Characteristic microstructures observed on the surface rupture of the 2011 Fukushima Hamadori Earthquake

*Tetsuhiro Togo[1]

1. THE EARTH

On April 11, 2011 a Mj7.0 earthquake hit on Hamadori district of Fukushima Prefecture, which caused serious human and economic damage. This earthquake was remotely triggered by the Tohoku-Oki earhquake just one month ago, and it was caused by the large displacement that occurred in the subduction zone applied tensile stress to the inland faults. In this earthquake, two faults, the Idosawa Fault and the Yunodake Fault, distributed in the Hamadori district of Fukushima Prefecture were activated, and the source mechanism is a normal fault with a tensile axis was directed to ENE-WSW (Earthquake Research Committee, 2011).

In this study, we present the surface and the cross-sectional structure observed by the optical and electron microscopic of the fault surface which was collected on April 16, 2011, five days after the occurrence of the earthquake. The purpose of this study is to perform 1) observations that contribute to the identification of fault planes at the outcrops and trench walls, and 2) to conduct observations that can lead to elucidation of phenomena occurring on the fault plane during seismic activity. Sampling was conducted at the surface rupture of the Idosawa Fault, which appeared along the prefectural route 134 in Okubo, Tabito, Iwaki City, Fukushima Prefecture. This is the same location as Fig. 4 in the emergency field survey report of Maruyama et al. (2011). The surface rupture at this point is emerged in the basement rock, and the fault breccia contains rock fragments, such as tonalite and mafic schist which derived from the Abukuma metamorphic rock, but all are highly sheared. The matrix is composed of the fine dark green clay minerals.

At the Japan Meteorological Agency's Yamada Station located around 3 km southeast away from the sampling point was recorded 19.5 mm of precipitation since 17:00 on April 11, the day of the earthquake. However the location of the outcrops appeared under the ditch of the road, and the concrete block was covered over the fault plane, therefore the preservation of the slip surface is extremely good. Slicken-lines are clearly left on the slip surface, and a large number of “mud balls” in a diameter of 5 mm or less are attached to the surface. The block sample on the slip surface was impregnated with epoxy resin in a vacuum, cut and polished while cooling with cutting oil, and a layer containing extremely fine particles was partially preserved just beneath the slip surface. This layer looks black-colored in the cross-sectional hand specimen and contains “mud balls” structures which contain small particles such as quartz. These structures were possibly created by the strong shear due to the fault activity such as Clay Clast Aggregates (CCA, Boutareaud et al. 2010), however it is characterized by an irregular shape compared to laboratory experiments. Scanning electron microscope observation revealed that the very fine automorphic, spherical, or amoeboid mineral particles with a diameter of <1 μm were attached to the clay minerals. These mineral particles adhering to the fault surface have been already observed on the Arima-Takatsuki Tectonic Line and the Nojima Fault (Togo et al., 2019 JpGU), and I am considering the mineral composition and formation process.

This research reveals that the very delicate and distinctive structures are left near the earthquake fault surface and the quick field survey and sampling are needed for the observation. We will discuss the characteristic texture of the slip surface with the photographs taken during the observation.

Keywords: Idosawa fault, Fukushima Hamadori Earthquake, surface rupture, fault gouge

