Growth mechanism of base cloud on the August 29, 2000 eruption in the Miyakejima volcano

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In a series of phreatomagmatic activities of the 2000 AD. summit eruption at Miyakejima volcano some eruption accompanied with surge-like lateral moving ash cloud (base cloud). At Aug. 29 eruption, base clouds flowed down in all directions and some reached seashore of this island. The state of the eruption column and base cloud was recorded by observation of joint university research group, press and residents. We combine with occurrence situation of base clouds determined using photo images and field observation of eruption deposit including proximal area, and presume eruption mechanism.

At Aug.29 eruption, a rash of dark-colored plumes and amplitude of infrasonic wave and volcanic tremor indicate the maximum intensity apparently occurred about 04:30 to 06 a.m. Eruption occurred at crater group arranged NW-SE direction on southern margin of the caldera floor. Column collapse often occurred. The frequency between 04:40 and 05:47 is about 0.2 per min. Both case of whole collapse and partial collapse of ascending plume was observed.

base cloud occurred intermittently between 04:36 and 06:51. In SE-SW sectors, base cloud occurred when collapsed part of higher column fell outside of caldera rim. Its initial lateral velocity exceed 15m/sec, and runoff distance were about 2-3km. Extracted co-surge ash fell on the north side by effect of southern wind. Once surge occurred, ash cloud existed for several to dozens of minutes.

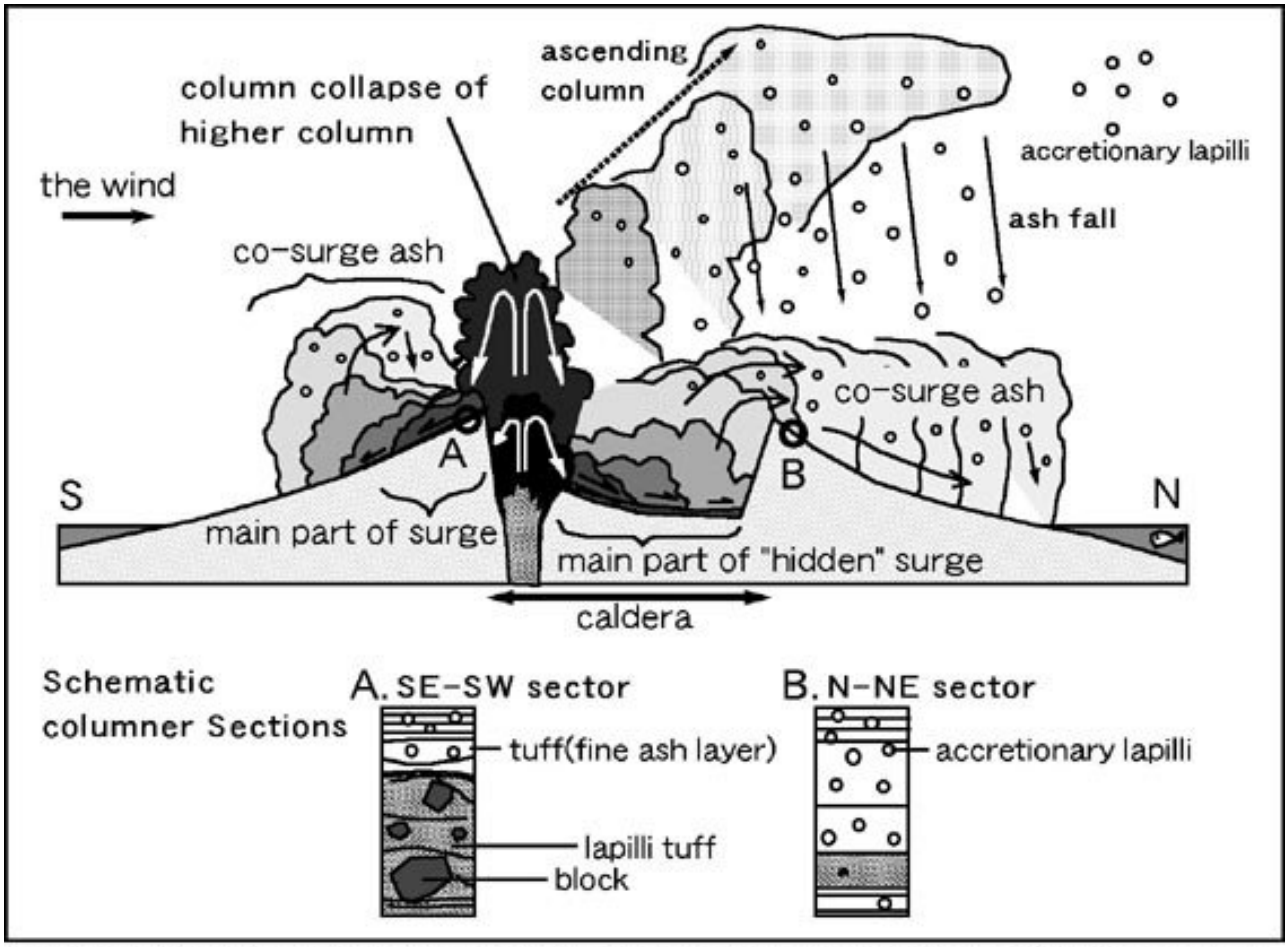
Contrariwise, in NE-NW sectors, base cloud occurred continuously, slowly (less than 10m/sec), and laxity shaped similar to co-surge ash stage cloud of base cloud in SE-SW sector.

The deposit of Aug.29 eruption composed mainly of stratified purplish fine ash layer and distributes mainly NNE direction from crater(s), and minor axis is observed to SSW direction. Volume fraction of essential materials is less than several percent. Immediately near the SE-SW sector margin of the caldera, the deposit is include large blocks and lapilli tuff units and characterized by depression-confined deposition and crudely cross-lamination. About 1km or more away from the craters, deposits transforms quickly alternating beds of fine ash and accretionary lapilli beds. Contrastedly, the deposit on the N-NE sector mainly composed fine ash and accretionary lapilli in spite of immediately near the caldera rim. Calculated total amount of Aug.29 deposit is 4*10^9kg. Solid mass eruption rate determined using amount of each deposition unit and inferred duration is about 10^6-7kg. It is one of highest rate in the series of eruptions on 2000 AD.

Qualitatively, column collapse occurred by the effect of low fraction of essential (magma) materials. For example, in Aug. 18 eruption, although eruption rate is almost same as Aug.29, column collapse has not occurred. The deposit of Aug. 18 containes essential material more than 40 percent.

It is not difficult to foresee frequently occurrence of base surge that may arise from frequent column collapse. But 400 meter-high caldera walls inhibited escape of base surge to outside. Only separated co-surge ash cloud over the wall and visible. Frequency of column collapse is enough to continuous release co-surge ash cloud from hidden surges. Thus, thick fine ash layer was formed on the NE-NW secters which was leeward of south wind. At the occurrence of large scale column collapse, pyroclast land on directly outside of caldera rim. Thus, high-momentum base surge occurred on SE-SW secters where the caldera rim close to craters.

Strongly contrasting deposits in the different sectors (SE-SW vs. N-NE) were formed as a result of interaction between unstable eruptive column and topographic depression of the center sifted to vent. Probably, on Aug.29 eruption, base surge may have spread broadly, when the caldera depression had not formed.



Schematic diagram showing the growth mechanism of base surge-like cloud (base cloud) occurred on August 29, 2000.