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An attempt of fault activity assessment using manganese minerals in fault zones of basement rocks

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Deformation structure, whole rock chemistry, mineral assemblage, SEM and TEM images analyses of the fault zone that the age of the latest earthquake is restricted are examined to clarify the relationship between the latest slip plane and mineralization in the fault zone of the basement rock. Mineralization in fault zones of basement rocks would provide a wider understanding for fault activity assessment, although the trenching survey is well established to estimate the rupture history of active faults. We select the Atera and Neodani faults, central Japan for this study. Studied fault gouges are developed in basement rocks and these probably ruptured during the recent earthquakes.

Two studied outcrops are located at Tase (outcrop A) and Ogo (outcrop B) along the Atera fault, one is at Osso (outcrop C) along the Neodani fault. The fault zone at outcrop A includes the fault gouge between the Cretaceous granite and Quaternary sediments. The fault gouge is composed of several different gouges with different colors. One of brown fault gouge zones is straight and continuous. This often intrudes into the other fault gouge zones. These evidences suggest that this is a possible latest slip plane. The fault zone at outcrop B is developed in the Nohi rhyolite, which is covered by a conglomerate layer. Two fault gouge zones are distributed in the fault zone. One of them is an intrusion vein, and the other is the latest rupture zone. The fault zone at outcrop C is in the Mesozoic formation, and the latest rupture zone is not identified in the several fault gouge zones (See Kutsuna et al. in this session for a detailed description).

Whole rock chemistry of the fault gouges is determined by X-ray fluorescence analysis (XRF). This analysis was performed in the Tono Geoscience Center, the Japan Atomic Energy Agency with the cooperation of Mr. Kazuhiko Kakamu using the Rigaku SYSTEM 3270. In each outcrop, one fault gouge contains higher amount of MnO compared with host rock. This is consistent with the possible latest rupture zone in outcrops A and B.

Mineral assemblage of the fault gouges is determined by powder X-ray diffraction method (XRD). Smectite is precipitated and/or plagioclase is disappeared in the fault gouge zone with higher MnO content.

SEM image analysis shows the shape of minerals with higher MnO content is stick-like and planar. SEM-EDX analysis reveals that higher Pb content is included in the zone with higher MnO content.

TEM image analysis was performed in Niigata University with the cooperation of Prof. Junji Akai and Takahiko Ogawara using the JEOL JEM-2010. Most of manganese minerals are amorphous, while some of them show crystal structure.

These results suggest that manganese has been precipitated in the fault gouge ruptured during the recent large earthquake. The manganese oxide and hydroxide are precipitated under the surface oxidic condition. Therefore, the fault gouges was ruptured under the subsurface oxidic condition, and manganese has been precipitated from the groundwater. In the fault zone of the basement rocks, the fault activity would be evaluated from the point of view of mineralization.

Keywords: fault zones, basement rocks, manganese minerals, fault activity assessment