Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SVC051-12 会場:301B 時間:5 月 22 日 17:15-17:30

海洋性島弧における地殻内マグマ長距離移動プロセス
Long-distance lateral magma transport in intra-oceanic arc volcanoes

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Recent geophysical observations in the Izu-Bonin intra-oceanic island arc indicate that magma is transported long distances laterally from the main basaltic composite volcano. When Miyakejima volcano erupted in 2000, seismic activity began beneath the volcano and migrated about 30km northwestward (Geshi et al., 2002). This event is interpreted to reflect northwestward dike injection from Miyakejima, transporting magma at a depth range between 12 and 20km (Kodaira et al., 2002). We demonstrated that long-distance lateral magma transport also occurred at Nishiyama volcano on Hachijojima Island using petrological, geochemical and structural studies of submarine and subaerial satellite vents (Ishizuka et al., 2008). Nishiyama provided evidence for two types of magma transport. In the first type, primitive magma moved laterally NNW for at least 20km in the middle to lower crust (10-20km deep) and is marked on the seabed as a series of submarine subparallel-aligning volcanic ridges. The other type is characterized by magmas that have experienced differentiation in a shallow magma chamber beneath Nishiyama and have been transported short distances (<5km). This latter type generates radially-distributing satellite cones. The long-distance magma transport seems to be controlled by a regional extensional stress regime, while short distance transport may be controlled by local stress regime affected by load of main volcanic edifice.

In this contribution, we report on recent investigations into the magma plumbing of Izu-Oshima volcano; an active basaltic volcano with extensive fissure eruption system. Cruise NT0906 accomplished 16 ROV dives in 2009. The dive areas were 1) NW of Izu-Oshima island, where the volcanism is expressed by NW-SE trending ridges, chains of volcanic edifices (NW chains) and the Higashi-Izu-Oki monogenetic volcanoes (HIMV) 2) SE of the island where NW-SE trending chains of volcanic edifices are also recognized (SE chains).

A bathymetric survey revealed that the subparallel NW-SE trending volcanic ridges extend up to 22 km to the NW and SE from the summit of Izu-Oshima volcano. The diving survey revealed that: 1) NW-SE trending ridges are eruption fissures, which erupted basaltic spatter and lava flows. 2) Basaltic effusives are petrographically similar among each ridge, while there are noticeable differences among the chains. 3) The NW chains are petrographically distinct from the HIMV in the same area. 4) Most of the NW-SE trending ridges have little sediment cover, implying that these eruption fissures are very recent.

Most of SE chains are petrographically and geochemically similar to the central and subaerial vents in the latest stage of activity of this volcano (last 2000 years), while NW chains are similar to the older subaerial satellite cones. Geochemical similarity between the submarine and subaerial chains on its extension implies that each volcanic chain represents an episode of lateral magma transport away from the main Izu-Oshima edifice. This scenario also explains the overlapping distribution of HIMV and NW chains which have clearly distinct sources. HIMV appears to be fed by ”in-situ” source, while NW chains are fed by magma plumbing system of Izu-Oshima volcano by lateral magma transport.

Magma transport at Izu-Oshima volcano, however, seems to be distinct from those at Hachijojima-Nishiyama volcano. Izu-Oshima system does not show compositional variation along the volcanic chain, and no primitive magma occurs in the chain. Long distance magma transport at the Izu-Oshima volcano seems to occur from shallow crustal magma chamber where extensive crystal fractionation and plagioclase accumulation take place.

Long-distance lateral magma transport in oceanic island arc volcanoes could be common phenomena where regional stress regime is favorable and important factor for construction of volcanic edifice and eruption system.
Keywords: Izu-Oshima volcano, intra-oceanic island arc, dyke, long-distance lateral magma transport