Quadruple sulfur isotope analysis ($^{32}S/^{33}S/^{34}S/^{36}S$) of the deep-sea Iheya North hydrothermal field, mid Okinawa Trough back arc basin

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Stable sulfur isotope ratio ($^{34}S/^{32}S$) has been widely used as a tracer of geochemical and biological processes in seafloor hydrothermal systems (e.g., Shanks et al., 1995). Recent technical development allows us precise measurement of third and fourth less abundant isotopes: ^{33}S and ^{36}S (Ono et al., 2006). These new information could be a new tracer distinguishing isotope mixing and exchange, as well as biological processes (Ono et al., 2007).

We have developed a fluorination and multi-GC technique, which allow us quadruple sulfur isotope analysis with precisions of <±0.4‰, <±0.02‰, and <±0.4‰ for $d^{34}S'(=1000\ln^{34}R/^{34}R_{CDT})$, $^{33}S'(=d^{33}S'-0.515d^{34}S')$, and $^{36}S(=d^{36}S'-1.90d^{34}S')$, respectively. We have applied this technique to deep sea Iheya North hydrothermal field, mid Okinawa Trough. We analyzed wide range of sulfur compounds, including chimney sulfide minerals, hydrogen sulfide of the vent, elemental sulfur and hydrogen sulfide within Polychaete and Galetheid colonies around the vent, sulfide in caldera sediment, and seawater sulfate near the seamount.

The results indicate that each sulfur compound has distinctive $^{33}S'$ values, which vary more than 0.1‰. The observed variation is larger than previously thought. This suggests that the $^{33}S'$ signature can be useful to distinguish volcanic H_2S from that produced by reduction of seawater sulfate, even if the two show similar $d^{34}S$ values.

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