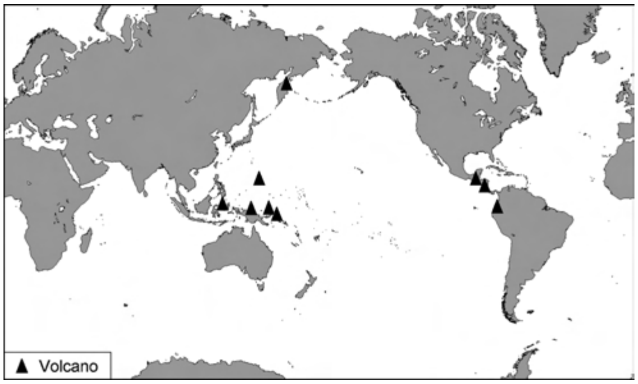
Bulletin of the Global Volcanism Network



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The text of the *Bulletin* is also distributed through the Volcano Listserv (volcano@asu.edu).

Anatahan

Mariana Islands, Central Pacific
16.35°N, 145.67°E; summit elev. 788 m
All times are local (= UTC + 10 hours)

Anatahan has erupted almost continuously since 5 January 2005, when it started a new episode of vigorous discharges. A summary of satellite images during 16 June-20 July 2005 (*BGVN* 30:07) showed that it was one of the most conspicuous eruptions on the planet in 2005.

Eruptions somewhat abruptly ceased on about 3 September. Significant discharges remained absent through as late as 29 September. Activity described below through early September is based on an array of material from numerous sources, including the US Geological Survey (USGS), the Washington VAAC, the U.S. Air Force Weather Agency (AFWA), the press, and the Emergency Management Office of the Commonwealth of the Northern Mariana Islands (EMO-CNMI).

Following the general discussions of activity, a report is included contributed by Setsuya Nakada from the Earthquake Research Institute (ERI), University of Tokyo, whose team of scientists made close-range observations of a distinctive eruptive phase called an ash-cloud surge from a helicopter on 24 August. On that day they documented the surge as a robust sub-horizontal plume slowly traveling over, and in contact with, the ocean surface.

Activity during Augus 2005. Throughout August eruptive activity continued, with plumes rising several thousand meters above the volcano. On 1 August and during 3-9 August the National Weather Service at Tiyan, Guam, issued numerous reports for the islands of Saipan and Tinian.

On 1 August a strong sulfur odor was reported by numerous residents, and ash was observed on aircraft at Saipan International Airport. According to a news article, flights leaving the airport were delayed.

A 4 August article published in the *Saipan Tribune* by John Ravelo was entitled "Engine trouble forces aircraft's emergency landing." What follows comes from the opening paragraphs of that article, describing events attributed to 3 August.

"An aircraft suffered engine trouble in mid-air early last night shortly after taking off from the Saipan International Airport, prompting it to return to the tarmac for emergency landing. The Ports Police said no one was injured in the incident. This happened as Saipan, Tinian and Rota remained under volcanic haze from Anatahan until last night . . ..

"The aircraft reportedly left the Saipan airport at approximately 6 pm. Minutes later, at about 6:15 pm, Ports Police on-duty airport supervisor Sgt. Greg Arriola said his office received a call that the aircraft was coming back due to 'problems with its left engine.'

"'The aircraft landed safely. Everybody was safe,' Arriola said. He refused to elaborate and name the aircraft, saying, 'we're still checking [on] the matter.'

"Arriola did not disclose the number of passengers aboard the distressed aircraft and where the plane was supposedly bound. The haze over Saipan has resulted in flight interruptions since Monday [1 August], temporarily stranding hundreds of passengers.

"According to the U.S. Geological Survey, volcanic ash threatens jets ... as it forms deposit in engines, restricts airflow, and clogs fuel nozzles. Minute particles of volcanic ash also contaminate aircraft's ventilation, lubrication, hydraulic and electronic systems. They cause erosion and pitting of leading edges of windshields and landing lights, as well as erosion of compressor blades."

The USGS and EMO noted that a seismic station on Sarigan, Anatahan's neighboring island 6.5 km to the W, recorded more than 40 earthquakes on 9 August, three of which had magnitudes of around 4. The seismic swarm began at around 0152 and occurred over the next eight hours. At around 0539, an M 4.2 earthquake occurred, and the National Earthquake Information Center traced the event to ~ 65 km NW of Anatahan.

Tremor and long-period earthquakes were recorded through 8 August. Later, an ash plume was detected on satellite imagery by the AFWA and Washington VAAC; it was at 5-5.5 km altitude extending approximately 220-400 km NW from the summit on 9 August. A Washington VAAC report that day was the 650th Anatahan report they had issued in 2005.

During the remainder of August 2005, eruptive activity continued and ash plumes rose to 6-8 km altitude. Volcanic tremor levels ranged between 20 and 65 percent of peak levels, and long-period earthquakes occurred sporadically. But, after around 0205 on 27 August, the seismic station went off-line. During 1-3 September activity continued, with ash plumes rising to a maximum of ~ 3 km altitude.

Eruptions halt on 3 September 2005. The USGS reported that based on remote-sensing data Anatahan appeared to have stopped erupting on 3 September (UTC), and initial data documenting that circumstance represented observations between 0901 and 2308 UTC. The earlier time corresponded to when AFWA last noted visible ash on a GOES 9 image. Ash could not be detected in satellite imagery through 1825 UTC due to cloud cover. A pilot report at 2308 UTC on 3 September indicated "no activity was occurring at the volcano." The Washington VAAC reported that no ash was detected in satellite imagery through 0025 UTC on 4 September under mostly clear skies. MODIS imagery at 0040 and 0345 UTC on 4 September also show no discernible ash being erupted under clear skies.

This was the first time that the USGS and the EMO reported an absence of volcanism on Anatahan since ash-bearing discharges started in early January 2005. Since then, tremor levels have been fluctuating, with occasional Strombolian explosions.

During an overflight the week of 7 September, USGS and EMO personnel did not see any ash emissions, only low-level steam-and-gas emissions. They noted that the crater floor was covered by sediment-laden water. In East Crater they saw an active geothermal system, consisting of mud pots, mini-geysers, and steam jetting from the crater walls.

Although volcanic seismicity was at low levels through at least 16 September, according to the World Data Center for Seismology (Denver, Colorado) a M 4.4 earthquake struck the Saipan region of the Northern Mariana Islands on 9 September 2005. It occurred at about 1301 local time, with the epicenter 80 km SSW of Anatahan.

Eruption observations, 24 and 26 August 2005. The following describes a 24 August helicopter visit to the vicinity of Anatahan, which included witnessing and documenting eruptive phenomena, but not landing. Photos were also taken on 26 August while passing well to windward of

Figure 1. View of Anatahan and plumes looking NW, taken from a helicopter around 1000 on 24 August 2005. The windward area is mantled with a light-colored, low hanging plume (far right). A large dark plume emerges from the vent (east crater); as it hugged the sea surface it advanced roughly horizontally and comparatively slowly A spike of light-colored cloud rises above the darker plume, over an area over the sea but not far from the island. Courtesy of T. Matsushima.

the island on a commercial airliner. The report was submitted by Setsuya Nakada, who was accompanied from Japan by colleagues Takeshi Matsushima (Institute of Seismology and Volcanology, Kyushu University), and Mitsuhiro Yoshimoto (Volcano Research Center, Earthquake Reserch Institute, University of Tokyo).

They had hoped to recover GPS and tiltmeter data from stations on Anatahan, and to find, exhume, inspect, and repair any ash-covered instruments. These instrumental data span the important period starting from last year, an interval that could shed light on the behavior of the volcano and the magma system during the eruption. Geological inspection and petrological sampling were also planned.

Anatahan's seismicity changed from continuous, strong signals to undergoing intermittent pulsations around the morning of 23 August, and a large (M 4.8?) LP earthquake occurred at 2045 on 23 August. Judging from this sudden seismological change and the LP event, the USGS scientists monitoring the seismicity (Andy Lockhart, Randy White, and others) suggested suspending landing on the island for at least a few weeks.

The team decided to fly over the island without landing to assess the state of burial of their geodetic observation site. They spent about an hour in the air there (about 1000 to 1100 on the 24th) viewing and photographing the scene. Besides the pilot, the helicopter carried Nakada, Matsushima, Yoshimoto, and Juan Camacho (EMO-CMI).

During the 24 August visit, dense ash clouds issued very vigorously from the active E crater. The cloud and hung over the summit calderas, their SW rims, and swept out over the sea to the SW and W of the island.

The photographs and the impressions of Camacho and his pilot from visits in July and May 2005 suggested that the activity level was higher on 24 August. The flight disclosed an island completely covered with thick layers of both wet (dark and probably very fine) ash deposits, and fresh dry ones on the island's S slopes. The dry ones lay under the ash cloud. Green areas were restricted to spots on the outer slopes. Many gullies had begun to develop on the surface of the thick ash deposit.

The observers saw a dark eruption cloud (densely ash-laden) vigorously blasting out of the active crater. A heavy ash cloud hung over the island (figures 1 and 2). The eruption cloud rose to ~ 800 m directly above the crater, and it increased up to ~ 2,000 m over the W part of the island, where it became lighter in color. Darker, vigorous emissions also came from the east crater's W side or NW side, and less frequently from its E side. Though this may have reflected the complex circulation of air within the east crater, another possibility was that the active crater had widened recently, especially to the E. Two ash emission points may have developed inside the large active crater.

Seismic amplitudes during the flight were weaker than recorded the afternoon of 23 August. Seismic signals consisted of intermittent pulses with duration intervals from 5 to 20 minutes. Such signals could presumably have corresponded with a series of Strombolian explosions, but on the flight these were not seen. No projectiles were observed–even near the base of the eruption cloud–although the vent was obscured by a profusion of drifting clouds (figures 1 and 2). Abundant ash-laden clouds passed vigorously and continuously from the active crater, escaping in

Figure 2. View of Anatahan looking from the S taken during the helicopter inspection around 1000 on 24 August. In addition to the eruptive clouds, this photo includes the eruptive vent area and some portions of the tephra covered island. Courtesy of T. Matsushima.

Figure 3. A close-up photograph documenting ash-cloud complexities from the eruption at Anatahan at about 1000 on 24 August. Looking N, the photo focused on a part of the dark ash cloud above the ocean. The plume is both dropping ash and billowing upwards. Along the cloud base and adjacent the ocean surface grew a light-colored fringe of expanding clouds. Courtesy of S. Nakada.

Figure 4. A N-looking photo of the 24 August eruption at Anatahan that is similar to the previous one, but better illustrating the rising upper portions of the dark ash cloud. Courtesy of M. Yoshimoto.

cycles of five's to ten's of minutes in duration, intervals seemingly similar to the seismicity during the flight.

Abundant ash fell from the dark ash cloud that drifted to the SW of the crater. Around 1000 a ring of ash-cloud surge expanded on the crater's southern rim. It advanced comparatively slowly, traveling SW (figures 1 to 4). Along the sea surface, many small lobes of ash cloud developed, moving slowly. These were reminiscent of lobes seen in surges observed at the Tar River Valley delta during the Soufrière Hills eruption. These eruptive scenes also appeared very similar to those observed on 29 August 2000 at Miyake-jima (Nakada and others, 2005a), where a low-temperature ash-cloud surge moved slowly from the summit crater. In the case of the ash-cloud surge seen at Anatahan, it may be that the passage across sea water had a profound influence, triggering behavior more closely phreatomagmatic than purely magmatic in character. The ash-cloud surge took place mainly as the observers approached the island. The surge was thought to correlate to an interval of elevated seismicity.

Tephra buried portions of the village ~ 7 km W of the active crater and reached 1.5 m thick. A photograph revealed that the GPS antenna, within a 50-cm-high pillar, remained distinct even though under considerable ash. The cable to the computer was also partly visible inside a collapsed hut, suggesting the prospect of still retrieving the data. The GPS end-point station ~ 1.5 km E of the crater was under a ~ 1-m-thick blanket of ash, but again the GPS antenna was seen on the edge of a small pond.

A thermal imaging camera system took an essentially simultaneous thermal (infrared) image and a visible-light

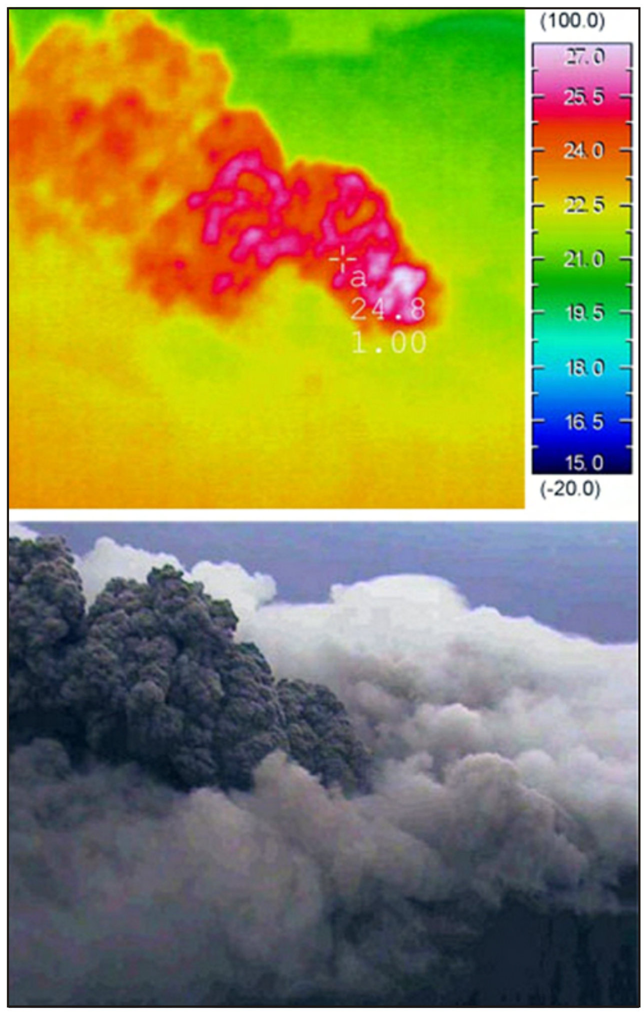

Figure 5. Anatahan's vent area emitting copious rising clouds as recorded in both a conventional (visible wavelength) photograph and a nearly simultaneous (infrared wavelength) thermal image. The photographer was looking northward from S of the crater around 1100 on 24 August. The shots were made with a thermal imaging camera (Thermo Tracer TH9100MV, NEC San-Kei Instruments, Ltd.) that takes the thermal and visual images in rapid succession. Courtesy of M. Yoshimoto.

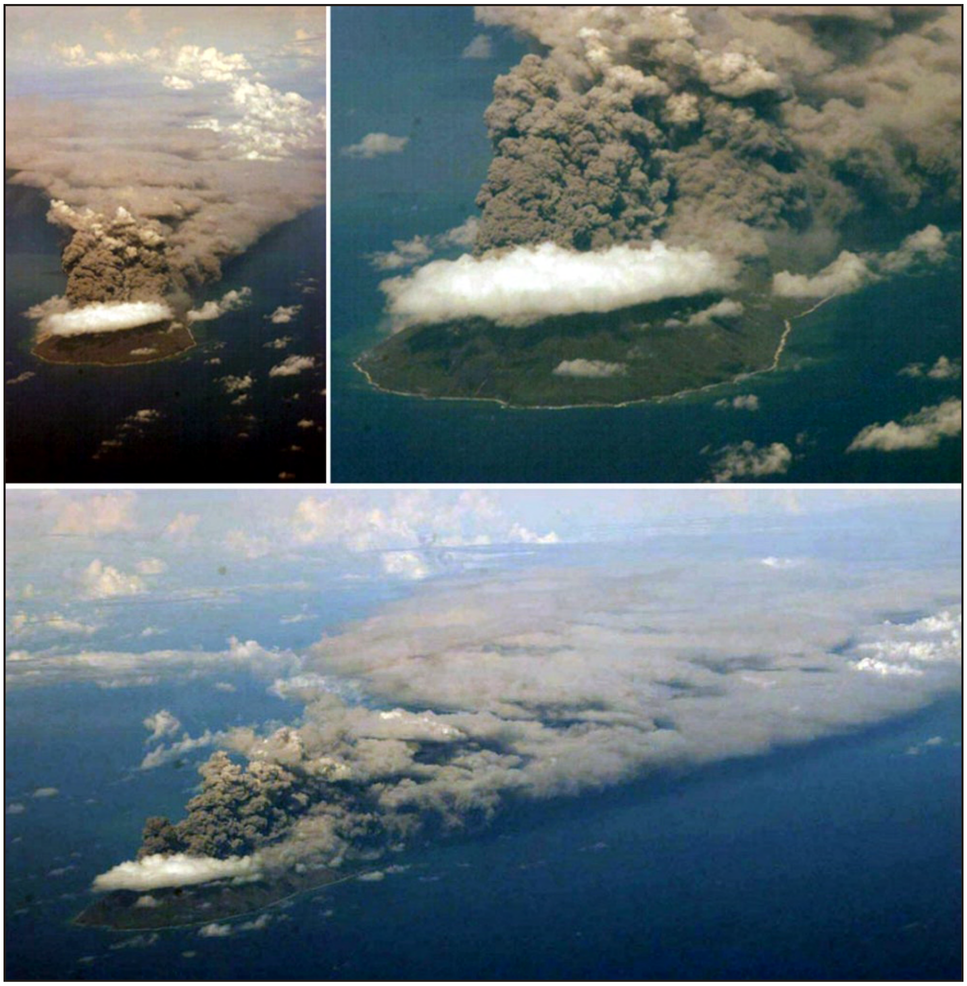

Figure 6. Three views of Anatahan looking SW as it discharged a large, buoyant ash plume on 26 August 2005. Photographs were taken en route from Saipan (CMI) to Nagoya (Japan). Courtesy of S. Nakada.

photograph (figure 5). The eruption cloud was too dense to capture the temperature distribution near the floor of the crater area. Instead, the images represented only the temperature distribution of the cooler, outer portions of the clouds, where temperatures ranged from 19.5 to 27°C (figure 5).

As Nakada and colleagues departed from the Mariana Islands, Anatahan's eruption was seen again (figure 6), this time from a commercial air flight (Northwest Airlines' flight NW0078) traveling from Saipan to Nagoya and departing at 0930 on 26 August 2005. The plume was directed SW. In addition to the very different plume morphology seen that day, the eruptive intensity was judged to have been higher than on 24 August (figure 6).

References: Hilton and others, 2005, Introduction to the special issue on the 2003 eruption of Anatahan Volcano, Commonwealth of the Northern Marianas Islands (CNMI): Jour. Volcanol. Geotherm. Res., v. 146, p. 1-7.

Nakada and others, 2005a, Chronology and products of the 2000 eruption of Miyakejima Volcano, Japan: Bull. Volcanol., v. 67, p. 205-218.

Nakada and others, 2005b, Geological aspects of the 2003-2004 eruption of Anatahan Volcano, Northern Mariana Islands: Jour. Volcanol. Geothermal. Res. 146, p. 226-240.

Watanabe and others, 2005, Geodetic constraints for the mechanism of Anatahan eruption of May 2003: Jour. Volcanol. Geothermal. Res., v. 146, p. 77-85.

Background. The elongate, 9-km-long island of Anatahan in the central Mariana Islands consists of large stratovolcano with a 2.3 x 5 km, E-W-trending compound summit caldera. The larger western caldera is 2.3 x 3 km wide, and its western rim forms the island's 790-m high point. Ponded lava flows overlain by pyroclastic deposits fill the floor of the western caldera, whose SW side is cut by a fresh-looking smaller crater. The 2-km-wide eastern caldera contained a steep-walled inner crater prior to the 2003 eruption whose floor was only 68 m above sea level. Sparseness of vegetation on the most recent lava flows on Anatahan had indicated that they were of Holocene age, but the first historical eruption of Anatahan did not occur until May 2003, when a large explosive eruption took place forming a new crater inside the eastern caldera.

Information Contacts: *Juan Takai Camacho* and *Ramon Chong*, Emergency Management Office of the Commonwealth of the Northern Mariana Islands (EMO-CNMI), PO Box 100007, Saipan, MP 96950, USA (URL: http://www.cnmiemo.org/; Email: juantcamacho@hotmail.com, rcchongemo@hotmail.com); *Charles Holliday* and *Jenifer E. Piatt*, U.S. Air Force Weather Agency (AFWA)/XOGM, Offutt Air Force Base, NE 68113, USA (Email: Charles.Holliday@afwa.af.mil); *Randy White* and *Frank Trusdell*, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025-3591, USA (URL http://hvo.wr.usgs.gov/cnmi/update.html; Email: rwhite@usgs.gov, trusdell@usgs.gov); *Andrew B. Lockhart*, USGS, Cascades Volcano Observatory, 1300 SE Cardinal Court, Bldg. 10, Suite 100, Vancouver, WA 98683, USA (Email: ablock@usgs.gov); *Saipan Tribune*, PMB 34, Box 10001, Saipan, MP 96950, USA (URL: http://www.saipantribune.com/); *Setsuya Nakada* and *Mitsuhiro Yoshimoto*, Volcano Research Center, Earthquake Research Institute (ERI), University of Tokyo, Tokyo, Japan (URL: http://www.eri.u-tokyo.ac.jp/nakada/anat_hp/anat_200508/; http://hakone.eri.u-tokyo.ac.jp/vrc; Email: nakada@eri.u-tokyo.ac.jp, myoshi@eri.u-tokyo.ac.jp); *Takeshi Matsushima*, Institute of Seismology and Volcanology (SEVO), Graduate School of Science, Kyushu University, 2-5643-29 Shin'yama, Shimabara, Nagasaki 855-0843, Japan (URL: http://www.sevo.kyushu-u.ac.jp/; Email: mat@sevo.kyushu-u.ac.jp).

Soputan

Sulawesi, Indonesia
1.108°N, 124.725°E; summit elev. 1,784 m
All times are local (= UTC + 8 hours)

On 18 October 2004 Soputan exploded, releasing a column of white-to-gray ash floating as high as 600 m above the crater rim and drifting E (*BGVN* 29:12).

On 12 December an eruption around 0050 produced an E-drifting ash cloud to ~ 1 km above the volcano. It was followed by a "hot cloud" that traveled about 200 m E towards Aeseput and a lava flow that traveled SW. The eruption was preceded by increased tremor on 11 December and visible incandescence in the crater. The Directorate of Volcanology and Geological Hazard Mitigation increased the Alert Level to 2 (on a scale of 1-4). According to the Darwin Volcanic Ash Advisory Centre an eruption cloud was visible on satellite imagery on 12 December at 0925 at an altitude of ~ 10.7 km.

On 1 February 2005 white vapor rose 50-75 m above the summit. Soputan began to erupt again at 0630 on 20 April, with a plume reaching ~ 1 km above the summit and drifting SE. In addition, lava fountains rose ~ 200 m above the volcano. From 1720 on 20 April until 0900 on 21 April, lava fountains rose 75-100 m. Rapid dome growth occurred and by 21 April the lava dome had spread about 250 m E and 200 m SW. On 22 April a "white ash plume" rose ~ 100 m, and on 23 April a dark gray ash plume rose to ~ 150 m and drifted NE. Ash eruptions through 24 April produced plumes to ~ 300 m above the volcano.

On 9 May a plume of white vapor rose 75 m above the summit. Soputan remained at Alert Level 2 through 9 May.

Further activities came to light as a result of a photograph taken during a violent eruption (figure 7). According to Syamsul Rizal, the photo was taken from Soputan volcano observatory, Maliku, ~ 12 km NW, on 18 July 2005. The eruption initially vented at the usual source on the NE flank. The pyroclastic flow that resulted was described from visible observations as less dense than those from collapses at Merapi and similar to those from Karangetang.

Figure 7. A photo of Soputan on 18 July 2005 showing the pyroclastic flow that occurred as a result of dome collapse. Photo courtesy of DVGHM and taken by Farid Bina.

Background. The small Soputan stratovolcano on the southern rim of the Quaternary Tondano caldera on the northern arm of Sulawesi Island is one of Sulawesi's most active volcanoes. The youthful, largely unvegetated volcano rises to 1784 m and is located SW of Sempu volcano. It was constructed at the southern end of a SSW-NNE trending line of vents. During historical time the locus of eruptions has included both the summit crater and Aeseput, a prominent NE-flank vent that formed in 1906 and was the source of intermittent major lava flows until 1924.

Information Contacts: *Directorate of Volcanology and Geological Hazard Mitigation* (DVGHM), Jalan Diponegoro 57, Bandung 40122, Indonesia (Email: dali@vsi.esdm.go.id; URL: http://www.vsi.esdm.go.id/); *Andrew Tupper*, Darwin Volcanic Ash Advisory Centre (VAAC), Bureau of Meteorology, Northern Territory Regional Office, PO Box 40050, Casuarina, Northern Territory 0811, Australia (URL: http://www.bom.gov.au/info/vaac/soputan.shtml).

Manam

Papua New Guinea
4.10°S, 145.061°E; summit elev. 1,807 m
All times are local (= UTC + 10 hours)

Manam erupted several times during October-December 2004 and January 2005 (*BGVN* 29:10, 29:11). The eruption on the evening of 27 January 2005 (*BGVN* 30:02) was more severe than the previous ones during the current eruption period; there were 14 people injured and one person killed at Warisi village. During April and May 2005, mild eruptive activity continued. Manam remained at Alert Level 2 from February 2005 through late May.

Throughout April 2005, both summit craters released occasional pale gray to brown ash clouds to a few hundred meters above the summit before being blown SW, W, and NW, resulting in fine ashfall. Occasional low rumbling and roaring noises from Southern Crater were heard on 23 April and 29 April. A weak to moderate glow accompanied by projections of incandescent lava fragments was visible on 28 April and 30 April. There were no audible noises and no night-time glow from the Main Crater.

April seismicity was at low-moderate level. Occasional weak volcanic tremors were recorded during the month. The daily number of low frequency earthquakes range between 700 and 1350.

A pilot reported an eruption on 13 June at 0445 UTC. The Darwin Volcanic Ash Advisory Centre (VAAC) reported that ash plumes from Manam were visible on satellite imagery on 16-17 June, 30 June, and 1-2 July. On 19 July ash from Manam was visible extending SW on satellite imagery. Ash was also visible on satellite imagery on 20 July. In all instances, the heights of the plumes were not reported.

According to the Rabaul Volcanological Observatory (RVO), during 15-21 August low-level volcanic activity continued at Manam, and the alert level was reduced to level 1. On 15 August, ash was emitted from Southern Crater. The Darwin VAAC reported that a low-level plume from Manam was visible on satellite imagery on 22 August. Mild eruptive activity continued during 22-28 August, with occasional emissions of weak-to-moderate ash plumes on several days. Ash clouds emitted on 22 and 26 August rose several hundred meters above the volcano's crater and drifted NW, depositing ash in areas between the towns of Jogari and Kuluguma, and beyond to Boisa Island.

During September, the Main Crater continued to release weak emissions of thin white-gray ash clouds. On 17 September, the ash clouds increased slightly in volume and were blown to the NW part of the island. No glow was observed at night and technical problems thwarted seismic recording. Manam remained at Alert Level 1, indicating low levels of activity, through 19 September.

Background. The 10-km-wide island of Manam, lying 13 km off the northern coast of mainland Papua New Guinea, is one of the country's most active volcanoes. Four large radial valleys extend from the unvegetated summit of the conical 1807-m-high basaltic-andesitic stratovolcano to its lower flanks. These "avalanche valleys," regularly spaced 90 degrees apart, channel lava flows and pyroclastic avalanches that have sometimes reached the coast. Five small satellitic centers are located near the island's shoreline on the northern, southern and western sides. Two summit craters are present; both are active, although most historical eruptions have originated from the southern crater, concentrating eruptive products during the past century into the SE avalanche valley. Frequent historical eruptions have been recorded at Manam since 1616. A major eruption in 1919 produced pyroclastic flows that reached the coast, and in 1957-58 pyroclastic flows descended all four radial valleys. Lava flows reached the sea in 1946-47 and 1958.

Information Contacts: *Ima Itikarai*, Rabaul Volcano Observatory (RVO), P.O. Box 386, Rabaul, Papua New Guinea; *Andrew Tupper*, Darwin Volcanic Ash Advisory Centre (VAAC) (see Soputan).

Langila

Papua New Guinea
5.525°S, 148.42°E; summit elev. 1,330 m
All times are local (= UTC + 10 hours)

The Darwin VAAC issued an activity report stating that the Rabaul Volcano Observatory (RVO) had noted elevated activity since 24 April 2005. Between 28 April 2005 and 4 May 2005 Langila emitted more ash than normal, and the International Federation of Red Cross And Red Crescent Societies (IFRC) determined that ~ 3,490 people had been affected by the eruption when ashfall damaged small food gardens and contaminated some water sources.

VAAC reports on 4 May and 6-7 May noted thin plumes extending NW 110 km and 75 km, respectively. Later, on 7-8 May, the identifiable plume was half as long and diminishing. Plumes and other diagnostics eventually became obscured by weather clouds. On 8 June analysts at the Darwin VAAC saw a low-altitude plume and a hot spot. The plume moved westward and remained visible into 9 June when it ceased being detectible.

During 13-19 June 2005, Langila's Crater 2 continued to erupt. At times the eruption was marked by moderate to strong emissions of thick gray-brown ash clouds occurring at irregular intervals. Ash clouds from the eruption rose variably to 700-1000 m before they were blown to the W and NW. At other times weak to moderate emissions of light gray ash clouds were observed. Considerable ash fell near the volcano and extended to the W and NW, between Warimo and Aimola. Crater 3 was quiet. Low and high frequency earthquakes and volcanic tremor were recorded.

The Darwin VAAC reported a Langila plume on 13 June to 3-4 km altitude, but cloud cover later obscured the plume. Another plume became visible on imagery on 16 June moving W at 30 km/hour at an estimated altitude of ~ 3 km; ongoing plumes became hard to see about mid-day on 17 June. Several other episodes of plume image detection were seen. One was identified by the VAAC on 21 June, with an observation of altitude to ~ 3 km and plume length reaching 300 km to the NW. The evidence of eruption only continued until the next day, when cloud cover obscured the area. A further, brief episode of plume detection occurred beginning early on 25 June but detection ended before noon. On 30 June, the Darwin VAAC repeated a US Air Force Weather Agency (AFWA) report on a Langila plume seen on imagery, blowing SW at 20 km/hr and reaching ~ 3 km altitude. By about 6 hours later that plume ceased to be visible.

Moderate levels of volcanic activity occurred at Langila's Crater 2 during 15-21 August. The activity was marked by occasional sub-continuous forceful emissions of ash clouds. The ash clouds rose as high as 1 km before drifting N and NW. Fine ash fell in villages along the coast. On the evening of 18 August projections of incandescent lava fragments were seen. Based on a pilot report, the Darwin VAAC reported that ash from Langila was visible in the vicinity of the volcano on 23 August, at 3-4.6 km altitude. A plume was seen a bit later on MODIS imagery extending 110 km to the NNW but ash was not visible in satellite imagery.

Background. Langila, one of the most active volcanoes of New Britain, consists of a group of four small overlapping composite basaltic-andesitic cones on the lower eastern flank of the extinct Talawe volcano. Talawe is the highest volcano in the Cape Gloucester area of NW New Britain. A rectangular, 2.5-km-long crater is breached widely to the SE; Langila volcano was constructed NE of the breached crater of Talawe. An extensive lava field reaches the coast on the N and NE sides of Langila. Frequent mild-to-moderate explosive eruptions, sometimes accompanied by lava flows, have been recorded since the 19th century from three active craters at the summit of Langila. The youngest and smallest crater (no. 3 crater) was formed in 1960 and has a diameter of 150 m.

Information Contacts: *Rabaul Volcano Observatory* (RVO) (see Manam); *International Federation of Red Cross And Red Crescent Societies (IFRC)* (URL: http://www.reliefweb.int/); *U.S. Air Force Weather Agency (AFWA)* (see Anatahan); *Darwin Volcanic Ash Advisory Centre* (VAAC) (see Soputan).

Rabaul

Papua New Guinea
4.271°S, 152.203°E; summit elev. 688 m
All times are local (= UTC + 10 hours)

The February 2005 eruption from the Tarvurvur cone at Rabaul and its aftermath were previously described (*BGVN* 30:07). In late August and September 2005 Tavurvur continued to produce discrete light to pale gray ash emissions. Emissions occurred at irregular intervals and with varying frequency. Discrete explosions also occurred. Ash plumes rose between 800 and 1500 m before they were blown to the N and NW, resulting in some ashfall on the eastern half of Rabaul Town. Areas further downwind were also affected. Roaring and rumbling noises accompanied the activity. Projections of incandescent lava fragments were visible at night but were less conspicuous compared to previous weeks.

Seismicity was at moderate to high levels, with most earthquakes associated with ash emissions and explosions. Small low frequency earthquakes not associated with ash emissions were also recorded. Ground deformation measurements from global positioning system (GPS) and tide gauge instruments fluctuated but the general trend showed a very slow rate of uplift.

One high frequency earthquake occurred on 12 September NE of Tavurvur. Prevailing SE winds during the last several months caused the ash plumes to drift to the N and NW. During 12-18 September there were some brief periods of NW winds that could mark the beginning of gradual wind transition from SE to NW winds, directions that would blow ash plumes away from Rabaul Town.

Background. The low-lying Rabaul caldera on the tip of the Gazelle Peninsula at the NE end of New Britain forms a broad sheltered harbor utilized by what was the island's largest city prior to a major eruption in 1994. The outer flanks of the 688-m-high asymmetrical pyroclastic shield volcano are formed by thick pyroclastic-flow deposits. The 8 x 14 km caldera is widely breached on the E, where its floor is flooded by Blanche Bay and was formed about 1,400 years ago. An earlier caldera-forming eruption about 7,100 years ago is now considered to have originated from Tavui caldera, offshore to the N. Three small stratovolcanoes lie outside the northern and NE caldera rims of Rabaul. Post-caldera eruptions built basaltic-to-dacitic pyroclastic cones on the caldera floor near the NE and western caldera walls. Several of these, including Vulcan cone, which was formed during a large eruption in 1878, have produced major explosive activity during historical time. A powerful explosive eruption in 1994 occurred simultaneously from Vulcan and Tavurvur volcanoes and forced the temporary abandonment of Rabaul city.

Information Contacts: *Rabaul Volcano Observatory (RVO)* (see Manam).

Bagana

Papua New Guinea
6.140°S, 155.195°E; summit elev. 1,750 m
All times are local (= UTC + 10 hours)

Bagana was last reported on in June 2004 (*BGVN* 29:06) summarizing MODIS thermal alerts during 1 January 2001-31 May 2004. Lava flows, which had erupted at an unknown time, were described in *BGVN* 29:05. Bagana has been in long-term eruption since 1972, but the volcano's remote location and intervals of separatist conflict on the island had restricted access by observatory staff, and subsequent reports remained infrequent. Several Rabaul Volcano Observatory (RVO) reports addressed Bagana volcanism during March-September 2005, revealing conditions seen on the ground. There were numerous MODVOLC thermal alerts posted for Bagana during the reporting interval. The rest of the reports relied on satellite-based observations of plumes produced for the purpose of aircraft safety.

RVO noted that during April 2005 Bagana continued its effusive eruption of lava. The summit crater released weak to moderate volumes of thick white vapor on most days. Occasional gray to brown ash plumes were reported. White vapor was visible in some areas of the SW flank. Summit glow was visible on most nights when it was clear, associated with the active lava flow on the upper S flanks. White vapor visible on the upper SW flank during daytime was also associated with a lava flow. Occasional loud roaring noises like jet engines and booming noises were heard on 17, 19, and 30 April. Some of the noises accompanied emission of thick, dark gray ash clouds.

According to the Darwin Volcanic Ash Advisory Centre (VAAC), on 17 March 2005 at 0726 a very small plume to ~ 2.4 km altitude and hot spot were visible on satellite imagery. Satellite imagery at 0551 on 13 May revealed a thin plume extending 28 km ESE below 3 km altitude. Similar plumes, blowing W, were identified at 0537 on 14 May and at 0634 on 15 May.

A plume from Bagana was observed in satellite imagery for 8 June. Darwin VAAC stated that the plume initially extended 65 km WSW, then W later in the day. The height of the plume was not stated. US Air Force Weather Agency analysts indicated that at 0955 local time on 8 June (2355 UTC on 7 June) the plume extended at least ~ 38 km W, rising up to ~ 3 km, and the MODIS image they provided showed four volcanoes in the region all emitting plumes (figure 8).

During 13-19 June, Bagana was relatively quiet with variable amounts of white vapor emitted from the crater. Weak projections of incandescent lava were visible until 17 June. During 8-10 June, several low-level plumes emitted from Bagana were visible on satellite imagery extending mainly to the WSW. A plume from Bagana visible on satellite imagery on 21 June extended W. The height of the plume was not reported. A thin plume emitted from Bagana was visible on satellite imagery on 30 June. The height of the plume was not reported.

During 10-16 August, the Darwin VAAC reported that satellite observations showed an ash plume from Bagana visible at a height of ~ 3 km, extending ~ 40 km SW of the summit. Ash was not visible on the image.

During 15-21 August, volcanic activity at Bagana remained at low levels. Variable amounts of thick white vapor were emitted from the summit crater. During several nights, dull-to-moderately bright incandescence was visible. Occasional low roaring noises were heard on 15 and 20 August. At night dull to moderately bright glow was visible on 16, 18, 20, and 21 August. On 20 August, lava flowed from the main crater. Incandescent lava avalanches occasionally originated from unstable areas of the lava flow.

Between 22 and 28 August 2005, Bagana was quiet. The summit crater released variable amounts of white vapor throughout. Continuous roaring noises were heard during a 30-minute period on 23 August, and bright glow was visible the nights of 23 and 24 August. There was a single expulsion of a thick dark ash plume on 24 August.

During 12–18 September 2005, occasional small volumes of ash escaped, and emissions consisted chiefly of weak to moderate volumes of white vapor. Beginning on 17 September occasional sub-continuous booming noises commenced. Some of the booming noises were accompanied by forceful emissions of whitish-brown ash clouds. This activity continued on 18 September. Ash plumes from the activity drifted to W and NW resulting in fine ashfall in downwind areas. Occasional sub-continuous jet-like noises began to occur on 18 September along with a reported lava flow. Glow was observed at night on 14 and 18 September. This could have been associated with cascading lava detached from steep portions of an active lava flow.

The seismograph remained off from 15 August onward through the reporting period due to technical problems.

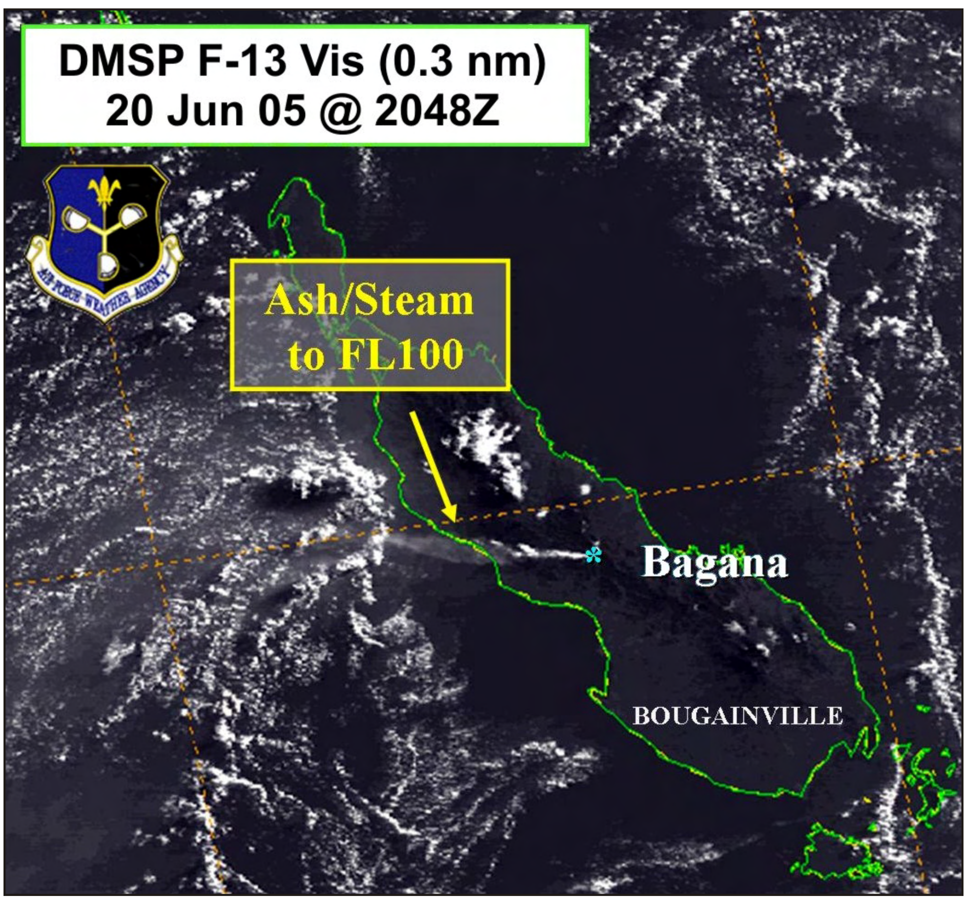

Figure 8.A DMSP image highlighting a Bagana plume seen on 20 June 2005. For scale, near its broad SE end, Bougainville island is ~50 km wide (measured in the NE-SW direction). Both images provided courtesy of NASA and the US AFWA.

Background. Bagana volcano, occupying a remote portion of central Bougainville Island, is one of Melanesia's youngest and most active volcanoes. Bagana is a massive symmetrical lava cone largely constructed by an accumulation of viscous andesitic lava flows. The entire lava cone could have been constructed in about 300 years at its present rate of lava production. Eruptive activity at Bagana is characterized by non-explosive effusion of viscous lava that maintains a small lava dome in the summit crater, although explosive activity occasionally producing pyroclastic flows also occurs. Lava flows form dramatic, freshly preserved tongue-shaped lobes up to 50-m-thick with prominent levees that descend the volcano's flanks on all sides.

Information Contacts: *Rabaul Volcano Observatory* (see Manam), *Darwin Volcanic Ash Advisory Centre* (see Soputan).

Reventador

Ecuador
0.078°S, 77.656°W; summit elev. 3,562 m
All times are local (= UTC - 5 hours)

Reventador ceased extruding significant new lava flows in early July 2005. Subsequent activity through this report interval, late September, was manifested as intermittent explosive eruptions. These were characterized alternately as Strombolian activity and short-duration Vulcanian events.

After the post-effusive phase and during the explosive phase a significant Vulcanian event took place at 2058 on 12 September, producing an ash column more than 5 km above the summit. Large bombs were ejected more than 2 km from the vent and small pyroclastic flows were evident in gullies descending from the cone. This event was preceded by more than a week of relative quiescence, indicating that future Vulcanian eruptions may occur with little warning.

This report was submitted by Jeffrey B. Johnson (University of New Hampshire), who collaborated with colleagues including Patricio Ramón, Liliana Troncoso, Guillermo Viracucha, Jaime Lozada, Daniel Andrade, David Rivero, Gorky Ruiz, Pete Hall, and Wilson Enriquez (Geophysical Institute, Escuela Politécnica Nacional, IG-EPN). They adhered to the practice of numerically naming lava flows, for example Lava #5.

End of significant lava effusions. *BGVN* 30:05 provided a detailed overview of recent active lavas erupted by Reventador between April 2005 and the end of June 2005. Visits to the caldera on 1 July revealed dramatic diminution in the advance rate of Lava #5 along the southern caldera margin. Within the first few days of July, Lava #5 had stagnated. Its furthest extent was ~ 4.5 km from the vent and about 50 m short of the furthest extent of Lava #4 (erupted in May 2005), which it was overriding.

Since the first few days in July, major lava extrusion had terminated. Despite intermittent MODIS thermal alerts (~ 1 per week from University of Hawaii (HIGP)), no significant lava flows have been directly observed by IG-EPN personnel or reported by the local populace. During July, it is likely that small lava flow(s) (under 1 km in length) were extruded from the southern breach of the cone during short-lived events lasting a few days or less. For instance, a photo taken on 1 August (figure 9) indicates a short, fresh lobe (named Lava #6), which was no longer incandescent during a night-time visit on 3 August.

Explosive activity. Pyroclastic explosions, which first occurred in early June 2005, continued intermittently until 25 September 2005. Significant Strombolian activity was noted at night by the local populace in the first few days of July, coincident with the decline of Lava #5 extrusion. In mid-July, explosive activity was minimal, but increased towards the end of the month and during August. Between explosions, voluminous vapor plumes were often observed and loud degassing sounds were often audible, but at times the volcano was also completely silent. Incandescence was also often visible in the cone, suggesting an open-vent configuration. Periods of quiescence separated explosive activity and generally lasted hours to days. Typical eruptive events, which occurred as many as 26 times a day (i.e., on 15 September), are identified clearly by seismic records. These emissions tend to alternate between discrete

Figure 9. Photograph of a fresh lava flow at Reventador on 1 August 2005. The flow, which appears as a white lobe, was stagnant. Courtesy of J. Johnson and the Geophysical Institute.

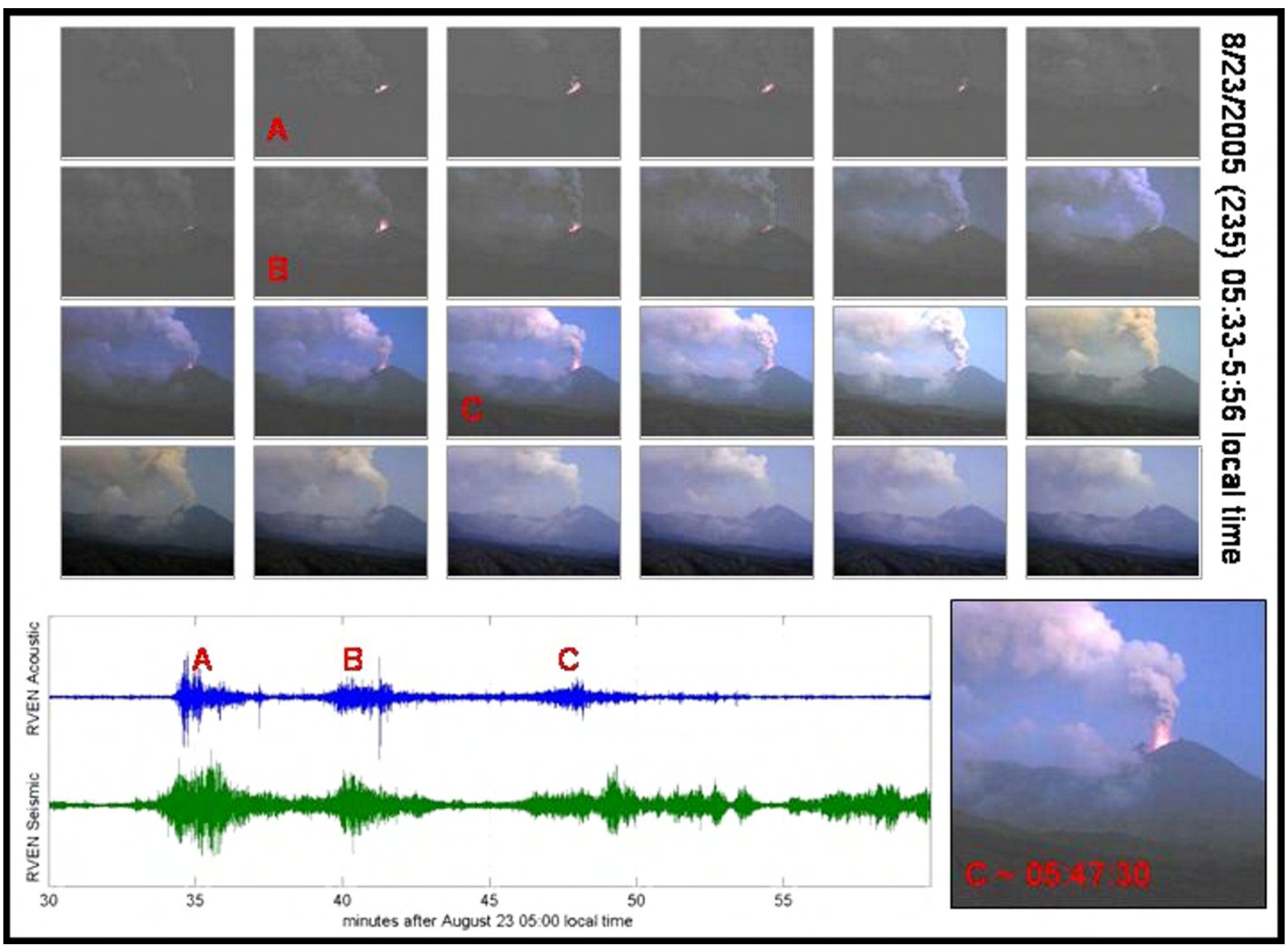

Figure 10. Strombolian activity at Reventador depicted in a sequence of still images taken at one-minute intervals along with accompanying infrasonic and seismic traces (signals recorded ~ 1.8 km from the vent). Courtesy of J. Johnson and the Geophysical Institute.

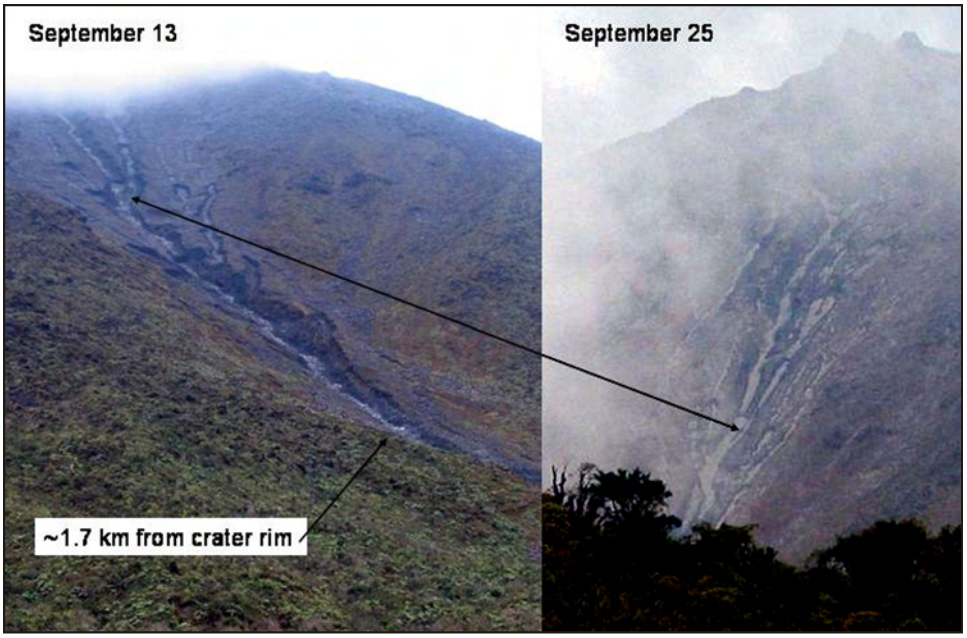

Figure 11. Photos of Reventador cone taken 12 days apart (13 and 25 September 2005, from different angles) show the channels and deposits of small pyroclastic flows. Arrow connects same location on cone in both frames. Courtesy of J. Johnson and the Geophysical Institute.

pyroclastic-laden, ash-rich explosions and extended-duration Strombolian-type fountaining (figure 10). Both types of events were capable of erupting large blocks up and over the crater rim (~ 200 m above the vent), which were often sufficiently massive to be visible from the highway ~ 7.5 km distant.

A period of relative quiescence, marked by an absence of large ash-generating plumes, was evident at the end of August and during first days of September. Vent incandescence was also notably absent during several days up until the large explosion at ~ 2058 on 12 September.

Preceded by a swarm of small volcano-tectonic events, the explosion was manifested by very short-duration transient signals, with arriving infrasonic and seismic waves lasting less than ~ 1 minute. However, peak-to-peak amplitudes the respective signals (~ 211 Pa and 4.9 mm/s) were substantially greater than other explosive events occurring at the volcano during recent months.

As previously mentioned, this short-duration explosion generated a more than 5 km-high ash-cloud and ejected large bombs aerially to more than 2 km. Small pyroclastic flows were confined to gullies on the cone and reached at least 1.5 km from the vent (figure 11).

Since this large event, incandescence has been routinely present in the crater and explosions have occurred with greater frequency (figure 12). Further large explosions occurring in the morning of 24 September were likely responsible for more pyroclastic deposits evident on the upper cone and in upper-flank gullies (figure 11, right-hand photo).

Monitoring. Reventador continues to be closely monitored by the IG-EPN (figure 13). A telemetered seismic network, consisting of three local short-period seismometers,

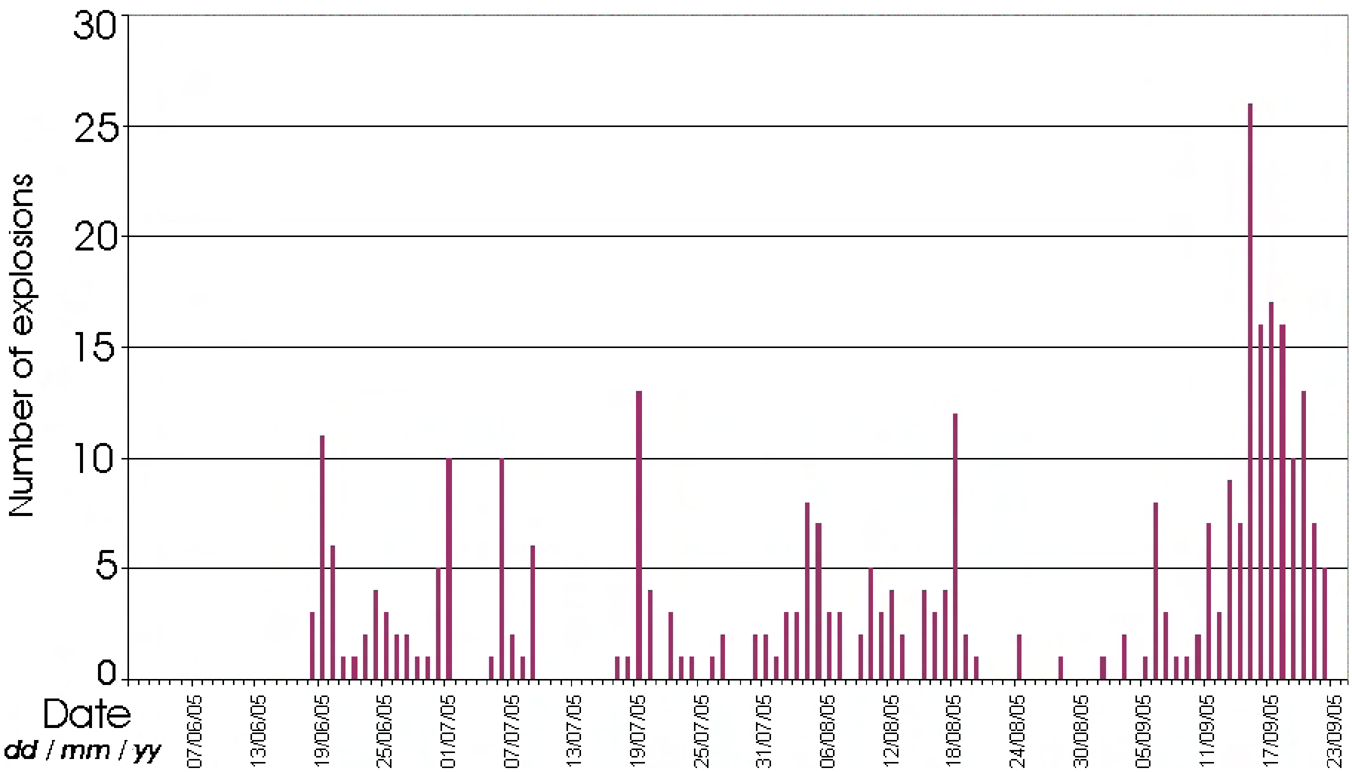

Figure 12. Summary of explosion counts at Reventador as identified by the IG-EPN seismic network between 1 June and 23 September 2005. Courtesy of J. Johnson and the Geophysical Institute.

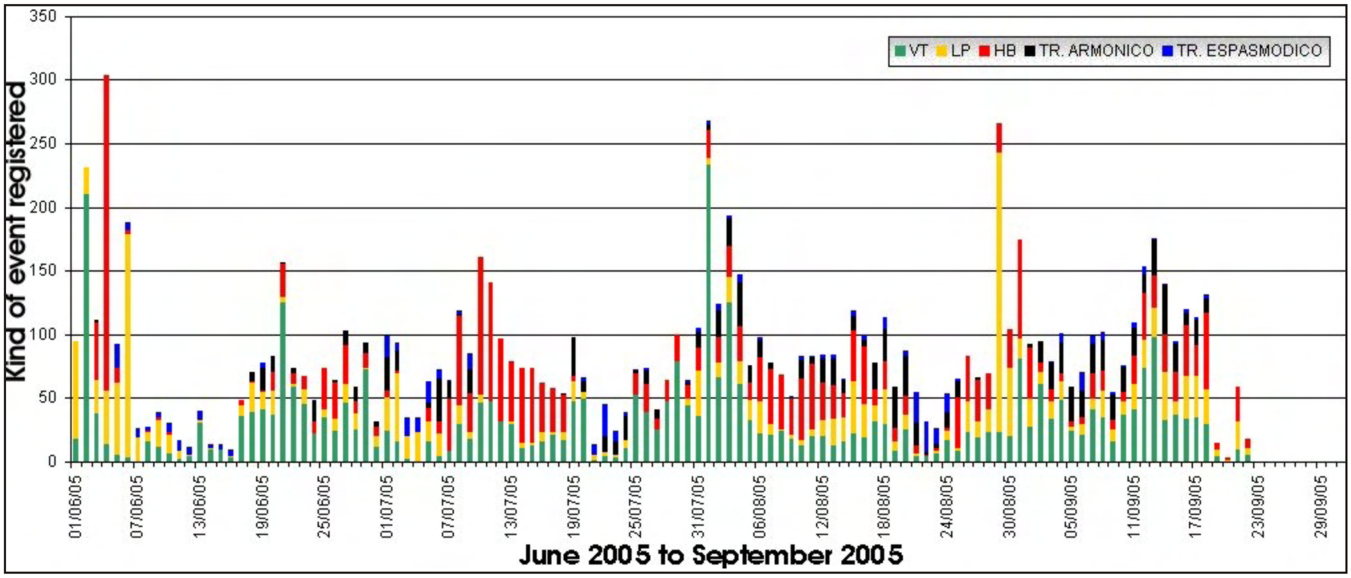

Figure 13. Summary of Reventador seismicity since 1 June 2005. Many of the tremor events were associated with vigorous degassing at the vent. Courtesy of J. Johnson and the Geophysical Institute.

is used to quantify the eruptive chronology of the volcano, including the quantities of volcano-tectonic events (VT), long-period events (LP), hybrid events, and harmonic and spasmodic tremor, and explosion events. Three temporary stand-alone dataloggers with broad-band seismometers and infrasonic microphones, installed with collaboration from the University of New Hampshire and the University of North Carolina, have supplemented this network throughout the summer.

Additionally, field visits by IG-EPN personnel have been conducted regularly. During an expedition on August 28, Differential Optical Absorption Spectroscopy (DOAS) and Forward Looking Infrared (FLIR) measurements were made to assess gas and thermal flux, respectively. DOAS measurements revealed a continuing flux of SO_2 estimated at ~ 850 tons/day. The FLIR measurements confirmed near-magmatic temperatures at the vent. It also confirmed stagnation of all lava flows on the volcano since their maximum surface temperatures had cooled into the range of ~ 50°C.

Background. Reventador is the most frequently active of a chain of Ecuadorian volcanoes in the Cordillera Real, well E of the principal volcanic axis. The forested, dominantly andesitic stratovolcano rises to 3562 m above the remote jungles of the western Amazon basin. A 4-km-wide caldera widely breached to the E was formed by edifice collapse and is partially filled by a young, unvegetated stratovolcano that rises about 1,300 m above the caldera floor to a height above the caldera rim. Reventador has been the source of numerous lava flows as well as explosive eruptions that were visible from Quito in historical time. Frequent lahars in this region of heavy rainfall have constructed a debris plain on the eastern floor of the caldera. The largest historical eruption at Reventador took place in 2002, producing a 17-km-high eruption column, pyroclastic flows that traveled up to 8 km, and lava flows from summit and flank vents.

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Fuego

Guatemala
14.47°N, 90.88°W; summit elev. 3,763 m
All times are local (= UTC - 6 hours)

Fuego remained active into 2005, although this report focuses on the interval 31 December 2003 through 11 May 2004. A previous report discussed activity through the end of 2003 (*BGVN* 29:11); this report, based mainly on information from INSIVUMEH (Instituto Nacional de Sismologia, Vulcanologia, Meterologia y Hidrologia) covers the interval from end of 2003 to 11 May 2004.

Figure 14 is a map of the Fuego-Acatenango region, emphasizing drainages and settlements frequently mentioned in activity and hazard reports. Fuego is moderately close to the centers of some of Guatemala's largest cities, including the Capital (2-3.5 million inhabitants, ~ 40 km NNE of Fuego's summit) and Antigua (~ 32,000 inhabitants, ~ 18 km NNE).

CONRED, the Guatemalan hazards agency (Cordinadora Nacional para la Reducción de Desastres) posted hazard information on their website, in part using a map format noting conditions seen from various perspectives. For example, the map issued for 9 January 2004 (during the largest crisis of the interval), included a title, a legend, a summary of critical hazards-oriented observations. One portion of the 9 January map reported a local wind velocity, N-NW at 12-18 km/hr, and the occurrence of fine and very fine ash falling within 5 to 15 km of the crater. The map also included key radio base stations and for each, a summary of the day's message content.

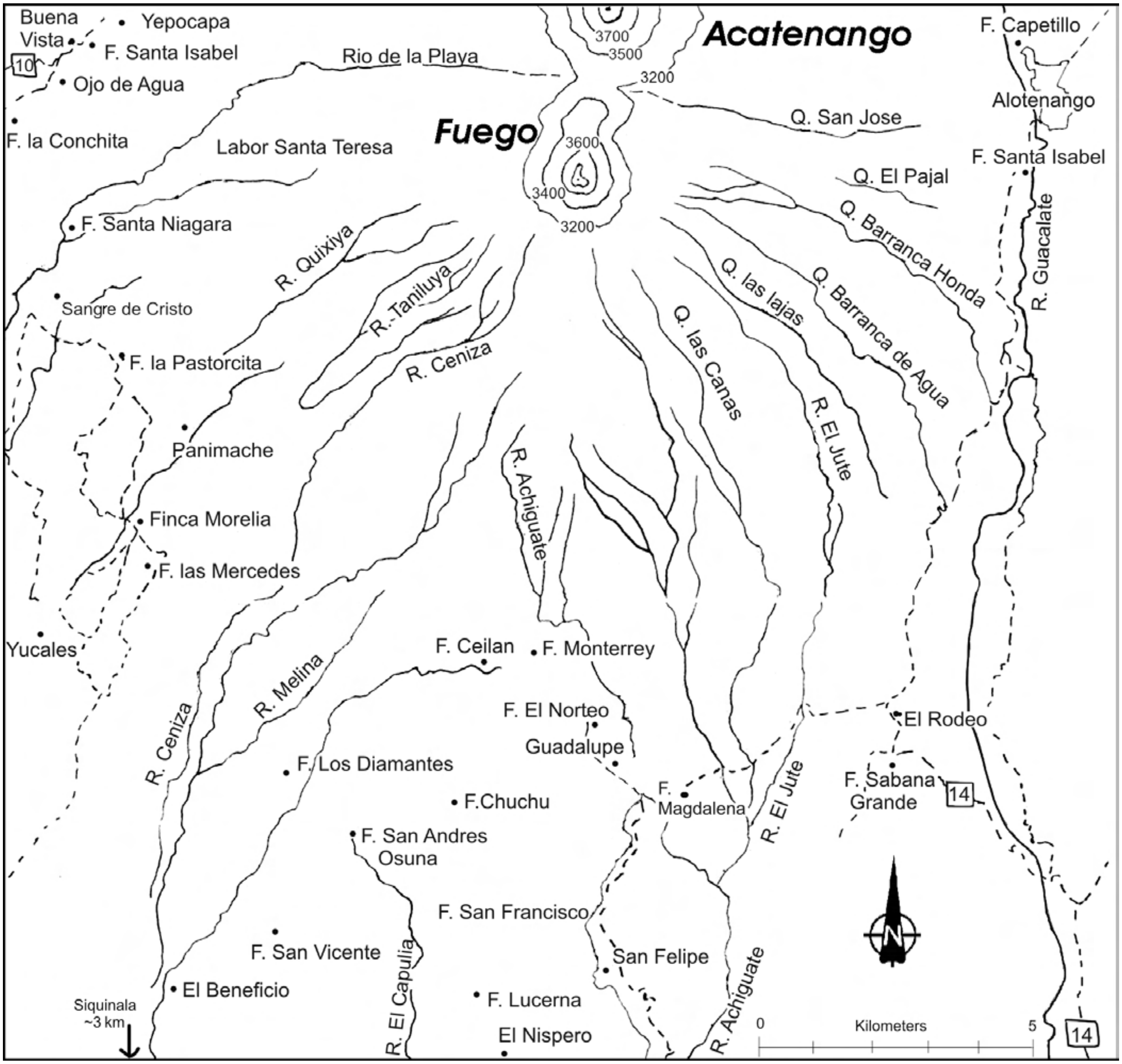

Figure 14. A sketch map of Fuego and adjacent Acatenango centered several kilometers S of these edifices. Numerous drainages emerge from the stratovolcano, their paths trending radially outward as well as in many cases curving decidedly S with distance from the volcano. Abbreviations 'R.' and 'Q.' apply to the Spanish-language terms Río (river) and Quebrada (canyon, and in this region these are often steep-sided, essentially gorges). 'F' stands for *finca* (farm or plantation, many of which grow the renowned Antigua coffee). A few contours are shown around these volcanoes (labeled in meters above sea level). The Fuego-Acatenango complex also contains two smaller (unlabeled) topographic highs, each one a few kilometers N of the better known peaks (i.e. N of Fuego, Meseta, and N of Acatenango, Yepocapa). Several towns off the map's margins are indicated with arrows and distances. Compiled by *Bulletin* editors from topographic maps.

Many early 2005 observations were hampered by rainfall. Table 1 summarizes numerous INSIVUMEH daily reports during February, but for the bulk of the entries, it chiefly presents Smithsonian/USGS Weekly Reports to portray longer time spans.

From the table, the pattern emerges of ongoing emissions with frequent plumes to 1 km and occasional higher plumes (several to ~ 2 km and one to ~ 3 km). Similar to previous months, the reports frequently mention dislodged lava blocks and mass wasting of volcanic materials.

The highest plume found in available reports of the interval occurred on 8 January 2004, when an ash plume rose ~ 3 km over the summit. Traces of ash fell in the Capital during this episode.

Fuego began its 8 January eruption around 1500 to 1600, expelling thick, broad columns of gases and ash to ~ 3 km above the crater. There were 25-30 explosions a minute accompanied by loud rumbling noises and acoustical shock waves felt 12 km away. Although no evacuations were ordered, settlements on the upper flanks were considered at risk, including San Andrés Iztapa, Chimaltenango, Comalapa, San Martín Jilotepeque, San José Poaquil, and Yepocapa.

The Washington VAAC added these observations: "[GOES 12] satellite imagery shows two plumes moving away from the volcano. The higher plume extends approximately 75 nm [~ 140 km] to the [N] and is estimated to be around FL250 [shorthand for 25,000 feet altitude, ~ 8 km]. A lower plume extends approximately 70 nm [126 km] to the [W] and is estimated to be up to FL190 (19,000 feet altitude, ~ 6 km). Hot spot activity has been fairly strong and constant over the past several hours."

A 20 February report described continued vigorous activity; ash emissions from the central crater rose to heights of 1.5-2 km above the summit (table 1). Light to moderate winds again blew the ash N and some traces fell in the Capital.

Background. Volcán Fuego, one of Central America's most active volcanoes, is one of three large stratovolcanoes

Date	Maximum plume height (above summit) and bearing	Activity Description
31 Dec-06 Jan 2004*		During 1-5 January, lava emitted from Fuego flowed 70-100 m from the crater. Avalanches from the lava-flow fronts traveled W toward Santa Teresa ravine and toward Trinidad ravine. Seismic stations on the volcano recorded almost continuous harmonic tremor.
07 Jan-13 Jan 2004*	~3 km	Ash emission starting around 1500-1600 on 8 January (see text).
21 Jan-27 Jan 2004*	~1.5 km, SSW (22 Jan). Smaller explosions to ~700 m above the crater.	Incandescent avalanches traveled a maximum distance of 1 km toward Zanjón Barranca Seca, La Trinidad, and Río Ceniza ravines. Not ashfall in populated areas. ~1.5 km from two strong explosions (evening of 22 January); blown SSW. During the rest of the week, smaller explosions sent plumes to ~700 m above the crater.
28 Jan-03 Feb 2004*	~1.1 km	Small-to-moderate explosions. The highest rising ash plume was produced from an explosion on 29 January. The plume reached above the crater and was accompanied by avalanches of volcanic material down Barranca Seca. A small amount of ash fell in Panimaché village and possibly in Santa Sofía. On 31 January two small collapses in the S edge of the central crater produced small avalanches of lava blocks.
16 Feb 2004	0.3-1 km, SW	Audible acoustic shock waves. Ashfall on upper edifice.
17 Feb 2004		Incandescent avalanches rose 200 m at night, , but some traveled into the drainages of the Taniluyá, Ceniza, and Zanjón Barranca Seca. A mudflow descended the Quebrada Santa Teresa (on Fuego's W-SW sides) carrying blocks up to 2 m in diameter. During 0855 to 1140 Fuego produced 10 explosions characterized as strong, resulting in warnings to civil aviation authorities. Ashfall on W- and SW-flank communities.
18 Feb 2004	1.5-1.7 km	A rapid succession of 15 early morning explosions at 10- to 30-second intervals were heard up to 8 km distant from the summit. Incandescent material landed on many of the upper slopes. Judging by the quantity and weight of ash fall, INSIVUMEH inferred that the eruption caused substantial changes in the summit area. Finer ash fell for 10 to 15 minutes on Finca Sangre de Cristo and environs. Besides aviation safety, concerns included drinking-water contamination. Ashfall up to 8 km from summit.
20 Feb 2004	1.5-2 km; light to moderate S winds	Loud outbursts and incandescent avalanches down the W-flank valleys of the Seca, Taniluyá, and Trinidad rivers, and to lesser extent down SE-flank valleys of the Las Lajas-El Jute rivers. Ash-bearing emissions came from the central crater at 4- to 9-minute intervals. Some traces of ash noted to the N, in the Capital.
25 Feb-02 Mar 2004*	~1.7 km	Weak-to-moderate explosions continued at Fuego, producing plumes above the crater. Avalanches of volcanic material traveled down several ravines, including Trinidad, Ceniza, Santa Teresa, and Taniluyá (to the W). Explosions on 28 February deposited small amounts of fine ash in the village of Sangre de Cristo, and explosions on 29 February deposited ash W and SW of the volcano in the villages of Yepocapa and La Cruz.
04 Mar-08 Mar*	~1.5 km	On 5, 7, and 8 March avalanches of incandescent volcanic material traveled as far as 1.5 km down several ravines, including Seca, Taniluyá, Ceniza, and Trinidad. Explosions on the 7th and 8th deposited ash 6-10 km from Fuego, including in the villages of Sangre de Cristo and Panimaché.
10 Mar-16 Mar 2004*	~1.7 km	Explosions; incandescent avalanches as far as 600 m down ravines on the volcano's W, SW, and S flanks; ash fell in W- to SW-flank settlements from Sangre de Cristo to Panimaché and Finca Morelia.
17 Mar-23 Mar 2004*	~1.3 km	Volcanic material traveled down the Seca ravine; ash fell in the village of Sangre de Cristo.
24 Mar-30 Mar 2004*	~1 km	Three strong explosions were recorded on 26 March; they caused incandescent avalanches in the Zanjón Barranca Seca and Trinidad ravines. On 29 March two explosions within 7 minutes produced ash plumes. A lahar occurred on 29 March in the Zanjón Barranca Seca ravine.
31 Mar-06 Apr* 2004	~1.2 km (5 April, drifting SSE)	Lahars flowed down Seca Ravine on 30 March, and passed near the village of Sangre de Cristo on 3 April. Incandescent avalanches descended several ravines, including Santa Teresa, Ceniza, and Taniluyá.
07 Apr-13 Apr 2004*	~1 km	Lava flowed 75-100 m from the central crater and avalanches of volcanic material traveled as far as 400 m towards Santa Teresa and Taniluyá ravines.
14 Apr-20 Apr 2004*	~2.3 km (16 April, drifting S)	During 18-19 April, small eruptions hurled incandescent material up to 50 m above the vent.
21 Apr-27 Apr 2004*	~1 km (steam)	Weak explosions produced steam clouds above the volcano. In addition, small avalanches of volcanic material occasionally traveled W toward Santa Teresa Ravine.
28 Apr-04 May 2004*	~1.5 km	Ash-bearing explosions. On 28 April, an explosion produced an ash plume above the volcano, and ash was deposited ~4 km SW of the volcano in the villages of Panimaché I and Panimaché II. In addition, a small volcanic avalanche traveled W toward the Santa Teresa ravine.
05 May-11 May 2004*		Explosions chiefly produced gas-and-ash clouds. On 5 May a small lahar traveled to the W down Seca ravine.

Table 1. Samples of Fuego activity during 31 December 2003 through 11 May 2004. Summaries based largely on *Smithsonian/USGS Weekly Reports* are shown as multi-day intervals (marked with an asterisk, "*"). Most of the reported eruptions in column 3 were ash bearing. Courtesy of INSIVUMEH.

overlooking Guatemala's former capital, Antigua. The scarp of an older edifice, Meseta, lies between 3,763-m-high Fuego and its twin volcano to the N, Acatenango. Construction of Meseta volcano dates back to about 230,000 years and continued until the late Pleistocene or early Holocene. Collapse of Meseta volcano may have produced the massive Escuintla debris-avalanche deposit, which extends about 50 km onto the Pacific coastal plain. Growth of the modern Fuego volcano followed, continuing the southward migration of volcanism that began at Acatenango. In contrast to the mostly andesitic Acatenango volcano, eruptions at Fuego have become more mafic with time, and most historical activity has produced basaltic rocks. Frequent vigorous historical eruptions have been recorded at Fuego since the onset of the Spanish era in 1524, and have produced major ashfalls, along with occasional pyroclastic flows and lava flows.

Information Contacts: *Instituto Nacional de Sismologia, Vulcanología, Meteorología e Hidrologia (INSIVUMEH)*, Ministero de Communicaciones, Transporto, Obras Públicas y Vivienda, 7a. Av. 14-57, zona 13, Guatemala City 01013, Guatemala (URL: http://www.insivumeh.pagina.de); *Coordinadora Nacional para la Reducción de Desastres (CONRED)*, Av. Hincapié 21-72, Zona 13, Guatemala City, Guatemala; *Washington Volcanic Ash Advisory Center (VAAC)*, Satellite Analysis Branch (NOAA/NESDIS), 4700 Silver Hill Road, Stop 9910, Washington, DC 20233-9910, USA (URL: http://www.ssd.noaa.gov/).

Soufrière Hills

Montserrat
16.72°N, 62.18°W; summit elev. 915 m
All times are local (= UTC -4 hours)

Soufrière Hills was relatively quiet through April and early May 2005, with activity increasing somewhat through June and several explosive events in late June and in July (*BGVN* 30:06). Table 2 summarizes activity during 8 July thorough 26 August 2005. Further text brings this report through 5 September, with the comment that slow dome growth continued.

On 6 August a vigorous eruption sent a plume to ~ 1.8 km above the volcano. Evidence of uplift and fracturing were observed on the crater floor, and an area of blocky lava resembling a small lava dome was observed. Due to poor visibility further observations will be necessary to determine if the feature is a new dome or was caused by the collapse, or uplift, of old dome rock.

Volcanic and seismic activity remained at elevated levels at Soufrière Hills during 12-19 August. Periodic ash venting continued, with a vigorous episode occurring on 18 August at 1800. On 16 August, the presence of a small blocky lava dome with talus slopes was confirmed. There was some ash venting from the dome, but no significant rockfalls were seen. Activity at Soufrière Hills remained at elevated levels during 2-9 September, the end of this reporting period. Observations made on 5 September suggested that slow lava-dome growth continued.

Background. The complex andesitic Soufrière Hills volcano occupies the southern half of the island of Montserrat. The summit area consists primarily of a series of lava domes emplaced along an ESE-trending zone. Prior to 1995, the youngest dome was Castle Peak, which was located in English's Crater, a 1-km-wide crater breached widely to the E. Block-and-ash flow and surge deposits associated with dome growth predominate in flank deposits. Non-eruptive seismic swarms occurred at 30-year intervals in the 20th century, but with the exception of a 17th-century eruption, no historical eruptions were recorded on Montserrat until 1995. Long-term small-to-moderate ash eruptions beginning in that year were later accompanied by lava dome growth and pyroclastic flows that forced evacuation of the southern half of the island and ultimately destroyed the capital city of Plymouth, causing major social and economic disruption to the island.

Information Contact: *Montserrat Volcano Observatory* (MVO), Fleming, Montserrat, West Indies (URL: http://www.mvo.ms/).

Report date (2005)	Number of earthquakes				SO_2 flux (metric tons/day)
	Hybrid	Volcano-tectonic	Long-period	Rockfalls	
08 Jul-15 Jul	10	2	—	—	660
15 Jul-22 Jul	16	19	13	11	608
22 Jul-29 Jul	4	29	5	23	510
29 Jul-05 Aug	4	8	9	33	986
05 Aug-12 Aug	3	3	5	14	770
12 Aug-19 Aug	8	5	13	12	570
19 Aug-26 Aug	6	5	13	15	900

Table 2. A summary of the weekly number of earthquakes (EQs), rockfalls, and averaged spot measurements of SO_2 flux at Soufriere Hills during July and August 2005. Cases of "mixed earthquakes" were unreported during the reporting interval. Date ranges go from noon on the starting day to noon on the end day. Courtesy of MVO.

Shiveluch

Kamchatka, Russia
56.653°N, 161.360°E; summit elev. 3,283 m
All times are local (= UTC + 12 hours [+ 13 hours in March-June])

From March 2005 until July 2005, the lava dome at Shiveluch continued to grow and ash-and-gas plumes and gas-and-steam plumes were frequent (*BGVN* 30:06). The alert level was at Orange.

On 7 July, the Russian News and Information Agency (RIA Novosti) reported that Shiveluch was producing pyroclastic flows and ash plumes rising to 5 km altitude. On 8 July, Kamchatka Volcanic Eruptions Response Team (KVERT) raised the alert level from Orange to Red, the highest level. Video footage taken the same day showed weak gas-and-steam plumes rising to ~ 5 km altitude. On 9 July, ash-and-gas plumes rose to 3 km altitude and the alert level was reduced to Orange. Ash plumes extended 27 km SW of the volcano during July 11-12.

Through July and August, the lava dome continued to grow and Shiveluch remained at alert level Orange. On 15 July, RIA Novosti reported that "[m]assive ash emissions from Shiveluch...are posing danger to nearby towns and villages. The Federal Earthquake Prediction Center's Kamchatka branch said ash storms, as well as mudflows from Shiveluch's slopes, could be dangerous for nearby settlements . . .. [T]he volcano began emitting massive ash clouds. Gas, ash, and magmatic material . . . are barreling down the slope . . .. The ash cloud has spread more than 700 kilometers to the [W] of the volcano, covering the peninsula and the nearby Sea of Okhotsk with a nearly 150-kilometer-wide strip."

On 19 July KVERT reported that a gas-steam plume extended 30 km SW from the volcano on 18 July and a gas-steam plume up to 3.5 km altitude was observed on 19 July. On 19 July, 23 July, and during 5-12 August, satellite data from the USA and Russia indicated a persistent 1 to 7 pixel thermal anomaly at the dome. On 23 July and 6 August, incandescence was observed at the lava dome. Fumarolic activity was visible on 6 August.

During 19-26 August, about ten shallow earthquakes were recorded, and a larger thermal anomaly was visible on satellite imagery. On 19 August a new viscous lava flow was emitted from the lava dome and continued to flow during 26 August to 9 September. Several ash plumes reached ~ 5.5 km altitude.

On 5 September, an ash plume rose to ~ 4 km altitude. On 8 September, a hot avalanche was accompanied by an ash plume that rose to a height of ~ 3.5 km altitude. The large thermal anomaly continued during the first week of September. On 7 September RIA Novosti reported that Shiveluch "is spewing gas and ash to heights of up to 5,000 feet [1.5 km]". On 16 September KVERT reported that the dome was continuing to grow and that viscous lava continued to flow from the dome. Incandescence at the lava dome was observed on 13 September. Gas-steam plumes up to 3. 5 km altitude and a large thermal anomaly were registered all week.

On 22 September KVERT raised the alert level to Red, the highest level, and reported that according to seismic data, at 05:15 UTC on 22 September, a paroxysmal eruption began. Ash plumes reached a height about 7.5 km altitude, and ash fall was noted from 06:00 until 08:00 UTC on 22 September by seismologists working about 9 km SW of the volcano.

KVERT reported, based on US and Russian satellite data, an ash cloud with a diameter of ~ 20 km located ~ 90 km to the NW of the volcano and, based on Russian satellite data, an ash cloud with a diameter of ~ 15 km located ~ 20 km to the SSE at about 3 km altitude. Ash fall was observed in Klyuchi on the night of 22 September. According to visual data, a new pyroclastic flow extended 10-15 km.

Background. The high, isolated massif of Shiveluch volcano (also spelled Sheveluch) rises above the lowlands NNE of the Kliuchevskaya volcano group. The 1,300 km^3 Shiveluch is one of Kamchatka's largest and most active volcanic structures. The summit of roughly 65,000-year-old Stary Shiveluch is truncated by a broad 9-km-wide late-Pleistocene caldera breached to the S. Many lava domes dot its outer flanks. The Molodoy Shiveluch lava dome complex was constructed during the Holocene within the large horseshoe-shaped caldera; Holocene lava dome extrusion also took place on the flanks of Stary Shiveluch. At least 60 large eruptions of Shiveluch have occurred during the Holocene, making it the most vigorous andesitic volcano of the Kuril-Kamchatka arc. Widespread tephra layers from these eruptions have provided valuable time markers for dating volcanic events in Kamchatka. Frequent collapses of dome complexes, most recently in 1964, have produced debris avalanches whose deposits cover much of the floor of the breached caldera.

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