J027-004 Room: C403 Time: May 27 14:30-14:45

Experiments for electron spin resonance dating of deep faults

Shin Toyoda[1], Kiyohiko Hidaka[2], Hirotsugu Nishido[3]

[1] Applied Phys., Okayama Univ. Sci., [2] Dept, Applied Phys,. Okayama Univ, Sci., [3] Res. Inst. Nat. Sci., Okayama Univ. Sci.

ESR (electron spin resonance) detect unpaired electrons trapped at lattice defects and impurities in minerals. ESR dating method is based on the fact that those trapped electrons created by natural radiation. Samples irradiated by gamma rays are measured by ESR together with one without irradiation to obtain natural accumulated doses. The doses are divided by the natural dose rates, measured separately, to deduce the age of the samples. Quartz is one of the minerals useful for ESR dating, which was shown first to be possible for dating of fault movements by Ikeya et al. (1982). They assumed that the stress during the fault movements erases the ESR signals completely. The following studies tried to simulate the zeroing process by laboratory experiments (e.g. Tanaka, 1989) while Fukuchi (1989) proposed another mechanism that frictional heating generated by fault movements erased the signals. On the other hand, the grain size plateau criterion, assuming that the smaller quartz grains should have more zeroing effect during faulting, was proposed and was shown to work well practically (Lee and Schwarcz, 1994).

It is an important issue for us to obtain the periodicity of the faulting at the depth of around 10 km in the aspects of disastor prevention. Those faulting occurs under a high normal pressure, which would lead complete zeroing of the ESR signals in quartz grains. However, the ground temperature at this depth might be too high to preserve accumulate ESR signals. The thermal stabilities of the ESR signals in quartz was once investigated to obtain closure temperatures of about several tens of centigrade (Toyoda and Ikeya, 1991). But it would include larger error because of the long extrapolation in the Arrhenius diagram from the results of laboratory heating experiments. Grun et al. (1999) investigated the thermal stabilities by investigating quartz grains extracted from cored granites, but the consideration of decay kinetics of the ESR signal was not sufficient.

We examined the deep sea sediments taken by ODP to investigate the thermal stabilities of the ESR signals in the geological environments. Those sample would best fit to the present aim of the study since the ground temperatures in the cores were measured and the thermal history of the sample would be well estimated. In addition, the content of the quartz was high enough. The only problem was the organic compounds which cause huge organic radical signals in the ESR spectra. We applied mixture of sulfate and nitric acids to remove those intefering signals.

We examined about 20 samples from Hole 808 (Leg 131) with depths of 0 to 1300 m from the surface of the sea floor. We will report in the presentation the profile with depth of the ESR signal associated with impurities and oxygen vacancies in quartz.

Fukuchi, T. (1989) Appl. Radiat. Isot., 40, 1181.
Grun, R., Tani, A., Gurbanov, A., Koshchug, D., Williams, I. and Braun, J. (1999) Jour. Geophys. Res. 104 17531.
Ikeya, M., Miki, T., and Tanaka, K. (1982) Science, 215, 1392.
Lee, H. K. and Schwarcz, H. P. (1994) Techtonophys. 35, 317.
Tanaka, K. (1989) Ph. D. Thesis, University of Kyushu.
Toyoda, S. and Ikeya, M. (1991) Geochem. Jour. 25, 437.