Geologic and geodetic study on the 2003 eruption at Anatahan, Northern Mariana Islands

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As very active volcanoes are distributed in the Northern Marina Islands, natives in most islands are being requested to evacuate from their home islands for long years. Some of volcanoes have calderas on the summits without notable distribution of large-scale eruption products. These geologic and social background is very similar to that of the Izu Islands. Anatahan Volcano erupted in May 2003, first in its historical period, and continued its high eruptive activity by June. The eruption column of Plinian eruption reached 13 km a.s.l and ash covered thickly whole the island. We visited this island in January 2004, following the first visit in July 2003 for clarifying eruption mechanism and understand deformation related to magma migration during and after eruption. Two GPS permanent stations were established on the western-end and eastern-end of the island (July 2003 and January 2004, respectively), and a key station was set on EMO in Saipan in July 2003. A part of money for this mission was defrayed from Disaster Prevention Research Forum.

Anatahan is a volcanic island of 4 km wide (SN) and 9 km long (EW), stratovolcano of basalt to dacite. Two calderas connecting to each other are located on the summit, within which several craters are recognized. Geological inspection of last year revealed that Plinian eruption was followed by phreatomagmatic eruption, being associated with breaking a lava dome once formed in crater. Active crater of the present eruption is 400 m across and about 80 m deep on the floor of the central crater within the eastern caldera. The bottom of the active crater is 10-20 m a.s.l this January; becaming shollower due to deposition of debris from outside. It was estimated about -30 m a.s.l just after the eruption. Thick deposition of Plininan pumice fall and gray surges (phreatomagmatic eruption) was confirmed near the crater, together with falling of abundant bombs from the breaking lava dome during and just after phreatomagmatic eruptions. A mound like a remnant of lava dome in the northern periphery of the crater, found in last July, was lost (collapsed), and, instead, a mound of hot blocks is located on the crater floor, inside the former dome-like mound. It is likely that the mound found last July was a surface of cryptdome that was collapsed during these six months. The cryptdome seems to be survived (appeared due to erosion of sediment cover) as a mass of hot debris on the crater floor. The temperature of the crater decreased from 300 degree C to about 150 degree C during six months. The origin of calderas was also examined in this mission. Products of phreatomagmatic eruptions thickly cover not only the caldera rims but also the outer slopes, and the deposits indicative of large-scale eruptions, like pumice flow deposits, were not found. The origin of calderas in this volcano probably is close to that in Miyakejima.

The Anatahan GPS station was involved in the GPS campaign for the tectonic research of the Mariana backarc region, continued since 1992. The station, about 7 km west of the active crater, was subsided by 18 cm without significant lateral movement during six months from January to July 2003. The movement during next six months was less significant. The former GPS movement clearly indicates deformation associated by migration of magma during the May-June 2003 eruptions, and may suggest the magma chamber located under the western part of the island rather than beneath the active crater. Successive GPS observation promises us to make clear the deformation mechanism related to magma activity in this volcano.