Topographical characteristics of volcanic cones in the Southwest Oahu volcanic field, Hawaii

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Upper part of the oceanic crust is mainly composed of basaltic sheet flows and minor volcanic cones(Shen et al., 1993; Hooft et al., 1996; Smith et al., 1999). The submarine volcanic cones have been investigated in the median valley of Mid-Atlantic Ridge (MAR), off-axis of East Pacific Rise (EPR) and hotspot related volcanic islands. Some morphological characteristics of the cones have been identified such as flat-topped volcanic cone or pointed volcanic cone(Smith 1988; Magde and Smith, 1995; Head et al., 1996; Clague et al., 2000; Clague et al., 2002). In order to understand the submarine volcanism, the genesis of volcanic cones is as important as the ridge process.

Although the Southwest Oahu Volcanic Field (SWOVF) have been recognized by GLORIA study, the high-resolution bathymetric data did not obtain before Japan-US joint research cruises in 2001-2002 using the facilities of Japan Marine Science and Technology Center. Therefore, morphological characteristics of the cones occurred in this area have been remained uninvestigated. The research cruses reveal that the volcanic field has many small volcanic cones. In order to characterize the morphological parameters in the volcanic cones, we study the DEM data using GIS tools.

Polygons which are supposed to be a volcanic cone were retrieved from the grid data using direction and angles of the slope face. The volcanic cones are defined by cyclic slope in the polygon. We can recognize three topographically different volcanic cones, flat-topped volcanic cone (FTVC), pointed volcanic cone (PVC) and combination of the two types. The GIS method combined with GROLIA data identified lava flow area from volcanic cone. The volcanic cones identified by the topographic characteristics have highly reflective area.

For each identified volcanic cone, we recorded height (h), basal area (S), slope area (ss), flat area (fs), slope angle (phi). From these variable, we calculated morphological parameters and attempt to morphological characterization. Among of parameters, flatness (f=fs/S) shows remarkable difference. After morphological classification with flatness, it became clear that PVCs account for 60%, composite volcanoes are 26%, FTVCs are 14% in SWOVF. Average of flatness of all of these volcanic cones is f=0.20.

Morphology of volcanic cone can be described by flatness (f) and height (h) (Smith, 1988). In this point of view, consider reported data calculated with variable area, high flatness volcanic cones produced mainly at fast spreading rate area and low flatness volcanic cones produced mainly slow spreading rate area. At Hawaii Puna ridge, volcanic cones has high flatness (Smith et al., 2002). Flatness of volcanic cones in North arch volcanic field resembles MAR. Flatness of volcanic cone in our research area resembles flatness of volcanic cones in EPR, which has first spreading rate. In EPR, axis mainly covered by lava flows, and volcanic cones occur in off-axis. So that, both volcanic cones in SWOVF and EPR may have builded at low effusive rate area. low flatness volcanic cones in SWOVF are limited to highly vesicular alkalic rocks. We infer that probably vesiclated alkalic rocks which have slow effusive rate formed low flatness volcanic cones.