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# Relationship between ESR signal intensity and grain size distribution in shear zones within the Atotsugawa fault system

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Shear zones are zones of strong deformation within active faults and constitute significant sources of information on the seismogenic behavior of faults. The Atotsugawa fault system, which is in the Northern margin of the Hida Highland lies within a complex tectonic zone consisting of the Pacific plate, the Philippine Sea plate, the Amurian plate and the Okhotsk plate. This system consists of the Ushikubi fault, the Atotsugawa fault and the Mozumi-Sukenobe fault. The study of deformational fabrics and features within these shear zones can give more clarification on geodynamics of faults. Moreover, seismogenic behavior of a fault depends greatly on fault zone internal structure and fault rock constitutive properties. Although there are many studies on shear zone descriptions and deformational mechanisms, only few relate the description of cataclastic rocks (fault gouge) with Electron spin resonance (ESR) signals, which is based on the detection of paramagnetic defects in minerals produced by natural radiation that have accumulated for a long time and produces a characteristic signal detectable with an ESR spectrometer. By measuring the intensity of these trapped electrons, the rate of comminution and displacement of a fault can be clarified or envisaged. This study therefore focuses on the relationship between grain size distribution (sieve method) and ESR analysis, and rate of deformation with proximity to a slip plane.

Three shear zones from both the Atotsugawa and the Ushikubi fault were investigated. Sieve analysis and photomicrographs from thin sections revealed that grain size becomes coarser away from the slip plane (e.g. Fig.1a and Fig.2) indicating that the effect of displacement is more close to the slip plane. However, an irregular pattern in the grain size distribution was equally observed in some of the shear zones. This could be due to multiple phases of deformation. ESR analysis showed a decreasing trend in the intensity of signals toward the fault plane (Fig. 1b and Fig. 2) indicating that the rate of comminution was more intense towards the slip plane. However, the decreasing trend in ESR signal intensity with proximity to the slip plane was not observed in some of the shear zones probably due to multiple phase of deformation as indicated by the anatomizing faults in the shear zone II of the Ushikubi fault.

Results from ESR analysis suggest that samples closest to a slip plane will have low signal intensity than those further away while grain size distribution analyses indicates that samples closest to a slip plane become finer due to intensive crushing that is always associated with large displacement during fault activities.

Keywords: Active fault, Shear zones, ESR signal intensity, Grain size distribution, Atotsugawa fault system

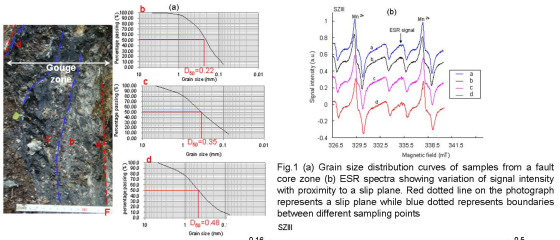


Fig.1 (a) Grain size distribution curves of samples from a fault core zone (b) ESR spectra showing variation of signal intensity with proximity to a slip plane. Red dotted line on the photograph represents a slip plane while blue dotted represents boundaries between different sampling points

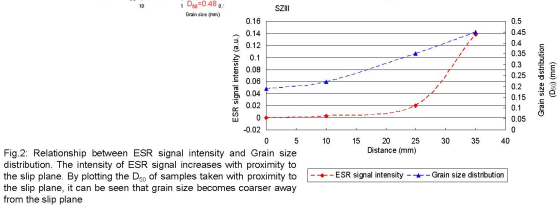


Fig.2: Relationship between ESR signal intensity and Grain size distribution. The intensity of ESR signal increases with proximity to the slip plane. By plotting the $D_{50}$ of samples taken with proximity to the slip plane, it can be seen that grain size becomes coarser away from the slip plane