

Processes from the generation to the deposition of rhyolitic phreatomagmatic eruption: examples of Hime-shima Volcanic Group

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In Quaternary Hime-shima Volcanic Group located at northeastern Kyusyu, Some about 50m-thick pyroclastic cones covered with about 50-100m thick rhyolitic lava flows. Because these cones have large crater-diameter and contain many obsidian blocks having quenched surfaces, these cones are presumed to be produced by phreatomagmatic eruption. We consider generation and deposition processes of rhyolitic phreatomagmatic eruption based on geological survey because rhyolitic phreatomagmatic eruption are not well understood.

Occurrences and formation processes of lavas and pyroclastic cones

Shiroyama, Darumayama and Inazumi lavas are shattered wholly and partially brecciated to a few meters to a few dozen centimeters. At lower part of lavas, there are pyroclastic dikes. Pyroclastic dikes are composed of lava blocks. These dikes are thought to be spiracles produced by the vaporization of water trapped under lavas emplaced at a wet environment.

Pyroclastic cones, whose dip angle are about 30 degree, are composed of dozens of tuff breccias, lapillie tuffs and tuffs. Granularity characteristics of tuff breccia and lapilli tuff layers are the large degree of concentration and the lack of fine materials. Also tuff breccia and lapilli tuff layers are divided into the continuous unit having the same thickness and the lenticular unit with reverse grading, which suggest that the former is estimated to be pyroclastic fall deposits derived from eruption clouds, and the latter is talus deposits derived from pyroclastic fall deposits. Over 90 % of component materials are lava-like non- to poorly vesiculated rhyolitic fragments, and the other are small amount of quenched obsidian fragments and andesite fragments derived from basement rocks. There are also some peperite blocks in pyroclastic cones, which are divided into the type with irregular fractures filled by basement rocks and the type mingling brecciated rhyolite and basemant rocks. These peperite blocks suggest that basement rocks got moist and passed through variable degree of mingling with ascending rhyolitic magma.

We consider formation processes of lavas and pyroclastic cones. At first, lava effusion on the wet sediment and the formation of many spiracles occured. Blocky peperites were produced by admixtures between magma and basement rocks in the conduit. Then, phreatomagmatic eruptions occured and pyroclastic cones were produced by repeated the fallout and the rolling motion of pyroclasts.

Mechanisms of rhyolitic phreatomagmatic eruption

It is necessary for driving phreatomagmatic eruptions to transfer heat from magma to external water instantaneously. Effective processes of heat transfer include the increase area of contact between magma and water. For high viscosity and yield strength of rhyolitic magma, however, the increase area of contact due to instability of fluid boundary cannot occur. Peperite blocks suggest that brecciated rhyolitic magma due to quench fragmentation admixed with watery basement rocks.

Next, we consider the water-flow into conduit and the trigger processes of phreatomagmatic eruption. Basement rocks with pore pressure will flow into conduit easily because of the decrease of internal pressure of conduit due to waned magma supply rate. Phreatomagmatic eruptions can occur when high pressure fluids fracture and flow into magma and make contact with molten magma. Even if the direct contact of molten magma and water cannot occur, phreatomagmatic eruption of destruction of phase-equilibrium type may arise when the vapor reservoir with the equilibrium between vapor and water in the brecciated part of magma can form.