Some Problems of Volcano Monitoring and Application of Robot

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It is expected that volcanic gas could be a fastest precursor of eruptive events. It is needed to develop gas sensor for automated gas sampling. Temperature change of fumaroles are reported in many cases before eruptions. But, sometimes, temperature decrease and increase are observed at several spots of a volcano before eruptions. It should be noted that temperature measurement should be conducted at number of spots at a volcano. For the aviation safety from volcanic ash cloud, close cooperation is necessary between volcanologists and meteorologists. In order to avoid risk, development of robot which can make sampling of solid ejecta and volcanic gas, temperature measurement etc. should be developed.

Volcano monitoring is carried out in manifold ways with modernized tools. In particular, we succeeded to predict impending eruptions in some extent. However, we are facing some problems for eruption prediction and disaster mitigation. In this article, I would like to point out some problems to take notice of volcano monitoring.

1. Monitoring of volcanic gas

Gas is light substance so that easily escape from the deep inteior to the earth's surface. It is recognized the change of concentration and component of volcanic gases is one of the important precursors of eruptive events. For instance, at the time of unrest episode of Campi Flegrei during 1982 - 1984, variation of gas composition at two fumaoles in the Solfatara crater were preceded before start of goround uplift and seismic swarms. There are two methods of gas monioring. One is the direct sampling from acive fumaroles, and the other is remote measurement by COSPEC. The repeated direct sampling and chemical analyses is the most reliable way. But, we have tragic history by this method. It is urgent need to develop gas sensors for major component which are located near to the active fumaroles. The data are telemetered to the base observatory at arbitrary time intervals.

2. Temperature measurement

Continous measurement of temperature of fumaroles and geothermal ground has no technical problem excluding disturbance of meteorological origin. N. van Padang began temperature measurement of several fumaroles near to the summit dome of Merapi Volcano from 1924. Before the eruption in 1930, he found increase of temperature at several fumaroles, and temperature decrease at other fumaroles before the eruption. From the above result, he abandoned temperature measurement for eruption prediction. The similar results were reported by A. Suwa and Y. Tanaka who made repeated temperarure measurements at over 80 points of cracks inside Mihara-yama crater after 1950 eruption. They observed the similar results as Merapi before the 1953 eruption. I would like to stress that temperature measurement should be done at many spots for eruption prediction.

3. Aviation safety from ash cloud

It is one of the urgent problems to get rid of aircraft incidence due to ash cloud. For this purpose, VAACs have been established in the International frame work. Their responsibility is to inform aircraft pilot in flight about the ongoing eruptive events near to their route, as well as prediction of ash cloud drifting extent. In this way, close cooperation between volcanologists and meteorologists is highly required. They should make drills and become skillful for this purpose.

4. Unmanned Volcano Surveyer (Robot)

Since it is dangerous to make survey near to active center of volcanoes, radio control machine which is equipped with required instruments such as ejecta sampler, gas sampler, IR radiometer, GPS, TV camera etc. Japan has high ability of robot technology. It is proposed to develop UVS which can be operated at least 3 hours from the base vehicle.

5. Comprehensive monitoring of volcanic eruptions on the earth

A sudden increase in stratospheric aerosols was recorded on 23 January at 17 km altitude by lidar of Kyushu University. However, at that time, no report of large explosive eruption and the source of aerosols has been not known. Later on, it was suspected the eruption of Pagan Volcano. From the point of view of aviation safety, it is proposed to establish [Global Volcano Monitoring Network].

a) Utilization of geostationary / orbital satellite: (Detection of ash cloud and thermal change).

b) Observation of infrasonic wave: (Detection of air wave from explosive source)

c) Lidar observation: (Detection of stratospheric aerosols)

d) Development of hydrophone:(Detection of submarine eruptions)