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Isotope systematics among H_2, CH_4 and H_2O in fluid associated with serpentinization

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Serpentinite-hosted hydrothermal systems have attracted considerable attention as sites of abiotic organic synthesis and as habitats for the earliest microbial communities, because hydrothermal fluids derived from ultramafic rocks are characterized by high concentrations of H_2 and CH_4. During water-rock reactions, Fe (II) in olivine of ultramafic rock is oxidized to Fe (III), which accompanies the reduction of water to yield H_2. Methane and hydrocarbons are often observed in serpentinite-hosted hydrothermal systems and are thought to be produced from H_2 and CO_2 via Fischer-Tropsch-type (FTT) reactions. On the other hand, H_2 and CH_4 can be consumed and produced by microorganisms such as methanogens and methanotrophs around the hydrothermal systems. When we collect and analyze samples, those chemical compositions could have been altered due to microbial activities. Therefore, it is very difficult to clarify processes related to H_2 and CH_4 around the serpentinite-hosted hydrothermal systems.

Isotopic compositions are useful tool to discriminate origins and reaction pathways of chemical components. As representative controlling factors of isotopic compositions are temperature equilibrium, isotopic compositions of substrate, and isotopic fractionation, the dynamics of isotopic compositions are complicated in natural environments. Therefore, polyphasic aspects, such as hydrological, geological and microbiological interpretations, are needed. However, even complete hydrogen isotopic analysis of H_2, CH_4 and H_2O from serpentinite-hosted systems and basic laboratory experiments has been reported in only a few studies. As the isotope systematics among H_2, CH_4 and H_2O in fluid associated with serpentinization remain unexplored, I will present the review of some previous studies and results of explorations of hydrothermal systems at Mid Cayman Ridge during YK13-05 cruise.

Keywords: serpentinization, stable isotope, hydrogen, methane