

Eruption scenario of Usu volcano, Japan

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The national research group on volcanic eruption forecasting is preparing the eruption scenarios (event trees with probabilities) for representative active volcanoes, such as Izu-Oshima, Miyakejima, Sakurajima, Shinmoedake (Kirishima), and Usu. During recent eruptions at Sakurajima and Shinmoedake, the eruption scenarios were prepared and used to try to evaluate the development of on-going eruptions.

At Usu volcano, after a sector collapse about 7 to 8 ka, the eruptive activity resumed in 1663 with the plinian and pyroclastic surge events. Since then, five summit eruptions with the plinian columns had occurred in the end of 17th Century, 1769, 1822, 1853, 1880-1889, and 1977-78, and three flank eruptions with phreatic to phreatomagmatic events had occurred in 1910, 1943-45 and 2000. These eruptions were recorded in old documents or observed geophysically from the beginning of 20th Century. These eruptions occurred statistically every 30+/-4 years. Except small flank eruptions, there is a good negative correlation between the erupted volume and frequency in log unit. Seismic precursory started generally a few days before the eruption in respective of eruption locations. The summit eruption started after acceleration of seismic activity, while the flank eruption did after passing the peak of seismic activity. In respective of the eruption locations, eruptions ended with the formation of lava domes or cryptdomes, except for the 1663 eruption. The larger the erupted volume, the shorter the eruption duration. As a whole, the volume of eruption decreased with time and the magma became less evolved from 75 % SiO₂ in 1663 to 69 % SiO₂ in 2000. Temporal development of three cycles of magma plumbing system, in each of which mafic magma injected into chemically zoned, shallow magma chamber, is proposed.

The probability of flank failure in future can be calculated about 0.01, and those of the summit and flank eruptions are about 0.3 and 0.5, respectively. The summit eruption starts with the plinian event column in about 0.75 probability, while the flank eruption starts in about 0.7 probability without magmatic eruption. However, this may be a rough indicator because these data are based mainly on the eruption records during these 300 years. For example, summit-subsidence eruption occurred at Miyakejima for the first time in about 2500 years, and pyroclastic flow eruption at Unzen in about 4000 years. Movement of the fault system suggesting a future sector collapse in the northern flank of the volcano was observed during the last two eruptions. New eruption scenario not based only on the past eruption records should be prepared.