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Development of a collapse caldera during the Miyakejima 2000AD eruption

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A 1.7 km across collapsed caldera was formed during the 2000AD eruption of Miyakejima volcano. The 2000AD activity began with dike intrusion from the shallow reservoir beneath the summit area on 26th June, 2000, and the dike propagated the northwest off of the volcanic island. Most part of the evacuated magma intruded within middle - upper crust without major surface breakout. The caldera collapse began 12 days after the beginning of the dike intrusion and continued for about 40 days as the continuous migration of magma from the collapsing reservoir into the dike.

At the beginning of the caldera collapse, the size of the caldera was ca 1 km across and 150 m deep. Growth of caldera was continued for 40 days with intermittent subsidence of the caldera floor. Averaged growth rate of the caldera is 15 million cubic meters per day and the final size of the caldera reached 1.7 km across and 0.6 cubic kilometers in volume.

At the first stage of the collapse, subsidence of caldera floor was carried by a double ring fault system with inner reverse fault and secondary-formed outer normal-slip fault. Across of the inner subsided area was 600 – 700 m. As progress of the caldera growth, landslides and rock avalanches of the caldera wall enlarged the horizontal across of the caldera and the ring fault system on the caldera floor was hidden by the debris. Depth of the caldera was kept at ca. 500m during the caldera growth, suggesting the balance of subsidence of caldera floor and reclamation with landslide debris from the caldera wall.

Phreatomagmatic eruptions occurred from the caldera mainly in the early stage and almost just after the caldera growth. Series of phreatomagmatic eruptions produced tephra consisting mainly with fine-grained clay-rich volcanic ash, although most extensive explosion on 18 August ejected volcanic blocks up to several meters across

within an area 3 km from the summit caldera. Total volume of the tephra was estimated about 1.6×10^{10} kg, and this volume is exceedingly smaller than the volume of the collapse ca 1×10^{12} kg, indicating that the intrusion of magma into the dike caused the caldera collapse. The tephra contain juvenile materials several 10s %, although most part of them consist of the accessory materials derived from the previous volcanic edifice. The juvenile materials are poorly vesiculated and show remarkable quench texture, suggesting rapid cooling by ground water. Change of compositions of the juvenile materials from andesitic to basaltic during the caldera collapse indicates the evacuation of andesitic magma from the reservoir and upward intrusion of a new basaltic magma from the deeper system triggered by the caldera growth.