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Fluid Characteristics and Circulation along the Chelungpu fault of Taiwan

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The Chi-Chi earthquake (Mw 7.6) was characterized by high rupturing and slip velocity with large displacement in the North suggested that the fault lubrication may be occurred during co-seismic period. The characteristics of fluid, thus, involved in the Chelungpu fault system are important for realizing the mechanism and behavior of the fault-fluid interaction. We analyzed geochemical characteristics, such as hydrogen and oxygen isotopes, physical properties and ionic concentrations of fluid samples retrieved in various depths along the boreholes the Hole-A and Hole-B of Taiwan Chelungpu fault Drilling Project (TCDP) to trace fluid sources. The results show that the source of fluid in the Hole-B was mainly from tap water, while there were two probable sources in the Hole-A owing to abrupt shift of ionic concentrations at depth of 200-300 m. The shallower fluid with lower ionic concentrations may be from the leakage of groundwater above the depth of 300 m. However, the deeper fluid may be the thermal water from the Kueichulin Formation because of high ionic concentrations, especially HCO3-, and higher oxygen isotope. Two sources of fluid in the Hole-A are representative of the fluid systems in the hanging wall and foot wall, respectively. The geochemical characteristics of fluid in the Hole-A imply that the fault zone served as a barrier in the inter-seismic period, resulting in distinctly different fluid between the hanging wall and foot wall. The frequent occurrences and the distributions of calcite vein provide the evidence for the upwelling of HCO3–rich fluid from the Kueichulin Formation and indicate that the fault served as fluid conduit during seismic faulting and allowed the fluid flow across the fault zone to precipitate calcite veins in fractures of hanging wall. This study, therefore, provides a mechanism to depict the fluid behavior in the Chelungpu fault system during different stages of fault development.