, high stress concentrates at the rupture front. This momentary excess stress will decay within critical distance of the frictional slips, and the fault will slip under residual stress. Large heat energy is released during frictional slip with residual stress state. Many studies have discussed in fault thermal anomaly such as; pseudotachylyte and vitrinite reflectance at principal shear zone (PSZ) of the seismogenic fault, however few paper published for excess stress state. The calcite twin stress meter can reveal stress condition around the PSZ and the excess stress state is the key to characterize whether the seismogenic fault developed at asperity or non-asperity and regular earthquake or slow earthquake.

In the Nankai trough seismogenic zone drilling project (NanTroSeize Project), deep riser hole of the site C0002 is located at large slip area of 1944 Tonankai earthquake, but this area is not necessary locked before earthquake. If an asperity locks stronger than the surround on the fault plane, high excess stress will be needed to fracture the asperity during rupture propagation. High stress will be found at the fault zone along the core sample penetrating the asperity zone. Stress distribution analysis will be a clue to know the lock condition of the fault zone. Excess high stress at of the PSZ decays with distance to the host rock. In case of seismogenic fault within elastic body, stress decay rate is inverse square root of distance from the PSZ, whereas slow earthquake fault in ductile body may have low stress decay rate.

The Okitsu Fault, Cretaceous Shimanto accretionary complex, Japan is ancient seismogenic fault in subduction zone, and this fault can be compare with target seismogenic fault of the NanTroSeize Project. The calcite twin analysis revealed that high stress was found at PSZ at eastern site of the Okitsu Fault, and it decays with invers square root of distance from the PSZ. Stress level of PSZ decrease with distance toward west along strike of the Okitsu Fault. These can be explain that this fault have developed at elastic host rock, and the eastern part of the Okitsu Fault have been locked before earthquake as asperity. This is new approach for fault science and applicable for NanTroSeize Project.

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