Transport property of fault zones and its application for fault slip behavior in the focal area of the 1999 Chi-Chi earthquake

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Internal strictures and transport and frictional properties are keys parameters to know the fault behavior during the earthquake. Field research on fault zones and laboratory experiments give us detail information about fault properties. Chelungpu (or Sanyi), Shuangtung and Shuilikeng faults which are developed around the focal area of 1999 Chi-Chi earthquake were selected for our fault researchs. Internal structure and transport properties of fault zone were compared among these faults. In Chelungpu fault, which preserves internal structure of shallower fault zone, thick fracture zone (several 10 m) and foliated fault breccia zone (10 m) were developed, but only a few mm thickness of fault gouge was identified in the boundary of the fault. In Shuangtung fault, which preserves information of deeper fault zone, thick clay-rich foliate fault gouge zone (about 8 m) was developed at the center of the fault. Even though fault breccia was not developed, thick fracture zone was developed. Strongly deformed black gouge (several cm) was developed in both boundaries of the thick gouge zone. Transport properties of permeability and specific storage with the change of effective pressure (Pe) were measured by laboratory tests up to 200 MPa of Pe. In Sanyi fault, permeabilities of fault rocks, including gouge and breccia, showed same orders (10^-15 m^2) with those of surrounding sedimentary rocks. In the case of Shuangtung fault, thick fault gouge zone showed low permeabilities of 10^-18 m^2 to 10^-19 m^2, and permeabilities of fracture zone and host rocks were 2 to 3 order of magnitude larger than those of fault gouge. Temperature and pore pressure building-up which are generated by the frictional heating (thermal-pressurization) within the center of the fault zone were calculated by the numerical model. Transport properties used for analysis were estimated from laboratory results. The numerical result showed that, in the case of Chelungpu fault, pore pressure had not increased so much while temperature rose up nearly thousand degrees. Shuangtung fault, on the other hand, pore pressure had built up and temperature was increased less than 300 degree and did not increased so much. This indicates that thermal pressurization would work well at the depth of the fault during fast fault motion. On the other hand, numerical basin analysis suggested that overpressure may have generated and maintained at the depth of this area and, this regional overpressure would reduce the effect of thermal pressurization.