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Parasitic† Eruptions on Sakurajima Volcano

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Spatial distribution of parasitic vents is closely related to movements of magmas at a certain depths of main conduit of the central volcano. A simple method for studying distribution of parasitic vents is presented: That is numbers of parasites per unit area according to radial distances from the central vent. On and around Sakurajima volcano, two peaks of the distribution diagram are found at roughly 2.5 and 8.5 km in radial distances. These can be interpreted into that the magmas branched away at different depths of the main vent. The branching mechanism is discussed from a standpoint of material mechanics. In this case, magmatic forces are assumed to be due to point dilatations that have proved effective in interpretation of surface deformations observed at various volcanoes. To interpret formation of parasitic vents, or outward fractures, on the flanks of a polygenetic volcano, the theory of maximum shear stress is adopted. As a result, a parasitic vent branches off from the main conduit at a depth that is related to the radial distance of the parasitic vent from the center of the volcano, and theoretically we may expect twin parasites symmetrically with respect to the center of the volcano. Whether new magmas outburst at the main crater or a new parasitic-vent fractures at the flank may depend on conditions of the main crater, the relative strengths of both the sites, and mechanism of branching. The three largest parasitic eruptions on Sakurajima volcano in historical times, the 1471～76, the 1779～80, and the 1914 eruptions, are examined: Each of these eruptions opened two vents on the opposite flanks of the central summit with a partly exception in the 1779～80 eruption. The exceptional case is suggestive for formation mechanism of twin parasitic cones. Formation of such twin vents is mechanically normal but empirically odd. An empirical fact that parasitic volcanoes only erupt once is hypothetically interpreted: Surroundings of parasitic conduits are probably strengthened mechanically by intrusion of magmas, and the sub-conduit may be tightly choked with lavas. We may say that the next eruption of Sakurajima volcano may take place at the summit crater, and otherwise, statistically, parasitic eruptions may burst probably on the flank and rarely at the sea. The parasitic vents would open at a region of "parasite-gap" on the flank, and would twin at the opposite sides of the summit. To improve the forecast, we need to clarify the formation mechanism of parasites in more detail.

Key words: parasitic eruptions, monogenetic volcanoes, maximum shear stress, Sakurajima volcano, twin parasitic vents.

1. Introduction

Parasitic volcanisms have been deemed as secondary though they are actually an important manifestation of volcanic forces. Parasitic eruptions on a polygenetic volcano occur when magmas branch off from the central conduit at a certain depth and erupt on the flanks forming cones. These parasitic cones are different from monogenetic ones formed in volcanic fields or volcano groups. The latter involves with the ascent of individual magma batches from great depths. Parasitic volcanoes are nevertheless considered to be monogenetic because their vents are generally not expected to experience additional activity when once an eruption cycle is over. Understanding the causes of parasitic eruptions, rather than eruptions from the central vent of a polygenetic volcano, is important because such vents may bring volcanic activity closer to human settlements, and because lava flows erupted from parasitic vents may more readily inundate areas low on the flanks of the volcano. Therefore, it is important to examine the distribution of parasitic vents and interpret the mechanisms that give rise to this distribution.

Of many historical records of eruptions on Sakurajima volcano, the three biggest eruptions all produced two vents on the opposite flanks of the central summit. Such characteristics of the Sakurajima eruptions should be the most suitable subject in the discussion of parasitic volcanisms.

† In the present paper, the author prefers "parasitic" to "lateral" because the former expresses the meaning of origination better. P.O.D. says that "parasite" is an animal or a plant, living in or on another & drawing nutriment from it.

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