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Structural and Downhole Logging Studies of Shatsky Rise: Preliminary Results from IODP Expedition 324

Takashi Sano[1*], Naoto Hirano[2], Sanzhong Li[3], Gerardo Iturrino[4], Expedition 324 Scientific Party[5]

[1]National Museum of Nature and Science, [2]Tohoku University, [3]Ocean University of China, [4]Lamont-Doherty Earth Observatory, [5]IODP

Shatsky Rise, an oceanic plateau located ~1500 km east of Japan, is one of the few large igneous provinces, and the area is as large as that of Japan. The rise mainly consists of three large volcanic massifs (they are called Tamu, Ori, and Shirsov Massifs from southwest to northeast). Massif sizes and inferred ages imply a trend of decreasing magmatic volume and age from southwest to northeast. Magnetic lineations show that the plateau formed along the trace of a triple junction, intimately related to ridge tectonics.
IODP Expedition 324 cored Shatsky Rise at five sites; one site (U1346) on the summit of Shirshov Massif and two sites each on Ori (Sites U1349 and U1350) and Tamu (Sites U1347 and U1348) Massifs. Basaltic lava flows were recovered at four sites, but only volcaniclastic sediments were recovered at Site U1348. Among the five drilling sites, downhole logging data were obtained at four sites (Sites U1346, U1347, U1348 and U1349). The logging data included natural and spectral gamma ray, density, neutron porosity, photoelectric effect and electrical resistivity as well as borehole formation oriented images from the Formation MicroScanner (FMS). Combined visual structure-geological observations and downhole logging data have helped to reveal the framework of volcaniclastic sediments and lava flows that build up Shatsky Rise.
Primary structural elements observed in the cores include sediment bedding, conjugate joints, veins, breccias, and microfaults. In addition, synmagmatic structures, such as amygdules, vesicles, pipe vesicles, sheet flow structures, and interpillow and intrapillow structures, were also examined. Two primary synmagmatic structures, pillow and sheet flow structures, are found in cores of basaltic lava flows. Thicknesses of individual pillows within stacked pillow lavas are range from ~20 cm to ~200 cm and those of stacked sheet flows are up to 23 m. Most veins are postmagmatic and were filled after cooling. Many horizontal veins show syntaxial growth, cross-cutting relation with other orientations, suggesting that horizontal contraction produced the syntaxial veins at a late stage of formation. FMS images of the basement sites confirmed the syn- and post-magmatic structures observed on the core samples. Electrical resistivity measurements in the basaltic basement also show distinctive high-resistivity zones that likely represent pillow and sheet flows, interspersed with low-resistivity zones that mark sediment interbeds and highly altered zones.

Keywords: IODP, Shatsky Rise, Structure, Downhole Logging