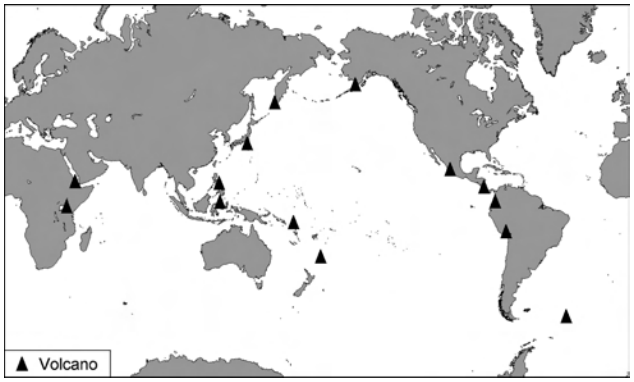
Bulletin of the Global Volcanism Network



Volume 31, Number 3, March 2006

Smithsonian
National Museum of Natural History

Editors: Rick Wunderman, Catherine Galley, Edward Venzke, and Gari Mayberry

Volunteer Staff: Robert Andrews, Jerome Hudis, Veronica Bemis, William Henoch, Jackie Gluck, and Stephen Bentley

Global Volcanism Program · National Museum of Natural History, Room E-421, PO Box 37012 · Washington, DC 20013-7012 · USA
Telephone: (202) 633-1800 · Fax: (202) 357-2476 · Email: gvn@volcano.si.edu · URL: http://www.volcano.si.edu/

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

Data are preliminary and subject to change; contact the original source or the Global Volcanism Program before using.

Raoul Island

Kermadec Islands, New Zealand
29.27°S, 177.92°W; summit elev. 516 m
All times are local (= UTC + 12 hours)

An eruption took place on 17 March 2006 at Raoul Island, killing one person. Brad Scott, New Zealand Institute of Geological and Nuclear Sciences (GNS), reported that on the evening of 12 March 2006 earthquakes began near Raoul Island. More than 200 earthquakes were recorded in the first 24 hours, with many of the larger events felt on the island. Earthquakes continued throughout the week, but the numbers gradually decreased.

An eruption from the Green Lake crater, within the Raoul caldera (figure 1), began at 0821 on 17 March. Other than the precursory seismicity, no water-level or temperature changes were observed, even only 24 hours before the eruption. Based on data from the seismograph on the island, the eruption appears to have continued for up to 30 minutes, although the most intense part of the eruption lasted for only 5 to 10 minutes. Following the eruption, the rate of earthquake activity doubled, but by 23 March the number of earthquakes was reduced to 10-20 per day. No thermal anomalies were detected by the MODIS satellite system during March 2006.

The 2006 eruption blew over mature trees out to ~ 200 m and deposited dark gray mud and large ballistic blocks. Many of the steep crater margins had post-eruption collapses marked by fresh landslides.

The New Zealand Department of Conservation evacuated five staff members from the island, but one worker,

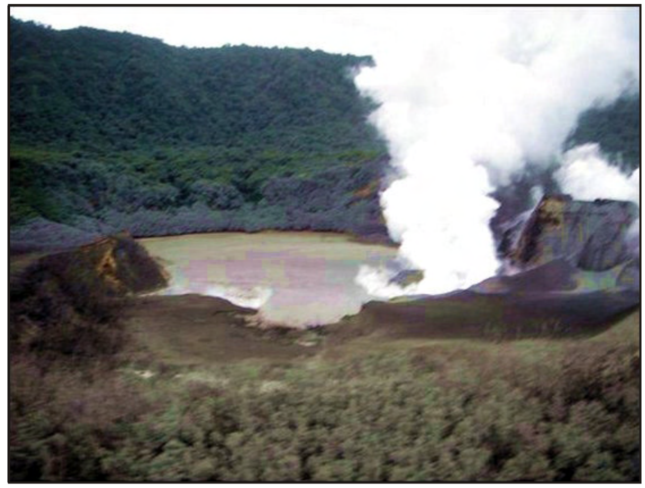


Figure 2. Photo reportedly taken by the rescue helicopter pilot John Funnell of the area affected by the volcanic eruption on Raoul Island, 17 March 2006. AP Photo; photo credit to John Funnell.

taking water-temperature measurements at Green Lake at the time of the eruption, was killed. Devastation left by the eruption thwarted efforts to find the missing worker (figure 2). A news story reported that the missing man left around 0730 on 17 March to walk to Green Lake. An hour later the volcano erupted.

Volcano monitoring of the Raoul crater lakes started after the 1964 eruption, as these lakes responded measurably before that event, consistent with a long-lived hydrothermal system. There are low-temperature (boiling-point) fumaroles in the vicinity of Green Lake and minor seepages of hydrothermal brine from the system (boiling hot springs)

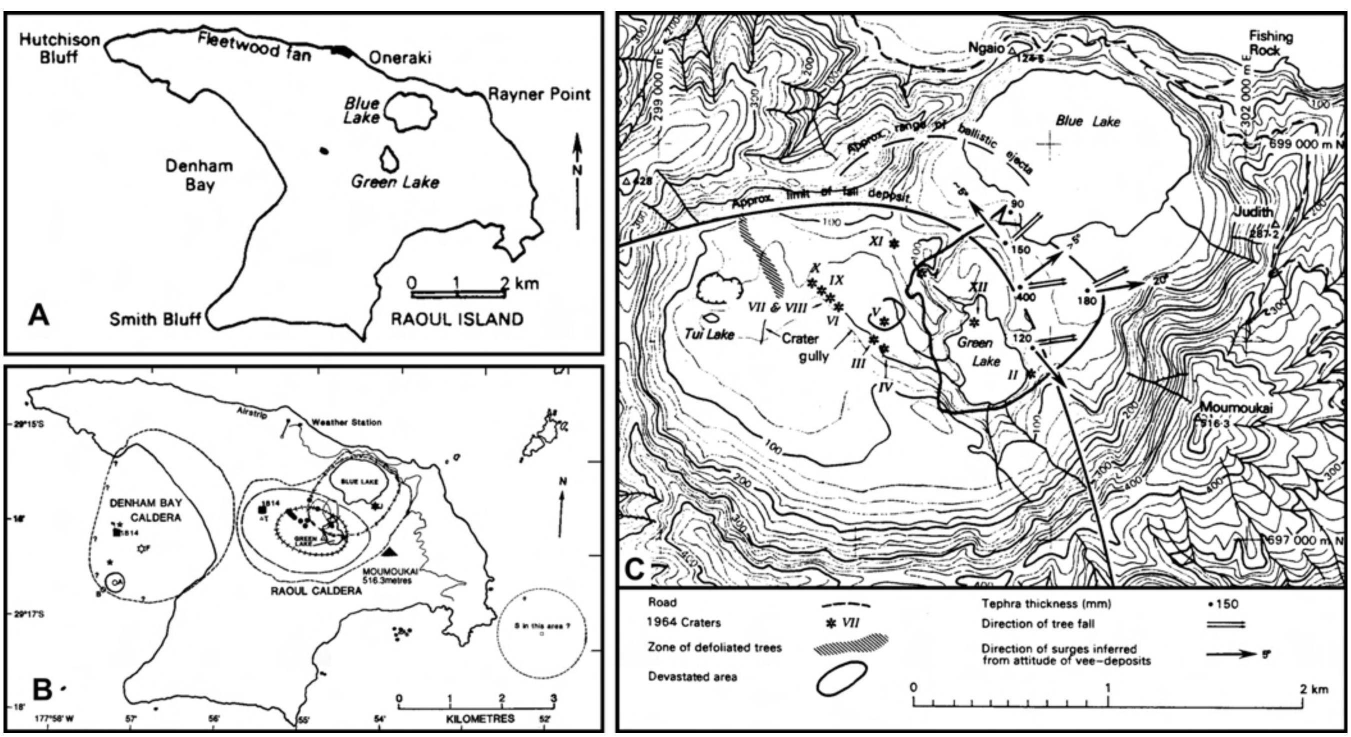


Figure 1. Maps of Raoul Island taken from New Zealand governmental publications issued considerably prior to the 2006 eruption. A) Sketch map of the entire island (from Lloyd and Nathan, 1981). B) A second sketch map showing key areas of volcanism during the past 4,000 years (from Latter and others, 1992). C) A more detailed view of Raoul caldera and the cratered interior of the island, with contour lines at 20 m intervals (from Lloyd and Nathan, 1981). The northern caldera contains three small lakes: Blue Lake (1.17 km², about 40 % overgrown), Green Lake (160,000 m²), and Tui Lake (5,000 m², drinking water quality). The island's high point is Moumoukai (516 m). Unfortunately, the currrent report mentions a few other features undisclosed on these maps. Courtesy of GNS.

along Oneraki Beach, outside of the caldera. The gases have strong hydrothermal signatures (as opposed to proximal magmatic). As such, they do not suggest single-phase vapor transport directly from a magmatic source to the surface, but rather are indicative of the presence of boiling hydrothermal brine at depth. GNS has no quantitative data from Denham Bay (offshore to the W of the island, but scientists from the organization found boiling-point (100° C) steaming ground on the steep crater walls, and gas and water seeps in the sea. Historical observations of volcanic eruptions from this caldera (and Raoul caldera) point to the likely existence of a sizable active system residing there.

Still and video footage taken of the post-eruptive scene on 17 March 2006 showed many new craters and reactivation of 1964 craters. The main steam columns were derived from Crater I, Marker Bay, and Crater XI. Fumarolic activity appeared near the mouth of Crater Gully and the stream that drains from Crater V. The area NW of Bubbling Bay, where there had been a fumarole, contained a crater about 20-30 m across.

In the main body of Green Lake there were two areas of strong upwelling. One occurred near the end of the peninsula S of Crater XII (a promontory that had been explosively removed). Jagged rocks were visible in the lake where it had been 2-4 m deep. There was also a new feature about 200-300 m N of Green Lake's Crater XII (figure 1B); the new feature included a moat near the edge of the crater floor, which contained a vigorously active vent. Green Lake's surface did not appear elevated at the time of the post-eruption 17 March observations.

Sulfur dioxide (SO_2) was detected by satellite about 5 hours after the 17 March eruption (figure 3). SO_2 data was collected by the Aura Ozone Monitoring Instrument (OMI), which is affiliated with the University of Maryland, the US National Aeronautics and Space Administration (NASA), the Royal Netherlands Meteorological Institute (KNMI), and the Finnish Meteorological Institute (FMI). The highest SO_2 values stood over and adjacent to the island and reached as high as two Dobson Units (DU, figure 3). Simon Carn noted that the total mass of SO_2 in figure 3 was ~ 200 tons. Subsequent observations did not detect further SO_2 discharge.

An aerial inspection on 21 March made from a Royal New Zealand Air Force Orion aircraft allowed excellent views of both the Raoul and Denham Bay calderas. Visible steam discharge from the vents had declined significantly owing to a 6-8 m rise in Green Lake's water level and the consequent drowning of most of the active vents. The lake level did not appear to have reached overflow level. Landsliding and collapse also blocked Crater I. Vigorous upwelling and gas discharge was still obvious through Green Lake, which appeared very warm.

There was no evidence of further eruptions since 17 March, nor was there any evidence that activity had occurred from the 1964 craters adjacent to Crater Gully (i.e. craters III, IV, and VI-X). However, many new craters formed at the mouth of Crater Gully where hot bare ground had been present. There was a possible NE-trend through the vents from Crater Gully to NE of Crater XII. In 1964 the craters aligned along three parallel fractures that tended NW. Heightened activity was not confined to the lake.

In Denham Bay GNS scientists observeed a weak plume of discolored water approximately coincident with the vent area. There was evidence of hydrothermal seepage along

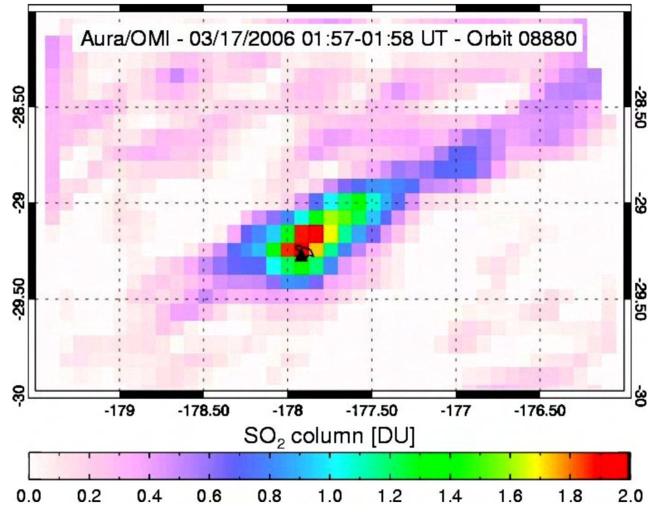


Figure 3. Atmospheric sulphur dioxide (SO_2) detected by the Aura/OMI satellite about 5.65 hours after the Raoul Island eruption's onset on 17 March 2006. (The eruption onset was at about 0821 local time and this SO_2 observation was at about 1358 local time (0158 UTC).) Image courtesy of Simon Carn, the OMI SO_2 group at the University of Maryland, and NASA/KNMI /FMI.

most of the beach (milky discoloration indicating mixing of hydrothermal brine and seawater). There were also discharges in the rocky bay halfway between Hutchison Bluff and the NW end of Denham beach (figure 1A). If these are confirmed as hydrothermal seepages, they represent a significant rise in the surface of the hydrothermal fluids in the system, consistent with that observed in the caldera.

On 23 March 2006, the GNS reported that scientists who flew over noted that the hydrothermal system under the island showed signs of over-pressuring. GNS volcanologist Bruce Christenson stated, "From our aerial observations, it is clear that the heat, gas, and water that are discharging into Green Lake are making this part of the volcano's hydrothermal system unstable." Several new steam vents opened in and around Green Lake during the eruption and some old ones had reactivated. Many of these were drowned as a result of lake-level rise. According to Christenson, "one explanation for the increased hydrothermal activity is that it is being driven by the intrusion of magma at depth."

Steve Sherburn of GNS reported on 24 March on the GeoNet website (the New Zealand GeoNet Project provides real-time monitoring and data collection for rapid response and research into earthquake, volcano, landslide, and tsunami hazards) that over the last few days the level of earthquake activity at or close to Raoul Island had continued to decline to a current level of only 5-10 earthquakes per day, most of which were probably too small to be felt on the island. There is no unequivocal seismic evidence for magma movement (such as the strong volcanic tremor observed before the 1964 eruption). Careful seismic monitoring of Raoul Island will continue.

Brad Scott reported on 3 April 2006 that activity continued to decline in the Green Lake crater area. The most recently available photographs showed the water level continuing to rise slowly in Green Lake, but it had not reached overflow level. Over the last few days the level of earthquake activity at or close to Raoul Island continued to decline and in early April there were only 2-5 earthquakes per day being recorded.

References: Latter, J.H.; Lloyd, E.F.; Smith, I.E.M.; and Nathan, S., 1992, Volcanic hazards in the Kermadec Islands, and at submarine volcanoes between Southern Tonga and New Zealand: Volcanic Hazards Information Series, no. 4 (CD 303), New Zealand Ministry of Civil Defense, 45 p. (Booklet) ISBN 0-477-07472-3

Lloyd, E.F., and Nathan, S., 1981, Geology and tephrochronology of Raoul Island, Kermadec Group, New Zealand: New Zealand Geological Survey Bulletin, no. 95, 105 p. (includes map in back pocket).

Background. Anvil-shaped Raoul Island is the largest and northernmost of the Kermadec Islands. During the past several thousand years volcanism has been dominated by dacitic explosive eruptions. Two Holocene calderas are found at Raoul. The older caldera cuts the center of Raoul Island is about 2.5 x 3.5 km wide. Denham caldera, formed during a major dacitic explosive eruption about 2,200 years ago, truncated the western side of the island and is 6.5 x 4 km wide. Its long axis is parallel to the tectonic fabric of the Havre Trough that lies W of the volcanic arc. Historical eruptions at Raoul during the 19th and 20th centuries have sometimes occurred simultaneously from both calderas, and have consisted of small-to-moderate phreatic eruptions, some of which formed ephemeral islands in Denham caldera. A 240-m-high unnamed submarine cone, one of several located along a fissure on the lower NNE flank of Raoul volcano, has also erupted during historical time, and satellitic vents at Raoul are concentrated along two parallel NNE-trending lineaments.

Information Contacts: *Brad Scott*, Institute of Geological and Nuclear Sciences (GNS), Wairakei Research Centre, 114 Karetoto Road, Taupo, New Zealand (URL: http://www.gns.cri.nz/ and http://www.geonet.org.nz/, Email: b.scott@gns.cri.nz).

Montagu Island

South Sandwich Islands, Antarctica
58.42°S, 26.33°W; summit elev. 1,370 m

Recent volcanism on Montagu Island was discovered based on satellite information (*BGVN* 30:11). Thanks to a visit from the South African icebreaker MV *SA Agulhas*, the first photographs of the island are now available, taken from just offshore. The *Agulhas* is an Antarctic supply and oceanographic research vessel built in the late 1970s; it is affiliated with the South African Department of Environmental Affairs and Tourism, Antartica and Islands Division. She left Cape Town on 1 December 2005, and her journey was the focus of several reports (e.g., Hunter, 2005). The westerly position of pack ice during the course of this voyage enabled the *Agulhas* to visit Penguin Bukta, an indentation (bay) in the coastal ice shelf (figure 4).

The *Agulhas* departed Penguin Bukta on 8 January to deploy drifting weather buoys and to install an automatic weather station on South Thule island at the extreme S end of the South Sandwich Islands. Besides the usual hazards of Antarctic travel and navigation, the South Sandwich Islands were the scene of some severe undersea earthquakes as the *Agulhas* entered those waters. This was of concern because such earthquakes can cause significant bathymetric change. The US Geological Survey posted detailed information on two large 2006 earthquakes to the E of the islands. The first, on 2 January, had M 7.3 and, fortunately, a moderately deep focal depth of 46 km.

The ship reached offshore of the remote, uninhabited Montagu island in mid-January 2006 (figures 5 and 6). These pictures were forwarded to the Smithsonian by Ian Hunter who received them from Frikkie Viljoen (the ice navigator), and Dave Hall (the ship's Master) after the *Alguhas* returned from Antarctica on 19 February 2006.

In an e-mail message to Hunter on the return leg of the voyage (on 16 January), Hall noted the following. "By now you will have heard that we successfully deployed the new weather station at Thule Island and had a good look at the eruption on Montagu. We got to within 1.5 miles [2.4 km] of the lava flow, but it was strangely disappointing. Although it was during the evening it was still full daylight so the lava flow was just the same colour as the surrounding rock, not dramatic at all! The most visible feature was the steam plume as the hot lava entered the sea. The top of the island was covered in cloud but that did part long enough to get a quick sighting of the summit, emitting the smoke and ash cloud."

John Smellie of the British Antarctic Survey reported hearing from a Falklands contact that an RAF flight sent at Christmas 2005 had taken photos and reported the eruption was "over." In addition, there could also be first-hand news from a yacht that was to be in the area during January 2006.

Background. The largest of the South Sandwich Islands, Montagu consists of one or more stratovolcanoes with parasitic cones and/or domes. The summit of the 10 x 12 km wide, polygonal-shaped island rises about 3000 m from the sea floor between Bristol and Saunders Islands. Around 90% of the island is ice-covered; glaciers extend to the sea over much of the island, forming vertical ice cliffs. The name Mount Belinda has been applied both to the high

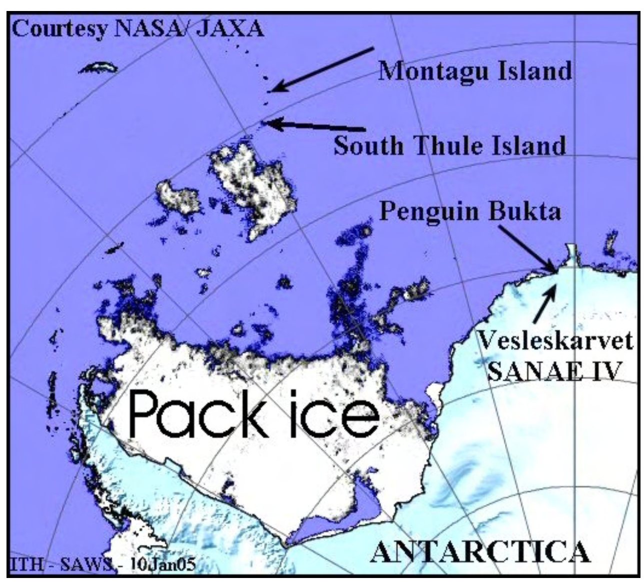


Figure 4. A map indicating the location of Montagu island with respect to features in the region. The pack ice is mobile and the position shown refers to conditions on 10 January 2006 as mapped by satellite radar (NASA/JAXA). Courtesy of Ian Hunter, South African Weather Service.

Figure 5. Lava from Montagu Island eruption entering the sea. The photo was taken on 13 January 2006 from the *SA Agulhas* while lying to the N of the Island. The geometry of the setting given here is based on the MODIS photo taken on 9 September 2005 (*BGVN* 30:11) that clearly indicates the lava flow streaming N into the sea. Courtesy of Dave Hall and Frikkie Viljoen, SA *Agulhas*, and Ian Hunter, South African Weather Service.

Figure 6. Photo taken on 13 January 2006 from the SA *Agulhas* from N of Montagu Island showing the lava field formed by the recent eruption. Courtesy of Dave Hall and Frikkie Viljoen, SA *Agulhas*, and Ian Hunter, South African Weather Service.

point at the southern end of a 6-km-wide ice-filled summit caldera and to the young central cone. Mount Oceanite, an isolated 900-m-high peak, lies at the SE tip of the island and was the source of lava flows exposed at Mathias Point and Allen Point. There was no record of Holocene or historical eruptive activity at Montagu until MODIS satellite data, beginning in late 2001, revealed thermal anomalies consistent with lava lake activity that has been persistent since then. Apparent plumes and single anomalous pixels were observed intermittently on AVHRR images during the period March 1995 to February 1998, possibly indicating earlier unconfirmed and more sporadic volcanic activity.

Reference. Hunter, Ian, (12 January) 2006, International Support for the *SA Agulhas*'s mission in Antarctica, in Ports & Ships, Shipping News–reporting from the harbours of South Africa & Southern Africa (URL: http://www.ports.co.za/didyouknow/)

Information Contacts: *Ian T. Hunter*, South African Weather Service, Private Bag X097, Pretoria 0001.(URL: http://www.weathersa.co.za/; Email: ian@weathersa.co.za), *Department of Environmental Affairs and Tourism, Antartica and Islands Division*, Private Bag X447, Pretoria 0001, South Africa; *John Smellie*, British Antarctic Survey, Natural Environment Research Council, High Cross, Madingly Road, Cambridge CB3 0ET, United Kingdom (URL: http://www.anarctica.ac.uk/, Email: jtsm@bas.ac.uk).

Tinakula

Solomon Islands, SW Pacific
10.38°S, 165.80°E; summit elev. 851 m
All times are local (= UTC + 11 hours)

According to Simon Carn, volcanic activity at Tinakula appears to have begun on 12 February 2006, with a small explosion followed by degassing. He noted some significant SO_2 emissions on 14 February, as well as small plumes from Ambrym and Aoba. As of 16 February, there was still a small SO_2 signal from Tinakula, but it was no bigger than that from Ambrym or Aoba. Andrew Tupper noted from visible MTSAT (Multi-functional Transport Satellite) images and an Aqua MODIS (Moderate Resolution Imaging Spectroradiometer) screen shot that a plume on 14 February was moving NNE at ~ 10 km/hour and appeared to be not far above summit level; the plume did not register on the IR imagery. MTSAT is a dual-mission satellite for the Japan Ministry of Land, Infrastructure, and Transport and the Japan Meteorological Agency performing an air traffic control and navigation, as well as a meteorological, functions.

On 27 February, Thomas Toba of the Solomon Islands government wrote to Herman Patia of the Rabual Volcano Observatory, confirming Tinakula activity. Toba contacted authorities from the Temotu Provincial Headquarters who confirmed that there were several small explosions from this volcano around early to middle February 2006.

Date (2006)	Time (UTC)	Satellite (A=Aqua, T=Terra)	Number of anomalies observed
11 Feb	1125	T	6
11 Feb	1425	A	10
11 Feb	2350	T	3
12 Feb	0240	A	4
13 Feb	2340	T	3
15 Feb	1500	A	2
18 Feb	1430	A	2
03 Mar	2325	T	1
06 Mar	1430	A	1
08 Mar	1120	T	1
08 Mar	1420	A	2
13 Mar	1135	T	1
15 Mar	1425	A	1
20 Mar	1145	T	1
09 Apr	1420	A	1
14 Apr	1135	T	1
16 Apr	1125	T	2
16 Apr	1425	A	1
18 Apr	1410	A	3
19 Apr	1455	A	1
21 Apr	1445	A	2

Table 1. MODVOLC thermal anomalies at Tinakula for mid-February through mid-April 2006. Since the start of monitoring by MODIS satellite sensors on 8 May 2001, no thermal anomalies had been measured at Tinakula before 11 February 2006. Courtesy of University of Hawai'i Institute of Geophysics and Planetology MODIS Hotspot Alert website.

Satellite thermal-sensor data (using the MODVOLC alert-detection algorithm) revealed a period of thermal anomalies on the uninhabited island of Tinakula during cloud-free intervals in early to mid-February 2006 (table 1). The anomalies were particularly numerous on 11 February. The information was extracted from the MODIS Thermal Alerts website maintained by the Hawai'i Institute of Geophysics and Planetology (HIGP) (see also *BGVN* 29:06 and 28:01). The satellites used were Aqua and Terra MODIS. Confirmation of the volcanic source of the anomalies was not broadly distributed until late March 2006.

Background. The small 3.5-km-wide island of Tinakula is the exposed summit of a massive stratovolcano that rises 3-4 km from the sea floor at the NW end of the Santa Cruz islands. Tinakula resembles Stromboli volcano in containing a breached summit crater that extends from the 851-m-high summit to below sea level. Landslides enlarged this scarp in 1965, creating an embayment on the NW coast. The satellitic cone of Mendana is located on the SE side. The dominantly andesitic Tinakula volcano has frequently been observed in eruption since the era of Spanish exploration began in 1595. In about 1840, an explosive eruption apparently produced pyroclastic flows that swept all sides of the island, killing its inhabitants. Frequent historical eruptions have originated from a cone constructed within the large breached crater. These have left the upper flanks of the volcano and the steep apron of lava flows and volcaniclastic debris within the breach unvegetated.

Information Contacts: *Hawai'i Institute of Geophysics and Planetology (HIGP),* School of Ocean and Earth Science and Technology, University of Hawai'i at Manoa, 1680 East-West Road, POST 602, Honolulu, HI 96822 (URL: http://modis.higp.hawaii.edu); *Simon Carn*, University of Maryland Baltimore County (UMBC), Joint Center for Earth Systems Technology (JCET), Total Ozone Mapping Spectrometer (TOMS) Volcanic Emissions Group, 1000 Hilltop Circle, Baltimore, MD 21250 (Email: scarm@umbc.edu); *Andrew Tupper*, Darwin Volcanic Ash Advisory Centre, Bureau of Meteorology, Australia (URL: http://www.bom.gov.au/info/vaac; Email: A.Tupper@bom.gov.au); *Thomas Toba*, Ministry of Energy, Water, and Minerals Resources, Honiara, Solomon Islands (Email: t_toba@mines.gov.sb); *Herman Patia*, Rabaul Volcano Observatory, P.O. Box 386, Rabaul, Papua New Guinea (Email: hguria@global.net.pg).

Lokon-Empung

Sulawesi, Indonesia
1.358°N, 124.792°E; summit elev. 1,580 m

The twin volcanoes of Lokon and Empung exhibited low levels of activity during 2005. Table 2 is a summary of reported gas emissions and number of volcanic earthquakes during 2005.

Background. The twin volcanoes Lokon and Empung, rising about 800 m above the plain of Tondano, are among the most active volcanoes of Sulawesi. Lokon, the higher of the two peaks (whose summits are only 2.2 km apart), has a flat, craterless top. The morphologically younger Empung volcano has a 400-m-wide, 150-m-deep crater that erupted last in the 18th century, but all subsequent eruptions have originated from Tompaluan, a 150 x 250 m wide double crater situated in the saddle between the two peaks. Historical eruptions have primarily produced small-to-moderate ash plumes that have occasionally damaged croplands and houses, but lava-dome growth and pyroclastic flows have also occurred.

Information Contacts: *Dali Ahmad*, *Hetty Triastuty*, *Nia Haerani* and *Suswati*, Center of Volcanology and Geological Hazard Mitigation (CVGHM), Jalan Diponegoro 57, Bandung 40122, Indonesia (Email: dali@vsi.esdm.go.id; URL: http://www.vsi.esdm.go.id/).

Date (2005)	Plume		Type A earthquakes	Type B earthquakes
	Height	Color/ composition		
18 Jan-24 Jan	—	—	9	75
24 Jan-30 Jan	35 m	white gas	3	88
02 May	—	—	3	44
09 May	50 m	white gas	3	139
26 Sep-02 Oct	15 m	white gas	6	117
03 Oct-09 Oct	25 m	white gas	5	126
10 Oct-16 Oct	25 m	white gas	6	177

Table 2. Summary of activity at Lokon-Empung during 2005, indicating the height and composition of plumes observed and the numbers of earthquakes recorded. Data courtesy of VSI.

Mayon

Luzon, Philippines
13.257°N, 123.685°E; summit elev. 2,462 m
All times are local (= UTC + 8 hours)

Since the previous report in December 2004 (*BGVN* 29:12) Mayon had remained quiet until 21 February 2006. On that day the Philippine Institute of Volcanology and Seismology (PHIVOLCS) reported that a minor explosion at 0941 produced an ash plume that rose ~ 500 m above the volcano's crater and drifted SW. Ash was deposited on the upper slopes of the volcano. The ash emission was accompanied by a small explosion-type earthquake, recorded only by seismographs around the volcano.

Prior to the explosion PHIVOLCS had seen an increase in seismicity at the volcano. Between 1545 on 20 February and 0520 on 21 February, there were 147 low-frequency earthquakes recorded, a number considerably above the five or fewer events per day normally detected. Seismicity also indicated some minor rockfalls, which probably resulted from lava blocks detaching from the summit. Steaming was observed. No incandescence was visible at the crater due to clouds obscuring the volcano.

PHIVOLCS reported that about nine earthquakes related to explosive activity took place at Mayon around 23 February. Cloudy conditions prevented visual observations, but the seismic events detected probably signified minor ash explosions. This was supported by reports from local residents who heard rumbling. The seismic network also recorded two low-frequency earthquakes associated with shallow magma movement. The SO_2 flux averaged 1,740 metric tons per day (t/d), similar to values obtained during the last measurements on 28 November 2005. The flux was well above the usual 500 t/d measured at the volcano. Mayon remained at Alert Level 2, with a 6-km-radius Permanent Danger Zone in effect. At this point the possibility of more violent eruptions triggered warnings to tourists and the public in general to remain outside of the danger zone.

Background. Beautifully symmetrical Mayon volcano, which rises to 2462 m above the Albay Gulf, is the Philippines' most active volcano. The structurally simple volcano has steep upper slopes averaging 35-40 degrees that are capped by a small summit crater. The historical eruptions of this basaltic-andesitic volcano date back to 1616 and range from strombolian to basaltic plinian, with cyclical activity beginning with basaltic eruptions, followed by longer-term andesitic lava flows. Eruptions occur predominately from the central conduit and have also produced lava flows that travel far down the flanks. Pyroclastic flows and mudflows have commonly swept down many of the approximately 40 ravines that radiate from the summit and have often devastated populated lowland areas. Mayon's most violent eruption, in 1814, killed more than 1200 people and devastated several towns.

Information Contact: *Philippine Institute of Volcanology and Seismology (PHIVOLCS)*, Department of Science and Technology, PHIVOLCS Building, C.P. Garcia Avenue, Univ. of the Philippines Campus, Diliman, Quezon City, Philippines (URL: http://www.phivolcs.dost.gov.ph/).

Miyake-jima

Izu Islands, Japan
34.079°N, 139.529°E; summit elev. 815 m
All times are local (= UTC + 9 hours)

According to a news report, there was a minor eruption at Miyake-jima on 17 February 2006 that consisted of small ash emissions. Residents of the island were warned that there could be gas emissions and mudslides. The Geological Survey of Japan (AIST) website reported that the SO_2 flux at Miyake-jima averaged about 2,000-5,000 tons per day in January 2006 (figure 7). The previous activity took place in November-December 2004, ending on 9 December 2004 when minor eruptions were reported after a two-year lull. As of mid-April 2006 no further activity had been reported.

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

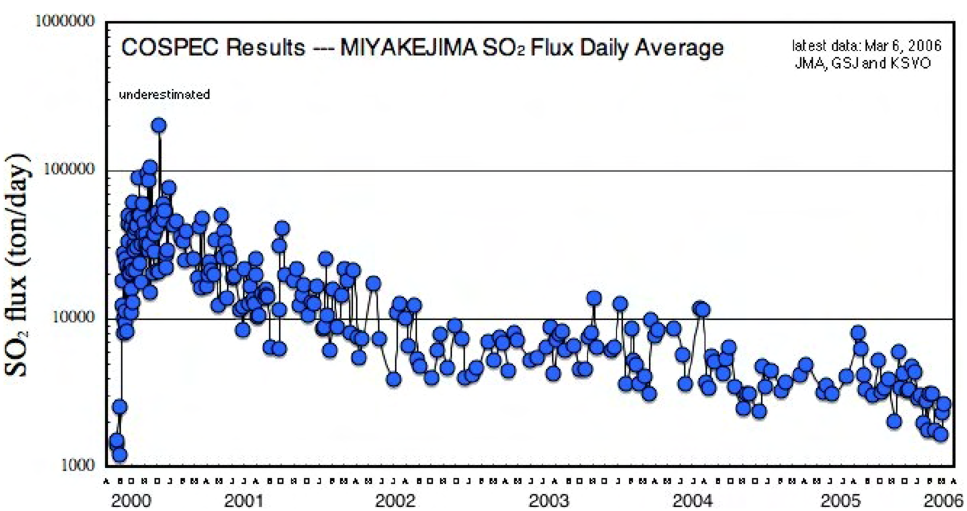


Figure 7. Sulfur dioxide (SO_2) flux monitoring of Miyake-jima by COSPEC V was conducted from 26 August 2000, peaking in early 2000 at values well over 100,000 metric tons per day and dropping off slowly after that. Daily monitoring was performed by the Japanese Meteorological Agency and Geological Survey of Japan.

eruptions. A 1.6-km-wide summit caldera was slowly formed by subsidence during an eruption in 2000; by October of that year the crater floor had dropped to only 230 m above sea level.

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.

Chikurachki

Kurile Islands, Russia
50.325°N, 155.458°E; summit elev. 1,816 m
All times are local (= UTC +11 hours)

Chikurachki last erupted during April to June 2003 (*BGVN* 28:07) and subsequently was apparently dormant for nearly two years. On 1 March 2005, observers in Severo-Kurilsk (~ 70 km NE of Chikurachki) saw a gas-and-steam plume rise ~ 400 m above the volcano. On 12 March 2005, MODIS satellite imagery showed an ash plume extending NNW from the volcano and led KVERT to raise the concern color code from Green to Yellow. On 23 March, satellite imagery showed a weak ash plume extending ~ 70 km E. The height of the plume was unknown, and on 25 March the hazard status was raised again from Yellow to Orange. Chikurachki is not monitored with seismic instruments but KVERT has access to satellite data and occasional visual observations of the volcano. Ash from Chikurachki fell on the southern part of Paramushir Island on 29 March. Ash deposits were visible on satellite imagery on 25 and 29 March; on the 29th they extended 19 km SE. Chikurachki remained at concern color code Orange.

During April 2005, weak fumarolic activity occurred at Chikurachki. Ash deposits covered the WNW slope of the volcano. On 7 April, an ash-and-gas plume rose to ~ 500 m above Chikurachki's crater and extended ~ 10 km S. The concern color code remained Orange through 15 April 2005 and was reduced to Yellow when satellite imagery during the week of 20-26 April did not show any thermal anomalies or ash plumes. Since that time there has been no further indication of activity.

In 2005 Gurenkoa and others published a study of glass inclusions and groundmass glasses from Chikurachki explosions in an effort to better understand the relatively rare, highly explosive eruptions of basaltic composition. Such eruptions may be important in terms of atmospheric impact because of the generally much higher solubilities of S in basaltic melts compared with silicic melts. Concentrations of H_2O, major, trace and volatile (S, Cl) elements by EPMA and SIMS from glass inclusions and groundmass glasses of the 1986, 1853, and prehistoric explosive eruptions of basaltic magmas were studied.

Background. Chikurachki, the highest volcano on Paramushir Island in the northern Kuriles, is actually a relatively small cone constructed on a high Pleistocene volcanic edifice. Oxidized andesitic scoria deposits covering the upper part of the young cone give it a distinctive red color. Lava flows from 1816-m-high Chikurachki reached the sea and form capes on the NW coast; several young lava flows also emerge from beneath the scoria blanket on the eastern flank. The Tatarinov group of six volcanic centers is located immediately to the south of Chikurachki. In contrast to the frequently active Chikurachki, the Tatarinov volcanoes are extensively modified by erosion and have a more complex structure. Tephrochronology gives evidence of only one eruption in historical time from Tatarinov, although its southern cone contains a sulfur-encrusted crater with fumaroles that were active along the margin of a crater lake until 1959.

Reference: Gurenko, A.A., Belousov, A.B., Trumbull, R.B., and Sobolev, A.V., 2005, Explosive basaltic volcanism of the Chikurachki Volcano (Kurile arc, Russia): Insights on pre-eruptive magmatic conditions and volatile budget revealed from phenocryst-hosted melt inclusions and groundmass glasses: Journal of Volcanology and Geothermal Research, v. 147, p. 203-232. (URL: http://www.sciencedirect.com/)

Information Contacts: *Olga Girina*, Kamchatka Volcanic Eruptions Response Team (KVERT), a cooperative program of the Institute of Volcanic Geology and Geochemistry, Far East Division, Russian Academy of Sciences, Piip Ave. 9, Petropavlovsk-Kamchatskii 683006, Russia (Email: girina@kcs.iks.ru), the Kamchatka Experimental and Methodical Seismological Department (KEMSD), GS RAS (Russia), and the Alaska Volcano Observatory (USA); *Alaska Volcano Observatory (AVO)*, a cooperative program of the U.S. Geological Survey, 4200 University Drive, Anchorage, AK 99508-4667, USA (URL: http://www.avo.alaska.edu/; Email: tlmurray@usgs.gov), the Geophysical Institute, University of Alaska, P.O. Box 757320, Fairbanks, AK 99775-7320, USA (Email: eisch@dino.gi.alaska.edu), and the Alaska Division of Geological and Geophysical Surveys, 794 University Ave., Suite 200, Fairbanks, AK 99709, USA (Email: cnye@giseis.alaska.edu).

Veniaminof

Alaska Peninsula, USA
56.17°N, 159.38°W; summit elev. 2,507 m
All times are local (= UTC - 9 hours)

On 7 September 2005, the Alaska Volcano Observatory (AVO) noted several minor bursts of ash from the volcano during the afternoon. Ash bursts continued to occur through at least 9 September, with ash rising less than 3 km altitude, and with the ash confined to the caldera. Over the following 2 weeks, minor ash emission continued at a rate of 1-5 events per day based on interpretations of seismic data. AVO reported that it was likely that diffuse ash plumes rose to heights less than ~ 3 km and were confined to the summit caldera. Cloudy weather during 16-23 September prohibited web-camera and satellite observations of Veniaminof, but seismic data indicated diminishing activity. On 28 September seismicity had remained at background levels for over a week, and there was no evidence to suggest that minor ash explosions were continuing.

On 4 November 2005, a low-level minor ash emission occurred from the intracaldera cone beginning at 0929. Ash rose a few hundred meters above the cone, drifted E, and dissipated rapidly. Minor ashfall was probably confined to the summit caldera. During the previous 2 weeks, occasional steaming from the intracaldera cone was observed. Very weak seismic tremor and a few small discrete seismic events were recorded at the station closest to the active cone. However, AVO reported that there were no indications from seismic data that a significantly larger eruption was imminent.

On the morning of 3 March 2006 ash again rose a few hundred meters above the intracaldera cone, drifted E, and dissipated rapidly. Ashfall was expected to be minor and confined to the summit caldera. Seismicity was again low and did not indicate that a significantly larger eruption was imminent. Over the week of 5-10 March, seismicity was low but slightly above background.

On the morning of 10 March, AVO received a report from a pilot of low-level ash emission from the intracaldera cone. Clear web-camera views on 9 March showed small diffuse plumes of ash extending a short distance from the intracaldera cone. The Anchorage Volcanic Ash Advisory Center (VAAC) reported a steam/ash plume noted on web-cam and satellite on 13 March 2006 at 0500Z (12 March 2006 at 2000 hours local), moving NNW at 9.2 km/hr and falling to the land surface. Web-cam images on 22 March showed a very diffuse steam-and-ash plume that was confined to the summit caldera, and on 24 March showed a steam-and-ash plume drifting from the summit cone at a height of less than 2.3 km. This level of activity was similar to that on 23 March, but higher than activity on 21 and 22 March, when a very diffuse steam-and-ash plume was confined to the summit caldera.

The flow of seismic data from Veniaminof stopped on the evening of 21 March 2006, and the problem was expected to continue until AVO staff could visit the site to repair the problem. Absent seismic data, the volcano could potentially still be monitored in other ways such as using web-camera and satellite images. Imagery was obscured by cloudy weather after 21 March. On 26 March 2006, a pilot reported a small ash plume rising above the volcano. Low-altitude ash emissions from Veniaminof were visible during 31 March to 7 April. On 6 April, a pilot reported an ash plume at a height of 3 km. AVO stated in its weekly report of 14 April 2006 that the seismicity at Veniaminof remained low but above background. Internet camera and satellite views had been obscured by cloudy weather, and AVO lacked new information about ash clouds or activity.

Background. Massive Veniaminof volcano, one of the highest and largest volcanoes on the Alaska Peninsula, is truncated by a steep-walled, 8 x 11 km, glacier-filled caldera that formed around 3,700 years ago. The caldera rim is up to 520 m high on the N, is deeply notched on the W by Cone Glacier, and is covered by an ice sheet on the S. Post-caldera vents are located along a NW-SE zone bisecting the caldera that extends 55 km from near the Bering Sea coast, across the caldera, and down the Pacific flank. Historical eruptions probably all originated from the westernmost and most prominent of two intra-caldera cones, which reaches an elevation of 2,156 m and rises about 300 m above the surrounding icefield. The other cone is larger, and has a summit crater or caldera that may reach 2.5 km in diameter, but is more subdued and barely rises above the glacier surface.

Information Contacts: *Alaska Volcano Observatory (AVO)*, a cooperative program of the U.S. Geological Survey, 4200 University Drive, Anchorage, AK 99508-4667, Geophysical Institute, University of Alaska, P.O. Box 757320, Fairbanks, AK 99775-7320, and Alaska Division of Geological & Geophysical Surveys, 794 University Ave. , Suite 200, Fairbanks, AK 99709 (URL: http://www.avo.alaska.edu); *Charles R. Holliday*, Air Force Weather Agency (AFWA), Offutt Air Force Base, NE 68113 (Email: Charles.Holliday@afwa.af.mil).

Colima

México
19.514°N, 103.62°W; summit elev. 3,850 m
All times are local (= UTC -6 hours)

Eruptive activity has continued at Colima from July 2005 through February 2006. Explosions that generated ash plumes were common during this period.

The Colima Volcano Observatory reported that ash emission continued at Colima during 29 June 2005 to 5 July 2005 and several plumes rose to 9-10 km altitude. On 30 June, lahars traveled SW down La Lumbre Ravine and SSE down Montegrande Ravine to a maximum length of ~ 10 km. The lahars did not reach populated areas. Due to the presence of new ash on the flanks of the volcano, seasonal heavy rains, and the subsequent threat of lahars forming, Universidad de Colima advised avoiding the ravines of La Lumbre, San Antonio, Monte Grande (in Colima state), and La Arena (in Jalisco state) throughout this interval.

The Washington VAAC reported that the Colima video camera and satellite imagery confirmed an explosive eruption on 5 July at 1821 (figure 8). The Mexico City Meteorological Watch Office (MWO) reported that the resultant ash plume reached an altitude of ~ 9.1 km and drifted NW. Pyroclastic flows accompanying the eruption traveled down the E flank.

Several explosions continued during 6-19 July, and small landslides traveled down the volcano's flanks during 8-9 July and 15-18 July. On 21 and 23 July, small ash emissions and lahars occurred. On the 21st during 1750-1830 a lahar traveled SSE down the Monte Grande ravine. Emissions rose to a maximum altitude of 9.1 km on 27 July. During 29 July to 1 August, steam-and-ash emissions occurred at Colima. According to the Washington VAAC, the highest-rising emission reached 6.1 km altitude on 30 July.

On 4 August the Washington VAAC reported that the Mexico City MWO observed a steam plume rising to 7.2 km altitude in imagery seen on the Colima video camera. During15-31 August, small explosions produced low-level ash plumes. The largest events, on 21 and 22 August, produced plumes that drifted W. On 31 August a 45-minute seismic signal associated with a lahar was recorded at the Monte Grande station. The lahar caused no damage.

Throughout the month of September, several small explosions occurred at Colima. On 16 September at 1045 an explosion sent an ash plume to ~ 9.8 km altitude. The local civil defense agency stated in a news report that ash fell on towns NW of the volcano. Prior to the explosion, microseismicity was recorded for several days. Universidad de Colima reported that microseismicity often precedes significant explosions. On 27 September at 0507 an explosion produced a plume to a altitude of ~ 7.6 km altitude. The plume drifted WSW, depositing small amounts of ash in the cities of Colima, Villa de Álvarez, and Comala. On 28 September another explosion sent an ash plume to an altitude of ~ 6.1 km altitude and drifted NNW.

Small explosions continued to occur from October through the end of February 2006 (the end of this report), and produced visible ash plumes. Several small explosions during 16-21 November 2005 produced steam-and-ash clouds to low levels above the volcano. Explosions on 12 December 2005 resulted in small amounts of ash deposited in areas SW of the volcano.

Background. The Colima volcanic complex is the most prominent volcanic center of the western Mexican Volcanic Belt. It consists of two southward-younging volcanoes, Nevado de Colima (the 4320 m high point of the complex) on the north and the 3850-m-high historically active Volcán de Colima at the south. A group of cinder cones of late-Pleistocene age is located on the floor of the Colima graben west and east of the Colima complex. Volcán de Colima (also known as Volcán Fuego) is a youthful stratovolcano constructed within a 5-km-wide caldera, breached to the south, that has been the source of large debris avalanches. Major slope failures have occurred repeatedly from both the Nevado and Colima cones, and have produced a thick apron of debris-avalanche deposits on three sides of the complex. Frequent historical eruptions date back to the 16th century. Occasional major explosive eruptions (most recently in 1913) have destroyed the summit and left a deep, steep-sided crater that was slowly refilled and then overtopped by lava dome growth.

Information Contacts: *Observatorio Vulcanológico de la Universidad de Colima*, Colima, Col., 28045, México (URL: http://www.ucol.mx/volcan/; Email: ovc@cgic.ucol.mx); *Washington Volcanic Ash Advisory Center (VAAC)*, Satellite Analysis Branch (SAB), NOAA/NESDIS E/SP23, NOAA Science Center Room 401, 5200 Auth Rd, Camp Springs, MD 20746, USA (URL: http://www.ssd.noaa.gov/VAAC/).

Figure 8. A photo of the explosive eruption on Colima on 5 July 2005 taken from the E. Courtesy of CVO.

Poás

Costa Rica
10.20°N, 84.233°W; summit elev. 2,708 m
All times are local (= UTC -6 hours)

Poás was last reported on in *BGVN* 28:09, covering the period from September 2001 to December 2002. The focus of activity at Poás during that time was the main crater and its fumaroles, and its low-pH, variably colored lake.

A field team from Observatorio Vulcanológico y Sismológico de Costa Rica, Universidad Nacional (OVSICORI-UNA) visited Poás on 25 January 2006 and found that the level of the volcano's hot acidic crater lake had risen in comparison to the previous month. Sustained rainfall during the previous months caused the water level to rise by ~ 4 m. The area of the lake increased by ~ 20%. Flooding occurred in relatively flat areas to the N, E, and SE. The shoreline extended about 150 m toward the SE. Scattered fumaroles and hot spots at the N base of the lava dome were flooded. Increased steaming was visible from the National Park. The average lake temperature remained at 22°C, with hot spots near the rim reaching up to 80°C. OVSICORI-UNA staff noted that in the past an increase in lake level during a rainy period has been followed by a decrease during the drier months of February to April.

On 24 March 2006 around noon, the first eruptions since 1994 began at Poás. The small, phreatic eruptions originated from the bottom of the volcano's Caliente Lake and dispersed mud, gas, and acid rain toward the S and SW parts of the crater. Witnesses described a sudden emission of water and sediments S of the lake. Roaring was heard in a nearby tourist area and weak earthquakes were felt. The strongest eruption occurred on the night of 24 March, when ejected volcanic material reached 200 m high and acid rain showered park headquarters, located 800 m S of the crater. During 25 March at least 8 eruptions took place. Due to the likelihood of more explosions the local National Emergencies Agency temporarily closed the park.

OVSICORI-UNA staff visited the E side of the volcano on 25 March and confirmed that water, blocks, and sediments from the bottom of the lake had been ejected. Several dozens of impact craters were seen with diameters between 15 and 60 cm, extending E as far as 700 m (figure 9). During 22-27 March, harmonic tremor was recorded. On the 27th, there was a reduction in seismicity and it returned to normal levels. No deformation was measured at the volcano. A news article reported that the area around the volcano was closed to visitors.

Following the eruptions that began on 24 March, seismicity at Poás decreased by 27 March and harmonic tremor that was recorded during the heightened activity ceased.

On 1 April 2006, OVSICORI-UNA staff visited Caliente Lake and its surroundings. During this visit the widening of the lake perimeter was confirmed as well as the emplacement of lake sediments and pre-existent blocks from both the bottom of the lake and its walls. Fracturing of the dome's N wall was also confirmed. The lake temperature was 54ºC, with a pH of 0.63. The water was light gray due to the great quantity of suspended sediments. The park surrounding the volcano was reopened on 1 April.

Background. The broad, well-vegetated edifice of Poás, one of the most active volcanoes of Costa Rica, contains three craters along a N-S line. The frequently visited multi-hued summit crater lakes of the basaltic-to-dacitic volcano, which is one of Costa Rica's most prominent natural landmarks, are easily accessible by vehicle from the nearby capital city of San José. A N-S-trending fissure cutting the 2,708-m-high complex stratovolcano extends to the lower northern flank, where it has produced the Congo stratovolcano and several lake-filled maars. The southernmost of the two summit crater lakes, Botos, is cold and clear and last erupted about 7,500 years ago. The more prominent geothermally heated northern lake is one of the world's most acidic natural lakes, with a pH of near zero. It has been the site of frequent phreatic and phreatomagmatic eruptions since the first historical eruption was reported in 1828. Poás eruptions often include geyser-like ejection of crater-lake water.

Information Contacts: *Eliecer Duarte Gonzalez*, Observatorio Vulcanológico y Sismológico de Costa Rica, Universidad Nacional (OVSICORI-UNA), Apartado 86-3000, Heredia, Costa Rica. (URL: http://www.ovsicori.una.ac.cr/); *Rafael Barquero*, Red Sismiológica Nacional, Sección de Sismología, Vulcanología y Exploración Geofisica, Escuela Centroamericana de Geología, Universidad de Costa Rica, Aptdo. 560-2300, Curridabat, San José, Costa Rica.(Email: RbarqueroP@ice.go.cr).

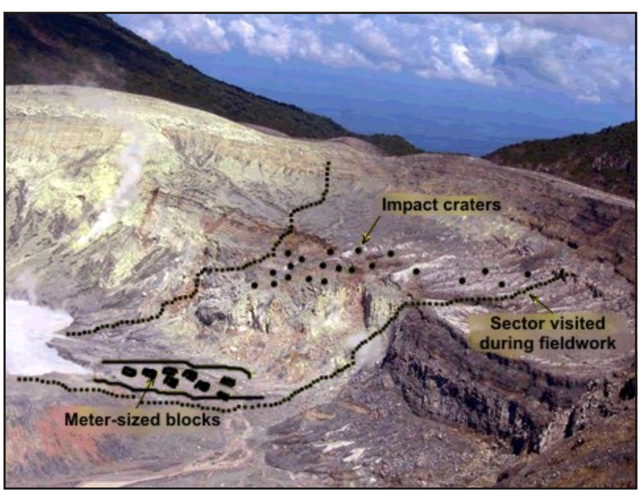


Figure 9. Photo of the E side of Poás, annotated with observations made by OVSICORI-UNA staff. Impact craters ranged in size from a few cm to 70 cm; blocks ranged from a few cm to 50 cm and were scattered randomly over the area investigated. Blocks of fine-grained lake sediments were also observed and collected. The material collected was interpreted as pre-existent solid material from the bottom of the lake that has been heavily altered by the action of hot acidic fluids during the last 12 years. Photo courtesy of Eliecer Duarte Gonzalez, OVSICORI-UNA.

Galeras

Colombia
1.22°N, 77.37°W; summit elev. 4,276 m
All times are local (= UTC -5 hours)

Galeras was last reported on in *BGVN* 31:01. During the first weeks of November 2005 seismometers recorded tornillo earthquakes (long-period events with seismic traces that look like screws in profile and are currently thought to be related to pressurized fluid flow at shallow depth). Minor deformation was also recorded at Galeras. The earthquakes were similar to those that occurred before eruptions in 1992-93. On 24 November at 0246 seismic signals indicated the beginning of an eruption. Ash fell in the towns of Fontibon, San Cayetano, Postobon, and in north Pasto. Activity decreased by the next day, so the Alert Level was reduced. Thousands of people were evacuated during the week prior to the eruption. Gas emissions continued through December 2005 and January and February 2006. During 23 January to 6 February, the lava dome in the main crater continued to grow; strong degassing occurred in several sectors of the active cone and around the lava dome. Galeras remained at Alert Level 3 ("changes in the behavior of volcanic activity have been noted") through February 2006.

During the last week of February, seismic stations detected an average of 280 small earthquakes per day. On 26 February a shallow M 4.8 volcano-tectonic earthquake below the volcano was recorded at 1009, followed by 35 smaller earthquakes. SO_2 flux of about 600 metric tons per day was measured during February. Steam and gas rose to ~ 700 m above the volcano.

During 27 February to 6 March an increase in the volume of the lava dome located in the main crater was observed. During March, seismicity at Galeras decreased in comparison to the previous several weeks and deformation was measured at the volcano. Plumes of mainly steam, gas, and small amounts of ash were emitted from the volcano and rose to a maximum height of 1.2 km above the volcano.

Due to an increase in tremor at Galeras beginning on the morning of 28 March 2006, INGEOMINAS raised the Alert Level from 3 to 2 (likely eruption in days or weeks). On 28 March, energetic signals and tremor began and seismic instruments detected very shallow low-energy hybrid signals, similar to ones recorded during 1991-1993 when dome emplacement occurred on the main crater's floor.

The increase in seismic energy ended on 29 March. The number of earthquakes beneath the volcano decreased during 28 March to 3 April (an average of 66 earthquakes was recorded daily), in comparison to the previous week (an average of 89 earthquakes was recorded daily). Steam columns rose up to ~ 500 m above the volcano and the outer layer of the lava dome at the volcano's summit cooled in comparison to previous weeks.

During 5-24 April, decreases were observed in seismicity, deformation, gas emissions, and temperatures. According to INGEOMINAS, most of the explosive eruptions at Galeras in the past 17 years occurred when parameters were at similarly low levels. In addition, the current lava dome has a significantly greater volume than the dome that was destroyed during an eruption in 1992. The volume of magma in the interior of the volcanic system is greater than during 1989-1993. Galeras remained at Alert Level 2.

Background. Galeras, a stratovolcano with a large breached caldera located immediately west of the city of Pasto, is one of Colombia's most frequently active volcanoes. The dominantly andesitic Galeras volcanic complex has been active for more than 1 million years, and two major caldera collapse eruptions took place during the late Pleistocene. Long-term extensive hydrothermal alteration has affected the volcano. This has contributed to large-scale edifice collapse that has occurred on at least three occasions, producing debris avalanches that swept to the west and left a large horseshoe-shaped caldera inside which the modern cone has been constructed. Major explosive eruptions since the mid Holocene have produced widespread tephra deposits and pyroclastic flows that swept all but the southern flanks. A central cone slightly lower than the caldera rim has been the site of numerous small-to-moderate historical eruptions since the time of the Spanish conquistadors.

Information Contacts: *Diego Gomez Martinez*, Observatorio Vulcanológico y Sismológico de Pasto (OVSP), INGEOMINAS, Carrera 31, 1807 Parque Infantil, PO Box 1795, Pasto, Colombia (Email: dgomez@ingeomin.gov.co; URL: http://www.ingeomin.gov.co/pasto/; Email: ovp@ingeomin.gov.co); *Washington Volcanic Ash Advisory Center* (VAAC), Satellite Analysis Branch (SAB), NOAA/NESDIS E/SP23, NOAA Science Center Room 401, 5200 Auth Rd., Camp Springs, MD 20746 USA (URL: http://www.ssd.noaa.gov/); *El Pais* (URL: http://elpais-cali.terra.com.co/paisonline/).

Ubinas

Perú
16.355°S, 70.903°W; summit elev. 5,672 m
All times are local (= UTC - 6 hours)

Ubinas began erupting ash on 25 March 2006. Since mid-2005 a small increase in fumarolic activity had been seen during visits to the crater by personnel from the Instituto Geofisico del Perú (IGP), UNSA local university, and the Instituto Geologico, Minero y Metalurgico (INGEMMET); it was also reported by local authorities. Increased fumarolic emissions described by INGEMMET were reported on 18 January 2006 by Diario Digital Sur Noticias. Fumaroles started to make strong jet noises, and seismic activity increased, in February 2006. The eruption that began on 25 March, described below, has continued through at least late April.

On 25 March farmers from Querapi village, 4 km from the crater, noted ash deposits on crops. A few millimeters of ash was deposited and quickly removed by rain. The volcano had been mostly cloud-covered during the previous few weeks, but on 27 March residents of Querapi noted a column of ash at 1430. On 30 and 31 March teams from IGP, UNSA, and INGEMMET visited the volcano (figure 10). Although there had been constant snow over the previous days, the summit was completely gray from ashfall. The ash thickness on rocks 2 km NW of the crater was 3 mm, just inside the summit crater there was about 1 cm, and at the inner pit crater edge there was 2 cm. Thick ash surrounded a new 30-m-wide vent in the crater base. This crater was emitting constant ash and gas with larger pulses approximately every 15 minutes. Near the edge of the pit crater were large numbers of flat circular mud discs up to 15 cm in diameter, many with central solid cores. These grew smaller and less frequent with distance. It is thought these are either huge accretionary lapilli, generated in storm clouds above Ubinas, or products of wet eruptions from the new vent. The crater area is dangerous and frequently smothered in ash clouds, so observations remain sketchy.

Ash emissions through 10 April covered local villages and damaged crops. Clear crop damage was visible around the village of Querapi, with potato and alfalfa leaves and flowers blemished in spots. This is the critical growing time for the crop, and thus any damage is serious for the local farmers. Cattle have been seen suffering from diarrhea.

Short periods of seismic recordings have been made at a site 2,500 m NW of the crater rim. On 20 November 2004 only 16 local events were recorded over 12 hours. In February 2005 there where 96 events over the same time period. Over 12 hours on 27 March 2006 there were 115 events. During this last interval, low-amplitude tremor events lasting 3 minutes on average were recorded, as well as long-period (LP) events. Over the 12 hours of observation the following events were recorded: 62 LP, 18 LP with precursors, 10 volcano-tectonic (VT), five VT with precursors, and 20 tremor events.

Background. A small, 1.2-km-wide caldera that cuts the top of Ubinas, Peru's most active volcano, gives it a truncated appearance. Ubinas is the northernmost of three young volcanoes located along a regional structural lineament about 50 km behind the main volcanic front of Peru. The upper slopes of the stratovolcano, composed primarily of Pleistocene andesitic lava flows, steepen to nearly 45 degrees. The steep-walled, 150-m-deep summit caldera contains an ash cone with a 500-m-wide funnel-shaped vent that is 200 m deep. Debris-avalanche deposits from the col-

Figure 10. Photo of Ubinas on 31 March 2006 showing an eruption plume rising from the summit crater. Photo by the Peruvian Civil Defense taken from Moquegua city, provided courtesy of the Associated Press.

lapse of the SE flank of Ubinas extend 10 km from the volcano. Widespread plinian pumice-fall deposits from Ubinas include some of Holocene age. Holocene lava flows are visible on the volcano's flanks, but historical activity, documented since the 16th century, has consisted of intermittent minor explosive eruptions.

Information Contacts: *Orlando Macedo*, Observatorio de Cayma-Arequipa, Instituto Geofisico del Perú at Arequipa city (IGP-Arequipa), Urb. La Marina B-19, Cayma, Arequipa, Perú (Email: omacedo@geo.igp.gob.pe); *Jersy Marino*, Instituto Geologico, Minero y Metalurgico (INGEMMET), Perú (Email: jmarino@ingemmet.gob.pe); *Benjamin van Wyk*, Laboratoire Magmas et Volcans (LMV), OPGC, France (Email: b.vanwyk@opgc.univ-bpclermont.fr); *Jean-Philippe Métaxian*, Laboratire de Geophysique Interne et Tectonophysique-Univ de Savoie, France (Email: Jean-Philippe.Metaxian@univ-savoie.fr); *Peruvian Civil Defense* (URL: http://www.indeci.gob.pe/); *Diario Digital Sur Noticias*, Tacna, Perú (URL: http://www.surnoticias.com/); *Associated Press* (URL: http://www.ap.org/).

Erta Ale

Ethiopia
13.60°N, 40.67°E; summit elev. 613 m
All times are local (= UTC +3 hours)

Viviane Grandjean wrote of her observations at Erta Ale during 24 December 2005-3 January 2006 in Bulletin No. 57 of the Société de Volcanologie Genève. On 26 December she saw the lava lake through clouds of gas; its surface was calm, with incandescent lava visible through the broken chilled surface. The S pit crater had an estimated diameter of 170 m and vertical walls, and the lava lake was about 80 m in diameter. It seemed to shrink during the next days, one part appearing hardened and forming almost a second terrace. The plates of cooled surface lava were seen moving and converging amidst degassing lava. Lava fountains were periodically visible and generally outlined the borders of the lava lake under the rim.

On 27 December, the walls of the crater were estimated at about 50 m high, with a crater diameter of about 300 m. Members of the group descended into the crater to inspect a series of active hornitos near the N vents. At one end of the line a vent lined with sulphur opened. In the interior cavity of a smaller vent temperatures of about 800°C were measured. Degassing occurred generally in the area. Lava fountaining continued.

The lava lake appeared lower and calmer to observers on 28 December, with a potential second terrace still forming. Some group members descended into the crater again and observed rockfall and continued lava fountaining.

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.

Information Contacts: Viviane Grandjean, c/o Société Volcanologique Européenne (SVE)-Société Volcanologique de Genève (SVG), Geneva, C.P.1, 1211 Geneva 17, Switzerland (URL: http://www.sveurop.org/).

Ol Doinyo Lengai

Tanzania
2.764°S, 35.914°E; summit elev. 2,960 m
All times are local (= UTC + 3 hours)

Typical activity continued at Ol Doinyo Lengai from December 2005 through mid-March 2006. Unusual activity, including a large plume and significant lava overflows from the summit crater, occurred during late March and early April. Much of the following information was posted on websites maintained by Fred Belton or Chris Weber, or was contained in email from local sources or visitors relayed by Belton or Celia Nyamweru. None of the reports regarding the unusual March-April activity originated from sources close enough to describe the exact nature of the eruption.

Activity during 20 December 2005-13 March 2006. The local Masai guide William reported an eruption from hornito T49B during a visit on 20 December 2005. When David Bygott climbed the volcano on 22 December the crater was inactive. A recent narrow flow of pahoehoe lava from the NW flank of T49B had flowed across the NW crater rim overflow, and was still warm and making cracking noises. A wide pahoehoe-textured lava flow from T56B had mostly turned white and appeared to be several days to a week old.

On 4 January 2006 Bernhard Donth observed lava escaping from T49B; spatter and little flows went in all directions. One bigger lava flow had reached as far as the NW overflow. A report from Christian Mann of a climb on 10 January only noted degassing from T47. A photo taken that day from the summit showed a white and brown crater with no indication of recent activity. However, Belton noted that during the previous weeks lava had apparently filled up the large open vent of T56B and had flowed from there and possibly other locations onto the NE part of the crater floor.

Chris DeVries and a group of other students from McGill University visited during 25-26 February. Many hornitos were intermittently degassing. T58B was spattering a bit, and magma was heard sloshing around. A small ~ 10-m-long flow had erupted from this vent earlier in the day; it was still very black and hot. T57B had a large opening to its NW, but it did not appear that any recent flows had come from this opening. The base of this cone later ruptured, and the lava inside drained out quickly and violently; the flow proceeded to the E overflow.

Christoph Weber arrived with a film team at the crater on 2 February 2006. The tallest hornito (T49B) reached approximately 2,890 m elevation (measured with GPS), ~ 60 m above the crater floor at the NW overflow (figure 11). No

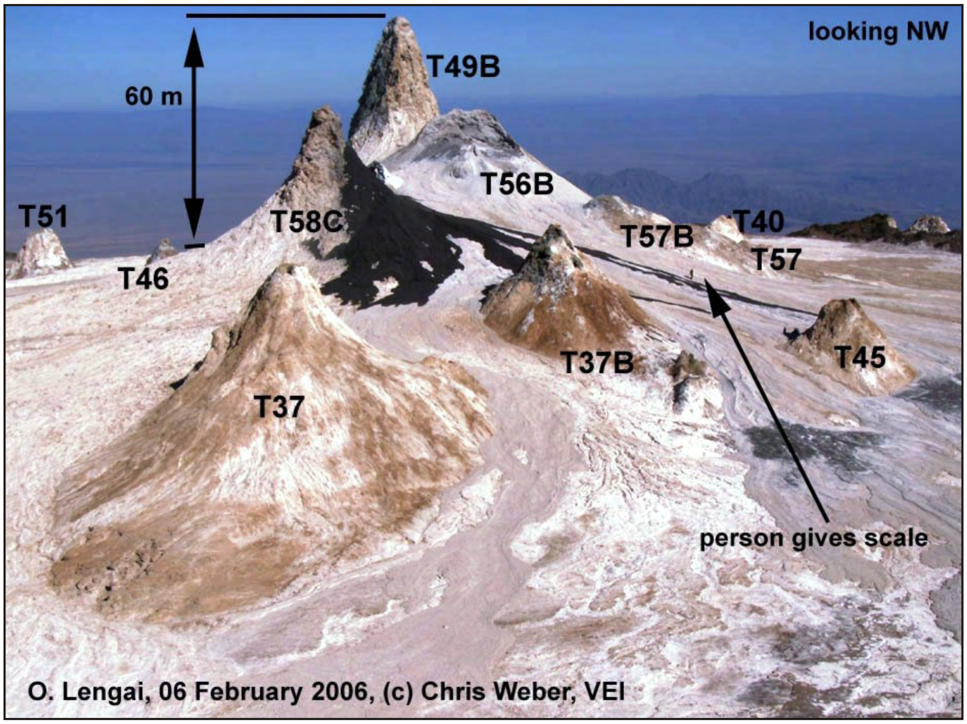


Figure 11. View of Ol Doinyo Lengai on 6 February 2006, looking NW at the central hornito cluster. Fresh lava flows are black. A person can be seen near the recent lava flow in front of T57B. Courtesy of C. Weber.

recent eruption had occured at T49B, but strong noisy degassing took place sometimes. Just E of T49B the hornito T56B had convecting lava deep inside and some days-old lava flows stretched from three different vents at T56B to the E overflow. After the major collapse of T56B in 2004, this hornito (at approximately 2,875 m elevation on 2 February) has nearly grown up again to its former shape and height. Also from T58C and the collapsed T58B hornito some days-old lava flows were found on the eastern slopes passing the old and weathered T37, T37B, and T45 cones.

The caldera-shaped collapsed T58B had its flat floor at ~ 2,865 m elevation with four active vents inside. Lava convection was close to the surface of T58B and inside the tall T58C. At 1300 on 2 February a sudden increase of activity took place with two lava fountains at T58B lasting only some seconds. At the same time lava spilled from all T58B vents, a T58C flank vent, and a T56B vent. Lava spatter with lava flows inside T58B and up to ~ 150 m towards the E occurred over the following 3 days. On 6 and 7 February, higher activity occurred with lava outflow at T58C. During an observation flight on 13 February, Weber noticed new lava flows from T58B and T56B. Crater rim overflow measurements on 2 February 2006 were unchanged since August 2005 (*BGVN* 30:10).

Photographs taken by Michael Dalton-Smith from a plane on 13 March 2006 showed many small flows extending in all directions from the central cluster. The flow over the NW rim seemed to be confined to a channel and did not spread out until it was further down the mountain.

Unusual activity starting in late March. David Peterson saw a fairly obvious plume at the top of the mountain (figure 12) on 28 March. A day or two after that he heard reports of lava pouring down the volcano's sides with some residents moving out of Engare Sero as a result. Unconfirmed news reports in *The Guardian* on 1 April described a scene of “rumbling” noises with lava and ash discharges on 30 March that prompted hundreds to as many as 3,000 local residents to flee the area. Peterson also relayed that his colleague Habibu reported on 1 April that the lava flows had abated. Another friend, Achmed, noted that a river of lava extending from the crater to the base of the volcano was about the "width of a four lane highway" (12 m). An Agence France Presse news report, with quotes from Emmanuel Chausi, a conservation officer with the nearby Ngorongoro Conservation Area Authority (NCAA), claimed that “huge plumes of detritus” were ejected during the nights of both 2 and 3 April, but no lava was reported.

Photos received from Dean Polley, taken 1 April, provide additional information about the eruption (figure 13). Based on these aerial photos, Belton's interpretation is that lava on 30 March must have erupted strongly from at or near the central cluster. A deep channel visible down the flank indicates a flow lasting some hours through a channel deepened by thermal erosion. A crater photo from Matt Jones also taken on 1 April (figure 14) confirmed that there had been recent strong activity from the T56B and T58C hornitos. C. Weber relayed that visitors who climbed the volcano later on (with guide Othman Swalehe) reported a lava channel 5 m wide and 2.5 m deep, starting from the T58C hornito, following the flow field to the SW and then continuing outside the crater at the W overflow where there was a channel 8 m wide and 3 m deep. The collapsed hornito area at T56B and T58B measured about 30 m N-S and 15

Figure 12. A photograph, undated, but from the time period of the eruption, shows a white plume from Ol Doinyo Lengai. This is probably what started the rumor of a major eruption. Fred Belton saw a similar cloud on 15 July 2004 when lava vaporized a big area of plants on the E rim. Fred Belton received this photograph, taken from Basecamp Tanzania, on 9 April 2006.

m E-W with an active lava lake inside. The tall hornitos T58C (partly collapsed to the SE), T49B, and T57B were mostly not affected by the collapse, and the W part of T56B remained standing.

Michael Dalton-Smith flew over on 4 April and saw more recent black flows partially covering the gray flows from 30 March. When Dalton-Smith drove from Seronera to the crater on 4 April, he had a great cloud-free view. Using binoculars it appeared that there was a huge fountain out of one of the hornitos, and all horintos had black plumes rising from them.

Figure 14. Photograph of the Ol Doinyo Lengai crater on 1 April 2006, looking NW at the central hornito cluster. The T58C hornito is completely split, with the south half removed. A significant portion of T56B is also missing. See figure 11 for a comparison with crater morphology on 6 February 2006 and identification of hornitos. Photo by Matt Jones, provided courtesy of F. Belton.

Background. The symmetrical Ol Doinyo Lengai stratovolcano is the only volcano known to have erupted carbonatite tephras and lavas in historical time. The prominent volcano, known to the Maasai as "The Mountain of God," rises abruptly above the broad plain south of Lake Natron in the Gregory Rift Valley. The cone-building stage of the volcano ended about 15,000 years ago and was followed by periodic ejection of natrocarbonatitic and nephelinite tephra during the Holocene. Historical eruptions have consisted of smaller tephra eruptions and emission of numerous natrocarbonatitic lava flows on the floor of the summit crater and occasionally down the upper flanks. The depth and morphology of the northern crater have changed dramatically during the course of historical eruptions, ranging from steep craters walls about 200 m deep in the mid-20th century to shallow platforms mostly filling the crater. Long-term lava effusion in the summit crater beginning in 1983 had by the turn of the century mostly filled the northern crater; by late 1998 lava had begun overflowing the crater rim.

Information Contacts: *Frederick Belton*, Developmental Studies Department, PO Box 16, Middle Tennessee State University, Murfreesboro, TN 37132, USA (URL: http://www.oldoinyolengai.org, Email: oldoinyolengai@hotmail.com); *Christoph Weber*, Volcano Expeditions International, Muehlweg 11, 74199 Untergruppenbach, Germany (URL: http://www.v-e-i.de/, Email: mail@v-e-i.de); *Bernhard Donth*, Waldwiese 5, 66123 Saarbruecken, Germany (Email: b.donth@saarschmiede.com); *Celia Nyamweru*, Department of Anthropology, St. Lawrence University, Canton, NY 13617, USA (Email: cnyamweru@stlawu.edu); *Guardian News*, Arusha, Tanzania (URL: http://www.ippmedia.com/); *Agence France Presse* (URL: http://www.afp.com/).

Figure 13. Aerial photograph of Ol Doinyo Lengai looking approximately ESE showing the summit crater and lava overflows, 1 April 2006. Courtesy of Dean Polley.