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Mass transfer characteristics of fault gouges in the Neodani fault zone, central Japan

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To clarify the rupture history of the active faults, the main active faults in Japan have been studied by the trenching survey. The trenching survey is a well established method, but we cannot estimate the rupture history in the fault zone consisting of only basement rocks. It is better to understand qualitatively the rupture history of the fault zones consisting of not only in the Quaternary formation but also basement rocks. From this point of view, we study the fault that has been studied by the trenching survey based on geological and mineralogical aspects to evaluate the fault activity from the basement rocks.
We study an exposure at Neo-Osso in the Neodani fault, central Japan. The Neodani fault is one of the well-known active faults in Japan, and the surface ruptures have been appeared along the Neodani fault when the 1891 Nobi Earthquake that is one of the largest inland earthquakes was occurred. The studied exposure has been exhumed by the road construction at Neo-Osso. The Mesozoic formation contact with the terrace deposit along the boundary striking N44W and dipping 80NE. This boundary shows an apparent reverse movement. The Mesozoic formation is composed of mudstone, greenstone, and chert, and this exposure extends to 3.5m apart from the boundary. Quartz veins are fragmented in the exposure, suggesting that all of the Mesozoic formation in the exposure is in the fault zone. Terrace deposit is composed of a lot of rounded gravel and the maximum seize is 20cm in diameter. The fault gouge zone is 5cm in thickness and composed of several different gouges with different colors. These gouges are distributed parallel, straightly and continuously. There are yellow ocher fault gouge, dark gray fault gouge, yellow ocher fault gouge, and brown gouge toward the boundary.
We collected total 8 samples that are 3 fault gouges, ruptured mudstone and greenstone, unruptured mudstone and greenstone, and gravel layer matrix. X-ray fluorescence (XRF) and powder X-ray diffraction (XRD) analyses were performed in the Tono Geoscience Center, the Japan Atomic Energy Agency with the cooperation of Mr. Kazuhiko Kakamu using the Rigaku SYSTEM3270 for XRF and the Rigaku XRDRINT1100 for XRD. We consider unruptured rocks as the origin of the fault gouges. The XRF result shows a great different of SiO2, MgO, and CaO contents between unruptured mudstone and greenstone. This difference suggests that brown gouge and dark gray gouge are mudstone origin, and yellow ocher gouge is greenstone origin. MnO content of the brown gouge is five times as much as that of unruptured mudstone, while that of the yellow ocher gouge is similar to that of unruptured greenstone. The increase of the CaO and MgO contents are recognized in the mudstone origin from source rock to fault gouges, while such increase is not recognized in the greenstone origin. The XRD result shows that plagioclase is disappeared and smectite is identified in brown gouge and dark gray gouge, and that there is no remarkably difference in yellow ocher gouge. Minerals with manganese are not detected in all of the samples.
The remarkable increase of the MnO content in the brown gouge suggests that the brown fault gouge became permeable due to fault rupture during the recent large earthquake, and that manganese has been precipitated under the surface oxidic condition from the groundwater. Therefore, minerals that were formed under the surface oxidic condition in the fault gouges would

be an evidence of recent activity of the fault.