

Bursary report for research cruise TN350 on board the RV Thomas G. Thompson by Alexander Diehl

RV Thomas G. Thompson cruise TN350 took place from 06th to 26th of March in 2018 to explore hydrothermal activity of the Brothers volcano in the southern Kermadec Arc, New Zealand. The cruise was set out to (1) assess the thermal state of the volcano for an upcoming IODP drilling leg, (2) investigate the volcanic rocks and (3) sample hydrothermal fluids and precipitates of the numerous hydrothermal venting sites. The focus was put on the assessment of fluid chemistry properties and their bearing for associated microbiological communities. Alexander Diehl joined the science party as fluid chemist and conducted on-board analyses of hydrogen and methane concentrations by gas chromatography.

The fluid sampling program focused on four sites at the Brothers Volcano. During the cruise three known venting sites, the North West Caldera Wall site, the Upper Cone site, and the Lower Cone site were sampled. Besides, preexisting plume evidence lead to the discovery of a new site near the North West Caldera Wall site at the outermost rim of the Caldera on the slope outwards the caldera. This new site was successfully sampled as well. With the help of ROV-Jason2 fourteen IGT (isobaric gas tight) samples were successfully recovered during the time of the cruise. These samples were recovered at the newly discovered site (2), the rather diffuse venting lower cone (2), the upper cone (2) and mainly at the NW Caldera Wall site (8 samples).

The measured temperatures of 320°C at the NW caldera wall (20°C higher than measurements on a previous RV Sonne cruise SO253 in 2017) and 200°C at the Upper cone site (80°C higher than on the previous RV Sonne cruise SO253) during the IGT sampling procedure suggests that the sampling worked well and the hydrothermal fluids could be recovered with little seawater entrainment. Onboard gas chromatography measurements of H₂ and CH₄ quantified the gas concentrations between <0.5 and up to 88 µmol/l and between 0.1 and 5.5 µmol/l, respectively. Of all samples taken, a number of aliquots were stored for later cation, anion and ⁸⁷Sr/⁸⁶Sr isotope analysis. Whenever possible, small crumbles of chimney specimen matching the fluid samples were taken for evaluation of the mineralogy precipitated by the fluids. Also grains of sulfate were recovered for microthermometric analyses.

The fluid analytic program will be carried out in cooperation with scientists from GNS science (Institute for Geology and Nuclear science) in Wellington. After the chemical data are produced they will be merged and processed together to get a comprehensive dataset of fluid chemistry for the samples. During the cruise, another cooperation with a microbiologist from GNS-Science was established. The gas chromatograph was used to measure CH₄ concentration in microbiological incubation experiments to control the growth of methane producing microbes cultivated from diffuse hydrothermal fluid samples.

In overall, the fluid sampling and gas measurements of the cruise were a complete success and the promising gas data and recovered fluid and rock samples will be used in Alexander's PhD thesis work to assess fluid rock interactions and phase separation in the subsurface of Brothers volcano.



THOMAS G. THOMPSON

