Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SIT41-08 Room:314 Time:April 28 12:00-12:15

Three-dimensional seismic structure of the Rainbow area, Mid-Atlantic Ridge 36 degree N

ARAI, Ryuta[1*] ; DUNN, Robert[1] ; CANALES, Pablo[2] ; SOHN, Robert[2]

[1]University of Hawaii, [2]Woods Hole Oceanographic Institution

Oceanic lithosphere formed along slow-spreading mid-ocean ridges is structurally and compositionally heterogeneous due to spatial and temporal variations in tectonic extension, magmatic accretion, and mantle temperature and composition. While mid-ocean ridges with greater magma supply host a greater abundance of hydrothermal systems, the relative roles of magmatic input, heat advection and faulting in controlling ridge structures are still poorly understood. These are particularly important to understanding formation and evolution of oceanic core complexes where ultramafic-hosted lithologies are exhumed at the seafloor by long-lived detachment faulting. The MARINER (Mid-Atlantic Ridge INtegrated Experiments at Rainbow) seismic and geophysical mapping experiment was designed to examine the relationship between tectonic rifting, heat/melt supply, and oceanic core complex formation at a non-transform offset of the Mid-Atlantic Ridge, 36 ^{o} 14 ' N, the site of the ultramafic-hosted Rainbow hydrothermal system. Using the seismic refraction data from this experiment, we constructed three-dimensional tomographic images of the crust and upper mantle around the Rainbow area. The seismic velocity images reveal undulations in crustal thickness across the ultramafic Rainbow massif, indicating temporal variations in melt supply, magmatic processes, and crustal construction. Previous studies suggest that a current heat source for the vents, which probably arises from a magmatic body, is required just beneath the hydrothermal vent, but the tomography does not detect a low-velocity anomaly indicating a significant magmatic system or high-temperature region beneath the Rainbow vent site. The only candidate region for high-temperatures and perhaps melt at shallow levels is much further to the south, and located roughly beneath the central valley of the spreading center. At the Rainbow massif, where mantle rocks have been recovered by direct sampling, mantle velocities near the seafloor are significantly reduced to ~ 5 km/s. This velocity reduction implies that an active hydrothermal circulation system altered the mantle via recharge and discharge of seawater.

Keywords: Slow-spreading ridge, Oceanic core complex, Rainbow hydrothermal field, Mantle alteration, Hydrothermal circulation, Seismic tomography