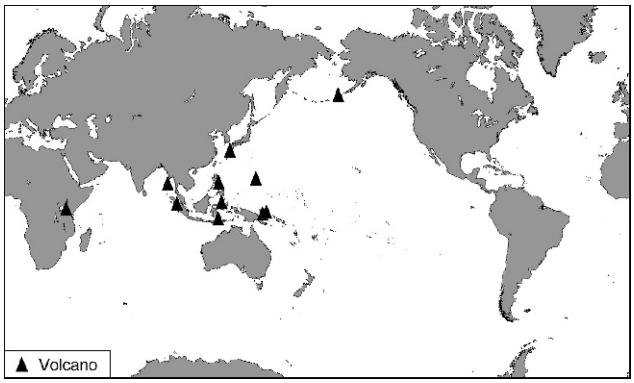
Bulletin of the Global Volcanism Network



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

Ol Doinyo Lengai

Tanzania, Eastern Africa
2.764°S, 35.914°E; summit elev. 2,962 m
All times are local (= UTC + 3 hours)

The previous report on Ol Doinyo Lengai (*BGVN* 32:11), often simply called Lengai, summarized seismicity and energetic ash emissions during 2007. The development of a single large cone with a prominent venting crater significantly changed the crater morphology.

This report discusses field observations by various individuals during December 2007 through March 2008. The reports and photos from visitors provided by Frederick Belton on his website form the source for much of which follows. Table 1 summarizes the observations from December 2007 through March 2008.

An accident last August highlights the hazards of summit access. On his 21 August 2007 ascent, Chris Weber's group evacuated a local Maasai porter who had fallen into an active lava flow (around 500°C) in the crater. The porter had managed to get out of the lava, but with both legs and one arm seriously burned. Initial treatment at an Arusha hospital was financed by Weber's tour company. As of January 2008 he was bedridden in his home near Engare Sero, experiencing pain and muscle wasting. Celia Nyamweru (see web address below) has appealed for financial support to assist the young man during his recovery.

Keller and Klaudius fieldwork, December 2007. Subsequent to publication of *BGVN* 32:11, we received an unpublished report by Joerg Keller and Jurgis Klaudius on their fieldwork during 5-11 December 2007. According to them, the 4 September eruption ended a period of about 25 years of activity dominated by the effusion of highly fluid natrocarbonatite lavas within the summit crater. The deep

Date(s)	Observer(s)	Brief observation(s) (Key: CV= climbed volcano; A=aerial observations/ photos from crater overflight; F = flank observation)
7 Dec 2007	Joerg Keller, Jurgis Klaudius	(CV) Geological samples collected; ash eruption with plumes rising to several thousand meters above volcano (see text)
25 Dec 2007	Jens Fissenebert, Paul Johns	(A/CV) Observations of crater from helicopter and ground (see text)
31 Dec 2007	Raphael Wolf	(CV) Volcano "shook 3 times as my guide and I were climbing"; vent of new cinder cone steaming
6 Jan 2008	Paul Johns	(A/CV) Helicopter landed in S crater, group walked to summit; eruption during flight to crater and 15 minutes after they left; large rocks (bombs?) had been thrown into the S crater
14 Jan 2008	Vegard Laukhammer	(CV) Experienced eruption (see text)
17-21 Jan 2008	Tom Pfeiffer, group from Volcano Discovery	(CV) (See text)
18 Jan 2008	Thomas Holden	(CV) New climbing route on the SE described
19 Jan 2008	Bernhard Donth, Thomas Schulmeister, William (Maasai guide)	(CV) Occasional rain of fine gray ash and small white pebbles during ascent; small ash jets from the active crater
04 Feb 2008	Michael Dalton-Smith	(F) (See text)
12 Feb 2008	Michel Picard	(A) Photographed a dark ash cloud
13 Feb 2008	Walt Bilofsky	(A) Ash rising from summit crater
15 Feb 2008	Gerrit Jan Plaisier, Rob Alakaposa	(A) Plume over Lengai to altitude of 11 km
15 Feb 2008	Benoit Wangermez (pilot)	(A) Summit crater heavily cloaked in fresh ash; ash cloud rising from crater; movie of eruption on Celia Nyamweru's website
20 Feb 2008	Nigel D'Aubrey	(A) Plume over Lengai
21 Feb 2008	KLM pilot	(A) Eruption
24 Feb 2008	Claude Humbert	(CV) Party of 11 people attempted to climb the S side, but terminated the climb about half-way up due to eruption
27 Feb 2008	reported to Michael Dalton-Smith	(F) Eruptions getting stronger; observed from Gol, massive cloud
27-28 Feb 2008	Flight crew	(A) Ash emissions at 1030 and 1200 on 27 Feb and 0530 on 28 Feb; ash cloud moved SW and dissipated
27-28 Feb 2008	Dave Rhys	(F) Eruptions observed from the Serengeti Plain and Ngorongoro Crater 3; single ash plumes rose rapidly following each eruption (none continuous) and dispersed S (thin ash coating on leaves around the rim of Ngorongoro crater)
01 Mar 2008	Max Voight	(A) Photo of ash plume rising
late Feb 2008, 1-2 Mar 2008	Benoît Wilhelmi (pilot)	(A) Photos of ash plumes
03 Mar-05 Mar 2008	Tony Drummond-Murray	(F) Massive eruptions (see text)
05 Mar 2008	Benoît Wilhelmi (pilot)	(A) Plume to altitude of ~15.2 km
11 Mar-12 Mar 2008	Benoît Wilhelmi (pilot)	(A) Strong ash eruption (see text)
18 Mar 2008	Benoît Wilhelmi (pilot)	(A) Photos of crater (see text)
22 Mar 2008	Benoît Wilhelmi (pilot)	(A) Photos of new crater (see text)
25 Mar 2008	Paul Westerman, friend, and Maasai guide	(CV) Walked to the top of the ash cone and heard the tremendous roar; no sulfur smell but some heat
26 Mar 2008	Paul Westerman	(F) From shore of Lake Natron observed some smoke and ash fall (on the downwind side) starting around 0930

Table 1. Summary of selected observers of Ol Doinyo Lengai from December 2007 through 26 March 2008. Observations for 2007 were reported in *BGVN* 32:11. Most of list is courtesy of Frederick Belton.

pit crater from the 1966/67 eruption period had gradually filled by about 1999/2000. According to the report, the last days of August 2007 were characterized by Weber as displaying seemingly increased lava output. A natrocarbonatite lava, collected by Weber during his ascent on 23 August, was analyzed by Keller at Freiburg University and was close to the average or standard composition for natrocarbonatite from the last 20 years.

During their field work on 5-11 December 2007, Keller and Klaudius observed intermittent but impressive explosions with ash plumes rising to several thousand meters above the volcano. This activity alternated with periods dominated by either minor puffing or degassing, or with seemingly dormant phases up to several days long. This pattern seemed to be representative of the period following the 4 September 2007 paroxysm, which Keller and Klaudius had also studied.

Keller and Klaudius reported that an impressive bomb field with impacted blocks of up to 1 m in diameter extended along the crater rim, on the E ridge to the summit, and on the flank down into the S crater. They noted that, given the observed sudden onset of explosions from the intra-crater vent, the summit area was potentially dangerous. They found that fumarolic activity in the N crater was strong, especially along the N rim. It was also observed within the upper part of the N flank.

According to Keller and Klaudius, the 4 September paroxysm complicated access to the summit. With the help of Maasai guides, they used a newly opened route on 7 December that follows a prominent steep ridge and ends at the SE edge of the S crater. They reported that the track was quite strenuous and, while being rather direct, took much longer (7 hours) than the old trail from the W. They found that, with ongoing explosive activity, the S crater was the only safe arrival place. An attempt to use the old W route during their descent was unsuccessful because the very cemented surface of the lapilli beds provided no grip on the steep entrance from above to the ascent chasm.

While at the crater, Keller and Klaudius collected fresh samples of black lapilli, ash, and bombs from the active cone. The large intra-crater cinder-and-ash cone (figure 1) occupied more than half of the former crater platform, with a crater diameter of ~200 m. Its location coincided with the large collapse structure formed during the March/April 2006 natrocarbonatite effusive activity (*BGVN* 32:02) (Kervyn and others, 2008), which has also been the area of strong lava emission before the explosive eruption of 4 September 2007. It had a slightly N-S elongation, oval shape and, despite the heavy fumes filling the crater, it appeared that two vents, a more northerly one and a more southerly one, were erupting.

The cone was formed by and covered by ash, black-to-brown lapilli, cinders, angular blocks, and cored oval bombs. The magmatic lapilli contained macroscopic phenocrysts of nepheline, garnet, and wollastonite. With time, the black lapilli and bombs on the slopes of the cone and in the ring plain around it turned white by weathering of their components. Products of the active cone have covered almost all the old natrocarbonatite structures. Only the spiny remnant of the T49B hornito still stands out at the northern crater rim of the cone. The surface of a blocky flow was also still recognizable at the foot of the N wall.

Analyses of the magmatic material were in harmony with the recent observations of Roger Mitchell and Barry Dawson (reported in *BGVN* 32:11), who analyzed the mineralogy after the 24 September 2007 eruption, and their suggestion that at the onset of the explosive eruptive period on 4 September 2007 a silicate component became involved in the eruptive activity. Mitchell and Dawson concluded that "in lacking clinopyroxene, the mantling ash is not nephelinite or melilitite and is unlike any other magma type previously recorded from the volcano."

During the December fieldwork, Keller and Klaudius collected samples and examined cross-sections of the 4 September 2007 ash. Proximal (near-source) accumulations of tephra in the S crater occurred to a thickness of ~ 20 cm in the depression and on the upper slopes of the S flank, decreasing to a thickness of 1 cm at the E starting point of the new trail. This compared with a thickness of ~ 5 cm at the upper parking site of the old W trail and the abandoned Maasai home closest to the volcano, 4.2 km away (figure 2). Towards Engare Sero village, relics of the ashfall were still locally preserved and indicated an original thickness of ~ 1 cm, consistent with eyewitness reports of ashfall over the village during 4 September.

Other observations. Jens Fissenebert's visit on 25 December 2007 to the summit by helicopter again confirmed that the ash cone had grown. He estimated that it covered

Figure 1. The ash-and-cinder cone that dominated the N crater of Ol Doinyo Lengai. Taken 7 December 2008 from the summit looking N. Courtesy of Joerg Keller.

Figure 2. The abandoned settlement of the Lesele family, located in the major ash fallout area W of the volcano. Note the ash on the roofs of the huts. Courtesy of J. Keller and J. Klaudius.

nearly the northern two-thirds of the crater floor. The N and W parts of the crater rim were indistinct, having been mostly covered by the growing flank of the new cone. Newly erupted ash and lapilli had filled in the flank area below the former crater rim and down through the "Pearly Gates" through which the former W climbing route passed.

Several eruptions were noted by Paul Johns when landing by helicopter on 6 January 2008. During early 2008, there were also occasional thermal anomalies measured by MODIS (table 2).

Vegard Laukhammer climbed the volcano with several others on 14 January 2008. Laukhammer reported arriving at the summit at 0652 (local time). "The visibility was so poor and there was so much smoke that we decided to try to climb down again after 10 minutes. . . . About 10 minutes later (0715), when we had been able to climb about 50 meters down from the summit, a thundering, ear-breaking sound came from the volcano. A large shower of rocks (many the size of a football) were thrown out from the volcano directly towards us 4 on the top" (translation from Norwegian by Sven Dahlgren, found on Belton's website). The climbers managed to descend without serious injury.

Tom Pfeiffer and a VolcanoDiscovery group stayed near and on Ol Doinyo Lengai during 17-21 January 2008. During this period episodic ash eruptions lasted several hours. These phases alternated with quiet intervals when there was only a weak plume of very fine gray ash and gas. After sunset on 17 January, strong ash eruptions started with plumes reaching about 500-1,000 m high, accompanied by strong lightning. After around 2130, Randle Robertson observed a fountain that appeared as a bright red-orange "blow-torch" rising from the summit crater to an estimated height of 500 m above the crater. The light was steady in appearance and lasted for at least 5 minutes. When the fountain died, a dark ash cloud emerged from the crater, which did not reach a great height. The volcano was more or less quiet during most of 18 January (figure 3).

At around 1600 on 19 January, weak explosions set in, increasing in intensity until the ash plumes reached about 500 m above the crater at around 1730 (figure 4). Blocks were ejected 300-400 m above the crater, and all explosions were near-vertical jets from two vents in the crater's W and central portions. Activity decreased after sunset. No incandescence was observed during the night. Activity intensified during the night, with loud-explosion sounds, and the hissing sound of gas-and-ash jets. During their descent on 20 January, ash eruptions continued until early afternoon.

Date (2008)	Time (UTC)	Pixels	Satellite
08 Jan	2030	2	Terra
17 Jan	2025	2	Terra
17 Feb	2240	3	Aqua
22 Feb	2300	1	Aqua
28 Feb	1135	1	Aqua
29 Feb	2305	1	Aqua
07 Mar	2310	1	Aqua
10 Mar	2045	4	Terra
03 Apr	1955	1	Terra

Table 2. MODIS/MODVOLC thermal anomalies measured at Ol Doinyo Lengai during January through early April 2008. Anomalies measured during 2007 were reported in *BGVN* 32:11. Courtesy of the Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System.

Figure 3. View looking N from the summit of Ol Doinyo Lengai, taken 18 January 2008. The large cone in the crater was quiet at this time. Courtesy of Volcano Discovery.

Figure 4. View looking N over the active crater from the summit of Ol Doinyo Lengai, taken 18 January 2008, showing the onset of ash eruption. Courtesy of Volcano Discovery.

Michael Dalton-Smith observed a fairly large eruption at 1200 on 3 February 2008 from the Gol mountains just E of Sanjan gorge. He saw a cloud that rose about ~1 km above the summit. Activity was present all day, ceasing around 1600, followed by renewed activity with ash rising 0.3-0.5 km above the crater.

At about 0600 on 4 February there was a larger eruption with the ash rising about 1.4 km. It was a fairly dense cloud that flattened out at the top. The camp manger of Asilia (where Dalton-Smith was staying) also said that there had been several large explosive eruptions three days before (on 1 February). Two explosions were heard, one in the morning and one in the evening.

On 6 February, Dalton-Smith opted to not climb because of strong eruptions. When he drove past the volcano he reported that "it was having some of the biggest eruptions in a long time" with continuous activity from sunrise to about 1400.

During 3-5 March 2008, Tony Drummond-Murray and his wife observed very strong eruptions (figure 5). Figure 6 shows pyroclastic flows from what appeared to be a collapsing ash column. The valley between Lengai and the escarpment itself was covered with a highly visible layer of light ash after the eruption on 4 March. On 5 March the plume appeared even larger than the one seen on 4 March.

At 1010 on 5 March 2008, pilot Benoît Wilhelmi observed a plume rising to ~15 km altitude. On 12 March, he also saw a strong ash eruption; weaker activity was also seen that day (figure 7). That photo indicates that the powerful eruptions of 3-5 March did not significantly alter the ash cone or crater rim. Large amounts of ash and cinders had piled up against the northward facing ridge below the summit. The S crater was covered in ash and cinder layers so deep that previously prominent erosion gullies were becoming indistinct. It appeared that all vegetation had either died or been buried.

Wilhelmi photographed the summit cone on 18 March at 1530 (figure 8). On 22 March, Wilhelmi photographed directly into the crater (figure 9). At that time there had been no reports of activity for three days, but the smell of hydrogen sulfide returned after being gone for days.

Table 3 lists a number of volcanic ash advisories (VAAs) issued in March 2008 by the Toulouse Volcanic Ash Advisory Center (VAAC).

Thomas Holden reported that as of 29 March 2008 there had been no activity at Lengai for 10 days. Chris Daborn (Tropical Veterinary Services Ltd.) reported on 2 April 2008 the following: "Lengai has of late quieted down significantly–first in changing ash colour from a 'salty' white to a more inert black and now with much smaller eruptions that barely extend above the mountain. We have heavy rains on at present which makes movement in the area difficult–but are also washing ash residue away." Jurgis Klaudius reported that he checked MODIS data and found a thermal anomaly in the N crater on 3 April 2008, indicating on-going eruptions then (table 2).

Figure 5. Large eruption of Ol Doinyo Lengai taken around 4 March 2008 from the Lake Natron area. Courtesy of Tony Drummond-Murray.

Figure 6. During an energetic eruption, small pyroclastic or debris flows propagated down the flanks of Ol Doinyo Lengai. This photo was taken around 4 March 2008 from the Lake Natron area. Courtesy of Tony Drummond-Murray.

Figure 7. Ash eruption from Ol Doinyo Lengai seen 12 March 2008 from the NNE. This image shows that the E, N, and W flanks of the ash cone had buried the original crater rim. Oversteepening of the cone flank in places resulted in small landslides which can be seen just below the cone as dark material covering the lighter areas of older weathered carbonatite. The peak beyond the ash plume is the summit. Photo courtesy Benoît Wilhelmi.

Figure 8. Aerial photo highlighting the summit profile of Ol Doinyo Lengai, as seen looking W at ~1530 (local time) on 18 March by Benoît Wilhelmi (pilot). Courtesy of Frederick Belton.

Warnings of hazards. Celia Nyamweru posted the following warning on her web site: "A team of Tanzanian, US, and French scientists visited the region around the volcano in January 2008, and interviewed local porters who routinely climb Ol Doinyo Lengai with tourists. Our observations and photos indicate continuing eruptive activity, and a growing threat to the region, as outlined below.

"Almost daily eruptions from the central caldera have filled the crater, and produced a steep lapilli-ash cone around the crater rim. A film clip of the crater made by a *Medecins Sans Frontieres* pilot confirms that the loose lapilli is near collapse. These conditions mean that there are very high risks of one or more of the following: 1) a debris flow or lahar (mix of hot ash, water/mud) down the existing

Figure 9. Aerial photo at Ol Doinyo Lengai looking sub-vertically, down into the new cone's crater. Taken at about 0930 (local time) on 22 March by Benoît Wilhelmi (pilot). Courtesy of Frederick Belton.

channels around the volcano; 2) burns from hot lapilli and ash; and 3) catastrophic collapse of the steep lapilli cones around the crater. The risks increase with increasing rainfall during the March-May rains.

"We also urge extreme caution to anyone driving in the river channels on the eastern and northern slopes of Lengai between Engaruka and Ngare Sero. There are scars of immense debris flows on the flanks of Kerimasi, and smaller scars on Ol Doinyo Lengai. These scars attest to catastrophic flows in the past, some of which carried rock fragments up to 50 cm in diameter for distances extending up to 10 km from Ol Doinyo Lengai. Even smaller debris flows could do great damage to vehicles and people moving along the eastern and northern slopes of the volcano."

Reference. Kervyn, M., Ernst, G.G.J., Klaudius, J., Keller, J., Kervyn, F., Mattsson, H.B., Belton, F., Mbede, E., and Jacobs, P., 2008, Voluminous lava flows at Ol Doinyo Lengai in 2006: chronology of events and insights into the shallow magmatic system: Bulletin of Volcanology, DOI 10.1007/s00445-007-0190-x.

Date	Time (UTC)	Information Source	Observed details
04 Mar 2008	0900	Satellite	Eruption occurred at 0630 (UTC), cloud rising to 12.2 km may contain some ash; stopped by 0900.
05 Mar 2008	0854	Meterological watch office (MWO) Dar-Es-Salaam	Eruption of very short duration; "simple puff", ash cloud to 10.7 km altitude.
06 Mar 2008	1730	MWO Dar-Es-Salaam	Eruption occurred at 0830 (UTC); cloud top at 9.1 km altitude, ash not identified from satellite.
09 Mar 2008	0845	MartinAir	Current eruption; ash plume to 8.8 km altitude, ash not identified from satellite.
10 Mar 2008	0711	Satellite	Cloud to 7.3 km altitude.
11 Mar 2008	1800	Infrared satellite	Possible brief eruption at about 1700 (UTC); cloud up to 12.2 km altitude, moving S.
13Mar 2008	1800	KLM pilot; MartinAir	Volcanism with ash cloud rising to 12.2 km altitude.
16 Mar 2008	0450	Satellite	Short eruption at ~0330 (UTC); plume reached 13.7 km altitude.
16 Mar 2008	2148	Satellite	Ash cloud to 12.2 km altitude.

Table 3. March 2008 Volcanic Ash Advisories (VAAs) relating to Ol Doinyo Lengai issued by Toulouse Volcanic Ash Advisory Center (VAAC).

Geologic Summary. 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 crater 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: *Joerg Keller* and *Jurgis Klaudius*, Mineralogisch-geochemisches Institut, Albertstr. 23B D-79104 Freiburg, Germany (Email: joerg.keller@minpet.uni-freiburg.de, jurgis.klaudius@minpet.uni-freiburg.de); *Jens Fissenebert*, Molvaro-Lake Natron Tented Camp and Campsite (http://picasaweb.google.com/Moivaro.Lake.Natron.Camp/Lengai25thDecember); *Vegard Laukhammer* (URL: http://www.vgb.no/perma/280695); *Frederick Belton*, Developmental Studies Department, PO Box 16, Middle Tennessee State University, Murfreesboro, TN 37132, USA (URL: http://www.mtsu.edu/~fbelton/; http://www.oldoinyolengai.org; Email: oldoinyolengai@hotmail.com); *J. Barry Dawson*, Grant Institute of Earth Science, University of Edinburgh, King's Building, Edinburgh EH9 3JW, U.K. (URL: jbdawson@glg.ed.ac.uk); *Roger Mitchell*, Lakehead University, 955 Oliver Road, Thunder Bay, Ontario, Canada P7B 5EI (Email: rmitchell@lakehead.ca); *Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System*, School of Ocean and Earth Science and Technology (SOEST), Univ. of Hawai'i, 2525 Correa Road, Honolulu, HI 96822, USA (URL: http://hotspot.higp.hawaii.edu/); *Celia Nyamweru*, Department of Anthropology, St. Lawrence University, Canton, NY 13617 USA (Email: cnyamweru@yahoo.com; URL: http://it.stlawu.edu/~cnya/); *Toulouse Volcanic Ash Advisory Center (VAAC)* (http://www.metro.fr/aeroweb/info/vaac/homepage/eindex.html and http://www.ssd.noaa.gov/VAAC/OTH/FR/message.html); *Michael Dalton-Smith* (Email: michaelds@digitalcrossing.ca); *Lake Natron Camp* (URL: http://www.ngare-sero-lodge.com/Natropn_camp.htm); *Chris Weber*, Volcano Expeditions International (VEI) (Email: mail@v-e-i.de; URL: http://www.v-e-i.de/).

Barren Island

Andaman Islands, Indian Ocean
12.278°N, 93.858°E; summit elev. 354 m

Thermal anomalies associated with the eruption that began in May 2005 were noted at Barren Island through 1 September 2007 (*BGVN* 32:07). Anomalies detected on 4 and 5 October 2007 again generated MODIS thermal alerts. On 23 December 2007 the Darwin Volcanic Ash Advisory Centre reported that an ash plume seen on satellite imagery rose to an altitude of 1.5 km and drifted S.

Geologic Summary. 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 historical eruptions.

Information Contacts: *HIGP MODIS Thermal Alert System*, Hawai'i Institute of Geophysics and Planetology (HIGP), University of Hawaii and Manoa, 168 East-West Road, Post 602, Honolulu, HI 96822, USA (URL: http://modis.higp.hawaii.edu/); *Darwin Volcanic Ash Advisory Centre*, Bureau of Meteorology, Northern Territory Regional Office, PO Box 40050, Casuarina, Northern Territory 0811, Australia (URL: http://www.bom.gov.au/info/vaac/).

Talang

Sumatra, Indonesia
0.978°S, 100.679°E; summit elev. 2,597 m

The Center of Volcanology and Geological Hazard Mitigation (CVGHM) lowered the Alert Level of Talang to 2 (on a scale of 1-4) on 27 January 2007 due to a reduced seismicity between 23 November 2006 and 24 January 2007, although gas plumes originated from South and Main craters. There had been eruptive episodes in April 2005 and elevated activity during late 2006 (*BGVN* 32:01).

On 17 March 2007, CVGHM raised the Alert Level based on increased "smoke" and tremors to 3 (on a scale of 1-4). The Darwin Volcanic Ash Advisory Centre (VAAC) reported that, based on information from CVGHM, ash plumes rose to altitudes of 3.4-3.9 km on 19-20 March. Local authorities and residents were advised to prepare for a possible evacuation. On 23 April 2007 the Alert Level was reduced to 2. During 18-25 June, thick brown ash plumes rose from Main crater to an altitude of 3.1 km. Diffuse "white ash" plumes rose from South crater to an altitude of 3 km.

On 29 November CVGHM raised the Alert Level to 3 (on a scale of 1-4) based on visual observations and seismicity. During 27-29 November, ash and steam plumes from multiple craters rose to altitudes of 3.1-4.1 km. A strong smell of sulfur dioxide gas was reported. Visitors were advised not to go within 3 km of the summit.

During 7-10 December, observations were limited by inclement weather. On 11 December, "smoke" rose from the Main crater to a maximum altitude of 3.3 km. Plumes were also observed from the South crater and Gabuo Atas solfatara field. On 14 December visual observations and a decrease in the number of earthquakes prompted a lowering of the Alert Level back to 2.

Geologic Summary. Talang, which forms a twin volcano with the extinct Pasar Arbaa volcano, lies ESE of the major city of Padang and rises NW of Dibawah Lake. Talang has two crater lakes on its flanks; the largest of these is 1 x 2 km wide Danau Talang. Most historical eruptions have not occurred from the summit of the volcano, which lacks a crater. Historical eruptions from Gunung Talang volcano have mostly involved small-to-moderate explosive activity first documented in the 19th century that originated from a series of small craters in a valley on the upper NE flank.

Information Contacts: *Darwin Volcanic Ash Advisory Centre*, Bureau of Meteorology, Commonwealth of Australia (URL: http://www.bom.gov.au/info/vaac); *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/).

Batu Tara

Lesser Sunda Islands, Indonesia
7.792°S, 123.579°E; summit elev. 748 m

Our last report (the first ever for this volcano) covered eruptive activity through 13 October 2007 (*BGVN* 32:12). This report continues coverage through early April 2008.

On 8 January 2007, gray plumes rose to 1.5 km altitude and drifted E. On 26 January, white plumes rose to altitudes of 1.7 km and drifted E. On 30 January, white plumes rose to altitudes of 1.5 km. and drifted E. The Darwin VAAC reported that eruption plumes were observed from a ship on 31 January, but ash was not seen in satellite imagery. The Alert level remained at 1 (on a scale of 1-4).

Thermal anomalies were first measured by the MODIS satellites on 17 January 2007 (1420 UTC). According to the Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System, through the end of 2007 anomalies were measured every 1 to 7 days. This trend of nearly daily anomalies continued up to 9 April 2008, with the following exceptions: a 10-day gap beginning 21 December 2007, a 10-day gap beginning 8 January 2008, and a 21-day gap beginning 2 February 2008.

The regularity and repeating character of the thermal anomalies suggest ongoing venting of hot fragmental material or lava flows, similar to March and April 2007 (*BGVN* 32:12). However, the late 2007 and early 2008 behavior and deposits have not been observed.

On 4 February 2008, the Center of Volcanology and Geological Hazard Mitigation (CVGHM) reported that since 9 October 2007, white plumes were a daily occurrence. On 11 March the Darwin VAAC reported that satellite imagery that day revealed an ash-and-steam plume from Batu Tara that rose to an altitude of 3 km and drifted SW. On 12 March satellite imagery revealed an ash-and-steam plume at an altitude of 2.1 km moving SE.

Geologic Summary. The small isolated island of Batu Tara in the Flores Sea about 50 km N of Lembata (fomerly Lomblen) Island contains a scarp on the eastern side similar to the Sciara del Fuoco of Italy's Stromboli volcano. Vegetation covers the flanks of Batu Tara to within 50 m of the 748-m-high summit. Batu Tara lies N of the main volcanic arc and is noted for its potassic leucite-bearing basanitic and tephritic rocks. The first historical eruption from Batu Tara, during 1847-52, produced explosions and a lava flow.

Information Contacts: *Darwin Volcanic Ash Advisory Centre*, Bureau of Meteorology, Commonwealth of Australia (URL: http://www.bom.gov.au/info/vaac); *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/); *Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System*, School of Ocean and Earth Science and Technology (SOEST), Univ. of Hawai'i, 2525 Correa Road, Honolulu, HI 96822, USA (URL: http://hotspot.higp.hawaii.edu/).

Lokon-Empung

Sulawesi, Indonesia
1.358°N, 124.792°E; summit elev. 1,580 m
All times are local (= UTC + 8 hours)

Our most recent report on Lokon-Empung discussed low seismicity and plume emissions between January-October 2005 (*BGVN* 31:03). Since then, available reports from the Center of Volcanology and Geological Hazard Mitigation (CVGHM) discussed seismic events in June and December 2007, and January 2008. Plumes mentioned in these reports were small, white in color, and only rose 15-40 m, occasionally up to125 m, above the rim of the active vent area (Tompaluan crater), in the saddle between the peaks of Lokon and Empung.

During 11-24 June 2007 CVGHM reported 52 A-type and 156 B-type earthquakes, but no tremor. Only one earthquake was felt by residents. The Alert Level remained at 2 (on a scale of 1-4).

On 9 December 2007, CVGHM raised the Alert Level from 2 to 3 based on visual observations, inflation detected by deformation instruments, and an increase in seismicity. The water in the Tompaluan crater changed color from green to gray and noises from degassing became stronger. Visitors were advised not to go within 2 km of the crater.

After a short period of decline, seismicity began to increase again on 22 January 2008, peaking on 3 February. Visitors were prohibited from going within 1 km of the crater.

Geologic Summary. 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.

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Langila

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

Satellite thermal anomalies occurred at or near Langila on three different days in early 2007 (*BGVN* 32:02). Although erupting regularly, only one other anomaly (on 2 April 2007) was detected after that time through 6 March 2008. Langila is noted for its ongoing fluctuating eruptions and occasional ash clouds that rise to more than 5 km altitude and pose a threat to aviation. Throughout this reporting period, April 2007 to January 2008, ash emissions were usually accompanied by weak to moderately loud roaring.

During May 2007, the Rabaul Volcanic Observatory (RVO) reported the emission of ash clouds from Langila's Crater 2. Ash plumes rose to an altitude of 3.3-4.3 km and drifted NW. Weak roaring noises were heard on 11-12 May and a weak glow was visible on 7-8, 11-12, and 15 May. Weak roaring noises were again heard on 20 May, and an increased phase of eruptive activity that began on 22 May continued until end of the month. The increased activity was characterized by forceful emission of thick pale-gray to dark gray-brown ash clouds from 22-27 May. The emission changed to subcontinuous thick dark gray-brown ash clouds on 28-29 May before changing back to occasional thick, pale-gray clouds on 30-31 May. Two large explosions on 30 May accompanied the ash emission. The ash clouds from these two explosions rose 4 km above the summit before being blown NW. On the other days, the ash clouds rose 2-3 km above the summit before drifting NW of the volcano. Continuous fine ashfall occurred at Kilenge Catholic Mission (~10 km NW) and surrounding areas during 22-31 May. The ash emissions were accompanied by occasional weak to loud roaring noises from the 22 to 28 May before turning subcontinuous during 29-31 May. On 30 May two large explosions produced ash plumes that rose to ~5.3 km and drifted NW. A weak glow was visible on 7-8, 11-12, 15, and 20 May and again on 29 and 31 May. Incandescence was visible on 29 May. On 26 May, the seismograph deployed at Kilenge became operational.

During June RVO reported a slight decrease in eruptive activity that began on 22 May, however, the emissions of

ash plumes from Crater 2 were occasionally forceful. The emissions were continuous on 6, 7, and 10 June and accompanied by roaring noises; booming noises were heard on 1 and 10 June. Ash plumes rose to ~ 2.3-4.3 km and drifted NNW. Based on observations of satellite imagery and information from RVO, the Darwin VAAC reported that on 3 June, an ash plume rose to an altitude of 3 km and drifted W. Ashfall was again reported at Kilenge Catholic Mission and surrounding areas. Seismic activity in June was at a high level, dominated by continuous tremor and occasional explosion signals. During the latter part of the month, seismic activity decreased to a low-moderate level. It was dominated by continuous irregular tremors and occasional harmonic tremors. Low-frequency earthquakes ranged from 1 to 7 events per day.

During July 2007, eruptive activity continued at a low level but included thin-to-thick, pale-gray ash clouds. Weak roaring noises were heard on 1 July, but glow was absent at night. On 2 July ash clouds were ejected forcefully and rose ~2 km, drifted NW, and resulted in a fine ashfall downwind. On 6-7, and 9-13 July, ash clouds rose less than 1 km above the summit before drifting NNW. Except for 1 July when weak roaring noises were heard, the volcano was quiet and without appreciable night glow. Seismicity registered at low-moderate levels, dominated by non-harmonic and harmonic tremor of continuous, irregular, or banded character. During July, the daily number of low-frequency earthquakes ranged between 1 and 12 events per day. The one high-frequency earthquake occurred on 27 July.

RVO reports noted mild but continuous ash and white vapor plumes from Crater 2 during 1 August-30 September. Ash plumes generally rose to altitudes of ~1.8-3.3 km and drifted WNW. On 8 August, a large explosion produced an ash plume that rose to an altitude of 5.3 km and drifted SW. Ashfall was reported downwind. Incandescent fragments were ejected from the summit on 21-22 September.

During 1-7 October 2007, RVO reported low-to-moderate eruptive activity consisting of continuous emission of pale gray ash clouds which rose to ~1.8-3.3 km and were blown W to NW. During the second week, the white vapor accompanied by pale gray ash clouds continued; these rose less than 1 km before being blown to the NW of the volcano. On 19, 16, and 27 October, the ash clouds rose less than 2 km before being blown WNW. Consistently, the ash emissions were accompanied by occasional weak-to-loud roaring or booming noises.

On most occasions, there was no glow observed at night, however, a weak-to-bright glow accompanied by projection of incandescent lava fragments was visible on 12 and 22 October. Crater 3 remained quiet. Seismic activity was at low-to- moderate level dominated by low frequency earthquakes and bands of harmonic and non-harmonic tremors. The daily number of low-frequency earthquakes ranged from 2-15. Less than 10 high-frequency events were recorded during October.

In January 2008, activity generally remained low. Some ash fell on 6-7, and 9 January with fluctuating glow visible. On 10, 13, and 25 January the incandescent glow was bright. More direct observations through late February 2008 by RVO staff and affiliates confirmed ongoing eruptions. During February, Crater 2 continued to erupt. Most days, these eruptions generated ash plumes typically rising a few hundred meters. Observers noted incandescent glow or noises on 7, 9, 11, and 21-23 February.

Geologic Summary. Langila, one of the most active volcanoes of New Britain, consists of a group of four small overlapping composite basaltic-andesitic cones on the lower eastern flank of the extinct Talawe volcano. Talawe is the highest volcano in the Cape Gloucester area of NW New Britain. A rectangular, 2.5-km-long crater is breached widely to the SE; Langila volcano was constructed NE of the breached crater of Talawe. An extensive lava field reaches the coast on the north and NE sides of Langila. Frequent mild-to-moderate explosive eruptions, sometimes accompanied by lava flows, have been recorded since the 19th century from three active craters at the summit of Langila. The youngest and smallest crater (Crater 3) was formed in 1960 and has a diameter of 150 m.

Information Contacts: *Herman Patia*, Rabaul Volcano Observatory (RVO), PO Box 386, Rabaul, Papua New Guinea; *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/); *Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System*, School of Ocean and Earth Science and Technology (SOEST), Univ. of Hawai'i, 2525 Correa Road, Honolulu, HI 96822, USA (URL: http://hotspot.higp.hawaii.edu/).

Garbuna Group

New Britain, SW Pacific
5.45°S, 150.03°E; summit elev. 564 m

Garbuna again began to erupt in March 2008. Prior to that, during late June 2007, the summit continued to release variable volumes of white vapor. Occasional increases in volume caused concern in local communities, although noises and night-time glow were absent. An investigation by the West New Britain Disaster Office indicated no other increased activity or emission of solid material. Vapor emissions from the active vent continued through October 2007. Through the end of 2007 and into January and February 2008 activity was characteristically uneventful, with no indication of an eruption.

A new eruption began on 11 March 2008. Gray ash clouds rose less than a kilometer above the summit before being blown SW, causing fine ashfall. Occasional booming noises were heard accompanying the ash emissions. Ash emissions continued on 12-13 March, and reports indicated most of the ash fell in the summit area. On 14-15 March the odor of sulfur was reported downwind. No glow was visible at night. Around this time, observations from the Kulingai Volcano Observatory (15 km SE) noted white vapor emissions from numerous vents at the summit area. During 17-18 March activity increased slightly with forceful and continuous emission of white vapor. Emissions rose vertically less than a kilometer before dissipating. There were no noises heard and no glow visible at night. A strong smell of sulfur was again noted to the E.

All of the monitoring equipment installed during 2005 and 2006 was destroyed. The two GPS stations at the summit and at the base remained out of service, and for most of the reporting interval there was no functioning seismome-

ter. Seismicity began to be monitored using a KD1 recorder, along with a portable seismometer to the E, at SiSi village. Seismicity fluctuated between low and moderate levels. On 17 March, seismicity increased to a moderate level characterized by non-overlapping tremor. Only three high-frequency volcano-tectonic earthquakes were noted during the first day of recording; no low-frequency events were recorded. Seismicity declined on 18 March but rose to a moderate level on 19 March.

Geologic Summary. The basaltic-to-dacitic Garbuna volcano group consists of three volcanic peaks, Krummel, Garbuna, and Welcker. They are located along a 7-km N-S line above a shield-like foundation at the southern end of the Willaumez Peninsula. The central and lower peaks of the centrally located 564-m-high Garbuna volcano contain a large vegetation-free area that is probably the most extensive thermal field in Papua New Guinea. A prominent lava dome and blocky lava flow in the center of thermal area have resisted destruction by thermal activity, and may be of Holocene age. The 854-m-high Krummel volcano at the S end of the group contains a summit crater, breached to the NW. The highest peak of the Garbuna group is 1,005-m-high Welcker volcano, which has fed blocky lava flows that extend to the eastern coast of the peninsula. The last major eruption from both it and Garbuna volcanoes took place about 1800 years ago. The first historical eruption of the complex took place at Garbuna in October 2005.

Information Contacts: *Herman Patia*, *Steve Saunders*, and *Felix Taranu*, Rabaul Volcano Observatory (RVO), PO Box 3386, Rabaul, E.N.B.P, Papua New Guinea.

Bulusan

Luzon, Philippines
12.770 N, 124.05 E; summit elev. 1,565 m
All times are local (= UTC + 8 hours)

Our last report on Bulusan described explosive eruptions and ashfall during 10 October 2006 to 12 May 2007 (*BGVN* 32:04). This current report will cover the events from late May 2007 to January 2008. There were ash-bearing eruptions on 31 July and 4 October 2007. Hazard concerns also included steam-driven explosions, lahars, and related flooding.

The Philippine Institute of Volcanology and Seismology (PHIVOLCS) reported on 20 May 2007 that seismicity remained high following an explosion on 12 May (*BGVN* 32:04). The seismic network detected 673 volcanic earthquakes during five days. The epicenters were located along a NW-SE trend. Ground deformation measurements conducted on 17 May on the NE flank revealed 4 mm of inflation since 7 April, measurements in a series which have shown continued inflation since June 2006. Sulfur dioxide flux measurements were 165-315 tons per day (t/d), below a baseline level of 500 t/d. The Alert Level was raised in mid-May from 1 to 2 (out of 5) due to the increased seismicity and inflation. On 22 May, heavy rain triggered lahars, but they were confined and did not affect populated areas. On 25 May 2007 sulfur emission reached 500 t/d.

During mid-2007, scientists from PHIVOLCS conducting an aerial investigation discovered lahar deposits and three steaming fissures. Scientists also observed steam plumes that rose to altitudes of 1.6-1.7 km and drifted NW and NE. The S flank had inflated by 3 mm. Residents near the base of the volcano noted the odor of sulfur dioxide.

No significant activity was reported during June 2007. Steaming from the active vents and fissures generally consisted of weak to moderate emissions of steam. On 13 July 2007, PHIVOLCS lowered the Alert Level to 1 due to a decline in activity including decreased seismicity, and lower than baseline sulfur dioxide emissions. On 19-21 June the NE and SE flanks were deflated when compared to previous surveys. Sulfur dioxide emission rates were 50-400 t/d.

On the morning of 31 July 2007 an explosion produced an ash plume that rose to an altitude of 6.6 km and drifted WSW and WNW. Initial field reports indicated that light ashfalls were experienced in Cogon, Gulang-gulang, Puting Sapa, Bolos, Monbon and Gabao in Irosin, and Sangkayon and Buraburan in Juban. Small to moderate sized earthquakes and ash explosions continued. On 2 August, white steam plumes rose from active craters and fissures.

On 28 September 2007 the number of volcanic earthquakes increased and PHIVOLCS noted a possible eruption. Explosions at 0134 and 0139 on 4 October 2007 caused a blanket of thick ashfall in sixteen villages that resulted in minor injuries and damage. Instruments recorded 40 volcanic earthquakes and eight short harmonic tremors during a 24 hour interval ending at 0526 that day. Moderate steaming from fissures were found on the SW flank.

According to the news source *Southen Luzon Bureau*, on 15 October 2007 PHIVOLCS found an additional six points of emission around the volcano, three each on the NW and SE slopes. Several other emission points had stopped on the N, SSW, and SW slopes. Overall, nine emission points were active. News reports also mentioned that residents in the village of San Rogue noted bulging of the ground. A deformation survey was allegedly conducted, but results were not available in PHIVOLCS reports.

In the 24 hours from 0800 on 6 January 2008, at least seven minor earthquakes were recorded, but no steaming was noted. Although the Alert Level remained at 1, authorities began to enforce a no-entry policy in a 4-km radius.

Geologic Summary. Luzon's southernmost volcano, Bulusan, was constructed along the rim of the 11-km-diameter dacitic-to-rhyolitic Irosin caldera, which was formed about 35,000-40,000 years ago. Bulusan lies at the SE end of the Bicol volcanic arc occupying the peninsula of the same name that forms the elongated SE tip of Luzon. A broad, flat moat is located below the topographically prominent SW rim of Irosin caldera; the NE rim is buried by the andesitic Bulusan complex. Bulusan is flanked by several other large intracaldera lava domes and cones, including the prominent Mount Jormajan lava dome on the SW flank and Sharp Peak to the NE. The summit of 1,565-m-high Bulusan volcano is unvegetated and contains a 300-m-wide, 50-m-deep crater. Three small craters are located on the SE flank. Many moderate explosive eruptions have been recorded at Bulusan since the mid-19th century.

Information Contacts: *Philippine Institute of Volcanology and Seismology (PHIVOLCS)*, University of the Philippines Campus, Diliman, Quezon City, Philippines (URL: http://www.phivolcs.dost.gov.ph); *Southern Luzon Bureau*, Philippine Daily Inquirer, PO Box 2353, Makati Central Post Office, 1263 Makati City, Philippines (URL: http://newsinfo.inquirer.net/).

NW Rota-1

Mariana Islands, Central Pacific
14.601°N, 144.775°E; summit elev. -517 m
All times are local (= UTC +10 hours)

During an April 2006 expedition (*BGVN* 31:05), scientists from the National Oceanic and Atmospheric Agency (NOAA) and Oregon State University aboard the research vessel *Melville* witnessed the volcano ejecting lava, bombs, and sulfur-rich (SO_2 and H_2S) plumes. This is the first site where explosive submarine eruptions have been directly observed from a submersible (see Videos, below).

According to William Chadwick, a brief visit to NW Rota-1 was made on 24 February 2008. With support from the NOAA Ocean Exploration Program and the U.S. Coast Guard, the scientists deployed a hydrophone and plume sensor. While on site, scientists found that the volcano was still erupting. There were no instruments left after the April 2006 visit, so the observational record was discontinuous. On the other hand, scientists visited the site four times in four years and consistently found that it was active. Moreover, Chadwick and colleagues had collected multibeam bathymetry in 2003 and 2006 (Walker and others, in press). Depth changes between those surveys were up to +40 m and extended from the eruptive vent at 550 m directly downslope to at least 2,000 m. They were consistent with volcaniclastic deposits from ongoing eruptions. The suggestion is that NW Rota-1 has been very active, if not continuously active.

On 24 February 2008 the *Melville* crew made a vertical cast over the eruptive vent with a light-scattering sensor and detected an eruption plume below 500 m depth. Hydrophone data also indicated eruptions with cyclic bursts about once a minute. These appear very similar to the explosions observed by ROV and hydrophone in 2006 (Chadwick and others, 2008). The explosion sounds were louder and more frequent in 2008 than in 2006. During the 2008 visit, explosion signals filled the 24-hour acoustic record. Before departure, the crew installed a hydrophone and plume sensor to record activity over the next year.

Resing and others (2007) described two types of venting at NW Rota-1. The first was a focused plume rich in Al, S, Si, CO_2, Fe, Mn, and ^3He. The second was a plume with diffuse flow, rich in Fe, Mn, CO_2, and ^3He, but without Al, S, and Si. Data suggested that the pH of these plumes were less than 1.0, primarily due to SO_2 and possibly HCl. The authors claimed that the volcano is producing some of the greatest chemical anomalies ever observed in non-buoyant hydrothermal plumes and greatly different from that observed in any other hydrothermal setting.

Videos. Eruption videos taken from an unmanned submersible on 29 April 2006 can be found at http://www.oceanexplorer.noaa.gov/explorations/06fire/logs/april29/april29.html website. The five videos are titled as follows: (1) The extremely dynamic Brimstone Pit, (2) Brimstone Pit erupting with glowing red lava jetting out of the vent, (3) Brimstone Pit erupting with glowing red lava and gas bubbles, (4) Brimstone Pit sulfur plume envelopes the Jason ROV [remotely operated vehicle], and (5) The pulse and shake of the Brimstone Pit during another eruption.

References: Chadwick, W.W., Jr., Cashman, K.V., Embley, R.W., Matsumoto, H., Dziak, R.P., de Ronde, C.E.J., Lau, T.-K., Deardorff, N., and Merle, S.G., 2008, Direct video and hydrophone observations of submarine explosive eruptions at NW Rota-1 volcano, Mariana Arc: J. Geophys. Res.-Solid Earth, doi:10.1029/2007JB005215 (in press).

Resing, J.A., Lebon, G., Baker, E.T., Lupton, J.E., Embley, R.W., Massoth, G.J., Chadwick, Jr., W.W., and de Ronde, C.E.J., 2007, Venting of acid-sulfate fluids in a high-sulfidation setting at NW Rota-1 submarine volcano on the Mariana Arc: Economic Geology, v. 102, no. 6, p. 1047-1061.

Walker, S.L., Baker, E.T., Chadwick, Jr., W.W., Resing, J.A., Lebon, G.T., Lupton, J.E., and Merle S.G., (in press), Eruption-fed particle plumes and volcaniclastic deposits at a submarine volcano: NW-Rota-1, Mariana Arc: J. Geophys. Res.

Geologic Summary. A submarine volcano detected during a 2003 NOAA bathymetric survey of the Mariana Island arc was found to be hydrothermally active and named NW Rota-1. The basaltic to basaltic-andesite seamount rises to within 517 m of the sea surface SW of Esmeralda Bank and lies 64 km NW of Rota Island and about 100 km north of Guam. When Northwest Rota-1 was revisited in 2004, a minor submarine eruption from a vent named Brimstone Pit on the upper south flank about 40 m below the summit intermittently ejected a plume several hundred meters high containing ash, rock particles, and molten sulfur droplets that adhered to the surface of the remotely operated submersible vehicle. The active vent was funnel-shaped, about 20 m wide and 12 m deep. NW Rota-1 is large submarine volcano with prominent structural lineaments about a kilometer apart cutting across the summit of the edifice and down the NE and SW flanks.

Information Contacts. *William Chadwick* and *Robert Dziak*, Oregon State University and NOAA Vents Program, Newport, Oregon; 2115 SE OSU Drive, Newport, OR 97365 USA (URL: http://oceanexplorer.noaa.gov/explorations/06fire/welcome.html).

Suwanose-jima

Ryukyu Islands, Japan
29.635°N, 129.716°E; summit elev. 799 m
All times are local (= UTC + 9 hours)

Our last *Bulletin* (*BGVN* 3211) covered eruptive activity during July 2005 to December 2007. This issue covers eruptions recorded by the Tokyo Volcanic Ash Advisory Center (VAAC) from December 2007 to March 2008. Kinoshita and others (2003) noted that Sakura-jima "has been the most eruptive in Japan, with the eruption columns a few kilometers above the crater occasionally."

Table 4 summarizes information gathered by the Tokyo VAAC from observers between 9 December 2007 and 21 March 2008. In all cases the VAAC could not detect plumes using satellite data. An overview of satellite and image monitoring of Suwanose-jima appears in an article by Kinoshita and others (2003).

Reference: Kinoshita, K., Kanagaki, C., Minaka, A., Tsuchida, S., Matsui, T., Tupper, A., Yakiwara, H., and Iino, N., 2003, Ground and Satellite Monitoring of Volcanic Aerosols in Visible and Infrared Bands: The CEReS International Symposium on Remote Sensing - Monitoring of

Date	Time (UTC)	Ash cloud altitude	Direction
09 Dec 2007	2340	1.5 km	W
10 Dec 2007	0734	1.8 km	W
14 Dec2007	0914	—	—
15 Dec 2007	0016	1.8 km	E
16 Dec 2007	0353	1.5 km	E
16 Dec 2007	2310	1.5 km	E
08 Feb 2008	0248	1.8 km	E
13 Feb 2008	0208	—	—
21 Mar 2008	1622	—	—

Table 4. A summary of Tokyo VAAC reports on ash plumes from Suwanose-jima during 9 December 2007 to 21 March 2008. Cases with only dashes in the data fields were when observers detected an explosion but they were unable to say more about a resulting plume. In many of the examples given, there were multiple Volcanic Ash Advisories issued, but no new data came to light. Courtesy of the Tokyo VAAC.

Environmental Change in Asia, Chiba, Japan, 16-17 December 2003, 10 p.

Geologic Summary. 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 (VAAC),* Tokyo, Japan (URL: http://www.jma.go.jp/jma/jma-eng/jma-center/vaac/vaac%20operation.htm).

Cleveland

Aleutian Islands, USA
52.825°N, 169.944°W; summit elev. 1,730 m
All times are local (= UTC -10 hours)

Our previous reports on Cleveland discussed short duration explosions on 6 February 2006 (*BGVN* 31:01), 23 May 2006 (*BGVN* 31:07), and on 24 August and 28 October 2006 (*BGVN* 31:09).

We received no further reports on Cleveland until June 2007. On 12 June, steam emissions were observed. The plume rose to an altitude of 3.7 km and drifted SE for 200 km. On 17 June, satellite imagery showed a significant thermal anomaly. Low level eruptive activity was suggested. No ash plume was detected. On 26 June, satellite imagery showed another thermal anomaly. On 20 July, the Alaska Volcano Observatory (AVO) raised the Alert Level from Advisory to Watch and the Aviation Color Code from Yellow to Orange, based upon an intense thermal anomaly in the crater and an associated steam-and-gas plume observed on satellite imagery. Three small SO_2 clouds produced by small explosions on 20 July were detected in OMI satellite data. Weak thermal activity was observed by satellite imagery throughout the month.

On 27 July AVO noted that low-level eruptive activity continued. Photographs from 27 July and a pilot report from 2 August indicated fresh volcanic ejecta on the slopes and summit. The E portion of Chuginadak Island was dusted with ash on 3 August. AVO lacks a local seismic system at the volcano was thus unable to track local volcanic earthquakes.

Thermal anomalies continued to be detected on satellite imagery, although clouds obscured satellite and web camera views of the volcano on most days during August through 11 September. A few clear views of the crater during this time revealed multiple thermal anomalies at the summit, indicating that low-level eruptive activity continued.

On 6 September, AVO lowered the Volcanic Alert Level for Cleveland from Watch to Advisory and the Aviation Color Code from Orange to Yellow, based on the observation that since late July, ash and gas plumes had been absent in satellite imagery and no reports of activity had been received. On 20 November the last weak thermal anomaly was observed for the year.

At 1200 on 17 January 2008, minor ash emission was detected, which drifted N. The plume height could not be determined. Thermal anomalies were found in the satellite imagery later that day. According to the AVO, on 8 February, during a break in the cloud cover, satellite imagery detected a diffuse ash plume extending about 12 km SE at an altitude below 1.5 km. Later that day AVO received pilot reports of a diffuse ash plume that rose to an altitude of 6.1 km and, according to satellite imagery, drifted NW. Due to the increased activity, the Volcanic Alert Level was raised to Watch and the Aviation Color Code was raised to Orange. During 10-11 February, a feeble thermal anomaly was marginally visible on satellite imagery.

On 12 February, the Volcanic Alert Level was lowered back to Advisory and the Aviation Color Code was lowered to Yellow. This occurred in response to the observation that minor eruptive activity appeared to have subsided and no further evidence of ash emission had been reported.

On 15 February, a minor explosion from Cleveland produced a small, diffuse ash plume that rose to an altitude of below 3 km and drifted NW. On 16 February, a brief explosion occurred. On 22 February, satellite imagery detected a low-level ash plume that drifted about 300 km SE. On 23 February, satellite imagery revealed a thermal anomaly. On 29 February, satellite imagery detected a weak thermal anomaly and a small ash plume that rose to an altitude of below 3 km. On 15, 27, and 30 March, weak thermal anomalies were detected. As of 4 April 2008, Cleveland remains at Advisory and the Aviation code Yellow.

Geologic Summary. Beautifully symmetrical Mount Cleveland stratovolcano is situated at the western end of the uninhabited, dumbbell-shaped Chuginadak Island. It lies SE across Carlisle Pass strait from Carlisle volcano and NE across Chuginadak Pass strait from Herbert volcano. Cleveland is joined to the rest of Chuginadak Island by a low

isthmus. The 1,730-m-high Mount Cleveland is the highest of the Islands of the Four Mountains group and is one of the most active of the Aleutian Islands. The native name for Mount Cleveland, Chuginadak, refers to the Aleut goddess of fire, who was thought to reside on the volcano. Numerous large lava flows descend the steep-sided flanks of the volcano. It is possible that some 18th-to-19th century eruptions attributed to Carlisle should be ascribed to Cleveland (Miller et al., 1998). In 1944 Cleveland produced the only known fatality from an Aleutian eruption. Recent eruptions from Mount Cleveland have been characterized by short-lived explosive ash emissions, at times accompanied by lava fountaining and lava flows down the flanks.

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