Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.21868

Subseafloor thermal structure of an active hydrothermal field revealed by isotope geothermometry of clay mineral

DR. JUN-ICHIRO ISHIBASHI[1], YUSHI ITATANI[2], TETSUJI ONOUE[2], YOUKO MIYOSHI[3] AND KEVIN FAURE[4]

[1]Kobe University
[2]Kyushu University
[3]AIST, Japan
[4]GNS Science, New Zealand

Presenting Author: ishibashi@port.kobe-u.ac.jp

Various chemical interactions are expected to occur in subseafloor region of an active hydrothermal field where ascending hydrothermal fluid and entrained seawater are encountered. Mineralogy and geochemistry of clay minerals provide important constraints for understanding thermal and hydrological structure in the subseafloor region. We studied clay minerals collected from sediment cores obtained by a scientific drilling from an active hydrothermal field in the Okinawa Trough back arc basin. We determined the oxygen and hydrogen isotope values of some representative clay fractions and applied isotope geothermometry to estimate the formation temperature.

The sediment cores were obtained from a crater-like depression surrounded by active and inactive hydrothermal mounds [1]. The sediment consisted of volcanic clasts such as pumiceous gravel and volcanic breccia. Hydrothermal alteration was recognized below 46 mbsf (meters below the seafloor), and minor sulfide and sulfate mineralization was recognized between 53 and 67 mbsf. Clay mineralogy changed with depth from smectite to illite (and chlorite). The oxygen isotope geothermometery yielded a liner and steep thermal gradient from 85 deg C at 48 mbsf to 220 deg C at 55 mbsf. Below 56 mbsf to 69 mbsf, high temperatures of 140-180 deg C was suggested by co-occurrence of illite and chlorite. The estimated thermal gradient agreed with a profile of homogenization temperature of barite collected from the same sediment core. The revealed subseafloor thermal structure is attributed to lateral migration of the hydrothermal fluid component at the depth around 55 mbsf from the main fluid conduit to the active vent site on the seafloor.

References:

[1] Ishibashi et al. (2022) Proc., 16th SGA Biennial Meeting, 153–155.