Neotectonic activities produce fault breccia, gouge and cataclasites through earthquake faults, which are life threatening. To manage such risks from earthquake hazard, it is important to have a comprehensive paleo-seismological data on active faults such as the Atotsugawa (64 Km) and Ushikubi (52 km) faults in Japan, which generated a 7.3-7.8 magnitudes earthquake that killed 203 people and destroyed 319 houses. Because of recurrent seismicity of those faults, their deformation history has partly been unraveled and the age of their recent activities extensively studied using various methods. With the "direct method", dosimetric age determination could be applied on the postulation of zeroing of total accumulated dose by seismogenic dislocation. Electron spin resonance (ESR) signals have been employed for dosimetric age determination of such events, by using the ESR signal called E'_1 in quartz that has a distinctive g-value. However, ages of faults obtained from that method have raised a lot of controversies. Another supplementing method is to use signal B in calcareous fault gouge. The short coming of this method is that the signal B was not present in all the samples investigated as was the case with a mixed signal termed the C' signal that exhibits properties of the E'_1 center in quartz and signal C in calcite. Signal C in calcite has been used for dating of fossil corals and shells, and has a resolving power for younger ages than the E'_1 center.

Although most fault gouges lack calcite grains, the fault gouges within Quaternary faults in calcareous metamorphic rocks that are distributed in restricted geologic areas within the active Atotsugawa fault system in the Hida metamorphic belt, central Japan contain significant calcite grains. Signal C observed in the fault gouge mixes with the E'_1 of quartz to produce a mixed signal. However, attempts to physically separate pure calcite grains from quartz grains by hand picking and signal separation methods have yielded no good results.

Initially, examination of the nature of C' signal revealed that the contribution of signal C (calcite portion) to the C' signal is proportional to the mass fraction of calcite. Intensity ratio of X-ray diffractograms and the mass ratio of calcite and quartz have been used to construct a calibration curve from where calcite portion (signal C) can be obtained and subsequently used to determine the age of fault activities. Moreover, the fault rocks in question require megascopic and microscopic description prior to ESR characterization.

This study therefore focuses firstly on characterizing the C' signal and to use signal C to estimate the age of the latest activity of the Atotsugawa and Ushikubi faults. Secondly to

do a petrographic description of the fault rocks and assess the relations between grain size distribution and ESR signal intensities along shear zones.

The intensity of the C' signal was measured using a JEOL, ESR spectrometer and the age (T_{ESR}=ED/D) of fault activities were obtained from the equivalent dose (ED) determined using the additive dose method and the annual dose of natural radiation (D) estimated from the concentration of radioactive elements. The ED of signal C was estimated from the intensity of the C' signal after irradiation and from the proportion of calcite estimated from the intensity ratio. The ED obtained from signal C was then used for the age evaluation.

The intensity of the C' signal responded differently to different dose rates and doses of additive artificial irradiation, and was slightly enhanced by irradiation dose at lower dose. With increasing irradiation dose, the intensity of the signal varied anarchically due to saturation. With the observed incidence of saturation, all data points fitted into a simple saturation growth curve and ED was obtained by backward extrapolation. With the mixed signal (C' signal), the obtained ED were larger than from their respective calcite portion (signal C).

Calibration curves revealed that the proportion of calcite in the samples range from 26-37 % and 9-17 % in the central and eastern part of the Ushikubi fault respectively and from 21-39 % in samples from the Atotsugawa fault.

The average ages obtained from calcite portions (signal C) from the Ushikubi fault extend in the range from 0.87± 0.11 to 1.43± 0.37 ka and are younger than that obtained in previous studies (1.9 ka), while from the master Atotsugawa fault, the average ages varied from 0.49±0.04 to 1.00±0.07 ka. These ages correspond to the historical earthquakes which occurred in and around the metamorphic area (AD 762 or 863 for the Ushikubi fault, and AD 1858 for the Atotsugawa fault).

This method that was used for dosimetric dating of calcareous fault gouge has proven to be applicable to the latest seismogenic events as young as 150 – 1200 years ago within an error range of about several hundred years. As for dosimetric dating of non-calcareous fault gouges more studies are recommended to explore any minerals other than quartz.

Based on observation of fault rocks, their grain size distributions analysis revealed that, samples further away from the slip plane have larger average grain size (d_{50}) than those

close to the slip plane. In most of the shear zones, ESR signal intensities also reduce in samples close to the slip plane. The variation in grain size distribution within some of the shear zones may indicates past multiple fault events in the study area, thus underscoring the need for further investigation of the possibility of recurrence of faults.

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