Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

BBG21-02 Room:102B Time:May 22 11:15-11:30

Geophysical results of the Southern Mariana Trough back-arc basin: From mantle to hydrothermal vent sites

Nobukazu Seama[1*], Kyoko Okino[2], Yoshifumi Nogi[3], Toshinori Sato[4], Tetsuo Matsuno[3], Shuro Yoshikawa[5], Nobutatsu Mochizuki[6], Masanao Shinohara[7]

[1]Earth and Planetary Sciences, Kobe Univ., Kobe, Japan, [2]AORI, Univ. of Tokyo, Chiba, Japan, [3]National Institute of Polar Research, Tokyo, Japan, [4]Earth Sciences, Chiba Univ., Chiba, Japan, [5]Application Lab., JAMSTEC, Japan, [6]Priority Org., Kumamoto Univ, Kumamoto, Japan, [7]ERI, Univ. of Tokyo, Tokyo, Japan

The southern Mariana Trough back-arc basin shows an EPR type axial relief in morphology and constant low mantle Bouguer anomaly along the spreading axis (Kitada et al., 2006), suggesting abundance of magma supply, even though the full spreading rate of 35 km/Myr is categorized as slow spreading. Further, five hydrothermal vent sites exit within 5 km near the spreading axis at 13 N; two sites on the spreading axis, one site at the eastern foot of the axial high, and two sites on an off-axis knoll. We selected this area as one of three integrated target sites for the Taiga Project, and we conducted series of JAMSTEC research cruises for four different types of geophysical survey, together with dive observation and samplings by the submersible Shinkai6500. The geophysical surveys consists of 1) a marine magnetotelluric (MT) survey of a 130 km length transect across the spreading axis using 10 ocean bottom electro-magnetometers, 2) a 15 km scale seismic reflection/refraction survey and seismicity observation using 9 ocean bottom seismometers (OBS), 3) near-bottom acoustic and magnetic mapping around all the hydrothermal sites using the AUV Urashima, and 4) a magnetometric resistivity (MMR) survey around the on-axis hydrothermal sites.

Two-dimensional electrical resistivity structure of the upper mantle from the MT analysis shows highly asymmetry, which may be affected by hydration driven by water release from the subducting slab; that may result in abundant magma supply to support EPR type axial morphology. Three-dimensional crustal velocity structure from the seismic refraction analysis shows low velocity at the central part of the spreading ridge and high velocity under the off axis seamount. The high velocity under the off axis seamount is interpreted as thick layer 3, suggesting past magma intrusion from the mantle. The reflection survey results show that some reflectors exist under the hydrothermal area. Three months OBS observation shows that the seismicity near the hydrothermal vent sites is very few, suggesting that hydrothermal activities are not related to tectonic stress. Moreover, the morphology of the mound and knoll near the three off-axis hydrothermal sites shows undeformed features without any faults, suggesting that their formation is closely related to an off-axis magma upwelling system rather than fault systems. The two on-axis hydrothermal sites (the Yamanaka and Snail sites) are located near the end of a 4th order spreading segment based on the observed offset of the neo-volcanic zone, suggesting that they are possibly locally developed in association with diking events in the segment. But the diking is probably an episodic event to provide heat source for each hydrothermal site, because of very few seismicity. Clear magnetization low at four hydrothermal vent sites except the Yamanaka site suggests that the hydrothermal activities have continued for long enough periods in wide enough areas to reduce the magnetic remanence of the crustal rocks. The different feature in the Yamanaka site suggests its activity has been short and/or small. The MMR results support this difference because low electrical resistivity region with 200 meter scale is located only at the Snail site but not at the Yamanaka site; the low resistivity region is probably due to the existence of hot crustal pore fluid.

Keywords: back-arc basin, seafloor spreading, hydrothermal activity, mantle structure, crustal structure, seismicity