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ESR Dating of Pseudotachylite

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ESR (electron spin resonance) dating method has been used to determine the ages of quaternary events. When a mineral receives radiation from natural radioactive elements, a part of paired electrons in quartz are ionized, and are trapped by lattice defects and impurties as unpaired electrons. The amount of unpaired electrons increases with time after geological zeroing event. The ESR age is obtained by dividing the total dose of natural radiation by the natural dose rate. Gamma ray doses are given to the sample to obtain the total dose by extrapolating the dose response of the signal intensity to the zero ordinate. The natural dose rate is calculated from U, Th, and K concentrations, and so on.

Quartz is one of the promising minerals useful for ESR dating. In the present paper, we attempted to obtain ages of a land slide event. We collected pseudotachylite from Lantan, Himalaya. A land of about 4 km in diameter has found to have slid several kilometers resulting in pseudotachylite at the base.

The samples were gently crushed sieved and soaked in 6N HCl for 1 night and then in 20% HF for two hours, but quartz grains were too small to be extracted. However, ESR signals of characteristic quartz were observed. As long as the sample is uniform, it is not crucial to extract pure quartz grains. With the usual procedure of ESR dating, gamma ray irradiation and ESR measurements, we obtained accumulated natural doses of 290 to 450 Gy.

The concentrations of radioactive elements, K, U, Th, which give most of the natural dose to quartz grains, were measured by the low background gamma ray spectrometry. We obtained 7.62 ppm of uranium, 21.1 ppm of thorium, and 3.72% of K2O. Assuming the cosmic dose rate of 0.1mGy/y, we obtained 6.22 mGy/y as the natural dose rate. The ESR ages are obtained by dividing the accumulated doses by the natural dose rate to be 64ka from Al center signal (an electronic hole trapped at Al impurity in quartz) and 72ka from Ti center signal (an electron trapped at Ti impurity in quartz) for a sample, and 56ka and 58ka for Al and Ti center signals, respectively, for another sample. These ages are consistent with some constraints of other geological events.