2. Activity of Sakurajima Volcano

Sakurajima volcano is a post-caldera volcano, located at the southern rim of the Aira caldera in the southern Kyushu. The main magma reservoir is estimated to be located 10 km deep beneath the caldera, and the sub-reservoir is located a few kilometers under the volcano (Ishihara, 1990). In the historical time, large eruptions were originated three times in 1471-1476, 1779-1781 and 1914. Each eruption ejected lava and pyroclastic materials of 1 to 2 km^3 from the both flanks of the volcano.

The current eruptive activity, summit eruption, started in October 1955, and has continued for 48 years. The area 2 km around the summit crater has been specified as an off-limits area, where no one can enter. The activity is characterized with intermittent explosive eruptions of a Vulcanian type and emission of volcanic ash. The annual number of explosive eruptions is shown in Fig. 1. The cumulative number of explosive eruptions is 7842 as of the end of 2002. The amount of volcanic ash ejected each year since 1978 is shown in Fig. 2. The amount of volcanic ash ejected from June, 1978 to December, 2002 is estimated to be 190 millions tons by the Sakurajima Volcano Research Center, Disaster Prevention Research Institute of Kyoto University.

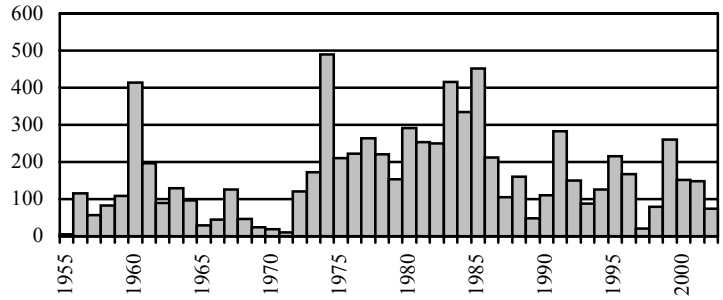

Fig. 1. Annual numbers of explosive eruptions at Sakurajima volcano (1955-2002)

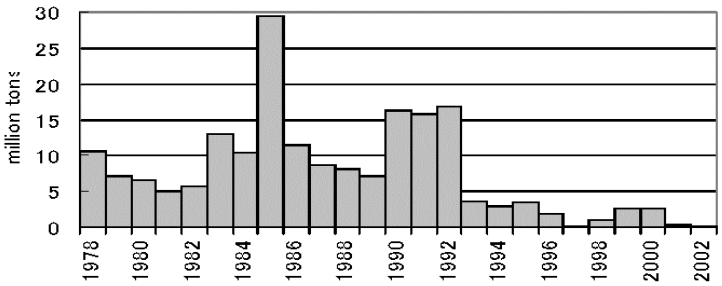

Fig. 2. Annual amounts of volcanic ash ejected from Sakurajima volcano (1978-2002)

Fig. 3. The summit crater of Sakurajima volcano on May 11, 2001. A small lava dome appears at the bottom of A-crater.

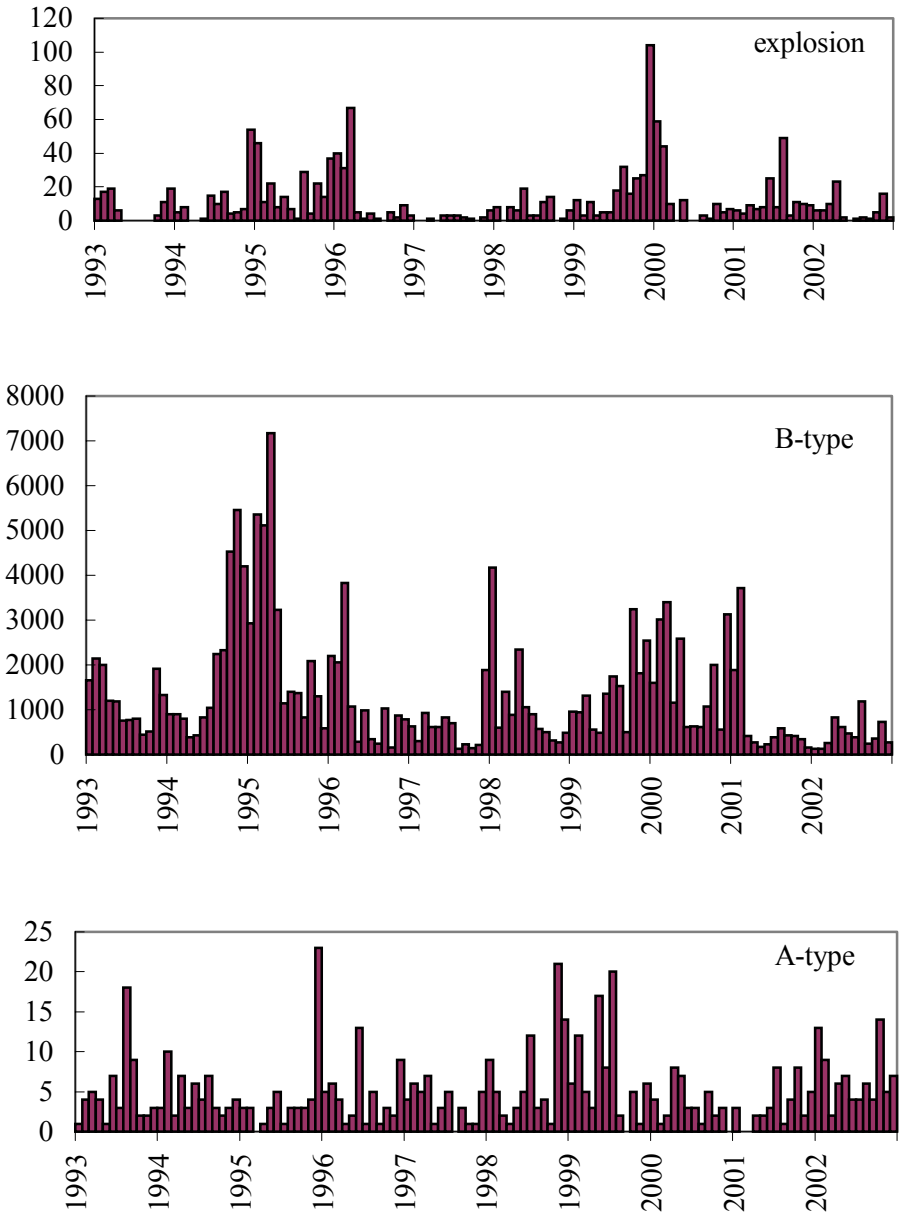

Fig. 4. Monthly numbers of explosive eruptions, B-type earthquakes and A-type earthquakes at Sakurajima volcano (1993-2002).

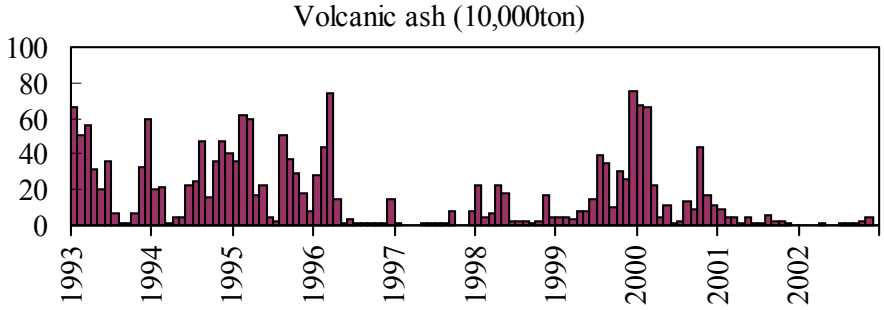

Fig. 5. Monthly amount of volcanic ash ejected from Sakurajima Volcano (1993-2002)

Fig. 6. A car damaged by lapilli stones on October 7, 2000

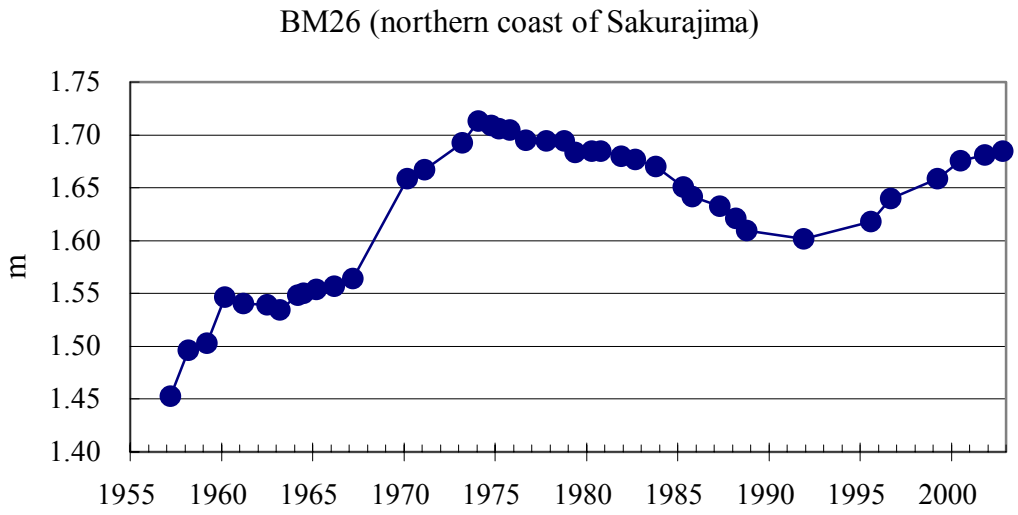

Fig. 7. Vertical ground deformation at Sakurajima volcano (Change in relative elevation of BM 26 at Sakurajima volcano). BM 26 is one of the nearest benchmarks to the center of the Aira caldera.

Explosive activity declined around 1993 (Ishihara, 1999). The amount of volcanic ash has rapidly decreased since 1993, though the number of explosive eruptions does not significantly decrease. This is related to a short duration of eruption, namely, most of recent eruptions ceased in a few minutes. Corresponding to the decrease in ejected ash, the ground deformation of the Aira caldera was turned into inflation in 1994. The summit crater became 250-300 m deep in 1995, which is the deepest record since 1955, and the flight distance of volcanic blocks ejected by recent eruptions became short (Ishihara, 1999). The summit crater has been still deep during the period from 1999 to 2002. Occasionally, a small lava dome, 20-40 m in diameter, appeared at the crater bottom, as shown in Fig. 3.

Monthly numbers of explosive eruptions, B-type earthquakes and A-type (volcano-tectonic) earthquakes during the recent 10 years are shown in Fig. 4. B-type earthquakes are low-frequency earthquakes related to extrusion of magma (Iguchi, 1994). Amounts of volcanic ash each month for the same period are illustrated in Fig. 5. During the period from 1999-2002, B-type earthquakes and ejection of volcanic ash increased in 1999 and 2000. A few strong eruptions however occurred, as indicated by a few numbers of volcanic advisories issued by the Kagoshima Meteorological Observatory: 4, 1, 0 and 0 times in 1999, 2000, 2001 and 2002, respectively. Two of 5 were issued associated with swarms of B-type earthquakes in 1999, which led to increase in explosive eruptions, and the others related to strong explosive eruptions in 1999 and 2000. The largest eruption occurred on October 7, 2000. In an hour, volcanic ash and lapilli of $(3\text{-}4)\times10^5$ tons were ejected, and more than 35 cars were damaged by lapilli of 1 to 3 cm at a parking area 6 km away from the crater, as shown Fig. 6.

The emission rate of sulfur-dioxide from the summit has kept high level (1400-4900 ton/day) during the period from 1974 to 1996, even if eruptive activity became low (Ishihara, 1999). The emission rate observed by COSPEC in November, 1999 and November, 2001 was 2800 and 1900 ton/day (Kazahaya, 2001). No clear relationship between eruptive activity and emission of sulfur-dioxide has been recognized at Sakurajima volcano.

As mentioned above, the deflation of the ground around the Aira caldera was turned into inflation in 1994. At Sakurajima, leveling survey has conducted along a coast road since 1957. The change in the relative elevation of BM 26, close to the center of the caldera is illustrated in Fig. 7. The reference point is BM 17, 6 km southwest away from the benchmark. BM 26 indicated gradual uplift by 8.4 cm from December 1991 to November 2002. This suggests that storage of magma under the caldera is in progress for future eruption. However, the rate of uplift is much smaller than those in the former inflation stage during 1964-1974. This may suggests that magma supply rate to the caldera has decreased during the past 10 years.

(Kazuhiro Ishihara)

References

Iguchi, M. (1994) A vertical expansion source model for the mechanisms of earthquakes originated in the magma conduit of an andesitic volcano: Sakurajima, Japan. *Bull. Volcanol. Soc. Japan*, **39**, 49-67.

Ishihara, K. (1990) Pressure sources and induced ground deformation associated with explosive eruptions at an andesitic volcano: Sakurajima volcano, Japan. In Ryan, M. P. (ed.), *Magma Transport and Storage*, John Wiley & Sons, 335-356.

Ishihara, K. (1999) Activity of Sakurajima Volcano, *Reports on Volcanic Activities and Volcanological studies in Japan for the period from 1995 to 1998*, 4-8.

Kazahaya, K. (2001) personal communication.