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Manganese concentration in the latest slip plane of the Neodani fault zone

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Occurrence, mineral assemblage and chemical composition of the fault gouges in the Neodani fault zone are studied to clarify the characteristics of the slip plane ruptured during the 1891 Nobi earthquake. Studied sites are Midori and Osso at Neo region of Motosu city in Gifu prefecture. Midori is at the site of 6m vertical displacement in the 1891 earthquake, and the trench site has been opened to the public as the Seismic faults observation and experience house. Samples collected from this site are studied. Osso is 1km away from the site (Naka) of 8m displacement in the 1891 earthquake, and probably ruptured during the 1891 earthquake from the trace of surface rupture. Fault exposure appeared by the road construction is studied. At both sites, fault plane is subvertical, and the Jurassic accretionary complex of Mino belt in the northeast side is bounded by the terrace deposit in southwest side. The accretionary complex of Mino belt contains the matrix of mudstone and blocks of greenstone and chert. At Midori, the surface displacement of the 1891 earthquake is equal to the displacement of the basement rocks, suggesting that the boundary of fault gouge and terrace deposit is slipped during the 1891 earthquake. At Osso, the fault gouge zone with a thickness of 3cm is developed, and divided into 3 different fault gouges based on their color. Brown fault gouge zone is inferred to be the rupture zone of the 1891 earthquake according to the cutting relationship.

X-ray fluorescence (XRF) and powder X-ray diffraction (XRD) analyses of 9 samples from Midori and 8 samples from Osso were performed. As enough amount of samples is collected at Osso, thin section observation, SEM observation and EPMA analysis are also performed. The results of XRF analysis shows MnO concentration at the fault gouge zones. At Osso, 3 kinds of fault gouges are divided into mudstone and greenstone origins based on SiO2, MgO and CaO contents. MnO content in the brown fault gouge of mudstone origin is 4 times greater than the origin of this fault gouge. The results of XRD show the precipitation of smectite and break down of plagioclase in the fault gouges. Manganese bearing minerals are not detected by XRD. Microstructure of the brown fault gouge shows that the fragments of quartz and greenstone are surrounded by brown material. These fragments with brown material are observed in section using SEM-EDX. SEM observation shows that manganese concentrates at the margin of fragments. EPMA analysis of these fragments clarified that Ba is concentrated with manganese, and Fe is not.

Generally, manganese is dissolved in the ground water, and is precipitated under oxidic condition. Basically, fault gouge is not permeable due to clay minerals. But the rupturing during earthquakes may temporally increase the permeability of fault gouges. If ground water flows from underground reductive condition to subsurface oxidic ones, manganese will be precipitated. Manganese concentration in the fault gouges may indicate fault gouges with manganese are ruptured recently. The occurrence of manganese is similar to the oceanic manganese nodules. But their growth rate is very slow (1mm/100 thousand year). Slip and/or frictional heating of fault may reflect to the manganese growth rate.

Keywords: Neodani fault, fault zone, latest slip plane, manganese concentration