Syn-Plinian vigorous lava fountain in andesitic volcanoes: Case study of the Sakurajima 1914 and 1779 eruptions and the Asama 1783 eruption, Japan

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Concrete examples of complex behaviors of erupting magma during explosive eruption will be reported on the basis of geological observations. The eruptive products of the Sakurajima 1914 and 1779 eruptions and the Asama 1783 eruption include evidence of a large-scale deposition of pyroclastic materials in the proximal areas during these Plinian eruptions and suggest syn-Plinian lava fountaining.

The geology, eruptive sequence, and eruption styles have been investigated for the above three eruptions (e.g. Yasui and Koyaguchi, 2004, Yasui et al., 2013). The initial Plinian eruption occurred from flank fissures on two sides of Sakurajima volcano in 1914 and lasted for about 36 hours (Stage 1). It was followed by the outflow of lava (Stages 2 and 3). The 1779 eruption followed a similar sequence as the 1914 erupiton. Old drawings and photographs of these eruptions show that a large amount of pyroclastic materials fell from the Plinian column in the proximal area. Pyroclastic cones are recognized along the fissures on the upper to middle flank slopes. Thus, the cones were considered to have formed simultaneously with the Plinian eruptions. Extensive clastogenic lava flows are also recognized on the slope. These cones and lava flows are composed of welded pyroclastic materials and are characterized by eutaxitic textures and abundant highly broken crystals.

In the case of the Asama 1783 eruption, the activity culminated in a climactic, explosive eruption after the intermittent Vulcanian eruptions of about three months. The eruptive style of the climactic stage of the Asama 1783 eruption is quite similar to that of Stage 1 of the Sakurajima 1914 and 1779 eruptions.

These eruptions have the common features of the formation of proximal cones and generation of clastogenic flows as well as dispersal of the pumice fall in the distal areas. Concerning the Asama 1783 climactic eruption, the volume of pyroclastic materials that fell onto the proximal area is estimated to be 20 times as large as that entrained in the Plinian column. This indicates that these eruptions have similar aspects to the high fountaining with minor tephra observed at Kilauea and Etna. The coexistence of a Plinian column and lava fountain indicates a complex behavior of erupting magma in the conduit. Annular, misty flow in the conduit may be a possible explanation in the case of the Asama 1783 eruption. That is, a gas-rich center is surrounded by a pyroclasts-rich lining and a Plinian column may originate from the center part. In the cases of the eruptions in Sakurajima, the progress from an explosive eruption at a higher flank in Stage 1 to the effusion of lava at a lower flank in Stage 2 could be explained by the propagation of a radial dyke. The condition of misty flow in the dyke system may be similar to that in Asama 1783 eruption.