Molecular and intramolecular ^{13}C isotopic study of hydrocarbons in serpentinite–hosted spring, Japan

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Abiogenic hydrocarbons have been reported in serpentinite-hosted systems [e.g., 1, 2], though the mechanism of hydrocarbon formation in serpentinite–hosted sytems has been poorly understood. We have conducted position–specific and compound–specific carbon isotopic analyses of hydrocarbons derived from serpentinite–hosted Hakuba Happo hot spring in Japan [3]. The C_1 to C_5 hydrocarbons showed isotopic depletion trend with increasing molecular weight. The isotopic distribution among C_1 to C_5 *n*–alkanes could be explained by the polymerization through step-wise addition of a single–carbon compound CH_4 or potentially $HCOO^-$. The observed $\delta^{13}C$ pattern was similar to those of Lost City and Logatchev–II hydrothermal systems [1, 4], thus the model was also applicable to other seafloor serpentinization fields. Furthermore, a novel isotopic analysis, intramolecular ^{13}C analysis of propane [5], was applied to natural sample from serpentinite–hosted Hakuba Happo. The Happo C_3H_8 showed that the $\delta^{13}C$ difference between terminal and central carbon–atom positions of propane was significantly smaller than that of thermogenic origin. The observed isotopic distribution within propane molecule agreed with the model prediction from the compound-specipic isotope analysis. Based on the systematic isotopic study, we present a conceptual model for abiotic hydrocarbon systhesis in serpentinite–hosted systems.

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