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ESR dating of Calcareous fault gouge of the Ushikubi fault, central Japan

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The ages of fault events of active faults have been estimated by using ESR signals of siliceous gouges. This technique of ESR method is limited by obtaining only ages that are greater than tens of millennia. So this study focuses on developing a new technique of using calcareous gouges to gain an insight into the age of latest seismogenic event within the Holocene.
Samples of calcareous gouges were collected from the central and eastern (at depth range of 0.2 and 29.5m) part of the active Ushikubi fault in central Japan.
After subjecting the samples to ESR analysis, the result presented as follows: the surface samples showed three distinct peaks with g-values (2.0060, 2.0033, 2.0007), and the core samples also showed three peaks with g-values (2.0003, 2.0022, 2.0066). The three peaks in both samples corresponded to A (SO_2^-), B (SO_3^-) and C (CO_2^-) signals. Isochronal annealing experiment revealed a unique behavior in the ESR spectra of signal C in both the surface and the core samples, in which decrease in signal intensity occurred at two stages. The first stage occurred from 0-150 degree centigrade and the second from 350-450 degree centigrade. ESR results on samples that were subjected to gamma ray irradiation (50Gy/hour) with a ^{60}Co source revealed that, some of the signals identified were saturated. However, the degree of saturation varied within signals in samples and as such signal B was used to determine the age of the Ushikubi fault. Saturation growth fitting of simulated and observed curves were used to determine the equivalent dose (ED) that was used to estimate the ESR age. The ESR ages ranged from 1.4-1.5 ka assuming no loss of water and radon in the central and 1.7-2.9 ka in the eastern part of the Ushikubi fault. By taking the average of the ages obtained from both the central and the eastern part of the Ushikubi fault, it was observed that the latest event on the fault occurred about 1.9 ka.
This technique proved reliable because the mean age (1.9 ka), obtained agrees with previous works on age determination of latest fault events indirectly by utilizing radiocarbon dating from trenching surveys in the study area. However, this new technique has some weak points which need to be improved. A younger age value would be obtained if the lower artificial irradiation dose rate (< 5Gy/hour) were used in the determination of the ED. Also, the gouge samples were not pure carbonate but contained portions of silica.

Keywords: ESR dating, Calcareous gouge, Active fault, paleoseismology, Central Japan, Strike-slip fault