Infiltration of surface water into deep fault zone during episodes of seismic faulting: a case study of the Nolima fault zone

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Crack-filling clays, calcite veins and weathered cracks are observed in the drill cores upto a depth of 1800 m, in the Nojima fault zone along which the 1995 Southern Hyogo Prefecture earthquake occurred. The crack-filling clays consist mainly of consolidated and unconsolidated clay and calcite veins, which filled in the opening cracks where no textures related to shearing can be recognized. Obvious zoning textures and color laminations are observed in the calcite veins at both meso- and micro- scales. Geological, petrological, isotopic and 14C data show that these crack-filling clay and carbonate veins probably formed by flowing of surface water or seawater downward into the deep Nojima fault zone during episodes of seismic faulting in the late Quaternary.

Crack-filling clays, calcite veins and weathered cracks are observed in the drill cores upto a depth of 1800 m, in the Nojima fault zone along which the 1995 Southern Hyogo Prefecture earthquake occurred. The crack-filling clays consist mainly of consolidated and unconsolidated fine-grained materials, which filled in the opening cracks where no textures related to shearing can be recognized. Most of the cracks observed in the 1800 m cores are grayish-yellowish brown in color. There are some obvious zoning textures and color laminations observed in the calcite veins filled in the cracks and cavities at both meso- and micro- scales.

Powder X-ray diffraction analyses show that the crack-filling clays are mainly composed of clay minerals such montmorillonite and carbonate materials such as sederite and calcite. Isotopic analyses show that the carbonate have variable values of d13C ranging from -18.5 permil to 4.3 permil and d18O (SMOW) ranging from -5.1 permil to 3.6 permil, which are similar to those of typical surface water and sea water reported in Japan so far. 14C dating results of 10 calcite and clay vein samples show a variable age ranging from 3.5 kyr B.P. to 5.8 kyr B.P.

Geological, petrological, isotopic and 14C data show that these crack-filling clay and carbonate veins and weathering probably formed by flowing of surface water or seawater downward into the deep Nojima fault zone during the late Quaternary. We infer that the infiltration of surface water downward into the deep fractured zone was caused by rapid change of groundwater potential during the episodes of seismic faulting.