中部沖縄トラフ熱水域の海底下に産する硫酸塩鉱物のストロンチウム同位体組成

Strontium isotope study of sulfate minerals obtained by scientific drilling from seafloor hydrothermal fields in the Okinawa Trough

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Since hydrothermal fields in the Okinawa Trough develop within sediment-rich geologic setting of a backarc rifting in the continental margin, significant fluid mineral interactions and fluid migrations are expected to occur within the sediment layer. We have demonstrated that pore fluid chemistry in the vicinity of active vents in these hydrothermal fields were represented by two distinctive components; one is entrained-seawater component and the other is hydrothermal component which has the same origin as the vent fluid. Sulfate minerals such as barite and anhydrite are known to occur abundantly in and around the hydrothermal fields, because they form by precipitation caused by encounter of these two components. Isotope ratios of Sr incorporated in these sulfate minerals would provide key information to understand these processes.
We studied barite and anhydrite occurred in sediment cores obtained from three hydrothermal fields, Aki Site at the Iheya North Knoll, Hakurei field at the Izena Hole and Gondou field at the western flank of Dai-san Kume Knol, in the mid-Okinawa Trough. The sediment cores were obtained by scientific drilling campaigns conducted in 2014, 2016 and 2017 under the framework of the Next-Generation Technology for Ocean Resources Exploration Project. Determination of Sr isotope ratios was conducted employing LA-ICP-MC-MS (laser ablation inductively couple plasma multi-collector mass spectrometry) technique, which enabled multi-point measurement of a single mineral crystal or mineral aggregate using a polished section. Using the same polished section, Sr/Ba ratio of barite or Sr/Ca ratio of anhydrite was determined by EPMA (electron probe micro analyzer) analysis.
Strontium isotope ratios of anhydrite in all three fields were close to that of the present-day seawater with a few exceptions. Strontium isotope ratios of barite showed wider ranges biased from that of the seawater. Higher $^{87}Sr/^{86}Sr$ ratios are recognized in Hakurei field while lower $^{87}Sr/^{86}Sr$ ratios in Aki site and Gondou field. Difference in Sr isotope ratio between barite and anhydrite is attributed to that barite precipitates from mixture of the hydrothermal fluid and seawater while anhydrite precipitates from heated-seawater. As supportive evidence for this idea, we confirmed Sr isotope ratio in the sediment core from Hakurei field agreed with the reported value of barite in an inactive chimney-shape sulfide/sulfate breccia had been collected. Occurrence of barite in limited layers whereas common occurrence of anhydrite in the sediment core would be attributed to a result of subseafloor migration of the hydrothermal fluid.

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