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Hydromechanical characterization of an active fault zone in near-surface sedimentary layers - a case study along the Chihshang Fault, eastern Taiwan

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The 35-km-long Chihshang fault is one of the most active segments of the Longitudinal Valley Fault (LVF), located along the plate suture between the Philippine Sea plate and the Eurasian plate in eastern Taiwan. Observations for the past two decades showed that the movement of the Chihshang Fault was composed of rapid creep and moderate co-seismic rupture. Measurements indicated an average creeping rate of about 20ąV30 mm/yr from 1986-2003. A decreasing creep rate was observed before the 2003 Mw=6.5 Chengkung earthquake and the surface shortening after the earthquake appeared to compensate the deficit in surface creep accumulated during 3-4 years before the earthquake. We set up an observatory for earthquake-creeping fault monitoring at Chinyuan in order to better understand the mechanisms of surface creeping of the Chihshang fault and the possible relationship with the variation in pore-fluid pressure. An integrated project was initiated for characterizing and monitoring the behavior of the creeping Chihshang fault at shallow depths, followed by the previous surface investigations. Eight boreholes at different depths from 30 to 100 m were drilled around the surface trace of the Chihshang Fault. Pore pressure variations in hydraulic observation wells induced by experiments (slug test) as well as natural changes (seasonal variation) were monitored. We also carried out surface electrical resistivity measurement. The surface and subsurface creeping rates were simultaneously measured using creepmeters and tiltmeters at the surface and TDRs in boreholes. Four

hydrogeological units and their hydraulic parameters were characterized based on the preliminary results. At least two major faults of east-dipping planes were identified with high storage coefficient and low transmissivity layers. The preferred direction of flow was inferred to be sub-parallel to the strike of the fault zone. The ground water circulation across the deformation zone is limited. Many fault creep events clearly are triggered by rainfall. The complex relation between rainfall, fault movement and pore pressure variation is being investigated. The coupling between rainfall and deformation induced by fault movement shows that water content changes in the upper sedimentary significantly influence the near-surface behavior of the fault. Particular attention is paid to coupling relationship between variations in water level in near-fault aquifers and fault movements.