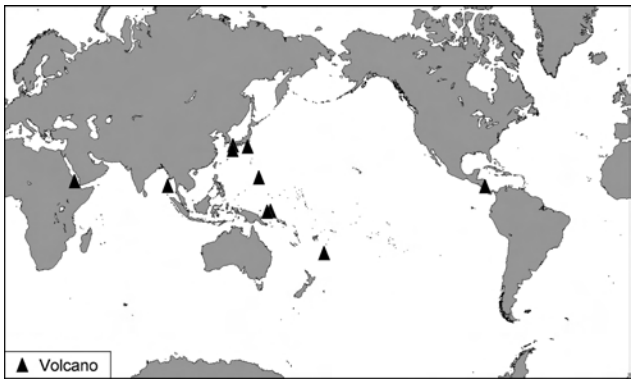
Bulletin of the Global Volcanism Network



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Concepción

Nicaragua
11.538°N, 85.622°W; summit elev. 1,700 m
All times are local (= UTC - 6 hours)

According to the Instituto Nicaraguense de Estudios Territoriales (INETER) an eruption occurred at dawn on 28 July 2005 from Concepción, which lies on the island of Ometepe in W-central Lake Nicaragua (figure 1). Concepción is frequently active at low levels and INETER reports suggested these new events as late as 31 July were not considered major behavioral anomalies indicative of an energetic reactivation of the volcano. A colored diagrammatic map that for the case of larger eruptions included hazard zones, refuges, and escape routes for three contingencies; it appeared in the press several days before the July eruption. Many of the scenarios indicated movement of people to the SE side of the island. The map noted that Concepción has 26 craters, and eruptions could occur from other than the central vent.

The 28 July eruption cloud deposited ash in the island town of Moyagalpa (~ 9 km W of the summit) and in lesser quantities on the mainland settlements W of the volcano, at San Jorge, Buenos Aires, Potosí, Belén, and in the vicinity of Rivas. Residents also smelled volcanic gases.

INETER recorded seismic tremor at a station N of the volcano, but no large earthquakes occurred. By the afternoon of 28 July ashfall had reduced considerably, or completely ceased, but gas emission continued. No thermal anomalies were observed on satellite imagery. During the night and the following day residents on Ometepe island's W side reported continued presence of ash and gas.

On the morning of 29 July, geodetic measurements determined that significant deformation had occurred, presumably related to magma injected. The seismic station to the N recorded constant tremor; during 0500-0800, a series of volcanic earthquakes may have been associated with small explosions in the crater. At 1025 the seismic station recorded a moderate explosion in the crater.

On 30 July the N seismic station registered tremor, which continued with variations. Significant earthquakes remained absent. On 31 July after 0300 tremor amplitude rose and it remained elevated for an undisclosed amount of time. However, episodes of ashfall diminished or ceased.

Background. Volcán Concepción is one of Nicaragua's highest and most active volcanoes. The symmetrical basaltic-to-dacitic stratovolcano forms the NW half of the dumbbell-shaped island of Ometepe in Lake Nicaragua and is connected to neighboring Madera volcano by a narrow isthmus. A steep-walled summit crater is 250 m deep and has a higher western rim. N-S-trending fractures on the flanks of the volcano have produced chains of spatter cones, cinder cones, lava domes, and maars located on the NW, NE, SE, and southern sides extending in some cases down to Lake Nicaragua. Concepción was constructed above a basement of lake sediments, and the modern cone grew above a largely buried caldera, a small remnant of which forms a break in slope about halfway up the north flank. Frequent explosive eruptions during the past half century have increased the height of the summit significantly above that shown on current topographic maps and have kept the upper part of the volcano unvegetated.

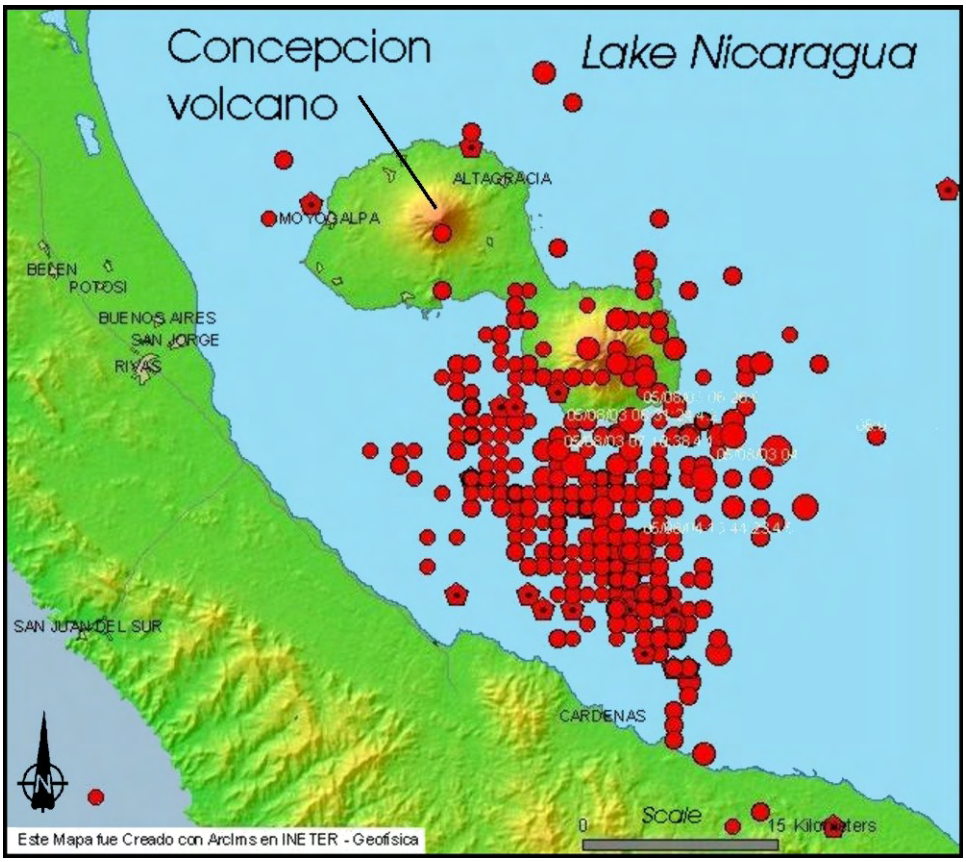

Figure 1. A map of the portion of Lake Nicaragua containing Ometepe island, the northern portion of which includes Concepción volcano. Eruptions there in late July led to ash falling on many of the labeled settlements to the W of the summit. Small dots represent epicenters detected during 2003-2005; they mainly centered 10-16 km to the SE and often off the island, but typically closer to the island's other volcano (Maderas). The largest were M_R 5.6 (date not given). Courtesy of INETER.

Information Contacts: *Instituto Nicaraguense de Estudios Territoriales* (INETER), Volcanology Department, Apartado 2110, Managua, Nicaragua (URL: http://www.ineter.gob.ni/geofisica/vol/concepcion/concepcion.html).

Miyake-jima

Izu Islands, Japan
34.079°N, 139.529°E
summit elev. 815 m

Seismicity and regular gas-and-steam plumes related to the eruption during the summer of 2000 continued through August 2003 (*BGVN* 28:10). From August 2003 through August 2005

gas emissions continued; SO_2 flux remained relatively high and nearly constant (4,000-9,000 tons per day) since October 2002 (figure 2). Eruptions were absent in 2003. Seismicity increased again in May 2003 to more than 700 events/month (table 1), compared to less than 450 the previous four months, a level higher than any recorded since August 2000 (*BGVN* 28:10).

The number of monthly events remained above 500 through February 2004, with counts of 1,449 in December 2003 and 1,353 in January 2004. Seismicity increased significantly during 5-15 March 2004, with more than 400 daily events recorded during 6-10 March (a high of 590 events on the 7th), before gradually declining, but resulting in a monthly total of 3,810. No unusual activity or eruptions accompanied the elevated seismicity. Although seismicity dropped in April 2004, more than 1,000 monthly seismic events were recorded during May-July 2004.

Seismicity was high again in November (1,015 events) and December (1,634 events) 2004, but the December seismicity was primarily due to over 700 events during 2-3 December. The amplitude of the continuous tremor also increased from below 1 μm/s to around 4 μm/s in June 2004. Amplitudes remained elevated, though variable, through December 2004.

On 30 November 2004 a minor ash eruption occurred after a 2-year lull. A minor eruption is defined as a small explosion with minor ash emission and plume height of less than 1 km. The Japanese Meteorological Agency (JMA) noted another gray plume on 2 December, and the Geological Survey of Japan (GSJ) listed minor eruptions on 2, 7-8, and 9 December 2004.

As of April 2005, the SO_2 flux was about 2,000-5,000 tons/day. The danger of destructive eruptions was considered to be small, and some residents of the island (~ 3,800 people), who had been evacuated since September 2000 were returning home as of May 2005. However, the GSJ noted minor eruptions again on 12 April and 18 May 2005.

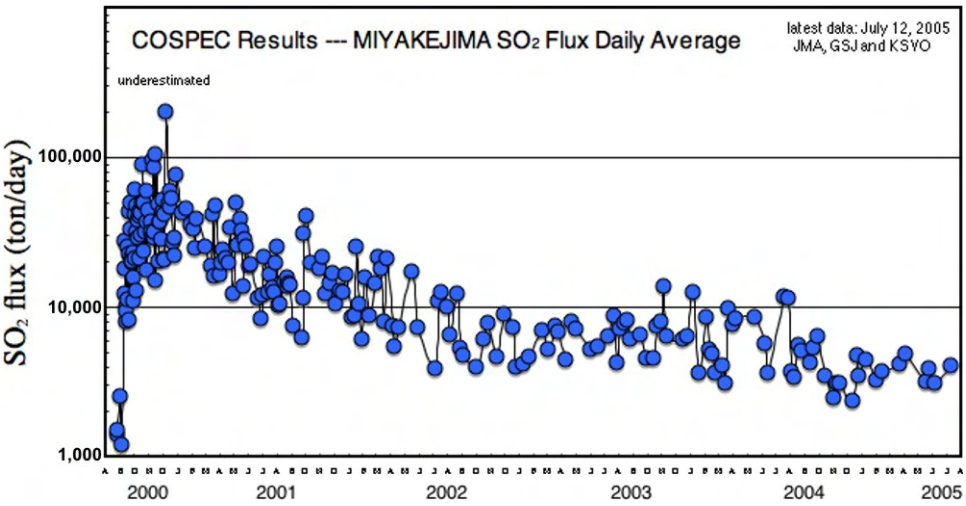

Figure 2. Daily average SO_2 flux from Miyake-jima between August 2000 and July 2005. Courtesy of Kazahaya Kohei, Geological Survey of Japan.

Month	Volcanic Earthquakes	Max. plume height (km) (date)	Plume Color (number of days, date)
May 2003	713	1.0 (3, 22)	W (22 days)
Jun 2003	811	0.9 (5)	W (17 days)
Jul 2003	762	0.8 (3)	W (13 days)
Aug 2003	562	1.0 (30)	W (7 days)
Sep 2003	551	0.9 (15)	W (17 days)
Oct 2003	649	1.0 (16, 27)	W (17 days)
Nov 2003	971	1.0 (14)	W (18 days)
Dec 2003	1,449	1.2 (4)	W (28 days)
Jan 2004	1,353	1.2 (28)	W (27 days)
Feb 2004	516	1.0 (16)	W (26 days)
Mar 2004	3,810 (590 on 7th)	1.0 (3)	W (25 days)
Apr 2004	317	1.0 (16)	W (24 days)
May 2004	1,014	0.6 (21, 28)	W (13 days)
Jun 2004	1,134 (tremor amp. increased to 4 μm/s)	0.8 (30)	W (13 days)
Jul 2004	1,025	1.0 (26)	W (16 days)
Aug 2004	643	1.2 (9)	W (11 days)
Sep 2004	468	1.0 (13)	W (14 days)
Oct 2004	776	1.0 (31)	W (21 days)
Nov 2004	1,015	1.0 (29)	W (25 days), G (1 day, 30th)
Dec 2004	1,634	1.5 (25)	W (28 days), G (1 day, 2nd)
Jan 2005	416 (tremor amp. drops below 1 μm/s)	1.0 (14, 22)	W (28 days)

Table 1. Summary of seismicity and plume observations at Miyake-jima, May 2003-January 2005. All reported plumes originated from the summit crater, and were described as white (W) or gray (G). Data courtesy of JMA.

Background. The circular, 8-km-wide island of Miyake-jima forms a low-angle stratovolcano that rises about 1,100 m from the sea floor in the northern Izu Islands about 200 km SSW of Tokyo. The basaltic volcano is truncated by two summit calderas, the youngest of which, 3.5 km wide, was formed during a major eruption about 2,500 years ago. A central cone, Oyama, rises 120 m from the floor of a nested 1.5-km-wide caldera at the eastern end of the larger caldera. Parasitic craters and vents, including maars near the coast and radially oriented fissure vents, dot the flanks of the volcano. Frequent historical eruptions have occurred since 1085 AD at vents ranging from the summit to below sea level, causing much damage on this small populated island. After a three-century-long hiatus ending in 1469, activity has been dominated by flank fissure eruptions sometimes accompanied by minor summit eruptions. A 1.6-km-wide summit caldera was slowly formed by subsidence during an eruption in 2000.

Information Contacts: *Japan Meteorological Agency (JMA)*, Volcanological Division, 1-3-4 Ote-machi, Chiyoda-ku, Tokyo 100, Japan (URL: http://www.

kishou.go.jp/english/); *A. Tomiya*, Geological Survey of Japan (AIST), 1-1 Higashi, 1-Chome Tsukuba, Ibaraki 305-856, Japan (URL: http://staff.aist.go.jp/a.tomiya/miyakeE.html; Email: a.tomiya@aist.go.jp); *Kazahaya Kohei*, Geological Survey of Japan (URL: http://staff.aist.go.jp/kazahaya-k/miyakegas/COSPEC.html); *Earthquake Research Institute* (ERI), University of Tokyo,Yayoi 1-1-1, Bunkyo-ku, Tokyo, 113-0032, Japan.

Kikai

Ryukyu Islands, Japan
30.789°N, 130.308°E; summit elev. 704 m
All times are local (= UTC + 9 hours)

An eruption in 2002 began on 11 May when discolored plumes were noted (*BGVN* 28:04). Anomalous seismicity began on 14 May 2002, when about 900 events were recorded (table 2). The number of events dropped to very low levels the next day, but then gradually increased to a peak of 967 on the 28th and almost that many on the 29th. During June 2002, seismicity was high on the 2nd (650 events), 3rd (> 300 events), and 8th (~ 240 events). There were also 117 tremor events during the month, 73 of them on the 15th. Plumes and ashfall were reported through 5 June (*BGVN* 28:04).

Activity for the following year consisted of low-level seismicity of less than 200 events per month, and frequent, almost daily, white plumes. Eruptive activity began again on 7-8 June 2003 when 800-1,000 m ash plumes were recorded. Although plumes were not reported, eruptions also occurred during 10-12 June. Additional eruptions were noted by JMA during 7, 14-17, 26, 27, and 30 July, and 12, 13, and 15-18 August 2003. All of the June-August eruptions caused ashfall. The last grayish white eruption plumes in 2003 were seen on 19 and 22 September.

From March to September 2004, Tokyo Volcanic Ash Advisory Center (VAAC) reports indicated a number of small eruptions at Kikai. Three plumes in March 2004 reportedly rose to 1.5 km altitude, but no ash was visible in satellite imagery (table 3). JMA also reported eruptions on those days, but only indicated plumes 700 m high.

Another plume on 1 June did have ash visible to satellites. This eruption was not included in the JMA observations. Plumes were seen again on 13 August and 25 September, again with JMA only reporting 700-800 m plumes compared to 1.2 and 1.5 km plumes, respectively, in the VAAC advisory. No seismicity was detected during 25 September-5 October 2004, the period following the eruption of a grayish-white plume to 700 m. Data from JMA through January 2005 indicate continuing volcanic earthquakes (less than 10/day in December) and almost daily white plumes as high as 700 m, but generally 400 m or below.

Background. Kikai is a mostly submerged, 19-km-wide caldera near the northern end of the Ryukyu Islands south of Kyushu. Kikai was the source of one of the world's largest Holocene eruptions about 6300 years ago. Rhyolitic pyroclastic flows traveled across the sea for a total distance of 100 km to southern Kyushu, and ashfall reached the northernmost Japanese island of Hokkaido. The eruption

Month	Volcanic Earthquakes	Max. plume height (km) (date)	Plume Color (number of days, date)
May 2002	6,012	—	—
Jun 2002	1,415	—	—
Jul 2002	198	—	—
Aug 2002	141	—	—
Sep 2002	110	—	—
Oct 2002	144	—	—
Nov 2002	83	0.6 (16)	W (11 days)
Dec 2002	102	—	—
Jan 2003	138	0.6 (2, 15)	W (30 days)
Feb 2003	182	0.6 (11, 20)	W (24 days)
Mar 2003	224	0.7 (4)	W (25 days)
Apr 2003	221	0.8 (27)	W (21 days)
May 2003	363	0.6 (22, 23, 26)	W (19 days)
Jun 2003	366	1.0 (7)	W & LW (13 days) GW (7th and 8th)
Jul 2003	94	0.8 (26)	W (11 days), GW & G (17th, 26th)
Aug 2003	166	0.8 (23)	W, LW (18 days), GW (12th, 16th)
Sep 2003	320	0.8 (1, 5, 19)	W (25 days), GW (19th, 22nd)
Oct 2003	166	0.6 (10, 19)	W (23 days)
Nov 2003	191	—	—
Dec 2003	186	0.6 (1)	W (29 days)
Jan 2004	157 (1-24 Jan)	0.6 (18, 29, 31)	W (26 days)
Feb 2004	40 (26-29 Feb)	0.6 (18)	W (25 days)
Mar 2004	110 (none 22-25 Mar)	0.7 (29)	W, LW (24 days), GW (5th, 24th, 25th)
Apr 2004	199 (1-26 Apr)	0.8 (6)	W, LW (27 days)
May 2004	164 (15-31 May)	0.7 (26)	W (20 days)
Jun 2004	250	0.7 (30)	W (13 days)
Jul 2004	249	0.8 (3)	W (14 days)
Aug 2004	219	0.8 (4, 24)	W (21 days), GW (13th)
Sep 2004	157	0.7 (25)	W (19 days), GW (25th)
Oct 2004	137	0.8 (11)	W (25 days)
Nov 2004	173	0.6 (5, 7, 13, 25)	W (28 days)
Dec 2004	205	0.7 (6)	W (30 days)
Jan 2005	144	0.6 (14, 23)	W (29 days)

Table 2. Summary of seismicity and plume observations at Kikai, May 2002-January 2005. All reported plumes were described as either white (W), light white (LW), grayish white (GW), or gray (G). Data courtesy of JMA.

Date	Time	Plume		Ash visible on satellite imagery
		Altitude (km)	Direction	
05 Mar 2004	0922	1.5	N	no
24 Mar 2004	1755	1.5	S	no
25 Mar 2004	0715	1.5	NW	no
01 Jun 2004	1330	—	W	yes
13 Aug 2004	1105	1.2	NW	—
25 Sep 2004	0937	1.5	W	—

Table 3. Date and time of eruptions from Kikai, the direction and altitude of observed plumes, and whether ash was seen on satellite image. Based on information from the Tokyo VAAC.

devastated southern and central Kyushu, which remained uninhabited for several centuries. Post-caldera eruptions formed Iwo-dake lava dome and Inamura-dake scoria cone, as well as submarine lava domes. Historical eruptions have occurred in the 20th century at or near Tokara-Iwo-Jima (also known as Satsuma-Iwo-jima), a small 3 x 6 km island forming part of the NW caldera rim. Showa-Iwo-jima (also known as Iwo-jima-Shinto), a small island 2 km east of Tokara-Iwo-jima, was formed during submarine eruptions in 1934 and 1935. Mild-to-moderate explosive eruptions have occurred during the past few decades from Iwo-dake, a rhyolitic lava dome at the eastern end of Tokara-Iwo-jima.

Date	Time	Event	Plume	
			Altitude (km)	Direction
28 Apr 2004	—	ash emission	3	SE
01 May 2004	0906	explosion	—	—
07 Jun 2004	—	gas plume	2	E
08 Jun 2004	—	gas and ash	2	E
09 Jun 2004	1003	ash plume	1.8	E
09 Jun 2004	1300	ash plume	—	—
30 Jun-05 Jul 2004	various	several explosions	max 1.9	—
30 Nov 2004	1607	eruption	1.2	—
20 Dec 2004	—	eruption	1.8	SE
21 Dec 2004	—	eruption	—	SE
22 Dec 2004	—	ash plume	—	—
24 Dec 2004	—	ash plume	—	—
25 Dec 2004	—	ash plume	—	—
27 Dec 2004	—	ash plume	—	—
29 Dec 2004	—	ash plume	1.2	—
01 Jan 2005	—	eruption	—	—
04 Jan 2005	—	eruption	—	—
06 Mar 2005	—	ash emission	1.5	—
08 Mar 2005	—	ash emission	1.2	—
09 Mar 2005	—	ash plume	1.8	—
26 Apr 2005	—	eruption	1.2	E
26 May-31 May 2005	various	several ash explosions	max 2.1	—
01 Jun-06 Jun 2005	various	several ash explosions	1.8	—
06 Jul 2005	various	several ash explosions	—	—
27 Jul 2005	—	eruption with ash	0.8	—
28 Jul 2005	—	ash plume	2.4	—

Table 4. Summary of activity at Suwanose-jima from April 2004 to July 2005 based on information from the Tokyo VAAC. "—" indicates data not reported or unknown.

Information Contacts: *Japan Meteorological Agency (JMA)*, Volcanological Division 1-3-4 Ote-machi, Chiyoda-ku, Tokyo 100, Japan (URL: http://www.kishou.go.jp/english/); *Tokyo Volcanic Ash Advisory Center*, Japan Meteorological Agency (JMA), 1-3-4 Ote-machi, Chiyoda-ku, Tokyo 100, Japan (URL: http://www.jma.go.jp/JMA_HP/jma/jma-eng/jma-center/vaac/; Email: vaac@eqvol.kishou.go.jp).

Suwanose-jima

Ryukyu Islands, Japan
29.635°N, 129.716°E; summit elev. 799 m

Several small eruptions during December 2003 and January 2004 at Suwanose-jima produced ash plumes to unknown heights (*BGVN* 29:03). Little activity was observed during the first four months of 2004. From the end of April 2004 to the end of July 2005, numerous eruptions and explosions produced plumes reported by the Tokyo Volcanic Ash Advisory Center (VAAC), including some observed by pilots (table 4).

Background. The 8-km-long, spindle-shaped island of Suwanose-jima in the northern Ryukyu Islands consists of an andesitic stratovolcano with two historically active summit craters. Only about 50 persons live on the sparsely populated island. The summit of the volcano is truncated by a large breached crater extending to the sea on the east flank that was formed by edifice collapse. Suwanose-jima, one of Japan's most frequently active volcanoes, was in a state of intermittent strombolian activity from On-take (Otake), the NE summit crater, that began in 1949 and lasted until 1996, after which periods of inactivity lengthened. The largest historical eruption took place in 1813-14, when thick scoria deposits blanketed residential areas, and the SW crater produced two lava flows that reached the western coast. At the end of the eruption the summit of On-take collapsed forming a large debris avalanche and creating the horseshoe-shaped Sakuchi caldera, which extends to the eastern coast. The island remained uninhabited for about 70 years after the 1813-1814 eruption. Lava flows reached the eastern coast of the island in 1884.

Information Contacts: *Tokyo Volcanic Ash Advisory Center*, Japan Meteorological Agency (JMA), 1-3-4 Ote-machi, Chiyoda-ku, Tokyo 100, Japan (URL: http://www.jma.go.jp/JMA_HP/jma/jma-eng/jma-center/vaac/; Email: vaac@eqvol.kishou.go.jp).

Anatahan

Mariana Islands, Central Pacific
16.35°N, 145.67°E; summit elev. 790 m
All times are local (= UTC + 10 hours)

Anatahan's third historical eruption began on 5 January 2005 (*BGVN* 29:12 and 30:02). On 5-6 April 2005, an eruption cloud rose to 15.2 km altitude, the highest yet seen at the volcano (*BGVN* 30:04). That eruption, estimated to have expelled 50 million cubic meters of ash, caused the temporary closure of Anderson Air Force Base on Guam. An eruption that began on 5 May and produced an extensive ash and steam plume was briefly described in *BGVN* 30:04, but further details follow. Plumes were frequently visible in satellite imagery; a summary of satellite observations is presented for 16 June-20 July 2005 (tables 5 and 6).

Observations during early May 2005. Activity surged to a moderately high level on 5 May, when an extensive ash-and-steam plume to 4.5 km altitude was visible in all directions. Ash extended 770 km N, 130 km S to northern Saipan, and 110 km W. Vog extended in a broad swath from 3,000 km W, over the Philippine Islands, to 1,000 km N of Anatahan. By 9 May harmonic tremor amplitude had decreased to near background levels, with a corresponding drop in eruptive activity. As of 10 May the Air Force Weather Agency (AFWA) reported ash rising to about 3 km altitude and extending 400 km W, with an area of vog less than half that noted on 5 May.

Anatahan began erupting suddenly from its E crater at about 1700 on 10 May. Within hours of the eruption's onset, a towering column of volcanic ash and gas rose to more than 10 km altitude, and the prevailing wind blew the ash W. An immediate concern was the potential for the tiny abrasive ash fragments to damage aircraft passing nearby and downwind from the volcano. The Washington Volcanic Ash Advisory Center issued an advisory that volcanic ash was present at 11 km altitude moving S at 65 km/hour and at 4.6 km altitude moving W at 20-30 km/hour.

The single seismic station on the island maintained by the Emergency Management Office of the Commonwealth of the Northern Mariana Islands (EMO/CNMI) was not working at the time, but a broadband seismic instrument installed 6.5 km W of Anatahan's crater on 6 May by scientists from Washington University in St. Louis recorded significant earthquake activity in the hours before the eruption began; the instrument was one of many installed to conduct a seismic experiment along the Mariana Trench. A preliminary review of the data shows there was a rapid increase in the number of small-magnitude earthquakes (probably less than M 2) to more than 100 per hour beneath the volcano within a few hours of the eruption onset.

A smaller but nearly continuous eruption column rose from the E crater of Anatahan for several days following 10 May. The resulting eruption clouds were generally below about 6 km altitude. On 11 May AFWA reported thick ash rising to 4.2 km altitude and moving WNW. The ash extended in a triangular shape from the summit 444 km to the WSW through 510 km to the NW. A layer of diffuse ash at 3 km altitude extended beyond the dense ash for another 1,000 km. A broad swath of vog extended over 2,200 km W nearly to the Philippines and over 1,400 km NNW of Anatahan. Although the ash plume diminished over the next few days, it remained significant, rising to 2.4 km altitude and extending 370 km WNW on 13 May. Personnel from EMO/CNMI and the U.S. Geological Survey (USGS) who were repairing and installing equipment on 14 May reported hearing a continuous roaring sound from 2-3 km W of the active vent. They also saw ash and steam rising by pure convection, not explosively, to 3 km altitude.

Observations during later May and June 2005. Following nearly continuous eruption from January through April 2005, on 23-24 May typhoon Chan-hom shifted the prevailing E winds to the S, blowing the eruption column toward Saipan and Guam. Light ashfall resulted in flight cancellations at the Saipan and Guam international airports. Residents of Saipan reported a rotten-egg smell associated with the ashfall. The ongoing explosive activity excavated a deep crater within Anatahan's E crater. Scientists estimated the inner crater was nearly at sea level by about 20 May; before the eruption, the floor of E crater was 68 m above sea level.

The spiny surface of a lava flow was first observed in the inner crater on 4 June. The flow appeared to form a mound-shaped lava dome, but its volume is unknown. New fault scarps and slump features were seen within the E crater, as well as additional faulting W of the E crater. A gradual increase in the number of long-period (LP) earthquakes and tremor began at Anatahan on 5 June. Both LP and tremor events peaked during 2230-0030 on 6 June. During the peak in activity, more than 350 LP events occurred. Tremor amplitudes briefly reached a new high for the current eruptive activity, and an ash column reached ~ 7.9 km altitude. On 6 June, tremor amplitudes returned to low levels. During the rest of the week of 1-7 June, ash plumes reached a maximum altitude of 4.3 km. On 5 June the EMO/CNMI seismic station was repaired and ash samples were collected from the site. Through 12 June, the seismic records showed only continuous ground shaking to varying degrees. The most intense periods of tremor lasted 3 to 10 hours and occurred about every 24-36 hours.

On 12 June, three LP earthquakes were recorded, the largest about M 2. Other earthquakes followed in the late afternoon and early evening of 13 June. During 17-26 June 2005, seismicity was at the highest level since the eruption on 6 April, with real-time seismic amplitude (RSAM) values at ANA2 consistently near 625.

Since 18 May, Anatahan has sent ash and steam continuously to 2.4 km altitude or higher, with seven eruptive pulses to 7.6 km altitude or higher. On 11 June, a 10 minute-long eruptive pulse sent ash and steam to 14 km altitude. On June 19, a 2.6 minute-long eruptive pulse sent a cloud of steam and ash to 15.2 km altitude; the cloud moved E and dissipated after about 7 hours. On 6 July, very high levels of tremor for about 30 minutes accompanied an eruptive pulse to 12.2 km altitude.

On 11 June beginning at 1622 three explosions produced a dense ash cloud that rose to an altitude of ~ 13.7 km. On 12 June, seismicity was at moderately high levels, with periods of strong tremor and frequent small LP earthquakes. Satellite imagery showed an ash cloud at an altitude of ~ 3 km.

Two strong explosions on 14 June removed much of the small new dome in the inner crater. Just before noon on 14 June, earthquakes began to occur at intervals of 1-2 minutes. For the next two days, episodes of intense tremor and earthquakes lasting about 1.5 hours occurred about every

Date	Time (UTC) and Satellite	Activity Summary
16 Jun	0340: NASA Aqua Modis (500 m res.) 0700: GOES-9 Visual	3-km-high ash/steam moving W-WSW at 19-28 km/hour out to 370 km; 3 km high thin ash/vog out to 1,500 km to W-WNW.
17 Jun	0125: NASA Terra Modis (500 m res.) 0448: DMSP F-13 Visual	3-km-high ash/steam moving W-WSW at 28-37 km/hour out to 185 km; 3 km high thin ash/vog out to 1,500 km to WNW.
18 Jun	0030: NASA Terra Modis (1 km res.) 0703: GOES-9 Visual 1041: DMSP F116 Night Visual	3-km-high dense ash/steam plume out to 314 km; volcanic haze out to 1,780 km W and 760 km NW.
19 Jun	0646: NOAA-12 Visual (0.6 km) 0700: Feng Yun-2 (2.8 km) 0725: GOES-9 Visual 0819: DMSP F-13 Visual (0.6 km) 0819: DMSP F-13 IR(2.8 km) 1034: DMSP F-16 Night Visual	Brief eruption at 0525Z, ash 15 km high moving E; cloud dissipated by 1400Z after migrating 400 km SE; 3-km-high ash/steam out to 250 km W; 2.4-km-high thin ash/vog out to 1,900 km WNW and 860 km NW.
20 Jun	0700: GOES-9 Visual 1016: DMSP F-13 Night Visual (2.8 km)	3-km-high eruption cloud moving 28-37 km/hour W; moderately dense ash/steam plume extends 695 km WNW; thin ash/vog out to 1,500 km NW.
21 Jun	0100: NASA Terra Modis (250 m res.) 0700: GOES-9 Visual	3-km-high eruption moving W at 37 km/hour extending 460 km W; 3-km-high ash/vog extending out to 1,570 km W, then shifting N and NE toward Volcano Islands.
22 Jun	0305: NASA Aqua Modis (250m res.) 0700: DMSP F-12 Visual (0.55 km) 0700: GOES-9 Visual	1.5-km-high eruptions moving W at 28 km/hour; ash/steam extending 280 km until obscured by clouds; thin ash/steam out to 1,940 km W.
23 Jun	0030: NASA Terra Modis (500 m res.) 0702: Enhanced GOES 9 Visual 0826: Enhanced DMSP F-12 Visual	Ash/steam plume out to 740 km; two SW/NE swaths of vog out 1,760 km N, 1,800 km NE, and 1,950 km W.
24 Jun	0130: NASA Terra Modis (500 m res.) 0647: DMSP F-12 Visual 0725: Enhanced GOES-9 Visual	3.5-km-high dense, continuous ash/steam plume extending over 695 km W; large area of vog extending over 1,760 km W, 1,440 km N, and over 1,430 km E.
25 Jun	0215: NASA Terra Modis (500m res.) 0525: NOAA-16 Visual 0725: Enhanced GOES-9 Visual 0841: DMSP F-13 Visual	3.5-km-high ash/steam plume out to 850 km; vog plume 2,000 km W, then 1,700 km N, then 1,940 km E.
27 Jun	0025: NASA Terra Modis (500 m res.) 0600: GOES-9 Visual 0744: NOAA-15 Visual (0.9 km)	3.7-km-high ash/steam plume 130 km W; 3-km-high thin ash/vog 1,480 km W, then 740 km N.
28 Jun	0405: NASA Aqua Modis (500 m res.) 0410: NASA Aqua Modis (2 km res.) 0717: DMSP F-12 Visual (1.8 km)	Moderately thick ash/steam plume 3 km high extends 150 km W moving at 27-37 km/hour; thin ash/vog extends 1,900 km W, then turns N moving over Ryukyu Islands.
29 Jun	0450: NASA Aqua Modis 0700: GOES-9 Visual	3-km-high moderately thick ash/steam plume reached between 420 and 600 km W moving 37 km/hour; thin ash/vog extends over 1,800 km W, then veers N over Ryukyu Islands.
30 Jun	0700: GOES-9 Visual 0911: DMSP F-13 Visual (1.0 nm) 1425: GOES-9 Split Window IR	3-km-high ash/steam plume extended 210 km W moving W about 27 km/hour; thin 3-km-high ash/vog extends over 2,400 km W, then veers N, reaching E Taiwan and East China Sea.
01 Jul	0135: NASA Terra Modis 0637: Enhanced DMSP F-12 Visual 0637: Enhanced HIMAWARI 0711: Enhanced GOES-9 Visual 2214: DMSP F-16 Visual	3-km-high ash/steam plume extending over 740 km W; area of vog extending about 2,300 km NW and over 1,480 km NNE; as vog area moves farther W begins to intermix with smoke from fires in China.
02 Jul	0030: NASA Terra Modis 0345: NASA Aqua Modis 0638: Enhanced NASA Visual 1049: Enhanced GOES-9 Split-Window IR	4.6-km-high dense ash/steam plume extending about 460 km W; area of vog extends farther W to approximately 2,200 km; as the area of vog get closer to China, it becomes intermixed with smoke from the fires in mainland China and begins to move E to a point about 1,800 km N of Anatahan before it is no longer detectable on imagery.
03 Jul	0800: Feng Yun-2 Visual 0823: DMSP F-13 Visual 1201: GOES-12 Split Window IR	5.5-km-high fairly dense ash/steam plume extending NW about 190 km; ash erupted earlier today reached initial level of 12.2 km SE of summit; area of ash/vog and haze extending W about 1,000 km.

Table 5. Daily summaries of Anatahan plumes seen in satellite imagery, 16 June-3 July 2005. Satellite abbreviations: DMSP: Defense Meteorological Satellite Program; Feng Yun: "Wind and Cloud"-Peoples Republic of China Earth Observing System meteorological satellite; GOES: Geostationary Operational Environmental Satellites; HIMAWARI: "Sunflower"-Japanese geostationary meteorological satellites; MTSAT: Japanese Meteorological Agency and Japanese Ministry of Transportation satellite; NASA: National Aeronautics and Space Administration; NOAA: National Oceanic and Atmospheric Administration. Courtesy of U.S. Air Force Weather Agency Satellite Applications Branch (Charles Holiday, Jenifer E. Piatt, Mickael A. Archuletta, Brent A. Persinger).

Date	Time (UTC) and Satellite	Activity Summary
04 Jul	0330: NASA Aqua Modis 0638: MTSAT Visual 0716: NOAA-12 Visual 0800: Feng Yun-2 Visual 0809: DMSP F-13 Visual	Fairly dense ash/steam plume 4.3-6.1 km high extending W approximately 390 km; area of ash/vog and haze extending to W about 2,200 km out into the Philippine Sea.
05 Jul	0110: NASA Terra Modis 0415: NASA Aqua Modis 0456: Feng Yun-2 Visual 0504: NOAA-16 Visual 0854: DMSP F-14 Visual 1801: GOES-9 Split Window IR	7.6-km-high fairly dense ash/steam plume extending W about 570 km; area of ash/vog and haze extending about 2,460 km W and into the Philippine Sea.
06 Jul	0320: NASA Aqua Modis 0706: DMSP F-12 Vis (1.0 nm) 0706: DMSP F-12 Vis (0.3 nm) 0840: DMSP F-14 Vis (0.3 nm)	4.3-km-high fairly dense ash/steam plume extending W about 1,100 km; 3.0-km-high thin ash/vog area out to about 1,900 km; in 0840Z satellite, eruption plume rises to about 12.2 km.
07 Jul	0100: NASA Terra Modis 0700: GOES-9 Visual	4.3-km-high ash/steam plume W to 1,060 km; 3-km-high thin ash/vog area W to about 1,940 km, then NNE about 1,200 km.
08 Jul	0305: NASA Aqua Modis (500 m res.) 0445: NASA Aqua Modis (2 km res.) 0700: GOES-9 Visual 0811: DMSP F-14 Visual (0.6 km)09 Jul	3.7-km-high ash/steam plume W to 1,160 km; 3-km-high thin ash/vog area W to 2,400 km, with lobes to N.
	0050: NASA Terra Modis Image 0350: NASA Aqua Modis 0638: MTSAT Visual 0834: DMSP F-13 Visual 2300: GOES-9 Split-Window	3-km-high very distinct ash/steam plume extending W about 630 km; large area of vog extending W to over 2,500 km, out to the coast of the Philippines and Taiwan; at 2300 another eruption extending to 9.8 km high and ~70 km S of summit.
10 Jul	0130: NASA Terra Modis 0638: Enhanced MISAT Visual 0800: Feng Yun-2 Visual 0825: DMSP F-13 Visual	Very distinct ash/steam plume 5.5-6.1 km high extending ~790 km WSW; large area of vog extending to over 2,600 km W to the coast of Philippines and Taiwan and another area of vog being caught up in the flow ~1,600 km NW of the volcano; between 10 Jul at 2200Z and 11 Jul at 1200Z, Kadena AB (RODN) surface reports indicated haze and 6-11 km visibilities.
11 Jul	0035: NASA Terra Modis (500 m res.) 0700: GOES-9 Visual 0810: DMSP F-13 Visual (0.6 km)	Beginning at 0700Z, 7.6-km-high plume measured 46 km NNE, and an ash/steam plume to 6.1 km measured 600 km W; beyond that point, thin ash/VOG, estimated below 4.6 km, extended 1,900 km W and veered N toward the Ryukyu Is; current eruptions (at 1500Z) are to 4.6 km moving W at 19-28 km/hour.
12 Jul	0420: NASA Aqua Modis (500 m res.) 0700: GOES-9 Visual 0757: DMSP F-13 Visual (0.6 km) 2322: DMSP F-15 Visual (0.6 km)	Eruption plumes are to 6.1 km, and light winds moving thick ash/steam out to 90 km W, and thinner ash/steam extended 140 km NE; area of thin ash/vog stretched W to coast of the Philippines, while vog continued to reduce visibilities over the Ryukyu Is.; Kadena AB surface observations indicated haze and 8-10 km visibilities between 0300Z and 1500Z; eruption to 11 km occurred at around 2300Z, and an ash cloud moved at 65-74 km/hour W.
13 Jul	0020: NASA Terra Modis (500 m res.) 0056: NOAA-17 Visual (0.9 km) 0700: GOES-9 Visual	At 0020 ash cloud seen about 74 km W; at about 0700 radar estimated another plume to 9.4 km, which remained stationary near the summit; at the same time, ash/steam to 6.1 km extended 185 km; thin ash/vog continued to the Philippines; vog over the Ryukyu Is.
14 Jul	0001: DMSP F-13 Visual 0638: Enhanced MTSAT Visual	Typhoon Haitang, sitting to NNW of Anatahan, caused extensive cloud cover; at ~930 km to W is area of vog that extends to the Philippine coastal region; faint plume extending to the N ~80 km; large area of vog SW of Typhoon Haitang and extending W.
15 Jul	0638: Enhanced MTSAT Visual	Extensive cloud cover over Anatahan making detection of any ash/steam very difficult; area of vog located along the E coast of central Philippines area extending E ~960 km.
16 Jul	0638: Enhanced MTSAT Visual	Convective activity persistent over the volcano, making ash/steam detection impossible; Super Typhoon Haitang is disrupting any remaining areas of VOG in the W Pacific.
18 Jul	2206: DMSP F-16 Visual (0.9 km)	6.7-km-high ash/steam plume extending 210 km NW.
19 Jul	2228: DMSP F-15 Visual (0.6 km)	Due to cloud cover, ash/steam not visible on satellite data since around 0000; current eruptions assumed to be 3-6.7 km high moving N at a maximum speed of 20 km/hour.
20 Jul	No visible ash in imagery	Due to cloud cover, ash/steam not visible on satellite data since about 0200; eruption plumes are assumed to 3 km high moving NW at 19-28 km/hour; an eruption to 15.5 km was detected by 2215, and ash moved SE at 29-37 km/hour; due to extensive cloud cover over the area, no ash was visible via satellite at any time during the past 12 hours; this is the 12th eruption with ash to 9.1 km and/or above since the beginning of June; as of 1000, ash was no longer visible in radar and eruption plumes were estimated to 9.1 km moving NE at 37-56 km/hour.

Table 6. Daily summaries of Anatahan plumes seen in satellite imagery, 4-20 July 2005. Satellite abbreviations: DMSP: Defense Meteorological Satellite Program; Feng Yun: "Wind and Cloud"-Peoples Republic of China Earth Observing System meteorological satellite; GOES: Geostationary Operational Environmental Satellites; HIMAWARI: "Sunflower"-Japanese geostationary meteorological satellites; MTSAT: Japanese Meteorological Agency and Japanese Ministry of Transportation satellite; NASA: National Aeronautics and Space Administration; NOAA: National Oceanic and Atmospheric Administration. Courtesy of U.S. Air Force Weather Agency Satellite Applications Branch (Charles Holiday, Jenifer E. Piatt, Mickael A. Archuletta, Brent A. Persinger).

12 hours, accompanying strong ash emissions from the E crater, with eruption columns higher than 2 km altitude. Quiet intervals in which the eruption column contained little ash were accompanied by continuous weak tremor.

On 19 June at 1525 a brief eruption produced a steam-and-ash cloud that reached an altitude of ~ 15.2 km (figure 3). Guam Meteorological Weather Office radar showed that the cloud drifted E. No seismic signal was clearly associated with the eruption. Two days before the eruption, the amplitude of continuous tremor was relatively high. During the days before and after the eruption, ash reached 3-4.6 km and drifted W.

During 22-27 June AFWA observed, on satellite imagery, a moderately dense cloud of ash and steam that rose to a maximum altitude of ~ 3 km, and drifted W. Additional thin ash and vog were visible to the W and NNW of the island. On 26 June AFWA identified, on satellite imagery, a dense cloud of ash and steam rising to ~ 3.7 km, moving towards the W, and vog to the W, N and NE of the island (figure 4). No particular seismic signal was associated with the eruptions. By 28 June the seismicity level dropped by about 80% from the continuously high levels of the last week.

On 3 July at 1646 an eruption produced a SSE-drifting plume to an altitude of ~ 12.2 km, according to Guam Meteorological Office radar. Vog briefly drifted S over the islands of Saipan and Tinian. During 29 June to 5 July, steam-and-ash emissions continued to rise to low altitudes. During 6-11 July, eruptive activity continued, with steam-and-ash plumes rising to a maximum altitude of 6.1 km. On 6 July beginning at 1730 tremor at the volcano increased, and an eruption produced an ash plume to an altitude of ~ 12.2 km. During 8-11 July, a thin layer of vog extended over much of the Philippine Sea (figure 5).

As of 1 August 2005, Anatahan was presumed to be in a state of constant eruption. For the first half of 1 August, volcanic tremor levels as recorded at Anatahan's E seismic station (ANA2) were between 40 and 60 % of the peak levels observed during 17-26 June. At 0800, the National Weather Service at Tiyan, Guam, issued a volcanic ash advisory for Saipan and Tinian. A strong sulfur odor from the emitted volcanic gases was reported by numerous residents, and ash was observed on the tips of aircraft at Saipan International Airport. Traces of ash were also apparent on solar panels powering equipment run by the EMO/CNMI on Saipan. According to the Air Force Weather Agency, continued cloud cover caused by a tropical storm inhibited ash detection on METSAT imagery. As of 1252 on 1 August, the ash plume was presumed to be at an altitude of 4.6 km, moving toward the S at 18-27 km/hour.

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.

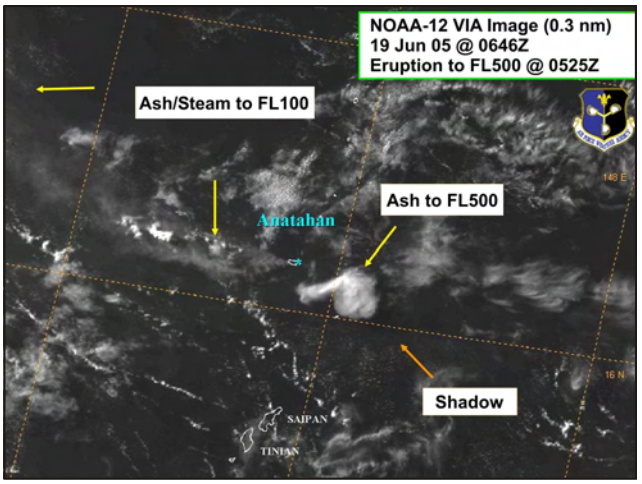

Figure 3. NOAA satellite image of the ash plume at FL500 (15.2 km) from the Anahatan eruption of 19 June 2005. This was one of the highest plumes ever recorded from the volcano. Its position SE of Anahatan is unusual; the usual direction of the ash and other emissions is W. Courtesy of US Air Force Weather Agency.

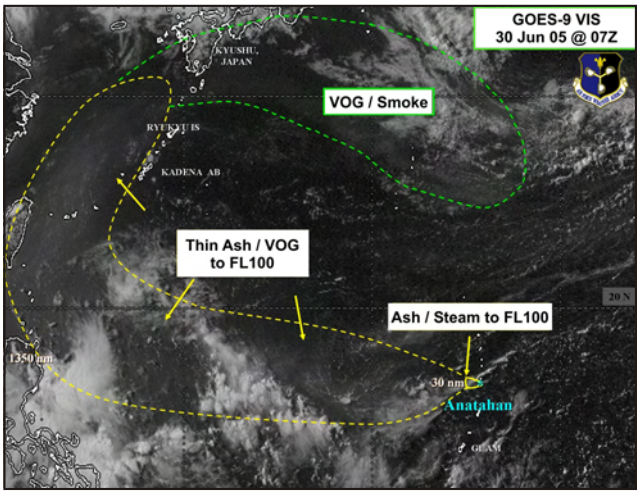

Figure 4. GOES-9 image of 30 June 2005 showing the extent of the atmospheric injection of Anahatan ash and gas. The emission reached the island of Kyushu. Courtesy of US Air Force Weather Agency.

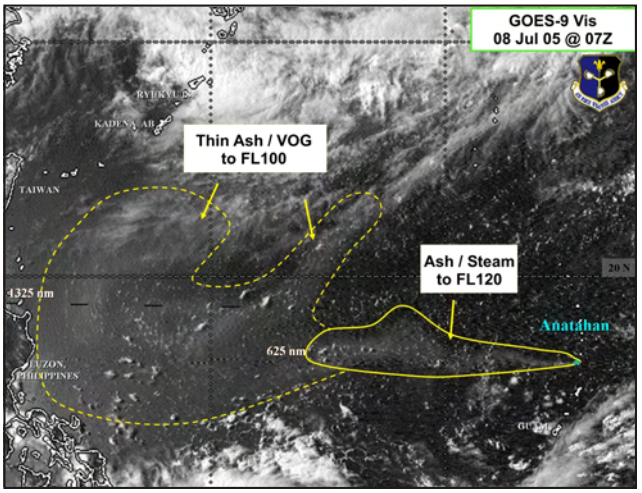

Figure 5. GOES-9 image of 8 July 2005 showing the ash plume and vog from Anahatan extending 2,450 km W almost to the Philippines and Taiwan. Courtesy of US Air Force Weather Agency.

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Pago

New Britain, SW Pacific
5.58°S, 150.52°E; summit elev. 742 m

Pago has remained quiet during April-August 2005, with no reports of volcanism since the end of the most recent eruption in early 2003 (*BGVN* 28:03 and 28:09). Reports since that time have described low-level emissions and seismicity (*BGVN* 28:12, 29:02, 29:04, 29:07).

In April the upper vents and the summit crater released small amounts of white vapor and occasional thin white vapor was reported from the lower vents. Seismic activity was low; the daily number of low-frequency earthquakes ranged from zero to a few. In June weak emissions of thin white vapor continued to be released from the upper vents but no emissions were noted from the lower vents. Seismicity in June remained low, with no more than 8 small, high-frequency earthquakes recorded per day. Similar activity continued through August. Visual observations on 27 and 28 August revealed emissions of very small volumes of thin white vapor being released from the upper vents of the fissure system. No emissions originated from the lower or main summit vents. Seismic activity was low throughout the month, and some small high-frequency earthquakes were recorded. The greatest number of high-frequency events recorded on any given day was 7 on 25 August. No noises were heard and no glow was observed during the reporting period.

Background. Pago is a young post-caldera cone that was constructed within the 5.5 x 7.5 km Witori caldera. Extensive pyroclastic-flow deposits are associated with formation of the caldera about 3300 years ago. The gently sloping outer flanks of Witori volcano consist primarily of dacitic pyroclastic-flow and airfall deposits produced during a series of five major explosive eruptions from about 5600 to 1200 years ago. The Buru caldera, which may have formed around the same time, cuts the SW flank of Witori volcano. The post-caldera cone of Witori, Mount Pago, may have formed less than 350 years ago. Pago has grown to a height above that of the Witori caldera rim. A series of ten dacitic lava flows from Pago covers much of the caldera floor. The youngest of these was erupted during 2002-2003 from vents extending from the summit nearly to the NW caldera wall.

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Ulawun

New Britain, SW Pacific
5.05°S, 151.33°E; summit elev. 2,334 m
All times are local (= UTC + 10 hours)

Long steam plumes during 22-23 August 2004 (*BGVN* 29:07) were observed on satellite imagery. Additional plumes were seen earlier that month, prompting the Darwin Volcanic Ash Advisory Center to issue advisories on four days.

Ulawun remained quiet from August 2004 until March 2005. During March 2005, weak to moderate volumes of thick white vapor were released from the main crater. On 27 and 28 March light gray emissions were observed, and small continuous volcanic tremor was recorded for six hours. The N vent remained quiet. Seismic activity continued at low levels with low-frequency earthquakes recorded. A tiltmeter was installed on 15 March but no significant movements were detected.

During April-July 2005 white vapor from the main vent was common, and plumes were frequently visible on satellite imagery. On 6 April, a thin plume was visible extending ~ 55 km to the SW. On 19 May a small plume to an unknown height extended W. Plumes to unknown altitudes were again released on 3 and 6 June. Plumes rising to 3 km altitude were seen on satellite imagery on 6 and 21 June. The 21 June plume contained ash, and initially extended W and WSW; imagery about six hours later showed the plume blowing NW. A short plume was visible at ~ 3 km altitude during 22-27 June, and on 27 June a pilot reported that the plume extended 37 km. During 30 June to 1 July, thin ash plumes were visible on satellite imagery, but heights were not given. No noise, night-time glow, or emissions were reported during this time. Small low-frequency earthquakes were recorded. Volcanic tremor was registered on 16-17 June.

On 9 August a plume drifting to the S was visible on satellite imagery (figure 6). During the rest of August, the summit crater released thick white vapor. Seismicity was characterized by small low-frequency earthquakes. One high-frequency earthquake and small periodic volcanic tremors were recorded.

Background. The symmetrical basaltic-to-andesitic Ulawun stratovolcano is the highest volcano of the Bismarck arc, and one of Papua New Guinea's most frequently active. Ulawun volcano, also known as the North Son, rises above the north coast of the island of New Britain across a low saddle NE of Bamus volcano, the South Son. The upper 1000 m of the 2334-m-high Ulawun volcano is unvegetated. A prominent E-W-trending escarpment on the south may be the result of large-scale slumping. Satellitic cones occupy the NW and eastern flanks. A steep-walled valley cuts the NW side of Ulawun volcano, and a flank lava-flow complex lies to the south of this valley. Historical eruptions date back to the beginning of the 18th century. Twentieth-century eruptions were mildly explosive until 1967, but after 1970 several larger eruptions produced lava

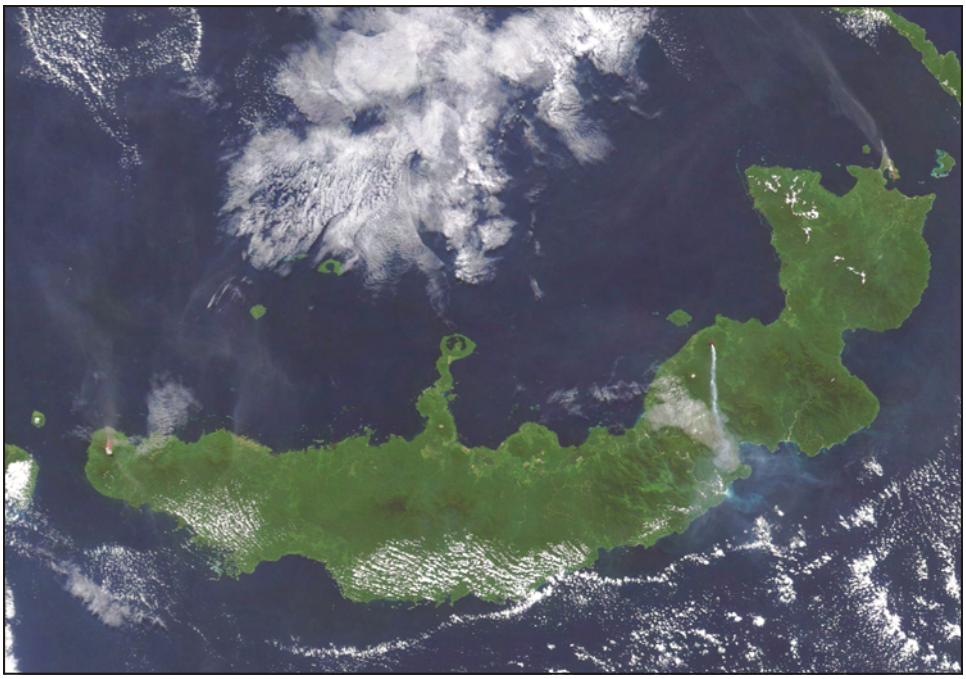

Figure 6. Terra MODIS satellite image of New Britain Island showing a distinct ash plume drifting S from Ulawun (middle right) at 0809 on 9 August 2005 (UTC). Plumes can also be seen originating from Rabaul (NW end of the island, upper right) and Langila (E end of the island, left). Photo courtesy of MODIS Rapid Response Team, NASA Goddard Space Flight Center.

flows and basaltic pyroclastic flows, greatly modifying the summit crater.

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Rabaul

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

As of July 2004 Tavurvur was releasing white vapor in variable amounts, seismicity was at a low level, and ground deformation continued as slow uplift (*BGVN* 29:07). Eruptive activity had stopped months earlier, in February 2004 (*BGVN* 29:04).

On 25 January 2005 ash rose to ~ 500 m above the summit and drifted E. Another ash emission on 31 January reached ~ 1 km above the summit but was not visible on satellite imagery. During 1-21 February, frequent eruptions of ash clouds rose a few hundred meters, drifted SE, and deposited ash mainly offshore. However, ashfall was reported in the town of Tokua during 18-21 February. Incandescent lava fragments were visible on several evenings. Between 200 and 350 daily earthquakes were associated with the eruptions. The number of seismic events leveled off around 20 February to between 150 and 200 per day. During 22-24 February ash fell offshore, but there were also reports of fine ash reaching Tokua airport.

Low-level eruptions continued during the first two weeks of March. During 22-28 March, eruptions continued every 10-20 minutes. Ash clouds rose several hundred meters above the summit, and moderate ash fell in Rabaul Town during 25-28 March. There were 100-200 daily earthquakes associated with the eruptions. No changes were recorded in ground deformation.

During April, May, and most of June 2005, low-level eruptive activity consisted of occasional emission of diffuse pale gray to gray ash clouds, which rose a few hundred meters above the summit. On 1-5, 17-22, and 25-30 April the ash clouds were blown NNW; on 6-16 and 23-24 April they drifted ESE. Fine ashfall occurred over Rabaul Town and villages downwind. Occasional roaring noises were heard throughout April. The daily average number of low-frequency seismic events increased from about 40 during the first half of the April to about 100 in the second half. One high-frequency event, on 26 April, was located NE of the caldera. Ground deformation indicated an inflationary trend. The real-time GPS site on Matupit Island, in the center of the caldera, has shown an inflationary trend since January 2005.

Photographs taken by visitors to Rabaul in late May to early June documented activity from two separate vents at Tavurvur. On 25 May there were two distinct plumes, one a very dark, coherent, ash column and the other a more diffuse white or light gray emission; the plumes appeared to mix a short distance above the volcano (figure 7). A single larger gray plume was seen on 5 June (figure 8). On 27 June the Darwin VAAC received a pilot report of an ash plume 37 km to the NW of the volcano. A pilot observed an ash plume from Rabaul on 28 July at a height of 3 km, but ash was not visible on satellite data.

On 9 August, a low-level ash plume at an altitude of 1.5 km was visible on a satellite image of Rabaul. As of mid-August Tavurvur continued to erupt with discrete ash emissions, although their frequency had declined and most were less vigorous. Some of the of ash-laden clouds were also lighter in color, suggesting less ash content. Ash plumes rose between 800 and 1,500 m and drifted N and NW, occasionally depositing ash on the E part of Rabaul Town and in areas farther downwind. Roaring and rumbling noises accompanied the activity. Projections of incandescent lava fragments were visible at night but were less conspicuous compared to the previous week. Seismicity was at a moderate to high level with most earthquakes associated with ash emissions and explosions. However, small low-frequency earthquakes not associated with ash emissions were also recorded. No high-frequency earthquakes

Figure 7. Photograph showing an eruption of the Tavurvur cone at Rabaul looking from the NW across Matupi Harbor on 25 May 2005. Two plumes, one white and the other dark gray, are originating from separate vents. The peak in the background is Turanguna. Courtesy of Roy Price.

were recorded. Ground deformation measurements from GPS and tide gauge instruments fluctuated, but the general trend showed a slow rate of uplift. As a safety precaution, people continue to be discouraged from venturing within 1 km of the erupting vent.

Figure 8. Photograph showing an eruption of the Tavurvur cone at Rabaul looking from the SE on 5 June 2005. The single large plume in this view was darker gray in the upper portion and lighter gray in the lower portion. White clouds above the plume appear to be meteorological clouds. Courtesy of Roy Price.

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 east, where its floor is flooded by Blanche Bay and was formed about 1400 years ago. An earlier caldera-forming eruption about 7100 years ago is now considered to have originated from Tavui caldera, offshore to the north. 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.

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Monowai Seamount

Kermadec Islands, SW Pacific
25.887°S, 177.188°W; summit elev. -100 m
All times are local (= UTC + 12 hours)

Monowai is a frequently active submarine volcano; during April-November 2003, eleven earthquake and T phase swarms from Monowai were recorded by the Polynesian seismic network (Réseau Sismique Polynésien, RSP) operated by the Laboratoire de Geophysique (LDG) (*BGVN* 28:11). Approximately 260 T phases in 2004 and 365 in January-August 2005 were detected and analyzed by LDG.

In 2004, four short swarms, of 2-3 days duration and 50-80 T phases per swarm (figure 9), occurred on 18-19 February, 31 March-2 April, 27-29 June, and 14 August. Between August 2004 and March 2005, no T phases from Monowai were recorded, indicating a period of quiescence at the volcano. In 2005, T phase swarms from Monowai were recorded on 2-3 March, 16-21 April, and 25-26 May.

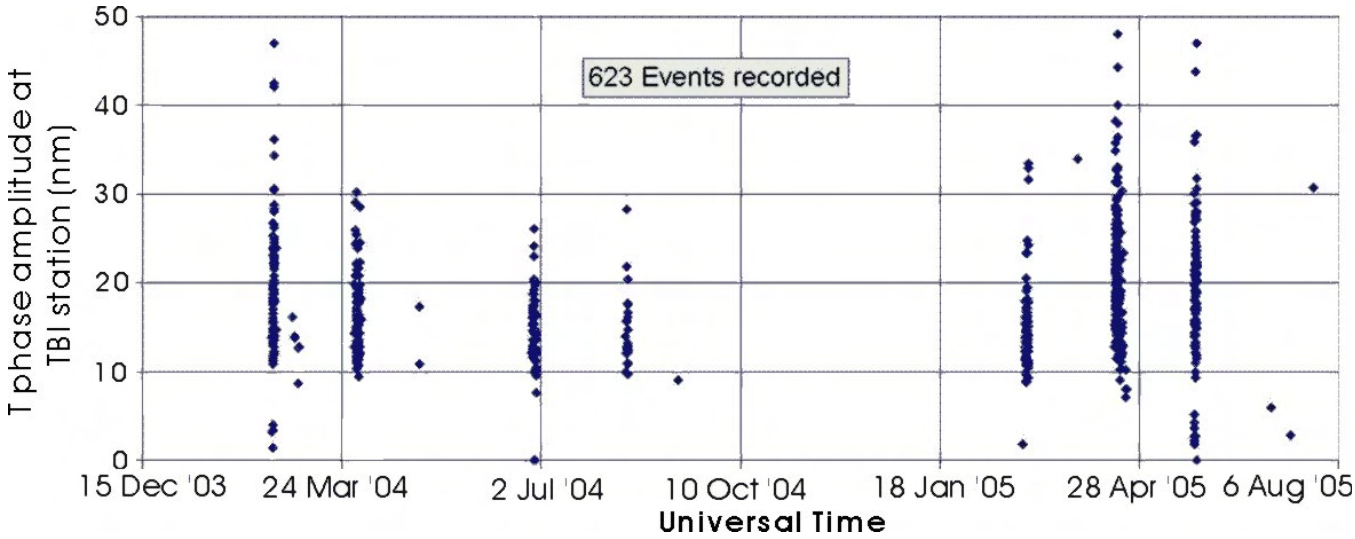

Figure 9. Amplitudes of T phases originating from Monowai Seamount recorded at TBI station on Austral Island (see map in *BGVN* 28:02), versus time. Courtesy of D. Reymond and O. Hyvernaud, LDG.

As of early August 2005, volcanic activity, as indicated by T phases recorded by RSP, resumed, though numerous events have not yet been analyzed.

Background. Monowai seamount, also known as Orion seamount, rises to within 100 m of the sea surface about halfway between the Kermadec and Tonga island groups. The volcano lies at the southern end of the Tonga Ridge and is slightly offset from the Kermadec volcanoes. Small parasitic cones occur on the north and west flanks of the basaltic submarine volcano, which rises from a depth of about 1500 m and was named for one of the New Zealand Navy bathymetric survey ships that documented its morphology. Numerous eruptions have been detected from submarine acoustic signals since it was first recognized as a volcano in 1977. A shoal that had been reported in 1944 may have been a pumice raft or water disturbance due to degassing. Surface observations have included water discoloration, vigorous gas bubbling, and areas of upwelling water, sometimes accompanied by rumbling noises.

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Barren Island

Andaman Islands, Indian Ocean
12.278°N, 93.858°E; summit elev. 354 m
All times are local (= UTC + 5 ½ hours)

Heavy monsoon rains that fell soon after the beginning of the eruption on 28 May made observations and fieldwork difficult, and the eruption appeared to have ended by 6 July (*BGVN* 30:05). Based on information from the Indian Coast Guard, Dhanapati Haldar noted that as of 6 June the mode of eruption was Strombolian, the same as that observed during 1994-95, with fire fountains rising ~ 100 m, a dark plume rising 1 km, and lava piling up on the W face of the main cone.

On 13 June an Indian Navy ship transported Geological Survey of India scientists Sumit Kr. Mitra, P.C. Bandopadhyay, Sanjeev Raghav, and Tapan Pal to the island. Prior to the visit the volcano was spewing a gray ash plume charged with water vapor from both the main crater and a subsidiary vent on the SW slope. Around 13 June activity at the subsidiary vent decreased considerably and lava debris formed a mound of loose hot fragments. Forceful ejection of bombs and lapilli continued from the main crater. The proximal accumulations of pyroclasts displayed some incandescence. Red-hot lava fragments were forcefully ejecting from the main crater to heights of more than 100 m, accompanied by loud explosions. Strombolian fire fountains every 15-30 seconds created an eruption column and mushroom-shaped plume that blew to the N. Hand specimen study revealed both jet-black and brownish black basaltic fragments. Both types contained large phenocrysts of plagioclase and pyroxene in a finer black groundmass with a porphyritic texture.

A story in the BBC News-World Edition of 11 July about the volcano becoming a tourist attraction served by charter boats included a statement that lava was flowing into the sea. However, the observation was not dated or attributed to a specific source.

According to a pilot's report described in a Volcanic Ash Advisory, ash was visible near Barren Island on 18 July at 0211 at an altitude of ~ 6.1 km. Ash was observed on satellite imagery at 0755 that day below 4.6 km altitude. MODIS imagery from the NASA Terra satellite at 0930 (0400 UTC) showed a distinct brown plume extending around 4.6 km NNE. A plume was again reported by a pilot on 18 August at an altitude of ~ 3 km, although ash was not visible on satellite imagery.

Background. Barren Island, a possession of India in the Andaman Sea about 135 km NE of Port Blair in the Andaman Islands, is the only historically active volcano along the N-S-trending volcanic arc extending between Sumatra and Burma (Myanmar). The 354-m-high island is the emergent summit of a volcano that rises from a depth of about 2,250 m. The small, uninhabited 3-km-wide island contains a roughly 2-km-wide caldera with walls 250-350 m high. The caldera, which is open to the sea on the W, was

created during a major explosive eruption in the late Pleistocene that produced pyroclastic-flow and -surge deposits. The morphology of a fresh pyroclastic cone that was constructed in the center of the caldera has varied during the course of historical eruptions. Lava flows fill much of the caldera floor and have reached the sea along the western coast during eruptions in the 19th century and more recently in 1991 and 1995.

Information Contacts: *Geological Survey of India*, 27 Jawaharlal Nehru road, Kolkata 700016, India (URL: http://www.gsi.gov.in/barvol.htm); *Dhanapati Haldar*, Presidency College, Kolkata, India (Email: haldar2115@yahoo.co.uk); *Jenifer E. Piatt*, U.S. Air Force Weather Agency (AFWA), Satellite Applications Branch, Offutt Air Force Base, Nebraska 68113, USA (Email: Jenifer.Piatt@afwa.af.mil, URL: https://afweather.afwa.af.mil/); *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/); *BBC News World Edition*, Room 7540, BBC Television Centre, Wood Lane, London W12 7RJ, United Kingdom (URL: http://news.bbc.co.uk/).

Erta Ale

Ethiopia
13.60°N, 40.67°E; summit elev. 613 m

The most recent reported observations of Erta Ale made during 22-23 January 2005 (*BGVN* 30:01) described hornitos on a chilled lava lake surface. The following report is courtesy of Tony Waltham, who recently authored an article discussing the Afar Triangle (Waltham, 2005). These observations from January 2004 further illustrate the shrinking of the lava lake previously noted by a February 2004 expedition (*BGVN* 29:02).

A group of English geologists who visited on 15-16 January 2004 observed an active lava lake estimated at about 25 m across almost in the center of the lower lava floor within the S crater (figure 10) with a turbulent lava surface ~ 3 m below its rim. Crusting was minimal, and there was no development of substantial lava rafts. Modest fountaining occurred mainly over the zone of rising lava under the southern margin, and none was observed to rise more than 3 m to rim level. A hornito just a few meters high was active on the SE side (figure 11), a few meters from the lake, and night viewing revealed incandescence from a few other fissures across the old lava floor. Minimal fumarolic activity within the crater generated some periods of thin blue haze, though there were major emissions of sulphurous fumes from many fumaroles and fissures around the remains of the old northern crater.

Reference: Waltham, T., 2005, Extension tectonics in the Afar Triangle: Geology Today, v. 21, no. 3, p. 101-107.

Background. Erta Ale is an isolated basaltic shield volcano that is the most active volcano in Ethiopia. The broad, 50-km-wide volcano rises more than 600 m from below sea level in the barren Danakil depression. Erta Ale is the namesake and most prominent feature of the Erta Ale Range. The 613-m-high volcano contains a 0.7 x 1.6 km, elliptical summit crater housing steep-sided pit craters. Another larger 1.8 x 3.1 km wide depression elongated parallel to the trend of the Erta Ale range is located to the SE of the summit and is bounded by curvilinear fault scarps on the SE side. Fresh-looking basaltic lava flows from these fissures have poured into the caldera and locally overflowed its rim. The summit caldera is renowned for one, or sometimes two long-term lava lakes that have been active since at least 1967, or possibly since 1906. Recent fissure eruptions have occurred on the northern flank of Erta Ale.

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Figure 10. Erta Ale's remaining lava lake in the lower floor of the South crater, 15-16 January 2004. Courtesy of Tony Waltham.

Figure 11. Telephoto view of Erta Ale's lava lake, with a hornito barely visible on the left side, 15-16 January 2004. Courtesy of Tony Waltham.

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