U-Th radioactive disequilibria in sulfide minerals from sea floor hydrothermal systems

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Although the time scale of hydrothermal activity constrains the size of hydrothermal ore deposits and the evolution of chemosynthesis-based communities in a submarine hydrothermal system, limited systematic dating studies have been conducted.
Sulfide minerals from axial ridge with high spreading rate were mainly dated with radioactive isotopes with short half lives such as 210Pb. 234U-230Th ages were successfully obtained for sulfide minerals from off axial areas in the fast spreading rates with a spectroscopy (Lalou et al., 1985) and from the slow spreading mid-Atlantic Ridge using a thermal ionization mass spectrometry (You and Bickle, 1998). We will show the results of 234U-230Th analyses with a MC-ICP-MS and also compare the results with ages obtained from other dating systems such as ESR dating.
Thorium is not soluble in sea water from which hydrothermal fluids originated, while uranium abundance is about 1 ppb. Thus when hydrothermal minerals precipitated without detrital component, 230Th/234U activity ratio is close to zero. In the minerals are kept in closed system 230Th/234U activity ratio increase with time and reaches secular equilibrium in 500ka. From 230Th/234U activity ratio, we can determine the age of the hydrothermal minerals.
Analyses are conducted as follows. A sulfide sample is decomposed with nitric acid after artificial tracers of 236U and 229Th are added for isotope dilution analyses. U and Th are separated from major elements with a solvent extraction chromatography resin, U TEVA resin (eichrom). U and Th are further purified with U TEVA resin and anion exchange resin (AG1-X8, Bio-rad). Isotope ratios of 234U/238U, 236U/235U, 230Th/232Th, 229Th/232Th are measured to obtain radioactivity ratio of (230Th/234U). We can obtain precise (230Th/234U) ratio with several hundred milligram sample by MC-ICP-MS analyses.
Four hydrothermal sites of South Mariana Trough were dated yielding ages from <100 a to 10 ka. The results suggested that the oldest age from each site is correlated with the distance from the spreading axis of the Trough. The U-Th radioactive disequilibrium ages were roughly consistent with ESR ages.
Most of the samples from Okinawa Trough samples yielded younger age than South Mariana Trough. Some of them show inconsistent ages with ESR ages.
Sulfide minerals from some sites show large variations in U and Th abundances, suggesting am open system behavior.
We will report the results of leaching experiments in the presentation.

Keywords: U-Th radioactive disequilibrium, seafloor hydrothermal vent

