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ESR dating of hydrothermal barites of the sea floor

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Barite ($BaSO_4$), the most common barium mineral, occurs principally as gangue mineral in hydrothermal polymetallic ore deposit. In this study, electron spin resonance (ESR) investigation of marine barite was carried out to evaluate its use as a dating for the evolution of a hydrothermal system in the sea floor.

We used two barite samples, chemically extracted from portion taken at the basal part of hydrothermal himneys, consisted of barite, sphalerite and pyrite. One, 903-R-7-2, was taken at the Archaean site (12°56.4'N, 143°37.9'E) in South Mariana spreading center during a dive, in the YK 05-09 cruise, made by deep-sea submersible vehicle (DSV) Shinkai 6500 performed by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). The other, 220-E, was taken at Hakurei site (27°15'N, 127°04'E) in the Izena caldron, Okinawa Trough by ROV Hyper-Dolphin (dive 220) during the NT03-09 cruise performed by JAMSTEC in July and August 2003.

ESR spectra were observed using a JEOL PX-2300 at room temperature with a microwave power of 1 mW, the modulation frequency of 100 kHz, and modulation amplitude of 0.1 mT.

ESR spectrum of marine barite is characterized by an electron-type center with g values of 2.003 4, 2.0022 and 1.9995 being consistent with SO3? (Kasuya et al. 1991). The signal intensity was enhanced with gamma ray irradiations in the dose range from 110 to 2600 Gy. The accumulated natural doses were obtained to be 232Gy for 903-R7-2 and 1725Gy for 220-E by extrapolating the saturation curve of dose response to the zero ordinate. The 226Ra activities of the barite were measured by gamma ray spectrometry using a low background germanium detector. The Ra concentrations were 7.72 Bq/g and 4.77 Bq/g, respectively, while those of Th series and K2O were not detected. The natural dose rates were calculated to be 303 mGy/y and 187mGy/y. The ages of the samples were estimated to be 770 and 9200 years old. However, the ages obtained by ^{2} ^{26}Ra-^{210}Pb methods are 31, and 25-33 years (Noguchi, 2006). Possible reasons for these inconsistencies will be discussed.

Keywords: electron spin resonance, dating, barite, hydrothermal activity, sea floor