Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36828

Thermogenic origin of hydrocarbons in the Hatchobaru geothermal system, Kyushu Japan

YUKI KONYA[1], AKIRA IJIRI[1], **JUN-ICHIRO ISHIBASHI**[2], KEIGO KITAMURA[3] AND JUN NISHIJIMA[3]

[1]Graduate School of Maritime Sciences, Kobe University
[2]Kobe Ocean-Bottom Exploration Center, Kobe University
[3]Faculty of Engineering, Kyushu University

We investigated the isotopic composition of C_1-C_4 hydrocarbons in fumaroles and geothermal fluids collected from the Hatchobaru geothermal field to elucidate their origin. Furthermore, we measured the clumped isotopes of methane in fumaroles to obtain temperature information of the formation.

The Hatchobaru geothermal field is located in the central part of Kyushu Island and hosts one of the largest geothermal power plants in Japan. The heat source of the Hatchobaru geothermal field has been associated with the late Quaternary volcanic activity of the Kuju Volcanoes. Contribution of magmatic volatile components from the heat source into the geothermal system had been confirmed by observing elevated helium isotope ratio of the geothermal fluids in previous studies.

The carbon isotopic composition of the hydrocarbons generally showed patterns coincident with thermal degradation of organic matter. On the $\delta^{13}C(CH_4)$ versus C_1/C_2 ratio diagram, the plots for the fumaroles and geothermal fluids were aligned along a region interpreted as representing production from thermal decomposition of maturated organic matter. The decomposition of maturated organic matter was supported by the relationship among the carbon isotopic compositions of CH_4, C_2H_6 and C_3H_8. Additional evidence for high temperature decomposition reaction was obtained from the clumped isotopes of CH_4, which yielded a formation temperature around 300ºC. This temperature range overlaps with the upper end of the reservoir temperature estimated based on quartz and alkali geothermometers. There results suggest that formation of hydrocarbons likely including methane originates form thermal decomposition in the deep region of the geothermal system.

This study is based on results obtained from the projects commissioned by the New Energy and Industrial Technology Development Organization (NEDO). Sampling of the geothermal fluids from the wells was conducted under collaboration with Kyuden Mirai Energy Co.