

# Geochemical study of hydrothermal activities found on an spreading ridge and off-ridge seamount in the southern Mariana Trough

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Hydrothermal fluids, 120 degree C clear and over 300 degree C black smoker fluids, were obtained from the spreading ridge and off-ridge seamount in the southern Mariana Trough, respectively, and the chemical compositions of the fluids were measured. The 120 degree C fluid venting on the spreading ridge was discovered on April 2003 during the dive study of a US group, while the black smoker venting from atop of the off-ridge seamount was discovered during the dive of Shinkai 6500 on November 2003. The estimated chemical compositions of both the endmember hydrothermal fluids were quite similar, the chemistry of the black smoker fluid venting from the off-ridge seamount was comparable with those of the venting fluids from the mid-ocean ridges. Then, we report the characteristics of the hydrothermal fluids obtained from the southern Mariana Trough and compare them with the mid-ocean ridge types. In addition we compared the chemical compositions between the ridge and the off-ridge hydrothermal fluids.

The hydrothermal vent site at the spreading ridge has been observed many snails around the striking vent, where was named 'Snail Mound' by the discoverer, Dr. Fryer, so the vent site is called 'Fryer site'. The black smokers on the atop of off-ridge seamount have been observed a complex of several chimneys on a sulfide mound and two clear shimmering chimneys and many dead chimneys have been observed on the eastern side. The hydrothermal site is named 'Pika site'. The temperature of the venting fluid of the Fryer site was been reported maximum 240 degree C, however, maximum temperature which we measured was decreasing to 120 degree C in five months. Temperature of the black smoker could not be measured exactly because of a trouble of the temperature probe, but it is certainly over 300 degree C. Around the both sites the seafloor was observed covering with pillow lava, it suggest that basaltic magma activity has been vigorous.

The recovered sample fluids were immediately divided into several bottles for each analysis. Concentrations of silicate, ammonium, and hydrogen sulfide were determined by colorimetry immediately and pH and alkalinity were measured on board. Another major components have been measured using ICP and IC after back to the laboratory.

At first we estimated the temperature of black smoker fluid at Pika site using silica geochemical thermometer, it was expected 330 degree C. Magnesium concentrations of the some black smoker fluid samples were nearly zero, it indicated that the collected fluid samples were very pure and contamination of ambient seawater was very low. The estimated chemical composition of the hydrothermal end-member at the Pika site were as follows: silica = 17mM, hydrogen sulfide = 8mM, chlorine = 600mM, iron = 8mM, manganese = 1.15mM). In addition, the measured pH value of 2.9 is slightly lower than that of the mid-ocean ridge types. The reported concentrations of hydrogen sulfide from the East Pacific Rise and the Mid Atlantic Ridge are distinctive each other, the values reported from the Pacific are higher (over 8mM) and it is comparable with the black smoker venting from the Pika site. And furthermore, the concentration of chlorine of the end-member fluid is higher than that of the seawater, suggesting that phase separation should be occurred beneath the seafloor.

Chemical compositions of the both hydrothermal fluids obtained from the Fryer and Pika sites were compared. The concentration of chlorine of the Fryer fluids was almost equal to the seawater, suggesting that phase separation was not occurred. The concentrations of hydrogen sulfide, potassium and manganese at Fryer site were lower than those of the Pika site, especially hydrogen sulfide was very low. The low concentration of hydrogen sulfide may suggest consumption of it beneath the seafloor.