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Stable isotope ratio is useful for quantitative estimation of hydrogenotrophs at hydrothermal ecosystems

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Hydrogen gas (H2) is a key molecular for deep-sea hydrothermal ecosystem because of its abundance and strong reducing power relatively to the other inorganic components. Although hydrogenotroph is one of the most important primary production processes, H2 utilization efficiency within subseafloor low-temperature hydrothermal ecosystem has not been quantitatively estimated due to lack of effective tracers.
The use of stable isotope ratio is an approach for quantitative estimation of subseafloor H2 metabolisms. The stable isotope ratio of H2 at hydrothermal site varied from ~-400permil at high temperature fluid to ~-750permil at low temperature biological habitat. It is likely due to water temperature change and subsequent temperature-dependent isotope equilibrium reaction between H2 and H2O, catalyzed by hydrogen metabolisms. Advantages of the use of the isotope ratio are 1) Large variation of the isotope ratio (>350permil) compared with analytical errors (<10permil), 2) Robustness for water mixing between hydrothermal fluid and seawater because of little H2 in the seawater, and 3) No requirement of in-situ and onboard experimental procedures, such as a radioisotope use, for example, other than gas extraction.
In addition to the hydrothermal observation, incubation experiments using stable isotope label to reveal a relation between H2 concentration and the isotope change, like an isotope fractionation factor, by each hydrogen metabolism will be presented. The results show a potential of the stable isotope use also to estimate a dominant counter part (oxidant) of hydrogenotrophic metabolisms.

Keywords: molecular hydrogen, H2, stable isotope, hydrothermal ecosystem