

U-Th radioactive disequilibrium dating of hydrothermal vent of Okinawa and South Mariana Trough

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Biological and ore-deposits research are progressing on hydrothermal vent of Okinawa Trough and South Mariana Trough. In this study, we measured the age of sulfide minerals from seafloor hydrothermal systems using U-Th radioactive disequilibrium dating. Thorium is not soluble in hydrothermal fluids and is not precipitated in hydrothermal minerals while uranium is precipitated in these minerals. Therefore, we can apply to U-Th radioactive disequilibrium dating because ²³⁴U in mineral decays to ²³⁰Th with time.

We analyzed uranium and thorium isotope ratio in these minerals by an ICP-MS with Multi collector type (IsoProbe). The rock sample was powdered to 100 - 250 meshes, and 250 - 500 meshes, and performed electromagnetism separation using the isodynamic separator. Then sample was leached by 5% HNO₃ with ultrasonically for 30 minutes and Milli-Q water 30 minutes, and dried at 80 C.

Before analysis by multi-collector type ICP-MS, we need to separate U and Th in sample solution after acid decomposition of sample. Especially, presences of Ba (barium) and Pb (lead) would make analyses difficult. In order to separate U-Th efficiently, we apply two steps of column chromatography (AG1X-8 and U/TEVA) were performed (Takamasa et al., Quaternary Geochronology, 2012).

Some sample from Archean site of South Mariana Trough, is also analyzed by ESR age for cross-check. These ESR ages were consistent with our U-Th radioactive disequilibrium age (Takamasa et al., Quaternary Geochronology, 2012). Moreover, our method can determine ages of minerals as young as 50 year, when a sample contains enough U but little Th.

The samples from Pika site, Urashima site, Archean site, and Snail site in South Mariana Trough yielded ages of 560-9000 year, 250-1160 year, <50-4000 year and < 100 years, respectively. These results suggest that the oldest ages from each site are correlated with the distance from the spreading axis.

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