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Characteristics of the fault zones of their activities terminated until the Early Pleistocene

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In the active fault surveys without younger sedimentary layers, it is desired that the new method is developed to assess the fault activity using the fault rocks in the basement rocks. To achieve this, it is important to understand the characteristic features of the fault zones not only active faults, but also the faults terminated their activities recently. We studied the fault zone of the Median Tectonic Line (MTL) in Yoshino, Nara, and compare its results with those of the active faults.

The MTL is the active fault in the west of the central part of the Kii peninsula, in which the fault activity is terminated recently in the east. In this eastern area, Okada and Togo (2000) show the fault which terminated its activity until 300 ka in the active fault maps. Sangawa and Okada (1977) reported an exposure of fault zone that makes a border of the Early Pleistocene Lower Shobudani Formation and the Cretaceous Izumi Group, and that is covered by the Middle Pleistocene Upper Shobudani Formation unconformably. Based on the sedimentary ages of their formations (Mizuno and Momohara, 1993), the MTL in this area is terminated until 1 to 1.2 Ma. The fault exposure reported by Sangawa and Okada (1977) is covered by concrete presently, we studied the fault exposures 13 km east and 1 km west away from the previous exposure.

In the former exposure, the fault gouge zone with ca. 1 m thickness strikes E-W. The Izumi formation is in the northern side of the fault zone, in which no exposure in the southern side. The Izumi Formation in this exposure is mainly mudstone. Bedding plane is subholizontal in the host rock, in which foliation is subvertical in cataclasite near the fault gouge. Composite planar fabric in foliated cataclasite indicates the uplift of the southern side. In the latter exposure, the fault gouge zone with ca. 10 cm thickness strikes E-W and distributes between the Izumi formation in the northen side and the Shobudani Formation in the southern side. Matsumoto (2001) reported that the MTL displaces the Upper Shobudani Formation and the activity of the MTL was continue had continued after the deposition of the Upper Shobudani Formation in this exposure.

The powder X-ray diffraction and X-ray fluorescence analyses were performed using the samples from these fault exposures. In the former exposure, the results of the powder X-ray diffraction analysis shows disappearance of mica and formation of chlorite in the foliated cataclasite close to the fault gouge, and decomposition of plagioclase in foliated cataclasite and fault gouge. The altered minerals indicate a remarkable alteration in foliated cataclasite rather than fault gouge. Smectite is not detected in fault gouge and cataclasite. The results of the X-ray fluorescence analysis show the increase of MgO, CaO, Fe2O3 and TiO2 and the decrease of SiO2 toward the cataclasite from the host rocks. From the cataclasite to the fault gouge, MgO, CaO, Fe2O3 and TiO2 decrease and SiO2 increases. The decrease of K2O is especially in foliated cataclasite rather than fault gouge. In the latter exposure, the results of the powder X-ray diffraction show the occurrence of smectite in the fault gouge. The results of the X-ray fluorescence show the increase of MgO, CaO, Fe2O3 and Al2O3 and the decrease of SiO2 toward the fault gouge.

The studied feature is compared by that of the active faults. In the active fault zone, the latest fault gouge is characterized by the formation of smectite and concentration of Mn. Smectite is the mineral formed under lower temperature. Mn deposits under the oxidized condition. These are consistent with recent near-surface condition of the active fault zone. The studied fault zones would be displaced in the deeper part because their activities have been terminated and present surface exposure should be exhumed from 1 to 1.2 Ma to present. Mn is difficult to concentrate in the deeper reduction condition.

Keywords: fault zone