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Volcaniclastic facies associations of Tamu Massif, Shatsky rise

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Shatsky Rise, a large oceanic plateau in the northwest Pacific, was formed during the Late Jurassic and Early Cretaceous at a rapidly spreading triple junction. Formation style of Shatsky Rise was poorly understood and sedimentary processes of volcaniclastics were not clarified.

Integrated Ocean Drilling Program (IODP) Expedition 324 cored five sites from Shatsky Rise, with 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. Cores from Site U1348 are a thick sequence (˜120 m) of volcaniclastic sediments topped with shallow-water carbonaceous sandstones. The volcaniclastic rocks from Site U1348 are generally highly altered, but a single interval containing fresh glass shards. We have examined sedimentary processes of the Tamu Massif based on facies analysis.

Shipboard Scientists have suggested that the thick sequence of volcaniclastic sediments is composed of four stratigraphic units, from Unit III to VI (Sager et al., 2010; Proc. IODP vol. 324). Our detailed facies analysis subdivided the Site U1348 section into six units. The clasts in Units III to VI are almost entirely composed of volcanogenic material, and are predominantly composed of various sized altered glass fragments and partly composed of carbonaceous sandstones. The sedimentary features of Units III to VI are inclined layers and foreset beds, mainly composed of parallel stratified altered vitric glass. Graded bedding (normal and reversed) and laminations are present throughout the section. We classified volcaniclastic rock of the section into 9 facies associations as a result of facies analysis.

The 9 facies are (1)-(3) three types of resedimented hyaloclastites (mainly mass flows), (4) in-situ hyaloclastite, (5) mixed facies of resedimented hyaloclastites / in-situ hyaloclastite, (6) low-density turbidites, (7) high-density turbidites, (8) grain flow deposites, and (9) mixed facies of cabonate clasts / epiclastics. The hyaloclastite are primary volcaniclastics, and turbidites and grain flow deposites are mostly epiclastics. Mixed facies of cabonate clasts / epiclastics is subdivided into 2 types.

The presence of hyaloclastite and turbidites, and no evidence of shallow marine sedimentary structures (e.g. wave ripples) indicate deposition of the volcaniclastic sediments in submarine environments at depths below wave base. The inclined layers may have been deposited as part of the ”slope apron” of a volcano. The gradual observed increase of dip with increasing depth in the core, implies decrease slope dip upward through time, possibly related to the progradation of a volcano slope apron.

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Keywords: Shatsky Rise, Tamu massif, facies analysis, submarine volcano, sediment gravity flow, hyaloclastite