Monitoring of volcanic activity by the observation of water balance-A case study of 1995 eruption of Kuju volcano,central Kyushu-

Sachio Ehara [1]

[1] Earth Resources Eng., Kyushu Univ.

Kuju volcano erupted on Oct.11,1995 and again erupted in the middle of December,1995. They are mainly phreatic explosions. However,vesiculated glass shards were detected from the volcanic ash deposits erupted in the middle of December. The volcanic steam discharge rate is still large even three years after the first eruption,althougy it decreased temporarily after the second eruption. We tried to clarify the water balance beneath the new crater zone by observing the volcanic steam discharge rate from the new craters and the net mass changes around the crater zone from the repeat gravity measurements. As a result,it is shown that underdround fluid flow is gradually reaching a new hydrological equilibrium state after the eruption.

1.INTRODUCTION

Kuju volcano erupted on Oct.11,1995 and again erupted in the middle of December,1995. They are mainly phreatic explosions. However,vesiculated glass shards were detected from the volcanic ash deposits erupted in the middle of December. The volcanic steam discharge rate is still large even three years after the first eruption,although it decreased temporarily after the second eruption. Recent heat discharge rates are about several hundreds MW,which is much larger than that discharged before the eruption(about 100MW).

2.SEISMIC ACTIVITY AND CRUSTAL DEFORMATION AFTER THE ERUPTION

The seismic activity is not so active after the eruption(Daily frequency of shallow events is about ten.) and the ground around the new craters has consistently subsided after the first eruption. The seismic active zone was just beneath the fumarolic fields before the eruption. The location of the shallow seimic active zone did not change after the eruption,even though new active craters opened outside the pre-existing fumarolic fields.

3.OBSERVATION OF WATER BALANCE

We tried to clarify the water balance beneath the new crater zone by observing the mass discharge rates from the new craters and the net mass changes around the crater zone from the repeat gravity measurements.

(1)Mass discharge rate from active craters

We estimated the mass(mainly H2O) and heat discharge rates from active craters remotely. Based on the observed discharge rates,we calculated the mass discharge rates for different periods and the total mass discharge since the first eruption occurred. The isotopic data show that about 35% of the discharged water from the craters is of meteoric origin. Then we estimated the total value of the discharged magmatic water. As a result,the diameter of the magma(assumed to be spherical) is estimated to be larger than 500m.

(2)Net mass changes calculated from the data of gravity changes

We did repeat gravity measurements around the new crater zone after the eruption. As a result,we clarified the rapid gravity decrease after the first eruption and the gradual gravity decrease after the second eruption even though the gravity rapidly increased just after the first eruption. The spatial patterns of such gravity changes are concentric ones around the crater zone,which means such gravity changes are related to the volcanic activities. We calculated the net mass changes by applying the Gauss's Potential Theorem to the gravity changes for different periods.

(3)Water balance beneath the new crater zone

We assumed the following fluid flow system to estimate the water balance beneath the crater zone:the high temperature volcanic gas which is discharged from the magma heats the groundwater around the fluid path. Then part of heated groundwater is vaporized and discharged from the craters. The groundwater is recharged from around the crater zone. As a result,the following result is obtained:during the first two months after the first eruption,the mass of the groundwater around the crater zone decreased,because the mass of the evaporated groundwater is much larger than that of the groundwater recharged from around the crater zone. However,the discharge rate of the high temperature volcanic steam supplied from the deeper part becomes smaller gradually and also the rate of recharged groundwater becomes larger gradually. These results show that the underground fluid flow system is reaching gradually a new hydrological equilibrium state after the eruption.

4.CONCLUSION

The water balance beneath the new crater zone of Kuju volcano,which began to erupt on Oct.11,1995, was estimated by combining the discharged rates of volcanic steam and the net mass changes estimated from gravity changes. As a result,it is shown that underground fluid flow is gradually reaching a new equilibrium state after the eruption.