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Asymmetric development of the Miyakejima 2000 caldera

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A circular caldera with 1.7 km across and 0.6 cubic km volume was formed during the AD 2000 eruption of Miyakejiema (Japan). Distribution of the fault inside the caldera indicates that the subsided area surrounded by the ring faults is a circular area with 700 - 800 m across. The assumed subsided area almost overlaps the area of the caldera floor at the northwestern center of the caldera. The assumed subsided area almost coincides with the area of the first collapse at the beginning of the caldera growth on July 8, 2000, showing that the position and size of the circular faults were almost constant during the development of the caldera. The topographic size of the caldera was modified by the landslides and avalanches of the caldera wall induced by the subsidence of the caldera floor. The outward migrated of the caldera wall reached 300 -500 m and the topographic across of the caldera became almost twice of the size of the real-subsided area at the end of the subsidence. This observation tells us that topographic horizontal size of the caldera is generally much larger than the real-subsided area and the topographic depth is shallower than the distance of real subsidence.

The 2000 caldera has a remarkable asymmetric structure. Outward migration of the caldera rim during the 2000 eruption was largest at the SE part (∼500m) and smallest at the NW (∼300m). Distribution of the thermal activities, such as distribution of the fumaroles, the location of main crater emitting volcanic gas, and eruption sites during the 2000 eruption, concentrate to the southern half of the caldera. A tilted block consisting of the previous volcanic edifice with many faults associated to the subsidence, distributes only at the SE part of the caldera.

Inclined ring faults are one of the possible explanations for the asymmetric structure of the caldera. The ground deformation detected before and after the eruption indicates that the pressure source, which is a possible magma chamber, exists 0.5 – 1.5 km south of the caldera center (Nishimura et al., 2002) and this observation also supports the oblique subsidence during the 2000 eruption. Local heterogeneity of the rock strength inside the volcanic edifice, reflecting the existence of the previous caldera structure and solidified conduit swarm is one of the possible explanations for the oblique development of the ring fault. Localized load of the projected volcanic edifice may also disturb the development of the ring fault.