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Sequential change of magma supply rate during the Hoei eruption, Fuji Volcano, Japan (AD 1707)

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The AD 1707 eruption of the volcano, known as Hoei eruption, is one of the most intensive eruptions of the volcano and caused severe damages in the downwind area. We reconstructed the sequence and change in mass discharge rate of the Hoei eruption from the detailed correlation between the timelines reestablished from historical documents and geological units.

The eruptive deposit was subdivided into 17 units on the basis of their facies with the mass of each unit established using isopach maps. However, from examination of historical documents, we only detected six obvious quiet intervals from historical documents. We thus defined an eruptive pulse as the period of continuous tephra fall divided by the obvious quiet interval. We then divided the course of the Hoei eruption into 3 stages on the basis of the pattern of eruptive pulses. The characteristics of the three stages are described as follows.

Stage I is characterized by quick firing of two energetic eruptive pulses (?25 km high column), with each of them showing intense outburst initially, followed by a decrease in intensity (?16 km high column). In this stage, silicic magma erupted in the early outburst phases and followed by mild phase of basaltic magma. Stage II consists of discrete firing of basaltic magma, resulting in the formation of a relatively low eruption column (?15 km high column). Stage III is principally characterized by sustained column activity of basaltic magma without a clear repose time. In stage III, the column height appears to be always above 13 km and at least three distinct active periods the column height is presumed to exceed 16 km.

The change in magma supply rate is summarized as follows. In initial silicic phase of stage I, the magma supply rate is high (3.3×10^{11} kg/day) and then lowered to the average of the whole range of the eruption (1.2×10^{11} kg/day). In stage II, the eruption become discrete and eruption rate decreased (0.8×10^{11} kg/day). During the stage, intrusion of magma presumably formed Mt. Hoei. Thus, magma supply from depth might continue in same rate during this stage. In the stage III, the supply rate recovered close to the average rate (1.1×10^{11} kg/day) and maintained until sudden termination of the eruption.

The newly reconstructed sequence of mass discharge rate did not show any clear evidence of a downward tendency before the eruption ended. This observation could indicate that the mass flow was not principally controlled by excess pressure within the magma chamber.

Keywords: Fuji Volcano, Hoei Eruption, AD1707, Plinian, tephra, eruption column