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ESR dating of barite in sulfide deposition formed by sea bottom hydrothermal activities

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At the initial stage of studies on the seafloor hydrothermal activities, their temporal changes were not argued. However, their temporal changes, which are most probably controlled by geothermal conditions, is now an important issue in order to discuss its influence to the biosphere. For this purpose, new dating techniques are necessary, which are applied to hydrothermal minerals, in addition to conventional dating techniques.

Kasuya et al. (1991) pointed out the possibility of ESR (electron spin resonance) dating of barite (BaSO_4). *Okumura et al.* (2010) made the first practical application of this technique to the sea bottom hydrothermal barite where preliminary ages were obtained. However, in this paper, detailed discussion was not sufficient, such as the occurrence of barite included in sulfide chimney, contribution of each natural radiation from surrounding environment, optimum measurement conditions, and the stability of the signal.

In the present study, we investigated three basic issues on ESR dating of barite;(1)Optimum condition for ESR measurement (2)Thermal stability of the signal (3)Inhomogeneity of accumulated doses and dose rates.

Barite (BaSO_4) was extracted from hydrothermal chimney samples (220-E, 1354-R1, 903R7-2) taken from two sites at Okinawa Trough and at the Southern Mariana Trough. The radioactivity distribution of the chimney sample was observed in one sliced piece of chimney piece (903R7-2) to find that radioactivity is concentrated in barite with imaging plate after cutting into 13 blocks. About 2.0g of each block was crushed and was soaked in 12M hydrochloric acid. The beaker was covered with a watch glass and left for approximately 24 hours. Then, 13M nitric acid was added. Finally, after rinsing in distilled water, the sample was filtered and dried. Impurities were removed by handpicking. The extracted sample was examined by X-ray diffraction to confirm that the grains are pure barite. The dose rate was calculated assuming alpha and beta particles in an infinite system. We ignored the contribution of cosmic rays and considered the shape of the chimney about the gamma ray.

As a result, it was found that the signal of SO_3^- in barite starts to saturate at 0.01mW. Annealing experiments revealed that the signal is stable enough for age range of 10^2 - 10^3 , which are the values we obtained for present samples. The inhomogeneity of accumulated doses and of dose rates will be discussed in the presentation.

Keywords: barite, electron spin resonance, dating, hydrothermal activities