3. Comprehensive Joint Volcano Observations

The comprehensive joint geophysical- and geochemical-observations have been carried out at active volcanoes in Japan, in order to reveal the volcanic activities and evaluate the eruption potential. In the sixth 5-years plan of the national project for prediction of volcanic eruptions, the joint observations were conducted at Iwate Volcano in 1999, Satsuma-Iwojima and Kuchierabujima Volcano in 2000, Unzen Volcano in 2001, Fuji Volcano in 2002, and the observation at Kusatsu-Shirane Volcano is planned in 2003. The participants were from national universities (e.g. Hokkaido University, Hirosaki University, Akita University, Iwate University, Tohoku University, University of Tokyo, Tokyo Institute of Technology, Shizuoka University, Nagoya University, Kyoto University, Tottori University, Kyushu University, Kagoshima University) and other institutes (e.g. National Research Institute for Earth Science and Disaster Prevention, Geographical Survey Institute, National Institute of Advanced Industrial Science and Technology, Japan Meteorological Agency, Geothermal Research Institute of Kanagawa Prefecture).

Observation at Iwate Volcano in 1999

The comprehensive joint volcano observation of 1999 was carried out at Iwate volcano, northeastern Japan, where significant activation in seismicity and ground deformation had been observed in 1998. The seismic activity and ground deformation observed in 1998 were interpreted to be caused by magma intrusion in a shallow part beneath the volcano. To evaluate the state of the volcano in 1999, observations were executed on seismic activity, ground deformation, gravity change, volcano-magnetic effect, self potential, geothermal activity and geochemistry of gases. Seismic experiments using controlled sources were also repeated to reveal temporal change in internal structure of the volcano. The results of the observations revealed that the geothermal activity was activated about one year later compared to the seismic activity and ground deformation. The seismic activity and ground deformation similar to those in 1998 but with smaller magnitude were observed at least till the middle of 1999. The repot on the observations is now in editing.

Observation at Satsuma-Iwojima Volcano in 2000

Continuous emission of gas has continued at the summit crater of Iwodake and its eruptive activity increased in 1996. Associated with the event in 1996, a volcanic earthquake (M2.9) occurred. Temporary seismic observation was conducted by installing 21 seismic stations at the summit and on the flank of Iwodake. A-type earthquakes are distributed around Iwodake and B-type events are concentrated beneath the summit crater. Focal mechanism of the A-type earthquakes is normal fault type and B-type earthquakes have an expansion source. Remarkable deflation around the summit crater was observed after 1996 due to emission of gas, and deflation of Kikai Caldera was also detected by GPS campaigns. Around the summit, positive SP anomaly caused by continuous gas emission is observed. Heat discharge rate was estimated and the rate decreased after the event in 1996. Emission rate of SO_2 is almost 500ton/day and temperature of fumarole attained more than 800 °C. SO_2 flux, maximum and equilibrium temperatures of volcanic gas from the summit crater also increased before the event and decreased after that.

Observation at Kuchierabujima Volcano in 2000

The volcano has repeated phreatic or phreato-magmatic eruption in and around the summit crater of Shindake. Last eruption occurred in 1980 and recently seismicity sometimes in creased in 1996 and 1999. Temporary seismic observation was conducted by using 4 short-period, 2 broadband seismometers and 2 accelerometers. HF events with normal fault-type are concentrated western part of the summit at very shallow depths of 100-500 m. Associated with increase in seismicity, inflation around the summit crater was detected by GPS. The source is located east of Shindake at a depth of 1 km. Change of geomagnetic total force was observed and it suggests demagnetization beneath the summit crater due to increase in temperature. Airborne survey of geomagnetic total force was conducted. Intensity of magnetization is weak at shallow depth of eastern part of the summit. This anomaly corresponds to the inflation source of the ground deformation. We also conducted VLF and ELF-MT surveys, airborne geothermal survey, temperature measurements and geochemical analysis volcanic gas from fumarole and hot spring, chemical analysis of underground water, paleomagnetic study on lava flows from Shindake and Furudake, and radio carbon age measurement of tephra.

The results of the joint observations in 2000 are summarized in “Reports of Geophysical and Geochemical Joint Observations at Satsuma-Iwojima and Kuchierabujima (2002), Sakurajima Volcano Research Center, Disaster Prevention Research Institute of Kyoto University, 184p.” and the reports can be downloaded from the following site; http://www.dpri.kyoto-u.ac.jp/~kazan/iwo-kuc.html

Observation at Unzen Volcano in 2001

The 2001 joint observation was the first comprehensive observation at Unzen Volcano after the 1990-1995 eruption. In the observation, we investigated seismic activity, ground deformation, gravity change, geomagnetic total force, resistivity structure, and temperature and geochemistry of volcanic gases. The low seismicity, deflation and recovery of magnetization intensity at shallow depth of the summit indicate that no magma newly intrudes at the shallow conduit and/or volcanic edifice after the last eruption. However we detected re-inflation of the pressure sources which had been deflating associated with lava effusion during the eruption. This suggests that the supply of magma to the deep reservoirs has started again.

During the 2001 observation at Unzen Volcano, a seismic reflection experiment was conducted using vibratory energy sources in order to detect the volcanic conduit as a program of the Unzen Scientific Drilling Project. The survey line is crossing over the Unzen graben and the magma ascent path inferred from geophysical observations. The experiment revealed the depression structure of the Unzen graben, and detected the strong reflection corresponding to one of the pressure sources inferred from the geodetic measurement. Moreover the narrow area, in which the strength of reflection is extremely weak, extends almost vertically from the sea level down to the pressure source. Volcanic earthquakes occur along the narrow area. Thus the area is interpreted as the volcanic conduit or dike intrusion in the volcanic edifice.

Observation at Fuji Volcano in 2002

In the joint observation at Fuji volcano in 2002, a dense seismic observation was started by installing 30 seismometers around the volcano in addition to the permanent stations operated by several institutions, in order to clarify the mechanism of low-frequency earthquakes originating deep beneath the volcano and to make 3D seismic imaging of the subsurface structure. Scientists of national universities also conducted an advanced hybrid gravity survey around the volcano by integrating absolute and relative gravity measurements, self-potential and MT surveys across the volcano, and CO_2 flux measurements at the summit.

(Hiroshi Shimizu, Sadato Ueki, Masato Iguchi and Hidefumi Watanabe)