Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SCG059-21 Room:105 Time:May 26 17:30-17:45

U-Th radioactive disequilibrium dating of hydrothermal sulfide minerals

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The time scale for a hydrothermal activity is an important factor which controls the evolutionary interaction of chemosynthetic-based communities in a submarine hydrothermal system and "Rock-Fluid -Ecosystem linkage".

Dating techniques involving radioactive disequilibria of ^{235}U, ^{238}U and ^{232}Th decay series have been applied for hydrothermal submarine ore deposits. Among previous studies, ^{230}Th-^{234}U disequilibrium dating applied for massive sulfide mounds from Transatlantic Geotraverse (TAG) deposit on the mid-Atlantic Ridge yielded a wide range of ^{230}Th-^{234}U ages from 2.6 to 38 kilo years. The results indicated episodic activities lasted which more than 30 kyr in the TAG area positioned on a slow spreading ridge. In this study, we have attempted ^{230}Th-^{234}U disequilibrium dating for younger hydrothermal deposits from Okinawa Trough and South Mariana Trough using a Multiple-Collector Inductively Coupled Plasma Mass Spectrometry (MC-ICP-MC) and examined its applicability for dating of younger hydrothermal activity. Before 1990, radioactive counting method was widely used to measure radioactivities of U and Th. But recently, mass spectrometry has made it possible to determine lesser amounts of uranium and thorium with higher precision.

The samples used in this study contain high amounts of sulfide and barite. Pb and Ba causes analytical interferences for U and Th isotope analyses, thus a good separation of the two elements is necessary. A two stage column chromatography was therefore used for the separation process.

The sulfide mineral from Izena hole of Okinawa Trough was separated by acidic decomposition from insoluble barite. The ^{230}Th-^{234}U disequilibrium age of three samples yielded 700 to 1000 years. It has thus been fairly possible to apply the ^{230}Th-^{234}U disequilibrium dating for young age hydrothermal deposits to about several hundred years. However, due to low U/Th ratios in these samples, the precision of this method deteriorates. In addition, it was found necessary to estimate the initial ^{230}Th /^{232}Th ratios to determine the age more accurately. The samples from Archean site of Mariana Trough have higher U/Th ratio and enables more precise dating. Samples from a big chimney form two isochrones yielding 700 to 1800 years.

The results show that we need analyze several samples to see if they form an isochron.

Keywords: U-Th radioactive disequilibrium dating, Hydrothermal vent