POSSIBLE FLUID DRIVEN OPEN CRACK EVENTS OBSERVED IN TAIWAN CHELUNGPU-FAULT BOREHOLE SEISMOMETERS

MA, K.F., Y. Y LIN, and H. TANAKA, H.

1 Department of Earth Sciences, National Central University, Taiwan, ROC

2 Department of Earth and Planetary Science, University of Tokyo, Japan

Taiwan Chelungpu-fault drilling project drilled two holes, 39m apart of hole-A and hole-B, and one branch crossing the Chelungpu fault to retrieve the fresh slip zone associated with the 1999 Chi-Chi earthquake. The TCDP hole-A is 2 km deep, and a 12-cm primary slip zone (PSZ) at the depth of 1111km was identified. After the successful drilling of the TCDP, the TCDP borehole was used as an in-situ fault zone dynamic observatory. A state-of-the-art 7 level seismometer, which placed from the depth of about 950m to 1300m crossing the large slip fault zone associated with the 1999 Chi-Chi earthquake was installed in the borehole. The seismometers were installed over the depth range of hanging wall and footwall with the depth interval of about 50-60m. We focus our studies on the possible fault zone related micro-events.

In addition to the observation of micro earthquakes, we observed events showing the distinct P-wave without S-wave. These distinct P-wave only events had been observed continuously through time. For the five months of observational period, more than 30 events were detected. These events can be classified into different group according to their similarities in P-wave. Group A shows the distinct upward motion, while the Group B shows the distinct downward motion. The events in the same group are almost identical in P-waves, but with slightly difference in pulse width. It suggests the events in the same group have similar mechanisms, but with different source dimension and stress drop. The characteristics of the events from waveform observations suggest these events are repeatable from different locations. These events in Group A and B have the apparent velocity mostly ranged from 4.9 km/sec to 5.8 km/sec for the incident angle of 40-50 degree. The preliminary analysis from particle motions indicate the events might be in the depth range of about 1300m to 1500m, and within 150-500m horizontal to the TCDP BHS site. The seismic waveform simulation from 2D finite-difference for a double-couple event in the dipping fault zone structure shows distinct S-wave in synthetics for events from these incident angles. While a modeling for a Compensated Linear Vector Decomposition (CLVD) with a dipole in NS direction gives the synthetics with distinct P-wave without S-wave. It suggests that these events might be resulted from open cracks in the fault zone. A cross fault experiment of fluid injection test (FIT) was carried out in

late 2006 and early 2007 with a high pressure fluid (~4MPa) injected in hole-B with chemical and gas observations and monitoring in hole-A. Whether these open cracks events are associated with the FIT or the existing features from fault zone remain a question. However, our observations show that these open crack events are lasting not only during the FIT experimental period but continuously through the observational period. Although the distinct features in chemical and gas observation were detected through the cross-hole experiment in FIT, no triggered events associated with FIT had been observed. The behavior of the open crack events might play a role to present the status of the stress on the locked splayed fault during the inter-seismic period.