

A precursory process of the 1914 eruption of the Sakurajima volcano inferred from experience of residents

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The 1914 eruption of the Sakurajima volcano was the largest eruption in Japan in 20th century. The eruption was commenced by plinian eruption at west and east flanks and followed by effusion of lava. Prior to the beginning of the eruption at 10 AM on January 12, abnormal phenomena were recognized by residents. Here, I try to interpret the abnormal phenomena based on recent knowledge obtained by volcano observations. 1) Discharge of CO₂. In July 1913, two people died in a valley of southern part of Sakurajima and it was recognized that the deaths were caused by lack in oxygen due to dense CO₂. Distribution of large discharge rate of CO₂ from soil gas and quite dense concentration in boreholes suggest a large gas reservoir. Concentration of CO₂ in gas from a hot spring increases when inflation of the volcano is detected by a strainmeter in present activity of Sakurajima. The discharge rate of CO₂ increased rapidly due to inflation of the volcano half year before the eruption. 2) Uplift of Sakurajima. In December 1913, water withered at a well, where the water had never withered even in low tides of spring tides. The water wells were located near the sea coast and the water level was balanced with tide level. Descend of water level was a relative displacement to uplift of Sakurajima. It is estimated that the ground was uplifted by 0.5 m and volume increase of a source was $1.4 \times 10^8 \text{m}^3$, assuming the source at a depth of 6km beneath central cones of Sakurajima. 3) Intense seismicity. Volcanic earthquake including felt one began to swarm at 3 AM on January 11 and the number of earthquakes increased until the beginning of eruption. 4) Acceleration of inflation. Sea bottom exposed at SW coast at 2 AM on the day of the eruption. An underwater rock, which had never appeared even in low tides of spring tides, was uplifted above sea water at least 60 cm. Taking theoretical tide level change into account, it is estimated that the rock was uplifted by 80 cm and the uplift was caused by volume increase $1.7 \times 10^8 \text{m}^3$ of a source beneath the central cones. The rapid inflation was associated with the intense seismicity. 5) Pressurization of underground water. Around 6-7 AM, it was found that water overflowed from wells and hot water was effused from sea coast. It is interpreted that the underground water beneath the volcano was pressurized due to ascent of magma to quite shallow parts at east and west flanks. It is estimated that intrusion rate of magma reached an order of $10^8 \text{m}^3/\text{day}$ immediately before eruption. On the other hand, intrusion rates of magma were $10^5 \text{m}^3/\text{day}$ during the period of frequent vulcanian eruptions at a crater of Minamidake from 1974 to 1992 and an order of $10^4 \text{m}^3/\text{day}$ during the present activity at the Showa crater. Intrusion rate of magma is an important parameter to forecast scale of eruption.