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Major and trace element geochemistry of basement lavas from Shatsky Rise: preliminary results from IODP Expedition 324

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Shatsky Rise, located approximately 1500 km east of Japan is a unique Pacific plateau, formed during the Late Jurassic and Early Cretaceous when magnetic polarity reversed frequently. Tectonic reconstruction based on the magnetic lineations indicates that three main volcanic edifices (Tamu, Ori and Shirshov Massifs from southwest to northeast) of the Shatsky Rise were sequentially formed along the trace of a rapidly spreading triple junction that migrated from southwest to northeast. According to the plume theory, the oldest and largest Tamu Massif can be interpreted as a product due to the arrival of a plume head, and other smaller massifs represent the transitional phase from plume head to tail. A critical test of this hypothesis based on lava geochemistry is one of the main objectives for IODP Expedition 324.

Five sites were cored during the expedition, and basaltic lava flows were recovered from one site each on Shirshov (Site U1346; summit) and Tamu (Site U1347; east flank) Massifs and two sites on Ori Massif (Sites U1349 and U1350; summit and east flank, respectively). These were complemented by previous ODP Site 1213 on the south flank of Tamu Massif. Shipboard geochemical data demonstrate that the lava flows consist of variably evolved tholeiitic basalt. Least-altered basalts from Sites U1347 and U1350 show broad similarities with Site 1213 basalts and display compositional ranges overlapping those of mid-ocean ridge basalt (MORB) and Ontong Java Plateau basalt. More specifically, they are slightly enriched in incompatible elements compared to normal MORB (N-MORB), showing some resemblance to enriched-type MORB (E-MORB). This suggests that Shatsky Rise magmas were formed by a mantle source slightly richer in the more incompatible elements than the N-MORB source and/or slightly lower degrees of partial melting possibly in the presence of residual garnet. Alteration-resistant elements such as Zr and Ti indicate that highly altered basalts from Sites U1346 and U1349 are also tholeiitic. Site U1349 basaltic flows appear to represent significantly less differentiated magmas than those recovered from other sites and have similarities with primitive ocean-ridge and Ontong Java basalts (i.e., the high-Mg Kroenke type). Shore-based geochemical studies of the basalts will likely provide more insights into the nature of the mantle source to assess the role of a possible mantle plume in the formation of the Shatsky Rise.

Keywords: Integrated Ocean Drilling Program, Shatsky Rise, Large Igneous Provinces, mantle plume