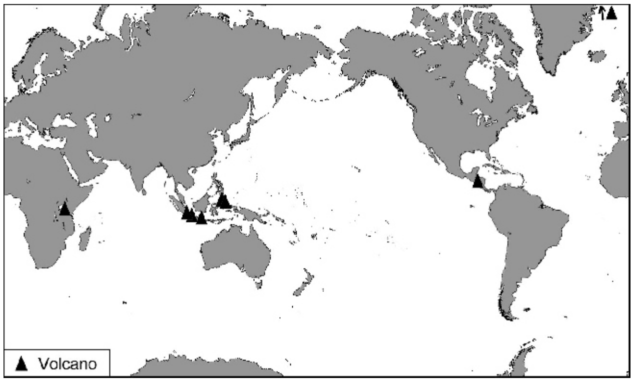
Bulletin of the Global Volcanism Network



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

Karangetang [Api Siau]

Sangihe Islands, Indonesia
2.78°N, 125.40°E; summit elev. 1,784 m
All times are local (= UTC + 8 hours)

Lava flows from Karangetang (figure 1) reached several kilometers in length by the end of May 2009, and some residents evacuated. Witnessed plumes were minor, many below 100 m above the summit, the tallest 700 m above the summit. Intermittent minor activity, including explosions, ashfall, and thermal anomalies, has continued in the last few years (*BGVN* 32:05, 32:08, 34:01), with no significant changes since 2007 (figure 2 and 3).

Based on a pilot observation, the Darwin VAAC reported that on 24 May an ash plume from Karangetang rose to an altitude of 3.7 km and drifted 75 km S. This was the tallest plume of the reporting interval.

On 31 May, based on seismicity, an increase in both volcanic tremor, and continuous air blasts (accompanied by rumbling sounds), the Center of Volcanology and Geological Hazard Mitigation (CVGHM) upgraded Karangetang's hazard status from Alert Level 3 (*Siaga*) to 4 (*Awas*) the highest level (figure 4). According to the website "Natural Disasters in Indonesia," hundreds of people were evacuated from near the volcano and the total number of vulnerable residents was 3,000. The Alert Level fell back to 3 on 9 June.

Tremor was reported on 30 May and became continuous at times during the morning of 31 May (0600-1200). That same time interval saw the largest number of earthquakes. Craters I and II initially produced white plumes to heights of ~ 10-25 m and visible incandescence.

Beginning at 0630 a dense white to brownish plume from the principal crater reached a height of ~ 100 m above the peak. At 0824 there was a continuous expulsion of lava which flowed S, traveling ~ 2.3 km down the Kali Batuawang river. Lava also flowed ~ 1.5 km into the Kali Kahetang and Kali Keting rivers. Lava flows periodically traveled ~ 1 km down the Kali Nanitu and Batang rivers. At 0828 a thick grayish to plume was continuously ejected to a height of ~ 25-700 m accompanied by a rumbling sound of low to medium intensity.

Figure 2. A 2007 photo of Karangetang taken from the sea (direction unspecified) showing multiple peaks and abundant unvegetated lava flows of young ages. The more distant cone may have been steaming. Photo by Mark Tolosa.

In connection with the upgrading of the hazard status to Alert Level 4, CVGHM stepped up its monitoring and sent a team to the field. The regional government was alerted to the possible fallout of hot ash and the expulsion of lava flows. Numerous threatened towns and sub-districts were mentioned. These included Siau Timur, Kampung Kola-Kola (Bebali village); Kampung Bolo and Kampung Kopi, (Tarorane village); Kampung Hekang, Tatahadeng village, the village of Dame 1, the village of Karalung along the Kali Beha Timur river and, Kampung Dompase, along the banks of the Kali Nanitu and Kali Kinali rivers. There was the constant threat of lahar (mud flows) along the length of the rivers that originate from the active crater, including the Batu Awang, Kahetang, Keting, Batang, Beha Timur, and Nanitu rivers.

People were cautioned not to approach Karangetang closer than 3 km from the summit, particularly under conditions of heavy rain. Residents of the village of Dame and part of the population of the township of Tatahadeng were advised to maintain a high level of alertness to the dangers of pyroclastic flows and lava flows. In the case of sudden tephra falls, authorities recommended the public don face masks. As previously mentioned, on 9 June 2009 the alert level was reduce from 4 to 3.

MODVOLC. There were numerous MODVOLC thermal

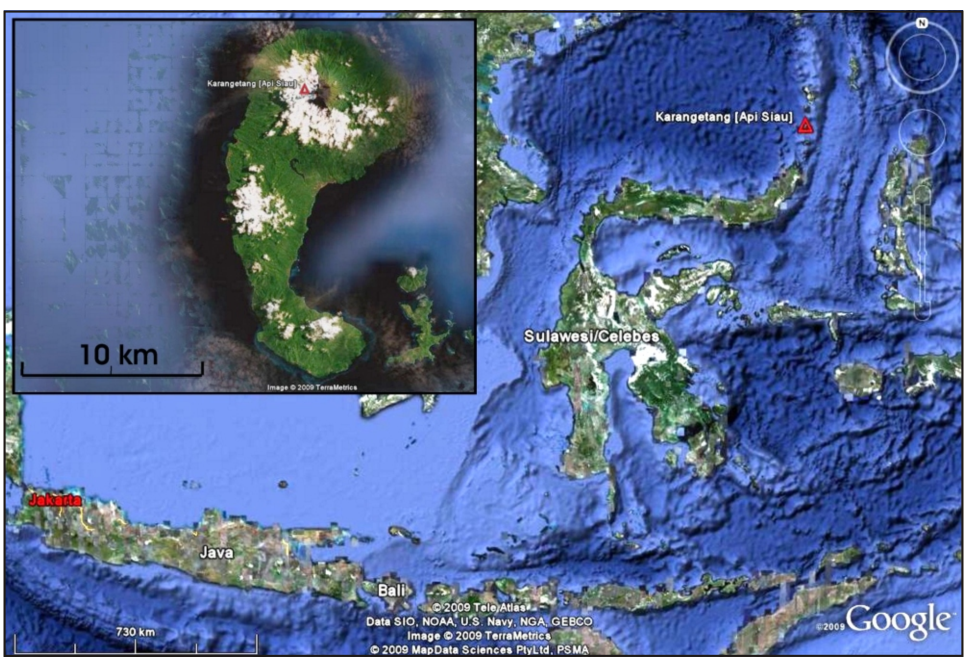

Figure 1. Map of the islands in the region around Karangetang, including Java, Bali, and Sulawesi (Celebes). Karangetang resides at upper right on Siau island, which is ~ 24-km-long, too small to see at this scale. (inset) An enlarged satellite image of Karangetang; white areas are clouds over volcanic peaks on the island. Maps have N directly upwards; scale bars are at lower left. Both maps courtesy of Google Earth.

alerts during 2 December 2008-25 February 2009 (*BGVN* 34:01). As of late June 2009, dates of subsequent MODVOLC alerts for Karangetang were 18 and 29 March; 25, 26, 28, and 30 April; and 7, 14, and 31 May; and 3 June. In effect, the alerts were broadly spread for more than a year and showed little if any response to the elevated activity seen during the crisis.

Geologic Summary. Karangetang (Api Siau) volcano lies at the N end of the island of Siau, N of Sulawesi. The 1,784-m-high stratovolcano contains five summit craters along a N-S line. Karangetang is one of Indonesia's most active volcanoes, with more than 40 eruptions recorded since 1675 and many additional small eruptions that were not documented in the historical record (Catalog of Active Volcanoes of the World: Neumann van Padang, 1951). Twentieth-century eruptions have included frequent explosive activity sometimes accompanied by pyroclastic flows and lahars. Lava dome growth has occurred in the summit craters; collapse of lava flow fronts has also produced pyroclastic flows.

Information Contacts: *Center of Volcanology and Geological Hazard Mitigation (CVGHM)*, Jalan Diponegoro 57, Bandung 40122, Indonesia (URL: http://portal.vsi.esdm.go.id/joomla/); *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/); *Darwin Volcanic Ash Advisory Centre (VAAC)*, Bureau of Meteorology, Northern Territory Regional Office, PO Box 40050, Casuarina, NT 0811, Australia (URL: http://www.bom.gov.au/info/vaac/); *Agence France-Presse* (URL: http://www.afp.com/); *Arnold Binas*, Toronto, Canada (Email: abinas@gmail.com; URL: http://www.summitpost.org/user_page.php?user_id=42443, http://www.flickr.com/photos/hshdude/collections/72157600584144439/).

Figure 3. A photo of the summit area at Karangetang taken from the observatory station at Salili, S of the volcano, on 13 August 2007. Lava flows and rock avalanches during 2007 were not directly visible from this point. Note the rugged topography of the active lava dome at the summit. Courtesy of Arnold Binas.

Ibu

Halmahera, Indonesia
1.488°N, 127.63°E; summit elev. 1,325 m
All times are local (= UTC + 9 hours)

Our last report on Ibu summarized MODVOLC thermal alerts (satellite thermal anomalies) from mid-May through late October 2008 (*BGVN* 33:09); those anomalies continued to be recorded almost monthly through June 2009. The anomalies suggest continued growth of a lava dome in the crater, an event previously documented by a photograph taken May 2000 and mentioned in *BGVN* 28:03. Authorities raised the hazard alert to Level 3 during June 2008. Several photos of Ibu in 2007 were taken by Arnold Binas (figure 5).

Geologic Summary. The truncated summit of Gunung Ibu stratovolcano along the NW coast of Halmahera Island has large nested summit craters. The inner crater, 1 km

Stages	Name	Code	Criteria	Interpretation
1	Aktif Normal	Green	Monitoring of visual, seismicity and other volcanic event do not indicate changes	No eruption in foreseeable future
2	Waspada	Yellow	Increasing activity of seismicity and other volcanic events, and visual changes around the crater	Magmatic, tectonic or hydrothermal disturbance, no eruption imminent
3	Siaga	Orange	Intensively increasing of seismicity with supported by other volcanic monitoring obvious changes of visual observation and crater. Based on observation data analysis, the activity will be followed by main eruption	If trend of increasing unrest continues, eruption possible within 2 weeks
4	Awas	Red	Following the main eruption, the initial eruption begins to occur as ash and vapor. Based on observation data analysis, the activity will be followed by main eruption	Eruption possible within 24 hours

Figure 4. Alert levels applicable to Karangetang (and commonly used in Indonesia) with brief explanation of their significance. From the Natural Disasters in Indonesia website.

wide and 400 m deep, contained several small crater lakes through much of historical time. The outer crater, 1.2 km wide, is breached on the N side, creating a steep-walled valley. A large parasitic cone is located ENE of the summit. A smaller one to the WSW has fed a lava flow down the western flank. A group of maars is located below the northern and western flanks of the volcano. Only a few eruptions have been recorded from Ibu in historical time, the first a small explosive eruption from the summit crater in 1911. An eruption producing a lava dome that eventually covered much of the floor of the inner summit crater began in December 1998.

Information Contacts: *Center of Volcanology and Geological Hazard Mitigation (CVGHM)*, Saut Simatupang, 57, Bandung 40122, Indonesia (URL: http://portal.vsi.esdm.go.id/joomla/); *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/); *Arnold Binas*, Toronto, Canada (Email: abinas@gmail.com; URL: http://www.summitpost.org/user_page.php?user_id=42443, http://www.flickr.com/photos/hshdude/collections/72157600584144439/).

Figure 5. Photos of Ibu taken on 27 July 2007 from a point on the NW crater rim, looking approximately SE. The top photo shows the location of the dome in the steep-walled crater. The bottom photo shows a close-up view of the dome. Courtesy of Arnold Binas.

Semeru

Java, Indonesia
8.108°S, 112.92°E; summit elev. 3,676 m
All times are local (= UTC + 7 hours)

Our last report (*BGVN* 32:03) covered through October 2006 in terms of CVGHM reporting and through February 2007 in terms of Darwin VAAC reporting. As has been the case for decades, Semeru's eruptions continued and were ongoing through this reporting interval, February 2007-March 2009. During the reporting interval, ash plumes were periodically observed over the summit at low altitudes of 3.7-4.6 km. Taller plumes, when they occurred, are noted below. There were several cases of plumes over 6 km altitude and as tall as ~ 7.6 km altitude. Pyroclastic flows ran out to distances as great as 3 km (table 1).

October 2007. Based on reports from CVGHM, the Darwin VAAC reported that an unconfirmed eruption was heard 17 km away on 31 October 2007 (table 1). No plume was seen in MTSAT-IR satellite imagery. A news report from *ANTARA News* on 5 November 2007 ("Ash blankets town near Indonesian volcano") noted that scientists monitoring the volcanoes confirmed Semeru as the source. The news report stated that initially residents thought the thin layer of ash had come from Kelut, a volcano that went to Alert Level 4 (the highest status) on 16 October. The eruption of Kelut, while emitting a large dome into a crater lake, triggered few if any sustained explosions (*BGVN* 33:03). Ash fell in Blitar, outside a 10 km danger zone around Kelut; Semeru is ~ 90 km away.

On 15, 17-19, and 21 May 2008 ash plumes, rockfall avalanches, and multiple pyroclastic flows were observed, as well as increased seismic activity. At that time, the alert level was raised from 2 to 3. By 22 May pyroclastic flows and rockfall avalanches had declined in frequency, and consequently on 5 June the hazard was lowered to Level 2. During 7-9 July 2008, ash plumes rose to altitudes of 4.9-7.6 km, the tallest of the reporting interval.

From January to mid-February 2009, explosion earthquakes occurred on average 100-150 times a day (table 1). Ash and cinder eruptions from Jonggring Saloko crater took place daily every 15-20 minutes, with plumes reaching altitudes of 3.7-4.3 km. During a ~ 5 minute interval on 6 March 2009 at 0010, a loud boom was followed by a bluish flash of lightning 5-7 seconds in duration.

Geologic Summary. Semeru, the highest volcano on Java, and one of its most active, lies at the southern end of a volcanic massif extending N to the Tengger caldera. The steep-sided volcano, also referred to as Mahameru (Great Mountain), rises abruptly to 3,676 m above coastal plains to the south. Gunung Semeru was constructed S of the overlapping Ajek-ajek and Jambangan calderas. A line of lake-filled maars was constructed along a N-S trend cutting through the summit, and cinder cones and lava domes occupy the eastern and NE flanks. Summit topography is complicated by the shifting of craters from NW to SE. Frequent 19th and 20th century eruptions were dominated by small-to-moderate explosions from the summit crater, with occasional lava flows and larger explosive eruptions accompanied by pyroclastic flows that have reached the lower flanks of the volcano. Semeru has been in almost continuous eruption since 1967.

Information Contacts: *Center of Volcanology and Geological Hazard Mitigation (CVGHM)*, Saut Simatupang, 57, Bandung 40122, Indonesia (URL: http://portal.vsi.esdm.go.id/joomla/); *ANTARA News* (URL: http://www.antara.co.id/en/).

Date	Plume height and drift direction	Seismicity and Observations
10-11 Feb 2007	E	—
03-05 May 2007	4.6 km; SW	—
25 May 2007	4.6 km; W	—
18-25 Jun 2007	4.2 km	—
06 Aug 2007	6.1 km	—
22 Sep 2007	7.3 km	—
31 Oct 2007	—	Eruption heard 17 km away
21 Apr 2008	6.1 km	—
15, 17-19, 21 May 2008	—	Increased seismicity. Pyroclastic flows up to 500-3000 m from the crater. On 21 May, incandescent ejections.
22 May 2008	—	Fewer pyroclastic flows and rockfalls; four up to 2.5 km from crater.
05 Jun 2008	—	Decline in seismicity.
07-09 Jul 2008	4.9-7.6 km; SSW	—
27 Jul 2008	4.3 km	—
05 Aug 2008	4.0-4.3 km	Plumes sometimes with incandescent tephra.
07 Aug 2008	4.3 km	Incandescent material ejected from the crater
21-22 Aug 2008	3.7 km; W	—
28 Aug 2008	Low-level	—
31 Aug 2008	4.6 km; SW	—
09 Sep 2008	4.3 km; SSW	—
10 Sep 2008	4.3 km	—
22 Oct 2008	4.3 km	—
Jan 2009	—	Average over 100 daily eruptive earthquakes. Four deep volcanic earthquakes on the 24th.
Feb 2009	—	Average of <50 eruptive earthquakes/day.
01 Feb 2009	4.0 km	—
21 Feb 2009	—	18 deep volcanic earthquakes.
03 Mar 2009	—	5 eruptive earthquakes.
06 Mar 2009	3.7 km	0010 local time (see text)
06, 12 Mar 2009	—	Volcanic seismicity had a maximum amplitude reached ±34 mm.
12 Mar 2009	4.5 km	Ash/cinder eruption accompanied by rumbling sounds lasting ~ 6 minutes
15 Mar 2009	4.3 km	Eruptive earthquake amplitude ±18 mm. Dense low-pressure ash-cinder eruption; changing to white air-blasts, then gradually diminishing.
16-22 Mar 2009	—	Averaged eruptive earthquakes around 1-30 daily; max. amplitudes less than 10 mm.

Table 1. Compilation of data on Semeru during February 2007-March 2009. Courtesy of CVGHM.

Slamet

Java, Indonesia
7.242°S, 109.208°E; summit elev. 3,428 m
All times are local (= UTC + 7 hours)

Minor eruptions were reported at the active crater during April-June 2009. Small amounts of ash fell several times during May. Witnesses saw lava fountains on 12 and 21-23 May. Previously, steam plumes were associated with heavy rains during 28 March-3 April 2007 (*BGVN* 33:04).

During 19-23 April 2009 Slamet's seismicity increased. On 20 April, diffuse white plumes rose ~ 50 m above the crater. During 21-23 April, the number of eruption tremors increased steadily, and dense, white-to-brownish plumes rose 50-800 m above the crater rim. The Alert Level was raised to 2 (on a scale of 1-4).

On 23 April, the Alert Level was raised to 3; people were advised not to climb the summit. According to a news article in the *Jakarta Globe*, a volcanologist from the Center of Volcanology and Geological Hazard Mitigation (CVGHM) stated that lava was ejected 600 m high and ash bursts occurred up to 112 times within a 6-hour period.

According to CVGHM, seismicity continued to increase or remain elevated during 23 April-17 May, peaking on 17 May. During this period, continuous eruptive quakes/tremors were recorded, together with an increase in amplitude (3-46 mm on 12-13 May, rising to about 20-32 mm between 17-24 May). Eruptions from the western part of the crater continued, and inflation was noted. During times of clear weather, observers reported that incandescent lava was ejected 25-100 m above the crater, and then fell back into and around the active crater. Gray and white "smoke" rose 100-800 m from the crater. Occasionally a thunderous noise accompanying eruptions of ash occurred, and ashfall was detected in areas 5-9 km away. The temperature of water in several locations on the flanks increased.

During 12 May and 21-23 May, lava fountains rose 100-400 m above the crater rim. During several eruptions, ejected incandescent material traveled down the W flank. White-to-gray "smoke" rose 150 m above the crater. On 22 May, ashfall was reported in Sawangan village, 5 km W. On 23 May, an ash plume rose 1 km above the crater and ash fell on the N flank. Ash accumulated to 1 mm depth near the observation post. The next day an ash plume rose 700 m above the crater.

Based on ground information from CVGHM, the Darwin Volcanic Ash Advisory Centre (VAAC) reported that on 27 May an ash plume from Slamet rose to an altitude of 4.3 km. Analysis of satellite imagery also indicated that a possible plume rose to an altitude of 6.1 km, but ash was not conclusively detected.

CVGHM reported that during 26 May-4 June activity from Slamet fluctuated, but decreased overall. They found decreases in both the number of earthquakes and the temperature of water in areas around the volcano. Inflation and deflation fluctuated within a range of 2 cm. White plumes rose 100-750. During 5-7 June, activity was characterized by inflation and an increased number of earthquakes. During that time, white plumes were accompanied by ash emissions that rose 200-800 m from the crater, incandescent material was ejected 50-200 m above the crater, and booming noises were reported.

As of 4 June 2009, the Alert Level remained at 3, based on visual data, deformation, earthquakes, and tremor. CVGHM urged the public to don face masks during heavy ashfalls, and to cover water sources to prevent contamination by volcanic ash.

Geologic Summary. Slamet, Java's second highest volcano at 3,428 m and one of its most active, has a cluster of about three dozen cinder cones on its lower SE-NE flanks and a single cinder cone on the western flank. Slamet is composed of two overlapping edifices, an older basaltic-andesite to andesitic volcano on the west and a younger basaltic to basaltic-andesite one on the east. Gunung Malang II cinder cone on the upper eastern flank on the younger edifice fed a lava flow that extends 6 km to the east. Four craters occur at the summit of Gunung Slamet, with activity migrating to the SW over time. Historical eruptions, recorded since the 18th century, have originated from a 150-m-deep, 450-m-wide, steep-walled crater at the western part of the summit and have consisted of explosive eruptions generally lasting a few days to a few weeks.

Information Contacts: *Center of Volcanology and Geological Hazard Mitigation* (CVGHM), Jalan Diponegoro 57, Bandung 40122, Indonesia (URL: http://portal.vsi.esdm.go.id/joomla/); *Darwin Volcanic Ash Advisory Centre (VAAC)*, Bureau of Meteorology, Northern Territory Regional Office, PO Box 40050, Casuarina, NT 0811, Australia (URL: http://www.bom.gov.au/info/vaac/); *Jakarta Globe* (URL: http://www.thejakartaglobe.com).

Krakatau

Indonesia
6.102°S, 105.423°E; summit elev. 813 m
All times are local (= UTC + 7 hours)

Renewed eruptive activity from Anak Krakatau began in October 2007 (*BGVN* 32:09), with minor eruptions through that November (*BGVN* 33:01). This small but growing post-caldera cone first gained attention with a 1927 eruption (Simkin and Fiske, 1983). During October-November 2007 several eruptions were Vulcanian in nature (*BGVN* 33:01). The detailed chronology of behavior during October 2007 to 3 July 2009 is sometimes sketchy, but activity was apparently quite variable. Although one or more lulls may have occurred, eruptions clearly continued into 2009.

Many of these eruptions were minor, but some were large enough to cause the Center of Volcanology and Geological Hazard Mitigation (CVGHM) to raise the Alert Level to 3 (on a scale with 4 as the highest). The Alert Level was lowered and raised again throughout 2008 and into 2009 as activity warranted. People were advised not to go within 1.5 km of the summit.

During April 2009 some residents in neighboring Sumatra allegedly evacuated when they saw more intense activity (including plumes up to ~ 1 km above the crater). Some of the taller plumes during the reporting interval rose to ~ 3 km.

Activity through August 2008. According to a news article, by 22 November 2007, seismicity had declined in frequency. Based on an Antara News article, this decline in seismic activity was interrupted by incandescent rock ejections on 20 January 2008 accompanied by plumes that rose to altitudes of 2.8-3.3 km. Eruptions reportedly had a "deafening sound" and could be seen from Sertung and Rakata islands. Seismicity again declined in early February 2008, and eruption plumes and ejected incandescent material were not seen during 4 February to mid-April 2008.

Seismicity increased during 14-21 April 2008, with the number of events per day peaking on 20 April. Ash plumes accompanied by ejected incandescent rocks were noted during CVGHM field observations on 16, 17, and 18 April. The eruption affected the summit and the E and S flanks. Booming noises were reported and occasionally heard at an observation post 42 km away.

Based on observations of satellite imagery and pilot reports, the Darwin Volcanic Ash Advisory Center (VAAC) reported that a low-level ash plume on 20 June 2008 rose to an altitude of 3 km and drifted NW.

During 22 June-1 July 2008, the number of seismic events decreased significantly and booming noises were less frequently heard. On 1-3 July ash emissions declined, although on 1 and 2 July low level ash plumes rose to an altitude less than 3 km and drifted NW.

Based on observations of satellite imagery, the Darwin VAAC reported that ash plumes from Anak Krakatau rose to an altitude of 3 km on 27 July 2008 and drifted NW.

According to an article in Antara News, eruptions increased in frequency during 10-11 August 2008. On 12 August, monitoring personnel reported that active lava flows and dense emissions of "smoke" continued, but that the frequency of earthquakes and eruptions had declined. Another news article indicated that explosions and earthquakes averaged ~ 120 per day during 11-17 August 2008. Monitoring personnel during that period observed plumes, active lava flows, and rock ejections.

Activity during March-May 2009. No additional reports by CVGHM were available during September 2008 through February 2009. Alerts based on thermal anomalies (see MODVOLC section, below) were not present during 31 August 2008 to 30 March 2009.

Seismicity increased significantly during 19-25 March 2009 and remained high through 5 May. During periods of clear weather on 25 March, white-to-gray plumes rose 400 m above the volcano. During 27-30 March and 1 April 2009 clear weather revealed ash plumes rising 200-800 m. On 2 April an ash eruption was seen on satellite imagery and reported by a pilot. A resultant ash plume drifted more than 60 km S.

During March through 25 April 2009, an episode of heightened seismicity produced thousands of eruptive signals (table 2); however, the seismic station shut down overnight during 1-26 April, and completely shut down during 27-29 April. CVGHM believed that this shutdown was the result of either blockage of sunlight from reaching the solar panels by tephra collecting there or because of impact-induced damage to the panels. On 29 April CVGHM installed a seismometer on Anak Krakatau at a location thought to be reasonably safe.

During April 2009 observers reported grayish-white to black plumes that rose to 50-1,000 m above the crater. They heard many loud booms. CVGHM observations carried out

Date (2009)	Eruptive	Air-blast	Deep volcanic	Shallow volcanic	Tremor	Harmonic tremor
27-30 Mar	175	102	3	68	—	—
31 Mar	152	72	5	32	—	—
01-24 Apr [1]	168	109	12	62	—	—
25-26 Apr [1]	116	—	2	51	—	—
27-29 Apr	No data	No data	No data	No data	No data	No data
30 Apr [2]	229	142	—	12	44	1
01 May	324	248	—	98	80	4
02 May	318	270	—	131	126	24
03 May	250	273	—	71	114	23
04 May	403	230	—	36	183	38
05 May	371	339	—	58	127	41
06 May [3]	132	127	—	44	82	23

Table 2. Type and number of earthquakes and tremor recorded at Krakatau during 27 March-6 May 2009. Values shown are daily averages unless otherwise indicated by footnotes below. [1]Average during12 hour period (daylight). [2] Starting at 0830 local time from a new, safer location. [3] During 0000 to 1200 local time. Courtesy of CVGHM.

on 24-25 and 29 April found the eruption venting from a crater near the volcano's peak on its SW slope. Eruptions generally sent incandescent blocks and ash ~ 500 m from the center in all directions. Some of the lofted ash blew E to SE and caused fallout up to 5 km away.

According to a news article on 29 April 2009, some residents in southern Sumatra near Krakatau evacuated because they had observed increased volcanism during the previous week. For example, observers reported loud blasts, lava flows, and ash plumes. In clear weather on 5 May "smoke" rose 500 m above the crater.

An Antara News article published on 18 June 2009 indicated that in the previous several days the number of small eruptions increased tremendously. It said that, according to Anto Prambudi, head of the monitoring post in Pasauran village, at least 828 small eruptions were recorded during 11-17 June 2009.

MODVOLC. MODVOLC thermal alerts were triggered through 9 December 2007 (*BGVN* 33:01). In later 2007, comparatively few alerts occurred, but became more prevalent again during mid-January 2008. After that, they were few or absent until mid-April; alerts were common and strong during the week ending 4 May. Consistent alerts were the pattern until the week ending 7 June, which had no alerts, but some continued in the next few weeks.

A seven-month gap in MODVOLC thermal alerts occurred during the interval 31 August 2008 to 30 March 2009. After that, alerts again became common again, particularly abundant during April 2009 (an episode of eruptions and heightened seismicity) and continued regularly through at least 3 July 2008.

The gap in alerts may have been influenced by downward biasing from poor weather conditions. On the other hand, for the cases with high numbers of alerts, false positives (due to fires for example) were unlikely on the desolate landscape of Anak Krakatau.

Reference: Simkin, T., and Fiske, R.S., 1983, Krakatau 1883–the volcanic eruption and its effects: Smithsonian Institution Press, Washington, DC, 464 p. [ISBN 0-87474-841-0]

Geologic Summary.The renowned volcano Krakatau (frequently misstated as Krakatoa) lies in the Sunda Strait between Java and Sumatra. Collapse of the ancestral Krakatau edifice, perhaps in 416 AD, formed a 7-km-wide caldera. Remnants of this ancestral volcano are preserved in Verlaten and Lang Islands; subsequently Rakata, Danan and Perbuwatan volcanoes were formed, coalescing to create the pre-1883 Krakatau Island. Caldera collapse during the catastrophic 1883 eruption destroyed Danan and Perbuwatan volcanoes, and left only a remnant of Rakata volcano. This eruption, the 2nd largest in Indonesia during historical time, caused more than 36,000 fatalities, most as a result of devastating tsunamis that swept the adjacent coastlines of Sumatra and Java. Pyroclastic surges traveled 40 km across the Sunda Strait and reached the Sumatra coast. After a quiescence of less than a half century, the post-collapse cone of Anak Krakatau (Child of Krakatau) was constructed within the 1883 caldera at a point between the former cones of Danan and Perbuwatan. Anak Krakatau has been the site of frequent eruptions since 1927.

Information Contacts: *Center of Volcanology and Geological Hazard Mitigation* (CVGHM), Jalan Diponegoro 57, Bandung 40122, Indonesia (URL: http://portal.vsi.esdm.go.id/joomla/); *Darwin Volcanic Ash Advisory Centre* (VAAC), Bureau of Meteorology, Northern Territory Regional Office, PO Box 40050, Casuarina, NT 0811, Australia (URL: http://www.bom.gov.au/info/vaac/); *Antara News* (URL: http://www.antara.co.id/en/); *Jakarta Post* (URL: http://www.thejakartapost.com/).

Telica

Nicaragua
12.602°N, 86.845°W; summit elev. 1,061 m
All times are local (= UTC - 6 hours)

Explosions occurred at Telica during January and through February 2000, after which the activity began to gradually decline (BGVN 25:03 and 25:09). Intermittent ash explosions and crater incandescence were seen through 2002, along with high levels of seismicity related to degassing and constant low tremor. The Geophysics Department of the Nicaraguan Territorial Studies Institute (INETER) monitors activity; visits to the crater described below are by INETER staff unless otherwise noted. Many observations were also made by a local resident who maintains the local seismic station.

Activity during 2000. Tremor remained constant during April-June 2000, with no ash emissions. Visiting geologists reported incandescence in the crater on 5 July 2000. INETER workers who reached the crater on 14 July heard a noise like an airplane turbine coming from the crater and saw glow. They also noted that there had been a widening of the crater due to wall collapses, and an increase in its depth, although the crater floor could not bee seen. On 8 August a crater visit revealed strong fumarolic activity, and sounds resembling gun detonations from the bottom of a new opening.

Residents living near the crater reported on 6 September that ash explosions occurred during the evening and plumes drifted NE. Unfortunately INETER technicians found no traces of ash on 12 September, following rainfall. Small landslides inside the crater were observed. A characteristic strong smell of sulfur was detected in the crater area. Due to the change in wind direction that occurs during September and October, gases and acid rain affected areas to the N, NE, and E. Intense rainfall caused a mudflow down a W-flank drainage.

In the visit on 27 October there was no exhalation of gases, but landslides along the south wall sent material onto the crater floor. Crater visits on 5 and 22 November showed abundant gas output. Jet-like sounds came from fumaroles on the NE wall. Gas emissions were low during December. There were minor landslides in the crater, heard in the last days of November and beginning of December.

Activity during 2001. On the afternoon of 17 January 2001 there were rumbles and a plume of ash and gases 200 m high. On 19 January a visit to the crater found ashfall, to a depth of 1 mm, deposited within a radius of 500 m. The vicinity of the seismic station and SW from the crater had been affected by acid rain. On 22 January visiting scientists observed another small explosion. Activity was low during field visits on 20 and 26 February.

A visit on 3 and 16 March found variable levels of gas emissions. Incandescence was observed within the new crater early on 21 March along with increased output gases. Shortly thereafter a loud explosion was heard, followed by a dark plume about 30 m high and increased glow, but no ashfall. Activity remained low in April.

INETER staff visited the volcano on 6 June and heard a strong jet-like sound, but fumarolic emissions were not abundant. Another visit on the night of 26 June revealed incandescence and landslides inside the crater. Visits to the volcano were made on 13, 16, and 25 July, but no volcanic activity was noted. On 15 July the Civil Defense in Leon informed INETER of sporadic gray ash columns that began the previous day. A local resident reported hearing an explosion at 0315 on 14 July, and saw five emissions of gas-and-ash later that day. This activity lasted until 15 July.

A visit on 15 September revealed little gas emission from the crater, but explosion noises were heard. On 25 October Civil Defense Leon was informed by several farmers that between approximately 0600 and 1000 local time they had observed a column of ash that drifted NW. INETER staff working in the area that day observed strong ash accompanied by expulsion of gas. Rumbling noises and explosions continued until 1430. On 22 November a visitor observed no change in the volcano. Minor ashfall was reported on the morning of 18 December, and the next day explosions were heard coming from the crater.

Activity during 2002. On 17 January 2002 visitors observed strong gas fumes. Observations on 7 March indicated that the crater was wider and deeper than in February. On a 10 July visit there were abundant gas emissions from the crater, a strong smell of sulfur, jet sounds, and noises of breaking rocks. Gas emissions were abundant on 23 August, with columns up to 300 m high, but no landslides, noises, sulfur odor, or incandescence was noted. Rockslides on the N wall of the crater and sulfur odors, along with typical fumarolic activity, were seen during September.

Visitors on 17 October reported abundant gas emissions and strong sulfur odors; noises similar to the movement of waves came from the crater bottom, and some incandescent points were seen. From 7 to 11 October large quantities of gases blew SE, damaging vegetation. Landslides were observed SW of the old crater. Fumarole temperatures were the highest recorded since 1999. Incandescence inside the crater was also observed over several days. Webcam observations in November and December showed intermittent small gas emissions.

Geologic Summary. Telica, one of Nicaragua's most active volcanoes, has erupted frequently since the beginning of the Spanish era. The Telica volcano group consists of several interlocking cones and vents with a general NW alignment. Sixteenth-century eruptions were reported at symmetrical Santa Clara volcano at the SW end of the Telica group. However, its eroded and breached crater has been covered by forests throughout historical time, and these eruptions may have originated from Telica, whose upper slopes in contrast are unvegetated. The steep-sided cone of 1,061-m-high Telica is truncated by a 700-m-wide double crater; the southern crater, the source of recent eruptions, is 120 m deep. El Liston, immediately SE of Telica, has several nested craters. The fumaroles and boiling mudpots of Hervideros de San Jacinto, SE of Telica, form a prominent geothermal area frequented by tourists, and geothermal exploration has occurred nearby.

Information Contacts: *Dirección General de Geofísica*, Instituto Nicaragüense de Estudios Territoriales (INETER), Apartado Postal 2110, Managua, Nicaragua (URL: http://www.ineter.gob.ni/geofisica/geofisica.html).

Unnamed

East Gakkel Ridge, Arctic Ocean
85.58°N, 85.00°E; summit elev. -3,800 m
All times are local (= UTC + 6 hours)

A sonar survey in 2001 along the ultraslow-spreading Gakkel Ridge (formerly known as the Nansen Cordillera and Arctic Mid-Ocean Ridge) by the *USS Hawkbill* submarine and the U.S. Coast Guard icebreaker *Healy* revealed two previously undiscovered volcanoes beneath the pack ice of the Arctic Ocean (*BGVN* 26:03). In July 2007, a research team led by Woods Hole Oceanographic Institution (WHOI) uncovered evidence of explosive volcanic eruptions in the same area of the seafloor.

At a depth of ~ 4 km, researchers found fresh, unweathered, jagged, glassy fragments of rock (pyroclastic deposits) spread out over an area of ~ 10 km^2 around a series of small volcanic craters on the Gakkel Ridge (figure 6). According to WHOI geophysicist Rob Reves-Sohn, chief scientist of the expedition, as quoted in the 14 August 2008 issue of *Oceanus*, “These are the first pyroclastic deposits we’ve ever found in such deep water, at oppressive pressures that inhibit the formation of steam, and many people thought this was not possible. This means that a tremendous blast of carbon dioxide was released into the water column during the explosive eruption.” Although no speculation was made by the scientists as to the age of the eruption(s) that caused these pyroclastics, the fresh nature of these surficial materials argue to their recency.

According to Cochran (2008), the Gakkel Ridge is the slowest spreading portion of the global system of mid-ocean ridges. Total spreading rates vary from 12.8 mm/yr near Greenland to 6.5 mm/yr at the Siberian margin.

A recent article by Sohn and others (2008) concerning the July 2007 expedition noted that roughly 60% of the Earth's outer surface is composed of oceanic crust formed by volcanic processes at mid-ocean ridges. Although only a small fraction of this vast volcanic terrain has been visually surveyed or sampled, the available evidence suggests that explosive eruptions are rare on mid-ocean ridges, particularly at depths below the critical point for seawater (a depth of ~ 3,000 m). A pyroclastic deposit has never been observed on the sea floor below 3,000 m, presumably because the volatile content of mid-ocean-ridge basalts is generally too low to produce the gas fractions required for fragmenting a magma at such high hydrostatic pressure. Liu and others (2008) reported on recent analyses of many major and trace element collected from Gakkel Ridge.

The July 2007 expedition acquired photographs and video images of 'zero-age' volcanic terrain along the ridge and beneath the ice-cover ocean's surface. The axial valley at 4,000 m water depth was blanketed with unconsolidated pyroclastic deposits. Those included bubble-wall fragments (limu o Pele, also know as Pele's seaweed–fragments of large glass bubbles that shatter into pieces of curved, paper-thin, bubble walls), covering a large (greater than 10 km^2) area (figure 7). At least 13.5 weight percent CO_2 is necessary to fragment magma at these depths, which is about tenfold above the highest values previously measured in a mid-ocean-ridge basalt.

Sohn and others (2008) note that these observations raise important questions about the accumulation and discharge of magmatic volatiles at ultraslow spreading rates on the Gakkel ridge. They also demonstrate that large-scale pyroclastic activity is possible along even the deepest portions of the global mid-ocean ridge volcanic system.

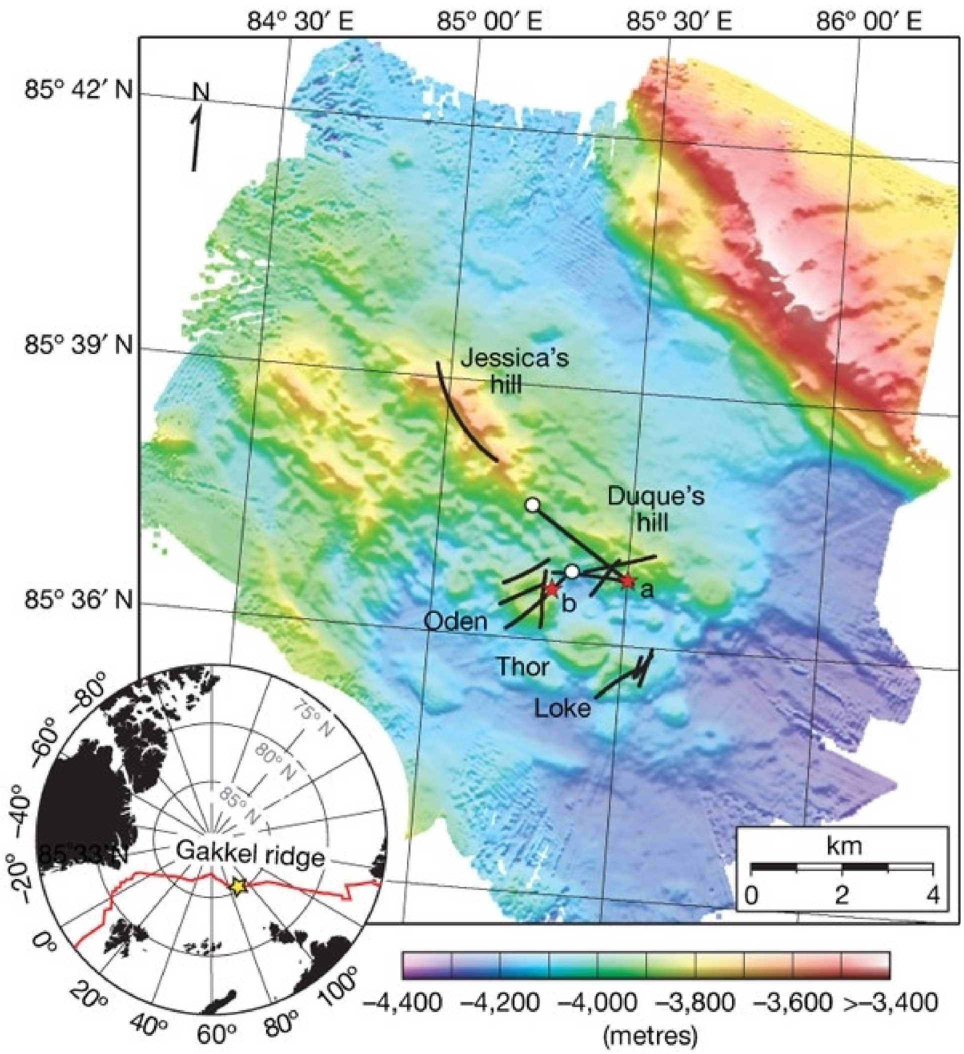

Figure 6. Detailed bathymetry (30-m grid spacing) of the Gakkel Ridge at 85ºE in the Arctic Ocean based on July 2007 WHOI research cruise. The inset map shows the location of the 85°E segment (yellow star) along the Gakkel ridge (red line) in the Arctic basin. The main panel shows illuminated, color bathymetry of the 85º E segment acquired during the Arctic Gakkel Vents (AGAVE) expedition. The axial valley contains large numbers of distinctive, cratered volcanoes, including a cone on a fault terrace of the northern valley wall. Photographic bottom surveys were conducted along profiles shown as thin black lines on the map. Pyroclastic deposit samples were collected at sites shown by white circles, and the photographs shown in figure 7 were taken at the sites shown by the lettered (red) stars. Named features include two volcanic ridges in the center of the axial valley (Jessica's hill and Duque's hill), and three cratered volcanoes along a ridge-parallel fissure to the S (Oden, Thor, and Loke). Courtesy of Sohn and others (2008).

References: Sohn, R.A., Willis, C., Humphris, S., Shank, T.M. , Singh, H., Edmonds, H.N., Kunz, C., Hedman, U., Helmke, E., Jakuba, M., Liljebladh, B., Linder, J., Murphy, C., Nakamura, K., Sato, T., Schlindwein, V., Stranne, C., Tausenfreund, M., Upchurch, L., Winsor, P., Jakobsson., M., and Soule, A., 2008, Explosive volcanism on the ultraslow-spreading Gakkel ridge, Arctic Ocean: Nature, v. 453, p. 1236-1238 (doi:10.1038/nature07075).

Cochran, J.R., 2008, Seamount volcanism along the Gakkel Ridge, Arctic Ocean, *Geophysical Journal International*, v. 174, no. 3, p. 1153-1173.

Liu,C-Z, Snow, J.E., Hellebrand, E., Brügmann, G., von der Handt, A., Büchl, A., and Hofmann, A.W., 2008, Ancient, highly heterogeneous mantle beneath Gakkel ridge, Arctic Ocean: Nature, v. 452, p. 311-316 (doi:10.1038/nature06688).

Carlowicz, M., 2008, Deeply submerged volcanoes blow their tops: Telltale rocks reveal evidence of a phenomenon scientists thought was impossible: Oceanus, 14 August 2008.

Geologic Summary. Two young volcanoes were discovered along the eastern part of the slow-spreading Gakkel Ridge during a bathymetric survey from a submarine in 1999. The westernmost volcano showed evidence of highly reflective, sediment-free surfaces and young faults overprinted by lava flows. During January-September 1999 global seismic networks detected an earthquake swarm corresponding to the approximate location of this volcano. The correlation between the locations of the earthquake epicenter locations and the strongly reflective, untectonized western volcano together with the volcanic character of the seismic record provided evidence that lava erupted on the East Gakkel Ridge within days to months prior to a May 1999 submarine survey (Edwards et al., 2001). Because 12-kHz sonars can penetrate through thin sediments covering acoustically reflective lavas, it is possible that no eruption occurred on Gakkel Ridge in 1999. Historical global seismic records indicate that this was the only earthquake swarm detected on the Gakkel Ridge in about 100 years.

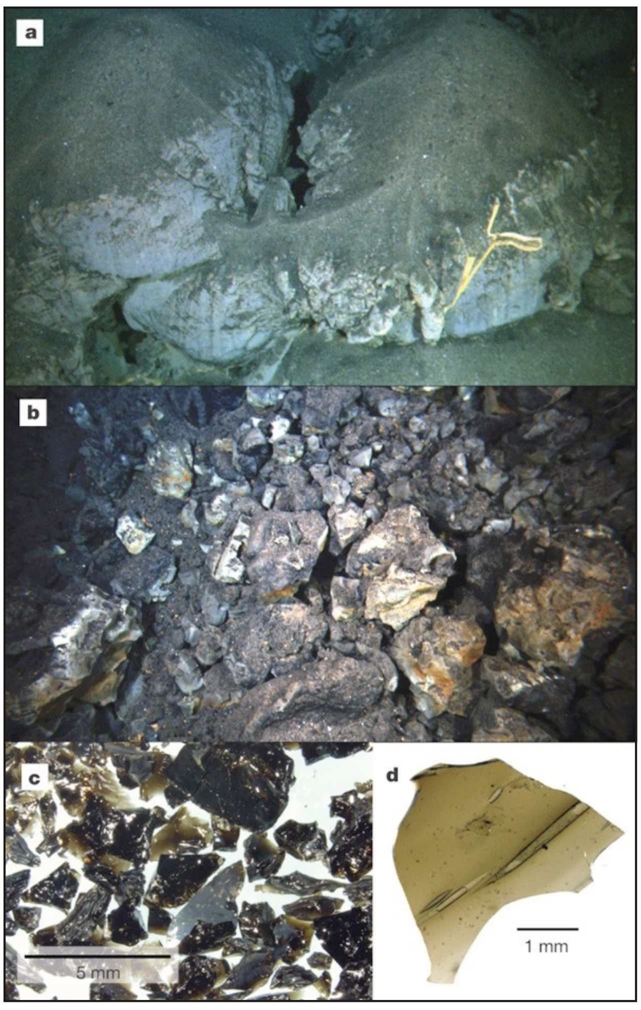

Figure 7. Photographs of pyroclastic deposits taken during July 2007 WHOI research cruise. (a) One frame from a high-definition video camera taken on the S side of Duque's hill (see figure 6 for location). About 10 cm (visually estimated and confirmed during sampling) of pyroclastic material is piled atop a high-standing, weathered, pillow feature. The exoskeleton of an as yet unidentified species of *hexactinellid* sponge (glass sponge, or a sponge with a skeleton made of 4- and/or 6-pointed siliceous spicules) is visible in the foreground. (b) High-definition video frame grab of talus blocks possibly representing ejecta from a vulcanian explosion on Oden volcano (see figure 6 for location). (c) Glassy, granular, pyroclastic material. (d) Bubble wall fragment from pyroclastic deposit. Courtesy of Sohn and others (2008).

Information Contacts: *Oceanus: The Online Magazine of Research from Woods Hole Oceanographic Institution* (URL: http://www.whoi.edu/oceanus/).

Ol Doinyo Lengai

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

This report chiefly discusses observations made at Ol Doinyo Lengai (hereafter called Lengai) in the first half of 2009. Broadly speaking, the active N crater continued to be the scene of venting. More specifically, the cone that covers much of what was the N crater contained a steep-sided crater with a tight cluster of active hornitos and spatter cones on its floor. Conditions during 2009 visits were generally calm, although minor eruptions on the crater floor continued. This is in contrast to explosive eruptions during September 2007-March 2008 (*BGVN* 32:11, 33:02, 33:06, 33:08, 34:02).

In the late stages of preparing this issue we received a report from Tobias Fischer stating that when he and his team visited on 11-12 June 2009, one side of the crater contained a convecting lava lake. That report will appear in our next issue.

Most of the groups that arrived at Lengai in 2009 did not ascend to the active crater and the SE route remained difficult. Gas samples collected here in 2005 were published and interpreted in Fischer and others (2009). The next subsection confirms original interpretations of a 2007 satellite image.

September 2007 ASTER image. David Sherrod was among USGS visitors during January 2009, working with local government officials and studying tephra deposits from explosive eruptions during September 2007-March 2008 that were distributed well out from the volcano (*BGVN* 34:02). When commenting about the cause of the large lobate black areas on Lengai's NW, W, and E sides seen in ASTER imagery from 4 September 2007 (*BGVN* 32:11) he noted, "the lava flows of late 2007-early 2008 are far more restricted than the blackened areas visible on the photos."

This is in agreement with the statement by Roger Mitchel in the original discussion (and the original figure caption). Sherrod also said, "I'm fairly certain [the dark lobes] are burn areas. The fires can be natural, but they are also set by herdsman to improve access and grass quality. The dark areas show on many past images, including those from times in the absence of eruptions. They commonly have well-defined margins and thorough coverage within. Lava flows have well defined margins but more erratic coverage within the bounds, creating digitate lobes."

Comments on aviation hazards during 2007-2008. Comparatively few pictures or comments on aviation hazards have emerged from the recent episode of Plinian eruptions during 2007-2008. Ben Wilhelmi took a series of photos of the ground surface at distance from the volcano during a week in November 2007. From the air he saw ash as far away as 70 km from the volcano, including in many cases, over Masai villages that dot the landscape.

Wilhelmi's discussion and photos follows. "[During] 2007 and 2008 ... smoke and ashes sometimes [rose] up to 50,000 ft, 15 km high. It looked like a Hiroshima mushroom [cloud (figure 8)]. Here is ash deposit on my aircraft [(figure 9)]. Often the ash was invisible in the air though. [Three] turbine engines died in different companies because of ash intakes. It happened one of these engines [died] on me. Luckily I could finish the flight, but I didn't like the feeling to see the engine temperature in the red and [flying] on reduced power.

"In other countries, such an activity [as seen in figure 8] would have imposed the area to be closed within 200 miles [~ 320 km], that would have included Arusha and all the Serengeti [and] Ngorongoro [park and conservation areas]. "Competent" authorities were asleep, the regional companies happily kept on flying ... and subsequently lost 3 engines as I've said earlier. Costs could go up to $350,000 for a new turbine engine ... I certainly didn't complain as I could shoot [photos at will and] got to see incredible spectacles like this day with a 55,000 ft or 17 km high plume of smoke with an electric thunderstorm inside!"

February 2009 visit. Anatoly Zaitsev and Gregor Markl reported that in mid-February 2009 a group from St. Petersburg, Russia (A.N. Zaitsev, S.V. Petrov, T.A. Golovina, and E.O. Zaitseva) and Tuebingen, Germany (G. Markl and T. Wenzel) climbed the volcano. There were no ash or gas emissions during the visit, although on the crater floor lava bubbled and spattered.

The group reached the summit around 0830 on 18 February after ~ 4.5 hours of climbing. They ascended along the traditional W route (an approach enabling rapid access but potentially exposing climbers to eruptive debris). They stayed on the summit and in the N crater for ~ 5 hours. On the large cone in the N crater they walked around the active crater's rim on the W, S, and E sides (figure 10). They crossed the depression between the two rims on the S side of the cone, the outer rim belonging to an earlier stage of development, the inner rim lying along the margin of the current crater. In that depression they found meter-sized blocks (figure 11).

Three hornitos (spatter cones) were observed deep in the crater floor. One, with a broken upper part, was active throughout the visit. Inside that hornito they saw bubbling lava, and several times black spatter was ejected.

The surface of the cone around the deep pit crater's rim consisted of gray fine-grained ash with rare blocks of ejected silicate rocks. Later analysis of a sample taken from the surface of the cone using X-ray diffraction indicated significant amounts of calcite in addition to silicate minerals. The depression between the rims of a new and old craters was covered by numerous blocks and bombs of silicate rocks (nephelinites, wollastonite nephelinites, and ijolites) and partly altered natrocarbonatites.

Fumarolic activity in the northern crater was weak. The group observed just a few small cracks emitting gases that were relatively cold–probably less than 100°C.

Figure 8. A tall (roughly 15-17 km altitude) Ol Doinyo Lengai plume from the 2007-2008 eruptive interval taken at unstated date and directional bearing. Short burst of lightning were visible in the plume but were not captured in this photo. Courtesy of Ben Wilhelmi.

Figure 9. Two photos of Ol Doinyo Lengai ash deposits on leading surfaces of a small propeller-driven airplane from encounter with ash while in flight. Photographer and pilot Ben Wilhelmi commented that the ash was often invisible during the encounter.

Figure 10. Ol Doinyo Lengai's active crater as seen looking W along the rim. The crater resides in the cone that grew in the N crater in the past few years. Photo taken 18 February 2008. Courtesy of Sergey Petrov.

Figure 11. Large blocks found in the depression along the S upland portion of the active cone in Ol Doinyo Lengai's N crater. Note field gear for scale (right foreground). Photo courtesy of Tamara Golovina.

Summary of 2009 visits. Table 3 shows a list of observers known to have visited or flown over Lengai since 2009 began. Available photos and text indicate that on the crater floor, hornitos continued to spatter lava. Otherwise, relative calm was seen, typically even devoid of steam, during much of the interval 1 October 2008 through 25 April 2009.

Regarding his March visit to the summit, Stefan Lübben reported that amid wet and windy weather they could smell sulfur. But they heard nothing from the volcano.

On 7 April 2009 Alexander Daneel photographed the summit crater from the air (figure 12). Some of the same small lava cones inside the crater were seen to be active by Hervé Loubieres and Françoise Vignes on 1 September 2008. An aerial view on 25 April showed numerous hornitos that had formed in the previous 4-5 months (figure 13).

Gas chemistry. Based on chemical analyses of gas samples collected by Bernard Marty in July 2005 (*BGVN* 30:10) (figure 14), Fischer and others (2009) reported that a very small amount of melting of Earth's mantle, akin to that beneath mid-ocean ridges, can produce carbonatites. Their gas samples, containing minimal air contamination, revealed that the carbon dioxide came from the upper mantle below the East African Rift.

Fischer and others (2009) state, "On a global scale, our results imply that the regions of upper mantle beneath mid-ocean ridges, continental North America, and the East African Rift were identical in their volatile abundances and isotopic compositions. Despite small differences in some trace gases (for example Xe isotopes in MORBs–mid-ocean ridge basalts–versus [gases from continental wells]), the upper mantle appears to be a uniform and homogenous geochemical reservoir of CO_2 and other gases (N_2, He, and Ar) below both continent[s] and oceans."

Reference: Fischer, T.P., Burnard, P., Marty, B., Hilton, D.R., Füri, E., Palhol, F., Sharp, Z.D., and Mangasini, F., 2009, Upper-mantle volatile chemistry at Oldoinyo Lengai volcano and the origin of carbonatites, Nature, v. 459, p. 77-80 (doi:10.1038/nature07977).

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

Dates	Observer(s)	Brief observation(s) (CV=climbed volcano; F=flank observations; A=aerial observations/photos from crater overflight)
18-22 Jan 2009	Representatives from the U.S. Geological Survey, U.S. Agency for International Development, Geological Survey of Tanzania, and Tanzania Prime Minister's Office.	(F) See *BGVN* 34:02
18 Feb 2009	A.N. Zaitsev, S.V. Petrov, T.A. Golovina, E.O. Zaitseva, G. Markl, and T. Wenzel	(CV) See text above
14 Mar 2009	Stefan Lübben	(CV) Climbed through the Pearly Gates without difficulty. At summit, they smelled sulfur but heard nothing from the volcano.
07 Apr 2009	Alexander Daneel	(A, figure 12) Photos indicate small cones on the crater floor in similar spots to those seen active by H. Loubieres and F. Vignes on 1 September 2008 (BGVN 33:08). This lack of change suggests only minor volcanism from the crater during 1 September 2008 to 7 April 2009.
25 Apr 2009	Ben Wilhelmi	(A, figure 13) Photos showing numerous hornitos with spatter widespread on the crater floor and in places on the crater walls.

Table 3. Summary of selected observations describing Ol Doinyo Lengai during January-April 2009. Courtesy of Ben Wilhelmi and Frederick Belton.

Figure 12. Aerial view on 7 April 2009 looking SW across the Ol Doinyo Lengai crater. On the rim's E side there is a small slump (at left). Courtesy of Alexander Daneel.

Figure 13. Aerial photo of Ol Doinyo Lengai's crater floor taken on 25 April 2009 with uncertain orientation with respect to N. The floor contains numerous hornitos. According to the pilot and photographer, Ben Wilhelmi, who often flies over for observations, these features probably formed during the previous 4-5 months. Courtesy of Ben Wilhelmi.

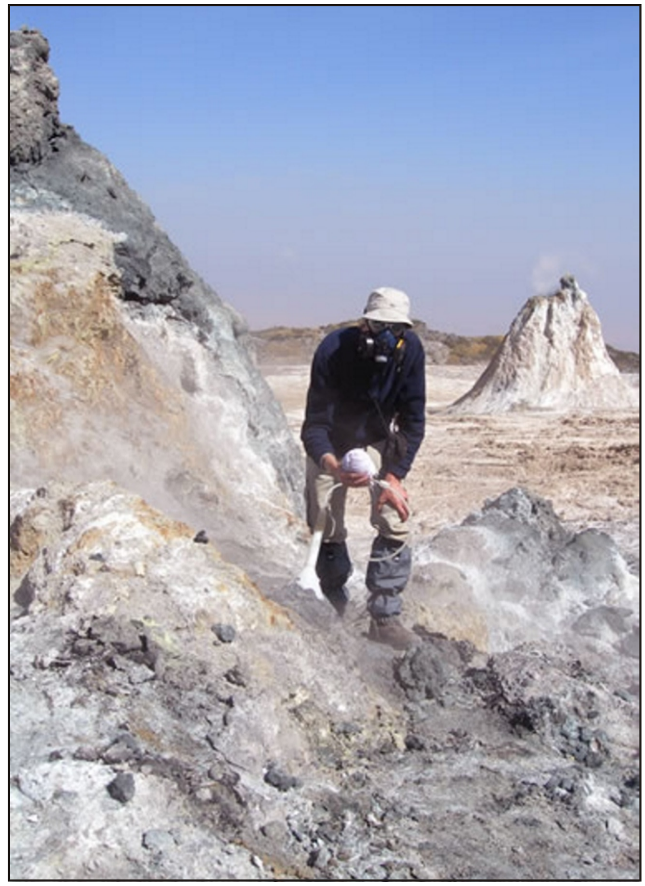

Figure 14. Collecting volcanic gas samples at Ol Doinyo Lengai's active crater in 2005 (Fisher, 2009). Courtesy of Tobias Fischer, University of New Mexico.

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.

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