Radioactive disequilibrium and ESR dating of barite in sea-floor hydrothermal deposits of the Okinawa Trough

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Barite ($BaSO_4$) is a mineral useful for radioactive disequilibrium (^{226}Ra-^{210}Pb and ^{228}Ra-^{228}Th) and ESR (electron spin resonance) dating methods. While the disequilibrium methods have often been used [1], ESR dating of barite has been recently developed since it was shown that the method is practically useful for barite extracted from sea-floor hydrothermal sulfide deposits [2]. With several basic works [3], the method have been almost established.

In the present study, three dating methods (^{226}Ra-^{210}Pb and ^{228}Ra-^{228}Th, and ESR) have systematically been applied to barite crystals extracted from sulfide deposits taken at the Okinawa Trough hydrothermal field. The samples were taken by the research cruises (NT01-05, NT02-07, YK04-05, NT11-15, NT11-20, NT12-06, KY14-02) operated by JAMSTEC both from active and inactive sites. ^{228}Ra with half life of 5.75 year was detected in the active chimney samples. The ^{226}Ra-^{210}Pb and ^{228}Ra-^{228}Th ages were obtained from the ativity ratios of daughter nuclei.

The obtained ESR ages range from 4.1 to 16000 years. The order of the oldest ESR age of the samples from the hydrothermal field was, from oldest to youngest, Izena Hole (Hakurei site), Iheya North Knoll, Hatoma Knoll, Daiyon-Yonaguni Knoll, Yoron Knoll then Irabu Knoll.

There are samples for which the ESR ages are older than ^{226}Ra-^{210}Pb and ^{228}Ra-^{228}Th ages, where, the order of the ages is consistent, i.e., samples with younger ^{226}Ra-^{210}Pb or ^{228}Ra-^{228}Th ages show younger ESR ages and vice versa. The age inconsistencies among three methods would most probably be because the barite crystals were formed by two or more hydrothermal events and were mixed together.

[1] Noguchi et al., (2011). *Jour. Mineral Petrol. Sci.* 106, 26-35. [2] Okumura et al., (2010) *Geochronometria*, 37, 57-61. [3] Toyoda et al., (2014) *Radiat.Prot. Dosimetry*, 159, 203-211