Fault Zone Monitoring and Resistivity Variations of the Chelungpu Fault Zone at the TCDP

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Abstract

The Taiwan Chelungpu-fault Drilling Project (TCDP) has drilled through the major fault zone at depth 1,111 m (hole-A) to investigate the structure of Chelungpu fault. Audio-magnetotelluric (AMT) deployed around the TCDP and got three extremely high resolution of AMT datum, simultaneously. Multiple frequencies tensor decomposition and constraint inversion has been applied. The GES dominant strike direction in N15ºE and clockwise changed gradually with depth; the lowest resistivity zone (< 10 Ω-m) has been discovered at between 1,100 to 1,500 m depth. Moreover, AMT measurement has measured 0.55 ohm-m water resistivity around the fault zone.

Time variations of resistivity are shown maximum changes of 52.1 percent in apparent resistivity and 20.9 degrees in phase during years 2004 to 2006. The change in apparent resistivity is strongest in the 1000 -100 Hz frequency band. As can be seen from the 1-D models this corresponds to a depth of 0-950 m, and is above the depth of the Chelungpu Fault. The time variations decrease in resistivity likely reflects distribution on groundwater in the hanging wall of the fault.

The characteristics of the lowest resistivity anomaly and clockwise GES implied the existence of a plenty of saline aqueous fluids around the Chelungpu fault which could detonated the large rupture of the Chelungpu fault and caused by the Chi-Chi earthquake. Both of the lowest resistivity anomaly and the GES evidences are most significant with the Chinshui shale and the active fault zone beneath TCDP, central Taiwan.

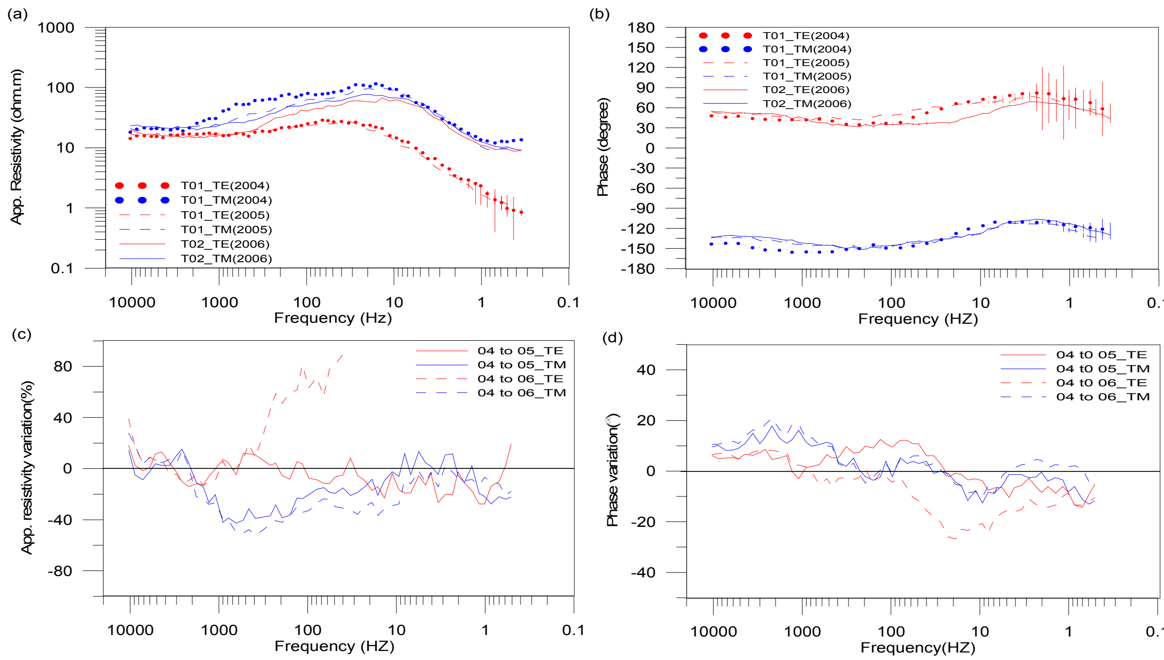

Figure 1. (a) Shows the apparent resistivity and, (b) phase data from AMT sounding during 2004-2006 in TCDP site. The red lines are TE mode and blue lines are TM mode. (c) Time variations of apparent resistivity in percentage and, (d) phase variations with time in degree. The circle symbols are initially measured in T01 station.

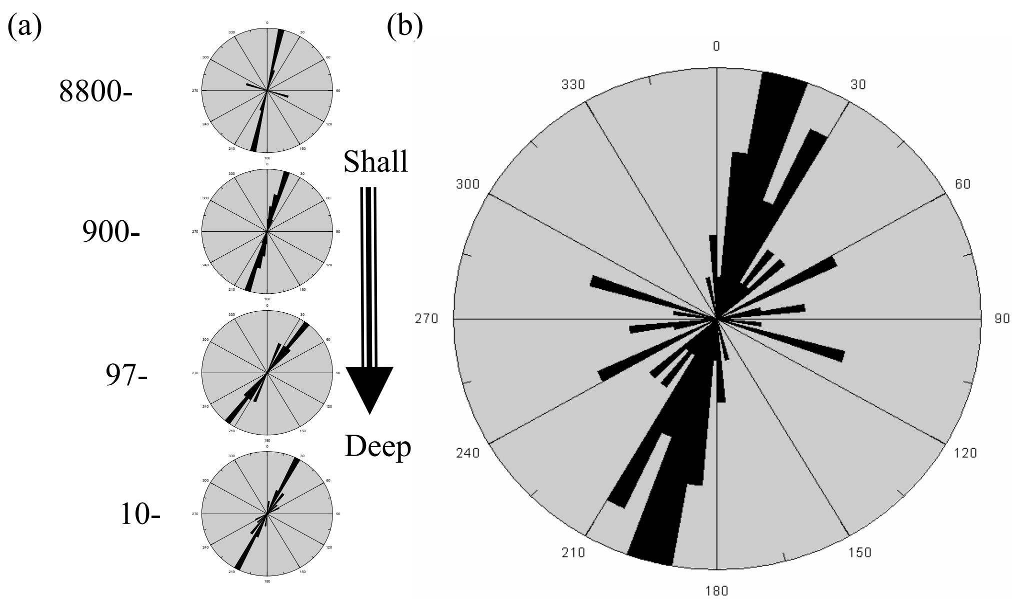

Figure 2. (a) Variations of geoelectric strike direction as a function of frequency using tensor decomposition (b) geoelectric strike all frequencies showing a dominant direction of N15˚ E.

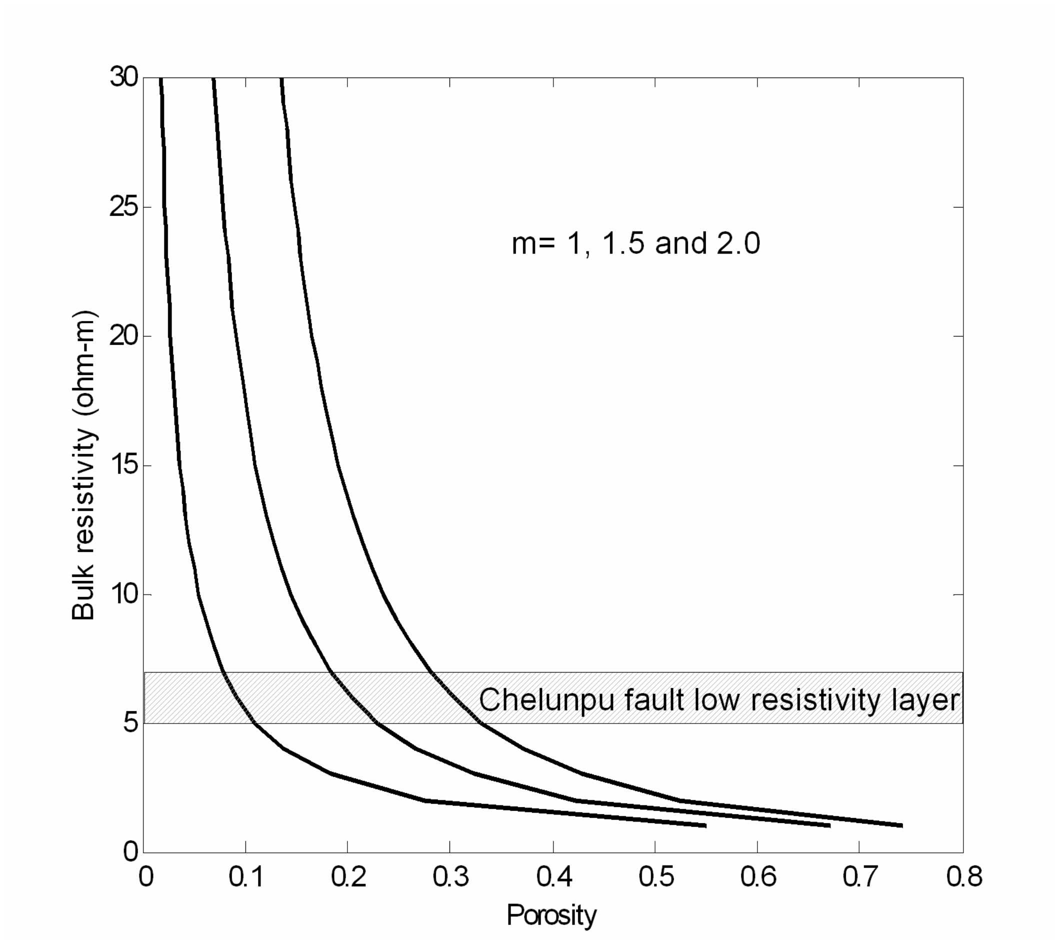

Figure 4. Show relationships with the resistivity and porosity. Shadow zone is Chlunpu fault low resistivity layer.

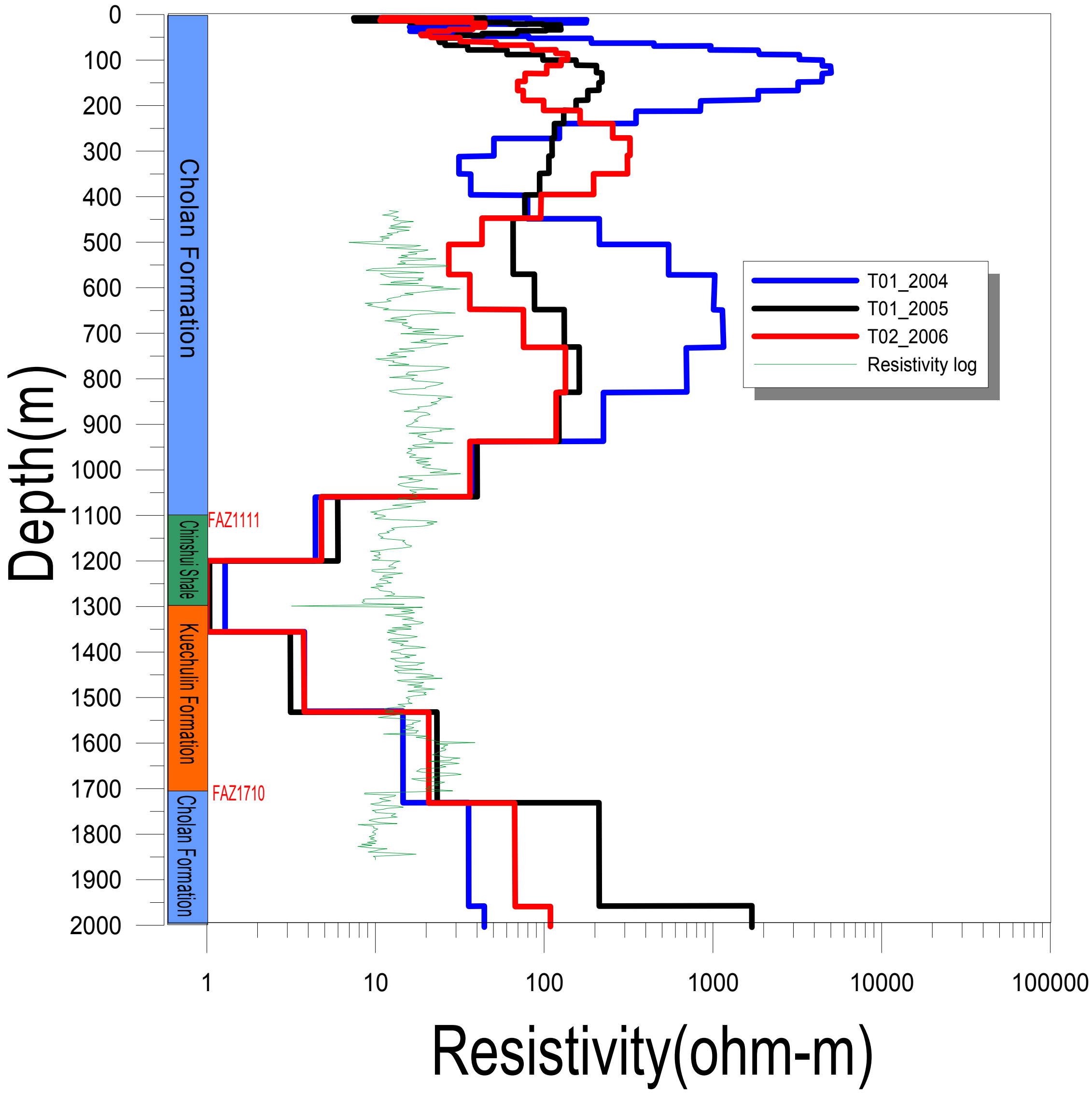

Figure 4. The AMT results by 1-D inversions (TM mode) during 2004 to 2006 and simple strata and fault zones of TCDP-A, and combined with resistivity log. The low resistivity zone had been identified in depth 1100 to 1500 m by electromagnetic method. FAZ1111 has been identified mainly Chelungpu fault and FAZ1710 has been identified the Sanyi fault.