

What can we learn through volcano drilling? Results of conduit drilling

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We can get important information on volcano structures through drilling, and it verifies various models of volcanoes formed based on the results by physical exploration and on petrological data of eruption products. A plenty of new volcanological knowledge was issued through drillings at Kakkonda and Nigorikawa areas and Aso, Fuji and Izu-Oshima volcanoes. Unzen Volcano has not experienced explosive eruptions due to effective degassing from initially hydrous magma. The conduit drilling carried out during 2002-2004 aimed to clarify the mechanism of such effective degassing by examining lavas sampled from the conduit and logging data in and around the conduit. Setting the target into the hypocenter region of isolated tremors that occurred just before magma extrusion of the last eruption, drilling was started from the northern slope of Mt. Fugen and the inclination reached up to 75 deg from the vertical. The total length is about 2 km, about 1.5 km horizontally and 1 km vertically. Coring was carried out in spots near the conduit and cutting slimes were taken every 2 m from the depth intervals without coring, the latter which was used to get the geological information of along the well trajectory. Physical data were taken nearly continuously down to 1.8 km, adopting the Tough logging method in the deepest part.

Multiple lava dikes (max of each, less than 40 m thick) of different ages with abundant thin tuffisites were developed vertically, trending nearly in the east-west direction, within about 300 m width around the target. Dike lavas and host rocks were hydrothermally altered heavily, suggesting circulation of hydrothermal fluid after the last eruption. The conduit of the last eruption was confirmed in the southern end of the conduit region by chemical identification of dike lavas with lavas of the last eruption together with the highest temperature along the well. The conduit had been cooled as low as 160 to 180 deg C, due to sufficient circulation of hydrothermal fluid since the end of eruption. Negligible loss circulation during drilling of the conduit region and scarce occurrence of open cracks suggests lateral degassing from the conduit during eruption. On the other hand, tuffisite is the evidence of vertical degassing from the ascending magma, and is the fossil of isolated tremors. This suggests that degassing occurred vertically using the conduit itself during eruption.

It became clear by the conduit drilling of this time that conduit region consisting of parallel multiple dikes develops under the active volcanoes, where hydrothermal fluid can circulate soon after the eruptive activity. Efficiency of degassing does not depend on the property of country rocks, but degassing occurs effectively using the conduit. Volcano drilling makes us possible to investigate not only the subsurface structure but also mechanisms of eruption.