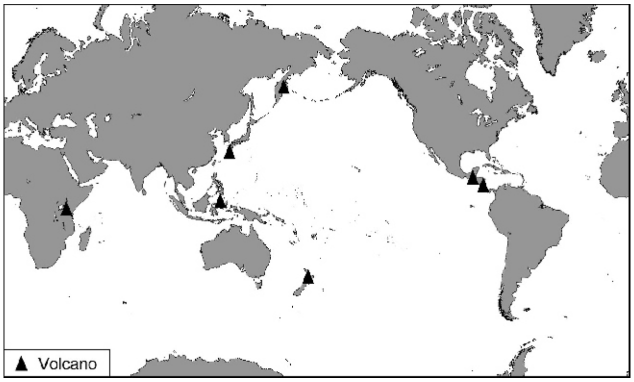
Bulletin of the Global Volcanism Network



Volume 32, Number 11, November 2007

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

Bezymianny

Kamchatka Peninsula, Russia
55.978°N, 160.587°E; summit elev. 2,882 m
All times are local (= UTC + 12 hours)

As reported in *BGVN* 31:11, after a period of moderate volcanic activity following the extensive eruption of 9 May 2006, heightened activity occurred at Bezymianny during December 2006 before returning to moderate activity through early 2007. This report covers the period from May through December 2007. It was drawn mainly from reports of the Kamchatkan Volcanic Eruption Response Team (KVERT).

Based on satellite data from 10 May 2006, KVERT reported that a large thermal anomaly with a temperature of ~ 51° C appeared over Bezymianny's summit lava dome.

At about 0330-0400 on 12 May, an explosive eruption may have occurred, according to seismic data from Kozyrevsk. Ash plumes rose to an altitude of 4 km and were visible on satellite imagery drifting in multiple directions. Ashfall was reported in the town of Klyuchi, a spot ~ 47 km NE of the volcano. On 13 May, an elongated thermal anomaly was seen on satellite imagery to the SE of the dome, which decreased in size through 17 May. That day, hunters saw a large (200 m wide) mudflow along the Sukhaya Khapitsa river.

KVERT reported that Bezymianny seismicity was at background during May-September 2006, but increased in early October. Satellite imagery observations showed a thermal anomaly in the crater on 4, 6, 8, and 11 October; fumarolic activity was observed during 6-7 and 10-11 October. Based on seismic interpretation, a hot avalanche probably occurred on 10 October and small eruptions also occurred on 14 October.

The Tokyo Volcanic Ash Advisory Center (VAAC) reported ash plumes to altitudes of ~ 10 km on 14 October. Those of 15 October reached 7.3-9.1 km altitude and drifted E and SE. A strong thermal anomaly was present in the crater around this time. Slightly elevated seismicity occurred during 16-19 October before returning to background during19-20 October. Based on observations of NOAA satellite images by the Tokyo VAAC, a stripe of ash deposits appeared on the ESE flank by 18 October.

Based on seismicity, KVERT interpreted that a series of explosions or collapses from lava flow fronts occurred on 5 November 2006. Two avalanches and an ash plume were also detected. Satellite imagery revealed a thermal anomaly over the lava dome. According to Aleksei Ozerov, the 5 November activity was caused by dome collapse. This demolished a significant section of the SE dome, involving a total volume of almost 200,000 m^3. The collapse produced a debris avalanche that traveled almost 3 km downslope.

According to a TERRA MODIS image on 9 November, a very bright (probably high temperature) gas-steam plume rose to about 35 km altitude. [This unusually tall plume height has not been confirmed.] On 10 November, KVERT reported continued growth of a viscous lava flow from the summit dome.

During an overflight around this time observers saw a 4-km-long deposit on the SE flank laid down by pyroclastic flows on 5 November. Lava flow-front collapses from older lava flows on the SE flank were also evident. Visual observations and video footage analysis indicated that gas-and-steam plumes drifted NE on 9 November and S on 13 November. Based on observations of satellite imagery, the Washington VAAC reported that an ash plume at an altitude of ~ 6.4 km drifted E on 15 November. Visual observations and video footage showed gas-and-steam plumes on 17 and 18 November.

Seismicity was above background during 19-20 November. A thermal anomaly occurred at the crater during 16-17 and 21 November. An ash plume reached 4.3 km altitude on 2 December. Seismicity was at background through the rest of December, except during 21-25 December, when it again rose. Ash plumes up to 4.5 km altitude and avalanches were registered on 23 December.

A paroxysmal explosive eruption occurred between 0917 and 1020 UTC on 24 December and a large column rose to ~ 13.0 km altitude. According to satellite data, ash clouds extended from the volcano over 850 km to the NE on 24-25 December. According to KVERT volcanologists, who circled the volcano by helicopter with cameras, this eruption destroyed a part of lava dome.

Geologic Summary. Prior to its noted 1955-56 eruption, Bezymianny volcano had been considered extinct. The modern Bezymianny volcano, much smaller in size than its massive neighbors Kamen and Kliuchevskoi, was formed about 4,700 years ago over a late-Pleistocene lava-dome complex and an ancestral volcano that was built between about 11,000-7,000 years ago. Three periods of intensified activity have occurred during the past 3000 years. The latest period, which was preceded by a 1,000-year quiescence, began with the dramatic 1955-56 eruption. This eruption, similar to that of Mount St. Helens in 1980, produced a large horseshoe-shaped crater that was formed by collapse of the summit and an associated lateral blast. Subsequent episodic but ongoing lava-dome growth, accompanied by intermittent explosive activity and pyroclastic flows, has largely filled the 1956 crater.

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Fuego

Guatemala
14.473°N, 90.880°W; summit elev. 3,763 m
All times are local (= UTC - 6 hours)

Fuego was previously discussed in *BGVN* 30:08. This report discusses ongoing developments at Fuego since July 2005 and through December 2006. In general, the volcano erupts vesicular, olivine-bearing basaltic lava flows. They traveled from the central crater hundreds of meters down the S, SW and W flanks, and the lava flow fronts released occasional blocky avalanches of incandescent material. The latter process is generally omitted from the rest of this report unless the avalanche(s) were particularly noteworthy, as in cases where pyroclastic flows were also noted.

On 17 July 2005, an ash plume ~ 3.5-4 km high accompanied small pyroclastic flows down Santa Teresa and Taniluyá ravines. This activity continued sporadically through October 2005.

From 2-7 November 2005, weak explosions and low ash plumes occurred along with lava flows that traveled down the volcano's S and SW flanks, extending 600 m towards the Taniluyá ravine, and 300 m towards the Cenizas ravine. On 14 November, two lava flows traveled from the S edge of the central crater 150 m toward the Cenizas ravine, and 400 m toward the Taniluyá ravine. A third lava flow traveled 600 m W towards the Santa Teresa ravine. Between 17 and 21 November, lava flows traveled S towards the Cenizas and Taniluyá ravines and W towards Santa Teresa ravine.

On 13 December 2005, two lava flows from Fuego extended 200-300 m W and SW of the central crater. On 27 December 2005 an ash plume rising ~ 7.6 km altitude extended SSW and SSE of the volcano; lava flows traveled ~ 2 km S down Taniluyá ravine, and W down Seca ravine, initially extending ~ 800 m and 1,200 m, respectively.

At 0602 on 27 December, a pyroclastic flow descended S. Ash fell S of the volcano in the port of San Jose. Later that day, lava flows extended 1.2 and 1.3 km, and pyroclastic flows descended 1.8 and 2 km down the Taniluyá and Seca ravines, respectively. Lava flows also traveled W toward Santa Teresa ravine, and SE towards the Jute and Lajas ravines. An ash plume rose ~ 7.6 km, and a small amount of ash fell W and SW of the volcano in the villages of Morelia, Santa Sofía, Los Tarros, and Panimaché (~ 7 km SSW). This activity continued through 29 December with more lava flows and bombs. The emissions hurled incandescent lava clots ~ 75 m high, spawned lava flows, and generated a dark plume rising to ~ 1 km above the crater rim.

January 2006 activity was essentially a continuation of December's with moderate-to-strong explosions and incandescent lava ejecta hurled ~ 40 m high. Explosions could be heard 25-30 km away. The explosions were accompanied by rumbling sounds and acoustic waves that shook windows and doors in villages near the volcano. Ash plumes rose ~ 1 km to ~ 1.5 km. On 22-23 January, there were Strombolian lava ejections rising ~ 100 m above the crater rim accompanied by block avalanches down the SW flank.

During February and March 2006, explosions moderated but activity continued. Weak-to-moderate explosions occurred; shock waves were sometimes felt in villages near the volcano. On 6-7 March, ash emissions up to ~ 4.6 km altitude were visible on satellite imagery.

From 22 through 28 March, Fuego ejected incandescent material up to ~ 50-75 m and gas plumes to ~ 300 m above the crater rim. Short pyroclastic flows from avalanches occurred on the upper flanks. On 28 March, pyroclastic flows traveled ~ 450 m S, and avalanches occurred from the lava-flow fronts.

On 17 April 2006, explosive ejections threw lava ~ 50-75 m above crater rim, and gas plumes rose to ~ 150-200 m. Lava flowed ~ 400 m S towards Taniluyá ravine.

During 17-18 May 2006 lava flows reached ~ 100 m SW towards the Taniluyá river and ~ 500 m SW towards the Cenizas river. Fumarolic gases rose to ~ 600 m above the crater rim and drifted E and W.

On 29 June 2006 fumarolic gases rose to ~ 125 m , spatter to tens of meters, and ash plumes ~ 2.2 km respectively above the crater rim. Lava flows extended ~ 400 m SW toward the Cenizas river. Pyroclastic flows traveled mainly SW along the Cenizas river, with a lesser number moving SW along the Taniluyá river.

On 3 July 2006, explosions discharged incandescent material hundreds of meters above the central crater and avalanches traveled ~ 300-500 m SW along the Cenizas river.

The only activity reported in August occurred on the 16-17th, when ash explosions reached 300-800 m above the crater rim, and explosions of incandescent material produced avalanches that descended 300-500 m SW towards the Cenizas, Taniluyá, and Santa Teresa river valleys.

The latter half of September 2006 continued the characteristic previous activity with explosions that sent incandescent lava 75-100 m above the crater rim and that generated hot avalanches SW towards the Taniluyá River.

On 15 November, lava flows traveled about 150 m SW, and avalanches occurred from the lava-flow fronts. On 17 November, three out of seven explosions propelled incandescent material 100 m above the central crater rim. Relative quiescence followed through December 2006.

Geologic Summary. Volcán Fuego, one of Central America's most active volcanoes, is one of three large stratovolcanoes overlooking Guatemala's former capital, Antigua. The scarp of an older edifice, Meseta, lies between 3763-m-high Fuego and its twin volcano to the N, Acatenango. Construction of Meseta volcano dates back to about 230,000 years and continued until the late Pleistocene or early Holocene. Collapse of Meseta volcano may have produced the massive Escuintla debris-avalanche deposit, which extends about 50 km onto the Pacific coastal plain. Growth of the modern Fuego volcano followed, continuing the southward migration of volcanism that began at Acatenango. In contrast to the mostly andesitic Acatenango volcano, eruptions at Fuego have become more mafic with time, and most historical activity has produced basaltic rocks. Frequent vigorous historical eruptions have been recorded at Fuego since the onset of the Spanish era in 1524, and have produced major ashfalls, along with occasional PFs and lava flows.

Information Contacts: *Instituto Nacional de Sismologia, Vulcanología, Meteorología e Hidrologia (INSIVUMEH)*, Ministero de Communicaciones, Transporto, Obras Públicas y Vivienda, 7a. Av. 14-57, zona 13, Guatemala City 01013, Guatemala (URL: http://www.insivumeh.pagina.de); *Coordinadora Nacional para la*

Reducción de Desastres (CONRED), Av. Hincapié 21-72, Zona 13, Guatemala City, Guatemala; *Washington Volcanic Ash Advisory Center (VAAC)*, Satellite Analysis Branch (SAB), NOAA/NESDIS E/SP23, NOAA Science Center Room 401, 5200 Auth Rd, Camp Springs, MD 20746, USA (URL: http://www.ssd.noaa.gov/VAAC/).

Irazú

Costa Rica
9.979°N, 83.852°W; summit elev. 3,432 m
All times are local (= UTC - 6 hours)

The Observatorio Vulcanológico y Sismológico de Costa Rica (OVSICORI-UNA) reported small-magnitude seismicity and stable fumarolic and crater lake conditions at Irazú over the period September 2001 to December 2003 (*BGVN 28:12*). This report summarizes monthly contributions from OVSICORI-UNA from January 2004 through September 2007.

Activity during January-December 2004. The lake level at Irazú remained high through 2004 with a green color from January to September and a light green and greenish yellow color in October and November. Convection cells occurred in the NW, SW, SE, NE, N edges of the lake throughout the year. Small areas of minor mass wasting occurred in the NE and SW walls, and fumarolic activity on the NW side remained constant with a low level of gas emission. A seismograph located 5 km SW of the active crater registered mild tectonic and low-frequency earthquakes throughout 2004. Peak activity occurred on 19 July 2004, with nine earthquakes occurring over four hours and an intensity of M 1.2-1.8 at focal depths of 5-15 km.

Activity during January-November 2005. The lake level remained high through 2005 with a greenish yellow color through April and darker green from May through November. A ring of lighter yellow color indicating iron-oxide deposits was visible from March through November 2005. Convection cells occurred in similar manner to the 2004 interval, and toward the lake's center of the lake. Small areas of minor mass wasting occurred in the NE and SW walls and fumarolic activity on the NW side remained constantly low. From January through March and again in October 2005, earthquakes (M 1-2) 3-16 km deep occurred from the active crater to a distance of 20 km NW and 15 km SE .

Activity during March-December 2006. During March through December 2006, the lake level at Irazú was high with a yellowish green color. The SW crater wall showed areas of minor mass wasting moving toward the lake. Similar to January-November 2005, convection cells were observed in various areas. In August, the gas emission temperature of the NW-flank fumarole was measured at 86°C (N-flank fumarole temperatures over 80°C have been reported for almost 40 years). In November 2006, the lake level, convection cells, and fumarolic activity remained constant but the lake color changed to light green. A seismograph located 5 km SW of the active crater registered continuing low level tectonic and low-frequency earthquakes. In mid-December, earthquake activity was reported by local residents, but no other changes were recorded.

Activity during 2007. In February 2007, the lake level receded, and the color changed to yellowish green. In March, measurements of the lake level indicated a descent of 4.48 m, with regard to September of the 2005 and lake color remained a greenish yellow with a temperature of 15 ºC. Temperature at a convection cell at the NE edge was 34 ºC. During the period March-September, the lake level continued to descend and fell an additional 3.87 m. The lake retained a light green color, with convection calls in the NE, at the N edge, and toward the center. Small areas of minor mass wasting continued in the SW crater wall, and fumaroles on the NW side continued minor degassing..

Geologic Summary. Irazú, Costa Rica's highest volcano and one of its most active, rises to 3,432 m immediately east of the capital city of San José. The massive volcano covers an area of 500 sq km and is vegetated to within a few hundred meters of its broad flat-topped summit crater complex. At least 10 satellitic cones are located on the southern flank of Irazú. No lava flows have been identified from Irazú since the eruption of the massive Cervantes lava flows from south-flank vents about 14,000 years ago, and all known Holocene eruptions have been explosive. The focus of eruptions at the summit crater complex has migrated to the west towards the historically active crater, which contains a small lake of variable size and color. Although eruptions may have occurred around the time of the Spanish conquest, the first well-documented historical eruption occurred in 1723, and frequent explosive eruptions have occurred since. Ashfall from the last major eruption of Irazú during 1963-65 caused significant disruption to San José and surrounding areas.

Information Contacts: *E. Fernández*, *E. Duarte*, *R. Van der Laat*, *W. Sáenz*, *M. Martínez*, *V. Barboza*, *E. Malavassi*, *R. Sáenz*, and *J. Brenes*, Observatorio Vulcanologico Sismologica de Costa Rica-Universidad Nacional (OVSICORI-UNA), Apartado 86-3000, Heredia, Costa Rica (URL: http://www.ovsicori.una.ac.cr/).

Ruapehu

New Zealand
39.28°S, 175.57°E; summit elev. 2,797 m
All times are local (= UTC + 12 hours)

A hydrothermal explosion at Ruapehu on 25 September 2007 was previously described (*BGVN* 32:10), with a plume and lahars discharged from Crater Lake. Since publication, new photos and additional information was provided by Brad Scott of New Zealand's Institute of Geological & Nuclear Sciences. In addition, an article came out on the tephra dam failure and subsequent lahar (Manville and Cronin, 2007). The tephra dam broke in March 2007 (*BGVN* 32:10) sending a big lahar down the Whangaehu Gorge and River (figure 1).

Photos of hydrothermal and lahar deposits on snow and alpine glacial ice were taken within days of the hydrothermal explosion. By 4 October, the mountain was blanketed in fresh snow, completely masking the recent deposits. Photos such as those included in this report (fresh deposits laid down on ice and snow from erupting high-altitude crater lakes) are comparatively rare.

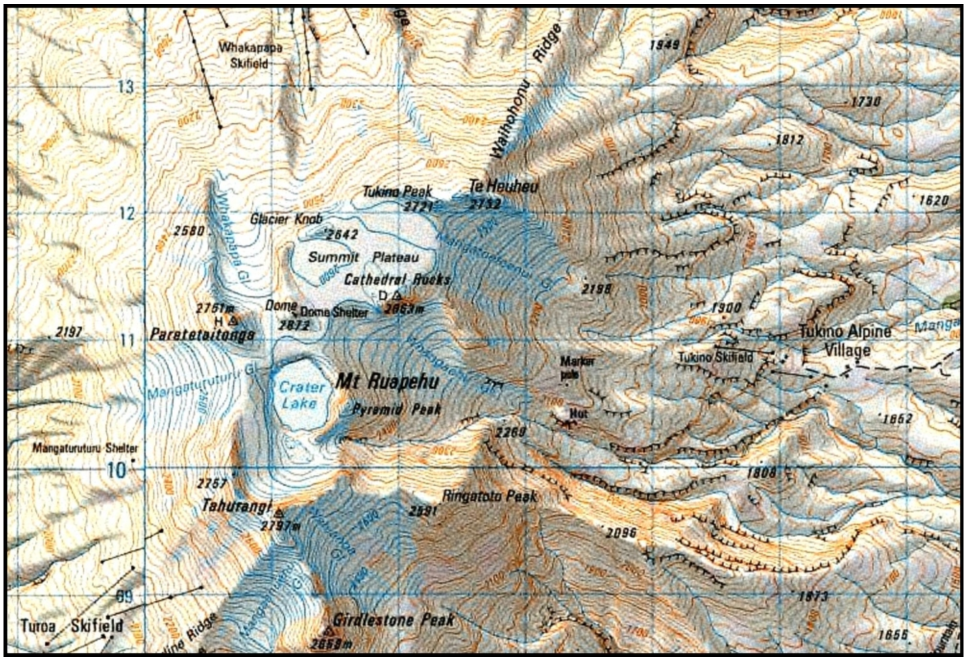

Figure 1. Map of Ruapehu oriented with N towards the top, showing glaciers and ski fields (note Whakapapa skifield and the valley of the same name towards the N). Crater Lake's outlet is at the SSE end of that lake, and it pours into the E-trending Whangaehu Gorge. The grid lines are at 1 km spacing; the contour interval is 20 m (100 m between heavy contours). Courtesy of Brad Scott, GNS.

Dome Shelter, located just N of Crater Lake, was directly in the path of the explosion. It was extensively buried by debris from the explosion and one person inside was badly injured.

Instruments recorded seismic and air-pressure signals associated with the hydrothermal explosion (figure 2). The seismic plot shows a strong wave initially arriving at 2026 NZ local time. The velocity of sound in air is several-fold slower that the velocity of vibrations through rock (seismic waves). In addition, the sound waves were recorded at a station ~ 6 km farther away from the signal source. Consequently the sound signal's first arrival was later.

Work is still in progress to understand the complicated lahar dynamics of this event. Three main lahars descended the mountain on 25 September. Two headed roughly E (one via the outlet and associated Whangaehu Gorge, the other, larger, out over the crater walls and down a glacier). Another lahar went N (over the crater walls).

The photo of Ruapehu's summit taken from a plane, shown in figure 11 in *BGVN* 32:10, was a view from the NE illustrating the scene shortly after the eruption. A similar photo appears here as figure 3, although this photo was taken from the E. In both these photos, the largest (most conspicuous) lahar follows a straight path from the summit area adjacent Crater Lake. It traveled over the Whangaehu glacier.

Ejecta apparently accumulated in the N Crater basin (figure 4) before some of it flowed down the Whangaehu glacier. The latter lahar was complex, owing to eruption-blasted water followed by runoff and other possible complexities still under study. The third lahar was small and came down the Ruapehu's N side. It passed near a ski slope (figures 5 and 6).

A view of Crater Lake looking S into the crater from the Dome Shelter (figure 7) shows the strong directionality of the blast to the N (towards Dome Shelter). Numerous small blocks and bombs are visible in the foreground. Near the lake appear some lighter textured deposits on the snow (figure 7). These are rather thin (less than 0.5-1 m thick) and cross some of the darker deposits. Initial field interpretations were that these lighter deposits formed in two ways. One is the deposits mark the absorption of ejected Crater Lake water into the snow pack. The second is that they preserve the aerosol developed on the fringes of a directed blast of steam and water discharged from the Lake. Figure 8 is similar to the previous one, only viewed standing on de-

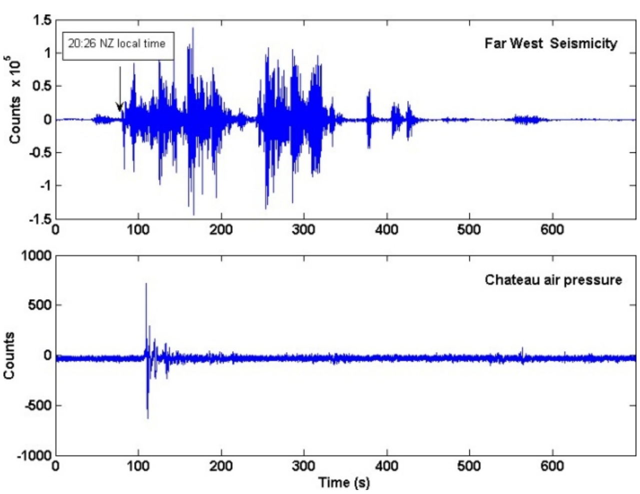

Figure 2. Seismic and air pressure plots of the eruption at Ruapehu on 25 September 2007. The seismic data were recorded at the seismic station termed the Far West T-bar, on the N flank of the volcano, ~ 3.1 km from the center of Crater Lake. The air pressure (sound wave) signal was recorded at the Chateau station, 9.1 km from the center of Crater Lake. Courtesy of GeoNet.

Figure 3. Photograph of Ruapehu taken from the E with a view centered on the largest 25 September lahar. That lahar made its descent on the surface of the Whangaehu glacier. The outlet for Crater Lake (upper left) feeds from the Lake's S (left) end, draining down the Whangaehu Gorge. In this photo, the steep sided Gorge becomes shrouded in clouds towards the lower left corner. Courtesy of GeoNet.

bris farther to the E, an area where significant runoff formed a long narrow channel, which in the foreground traveled downslope towards the viewer.

Dome Shelter and news-reported injury. Dome Shelter was partly buried by typical snow accumulation, over which came the deposits from the hydrothermal eruption, some of which invaded the structure (figure 9). To summarize news stories in the *New Zealand Herald* and *The Sydney Morning Herald*, four mountaineers were camped in the Shelter during the explosion. William Pike's left leg was injured and his right leg below the knee was crushed and pinned by deposits. He was rescued and ultimately flown out by helicopter but had suffered severe hypothermia. Doctors said at one point he was very near death, with body temperature in the 25-26°C range. They managed to save him after amputating the lower portion of his right leg. The news also reported that the Shelter was designated for emergency use only (not as a camping shelter).

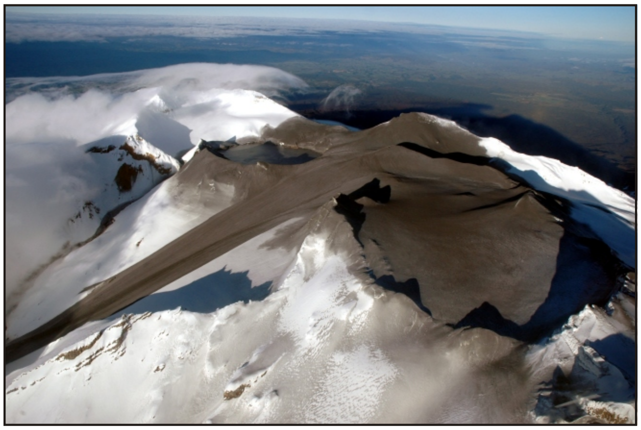

Figure 4. A view of Ruapehu taken from the NE. The Whangaehu Gorge (left back) drains from Crater Lake's outlet, containing a narrow, confined lahar there. In the upper center, Crater Lake is surrounded by gray ash. The dark area across the center to left is the large lahar down the Whangaehu Glacier. The large dark circular area at the right is the ash-covered N Crater basin. Courtesy of Brad Scott and GeoNet.

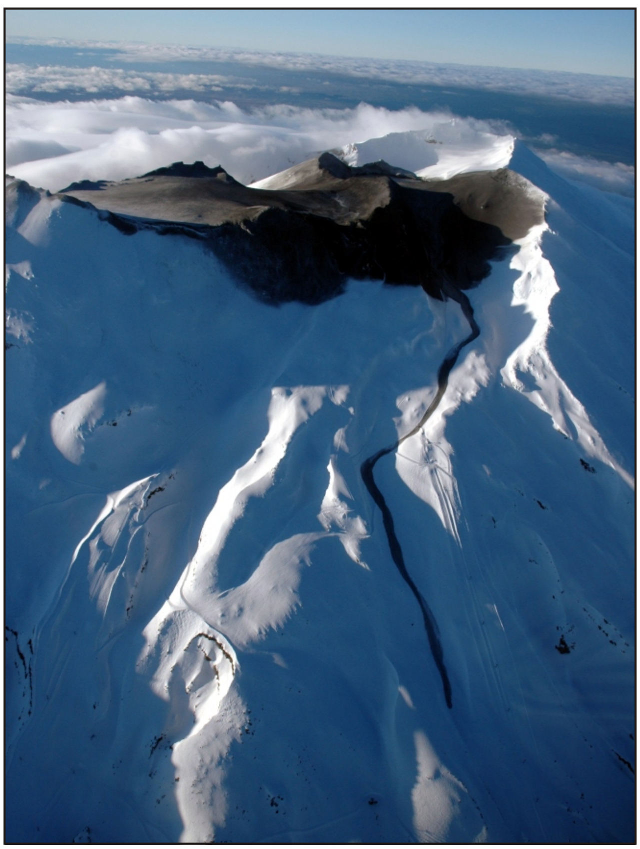

Figure 5. This view at Ruapehu was taken from the N and shows a small 25 September lahar down the Whakapapa Valley. The distal end of this lahar descended past the ski slope's Far West T- Bar (a piling for this ski lift is in the right background of the next photo). The prominent ash-covered ridge in the upper center is Dome Ridge, which obscures the view of the lake. Courtesy of GeoNet.

Figure 6. A Ruapehu lahar that traveled down the Whakapapa ski field. Levees appear at or near the lahar margins. The snow in this area is firm and groomed for skiing, and the lahar melted it by a few tens of centimeters. Courtesy of GeoNet.

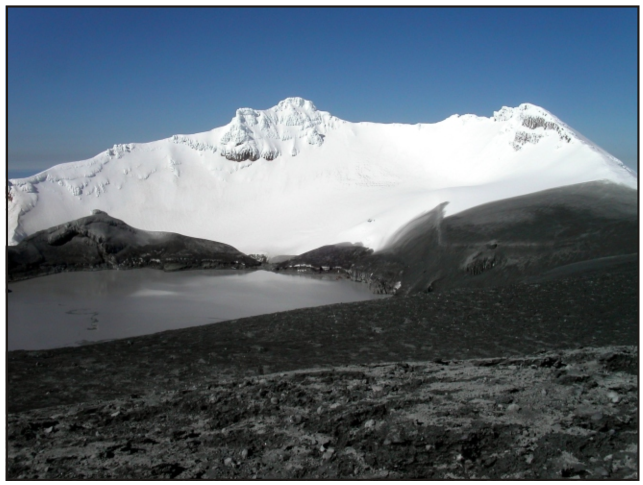

Figure 7. Ruapehu's Crater Lake as seen from the N at Dome Shelter. Courtesy of GNS.

GNS noted that the Shelter also houses monitoring instruments, equipment less damaged than initially thought. Data from one of the two seismic systems continued to flow, although the data were rather noisy. Accordingly, GNS began relying on nearby monitoring stations.

Reference: Manville, V., and Cronin, S.J., 2007, Breakout lahar from New Zealand's Crater Lake, Earth Observing Satellite, Transactions, American Geophysical Union, v. 88, no. 43, p. 441-442.

Geologic Summary. Ruapehu, one of New Zealand's most active volcanoes, is a complex stratovolcano constructed during at least four cone-building episodes dating

Figure 8. A photo of Ruapehu's Crater Lake looking SE from the Whakapapa Glacier showing the outlet (on the Lake's top-right). The lake surface contains disturbances caused by upwelling water and sulfur slicks (dark streaks). Note craters from ballistic ejecta. The long straight line is a runoff channel. Courtesy of Geonet.

back to about 200,000 years ago. The 110 cubic km dominantly andesitic volcanic massif is elongated in a NNE-SSW direction and is surrounded by another 100 cu km ring plain of volcaniclastic debris, including the Murimoto debris-avalanche deposit on the NW flank. A series of subplinian eruptions took place at Ruapehu between about 22,600 and 10,000 years ago, but pyroclastic flows have been infrequent at Ruapehu. A single historically active vent, Crater Lake, is located in the broad summit region, but at least five other vents on the summit and flank have been active during the Holocene. Frequent mild-to-moderate explosive eruptions have occurred in historical time from the Crater Lake vent, and tephra characteristics suggest that the crater lake may have formed as early as 3000 years ago. Lahars produced by phreatic eruptions from the summit crater lake are a hazard to a ski area on the upper flanks and to lower river valleys.

Information Contacts: *Brad Scott*, Institute of Geological & Nuclear Sciences (IGNS), Private Bag 2000, Wairakei, New Zealand (URL: http://www.gns.cri.nz/); *New Zealand GeoNet Project* (URL: http://www.geonet.org.nz/); *New Zealand Herald* (URL: http://www.nzherald.co.nz/); *Sydney Morning Herald* (URL: http://www.smh.com.au/).

Figure 9. Dome Shelter on Ruapehu as seen in relatively snow-free conditions at some point well prior to the eruption (top). Seen from the air after the hydrothermal eruption, the Shelter is covered by seasonal snow followed by mud and debris. Pre-eruption photo credit to Greg Bowker, post-eruption photo credit to Alan Gibson; accessed on the website of the *New Zealand Herald*.

Soputan

Sulawesi, Indonesia
1.108°N, 124.73°E; summit elev. 1,784 m
All times are local (= UTC + 8 hours)

Our last report on Soputan (*BGVN* 32:01) indicated that Soputan's lava dome was still emitting gas and generating rockfalls and ash plumes to 12 km in altitude through December 2006. This report, which includes a map (figure 10), discusses activity through November 2007.

According to the Center of Volcanology and Geological Hazard Mitigation (CVGHM), diffuse ash plumes rose from Soputan to an altitude of 1.8 km during 20-25 June 2007. The Alert Level remained at 3 (on a scale of 1-4), where it had been since 15 December 2006. Between 11 June and 1 July 2007 the only seismicity recorded was caused by rockfalls, with 107 events during 11-17 June, 124 events during 18-24 June, and 78 events during 25 June-1 July.

News accounts reported that Soputan erupted on 14 August, producing ash plumes that, according to the Darwin Volcanic Ash Advisory Centre (VAAC), rose to 4.6 km altitude and drifted W. Lava and rock avalanches were also observed. According to Yahoo! Canada News, volcanologist Sandy Manengke indicated that no injuries or damage were reported, but that villages along Soputan's base were covered in volcanic dust, and many residents were wearing face masks. According to Reuters, Saut Simatupang, head of Indonesia's Volcanology Survey, told the news agency that no evacuation was ordered and the Alert Level was not raised to 4 (maximum) because Soputan was unlikely to erupt in a way that would threaten the nearest village, 11 km from its crater. On 15 August seismicity decreased.

Based on observations of satellite imagery and information from CVGHM, the Darwin VAAC reported that an ash plume rose to an altitude of 4.6 km and drifted W during 14-15 August. Visual observations were made on 24-25 October and 30-31 October 2007 of white and gray plumes that rose to altitudes of 1.8-3.3 km and drifted W. In addition, based upon pilot reports and satellite imagery, the Darwin VAAC reported that on 25-26 October, ash plumes rose to 13.7 km altitude and drifted WSW. On 25 October, lava flowed 500-600 m down the W flank and flowed again on 30 October. Villagers and tourists were warned not to travel within a 6 km radius of the summit.

MODVOLC data (which is MODIS satellite thermal infrared data processed to indicate possible volcanism) is sometimes helpful in assessing lava and dome emissions at volcanoes. Alerts for 2007 appeared in August (7 alerts), October (23 alerts), and November (2 alerts). During 2006, alerts took place in December (11 alerts) and October (5).

According to CVGHM, the Alert Status was lowered from 3 to 2 on 23 November, based on a decrease in the number of earthquakes and seismic intensity, deformation measurements, and visual observations.

Geologic Summary. The small Soputan stratovolcano on the southern rim of the Quaternary Tondano caldera on the northern arm of Sulawesi Island is one of Sulawesi's most active volcanoes. The youthful, largely unvegetated volcano rises to 1,784 m and is located SW of Sempu volcano. It was constructed at the southern end of a SSW-NNE trending line of vents. During historical time the locus of eruptions has included both the summit crater and Aeseput, a prominent NE-flank vent that formed in 1906 and was the source of intermittent major lava flows until 1924.

Information Contacts: *Centre of Volcanology and Geological Hazard Mitigation (CVGHM)*, Diponegoro 57, Bandung, Jawa Barat 40122, Indonesia (URL: http://portal.vsi.esdm.go.id/joomla/); *Jenny Farlow*, Darwin Volcanic Ash Advisory Centre, Bureau of Meteorology, Australia (URL: http://www.bom.gov.au/info/vaac/; Email: j.farlow@bom.gov.au); *Hawai'i Institute of Geophysics and Planetology (HIGP) Hot Spots System*, University of Hawai'i, 2525 Correa Road, Honolulu, HI 96822, USA (URL: http://hotspot.higp.hawaii.edu/); *Reuters* (URL: http://www.reuters.com/); *Yahoo! Canada News* (URL: http://ca.news.yahoo.com/).

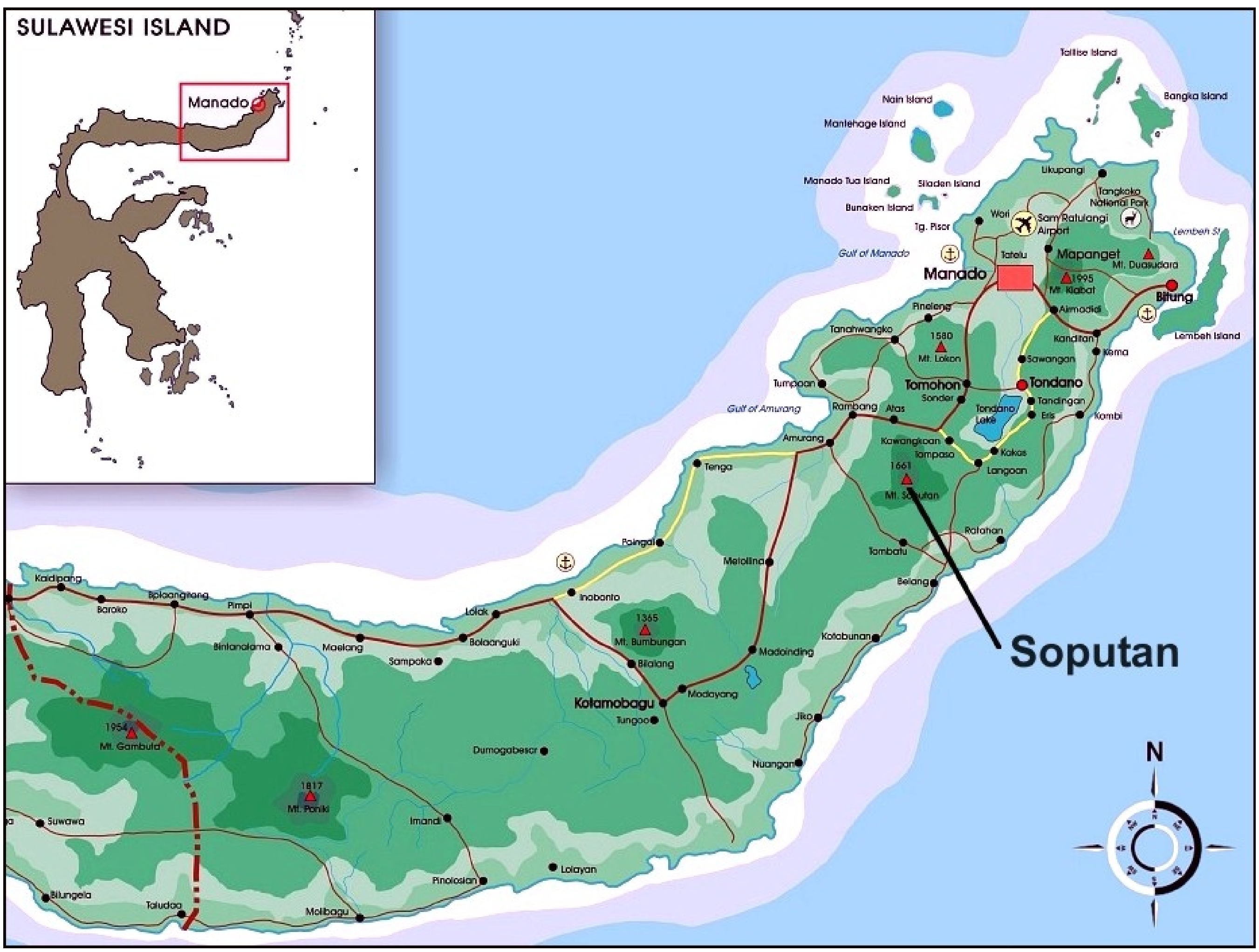

Figure 10. A map of northern Sulawesi island (Indonesia), with Soputan labeled. Inset shows entire island. Copyrighted map by pbi design (2002); graphic by Michael Wijaya.

Suwanose-jima

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

Suwanose-jima, in the East China sea, is one of Japan's most active volcanoes. Our last report on Suwanose-jima (*BGVN* 30:07) tabulated the seismicity and the numerous ash plumes seen between April 2004 and July 2005. The current report continues the tabulation from August 2005 to December 2007.

During the reporting interval, the Tokyo Volcanic Ash Advisory Center reported small explosions or eruptions, usually accompanied by ash plumes, every month during this period, except for November and December 2005, May 2006, and June 2007. Ash was seldom identified on satellite imagery. On 20 September 2006, the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite detected ash-and-steam emissions (figure 11).

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

Date	Event	Plume altitude (km)	Plume direction
11 Aug-12 Aug 2005	small eruptions	~ 3.4	—
22 Sep 2005	plume	~ 1.8	W
07 Oct-09 Oct 2005	eruptions	max. 1.8	SW, E, SE
01 Jan 2006	explosions	—	—
10 Jan 2006	explosions	~ 1.8	E
24 Jan 2006	plume	1.5	E
28 Jan 2006	plume	max. 1.8	W
29 Jan 2006	explosion	—	—
31 Jan 2006	plume	1.5	W
01 Feb 2006	explosions	—	—
06 Feb-07 Feb 2006	explosions	1.2	NW
08 Feb-10 Feb 2006	plumes	max. 1.5	E and SE
15 Feb-18 Feb 2006	plumes	max. 1.5	E and S
22 Feb-24 Feb 2006	eruptions	max. ~ 3	S, E, NE
02 Mar-08 Mar 2006	explosions	max. ~ 1.8	E, SE, S, NW
16 Apr 2006	ash plume	~ 1.5	—
07 Jun 2006	ash plume	2.4	—
30 Jun 2006	plume	1.2	NE
16 Jul 2006	ash plume	1.8	N
26 Jul-30 Jul 2006	explosions	max. ~ 1.8	N, straight up
11 Aug-14 Aug 2006	explosions	max. ~ 1.8	N and W
26 Aug 2006	plumes	1.8	Straight up
28 Aug 2006	plumes	1.5	E
19 Sep 2006	ash plumes	3.4	E
20 Sep 2006	ash and steam	2.1	N
06 Oct 2006	explosion	—	—
14, 16-17 Oct 2006	ash plumes	3	—
18 Oct 2006	explosion	—	—
27 Oct-28 Oct 2006	ash plumes	1.8	E
04 Nov-06 Nov 2006	plumes	1.2	E and SW
09 Nov 2006	plume	1.5	W
17 Nov 2006	plume	2.1	Straight up
19 Dec 2006	eruption	—	—
09 Jan 2007	plume	—	—
28 Jan 2007	plume	—	—
05 Feb-07 Feb 2007	plume	—	—
19 Feb-20 Feb 2007	plumes	—	—
02 Mar 2007	plume	1.2	W
17 Mar 2007	explosion	—	—
30 Mar 2007	explosion	—	—
02 Apr 2007	explosion	—	—
08 May 2007	explosions	—	—
26 Jul 2007	ash plume	1.5	SW
17 Sep 2007	explosions	—	—
16 Oct 2007	plume	1.5	E
22 Oct 2007	plume	1.5	W
26 Oct-28 Oct 2007	plumes	1.5	E and W
29 Nov-02 Dec 2007	plumes	1.2 - 1.8	E
10 Dec 2007	plumes	1.5 - 1.8	W
14 Dec-17 Dec 2007	plumes	1.5 - 1.8	E

Table 1. Summary of activity reported at Suwanose-jima from August 2005 to December 2007, based on information from the Tokyo VAAC. "—" indicates that data were not reported.

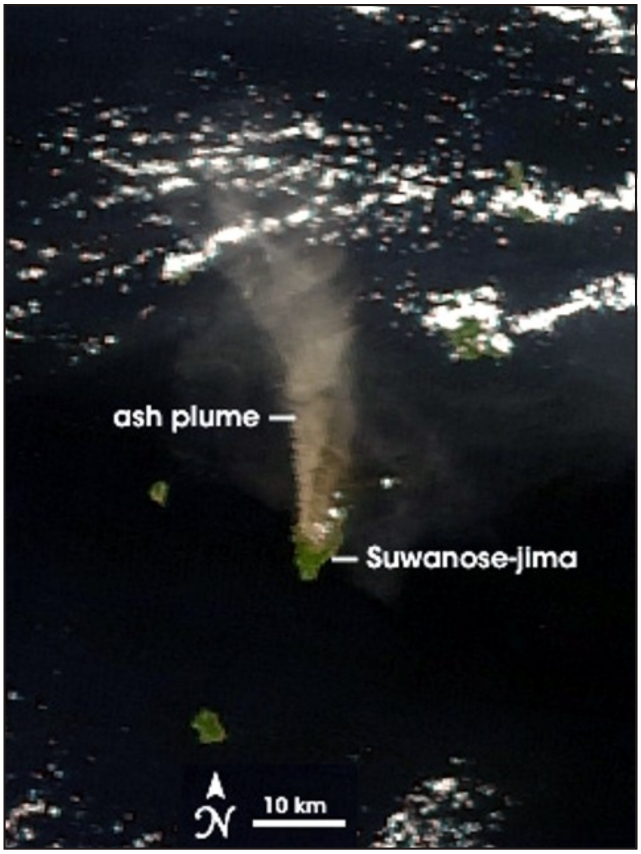

Figure 11. Ash plume blowing N from Suwanose-jima on 20 September 2006, seen in a MODIS image. In color images the plume's hue clearly distinguishes it from the banks of transversely oriented white weather clouds. NASA image created by Jesse Allen, Earth Observatory, using data provided courtesy of the MODIS Rapid Response team.

Moderate Resolution Imaging Spectroradiometer (MODIS) program (URL: http://modis.gsfc.nasa.gov/).

Ol Doinyo Lengai

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

Following explosive eruptions beginning on 1 January 1983, Ol Doinyo Lengai (hereafter called 'Lengai') entered a stage consisting chiefly of the effusion of numerous small fluid, carbonatitic lava flows in its active N summit crater. During March 1983 to early 2007, reports focused almost exclusively on the summit crater, the scene of numerous, often-changing hornitos (or spatter cones) and carbonatitic lava flows that slowly filled the crater. Lava began overflowing the crater, first to the W around 14 June 1993 (*BGVN* 18:07), then onto the NW flank (beginning in late October 1998, *BGVN* 24:02), E flank (beginning in early November 1998, *BGVN* 24:02), W flank (beginning in February 2002, *BGVN* 27:10), and N flank (beginning in January 2005, *BGVN* 30:04), making it important to chronicle changes on the flanks. Observations of activity throughout 2007 are summarized in table 2.

As this report goes to press, contradictory reports exist concerning impacts of eruptions on the volcano's flanks, with the key question concerning the amount of impact on those flanks by fires, lava flows, ashfall, or conceivably, volcanic bombs large enough to start fires on impact with the ground surface–or perhaps some combination of these and other processes.

Observations during 17-20 June 2007. A report posted on Frederick Belton's Ol Doinyo Lengai website described a visit by Rohit Nandedkar, Hannes B. Mattsson, and Barbara Tripoli during 17-20 June. They observed generally high, but variable, activity of the inner crater. A lot of sulfuric gasses escaped, mainly at fractures in the outer crater, but also from the big hornito on the SW side. Three spatter cones situated on the S and W side of the inner crater discharged spatter that splashed up to 15-20 m high at intervals of 20 minutes, with 30 minute breaks. All three cones were never active at the same time. The group saw three active interconnected lava ponds (mainly on the E side of the inner crater). The molten material was eroding the E side and destabilizing the adjacent cliff. The ponds were always active, but more vigorous activity lasted for intervals of several hours. On 19 June the crust of the inner crater burst near a big, half-collapsed hornito, sending a lava flow E.

Activity on 19 July 2007. On 20 July 2007 the Associated Press (AP) reported that "Lengai was believed to be the source of a series of shallow earthquakes experienced in the region over the past week" according to Alfred Mutua, the Kenyan government spokesman. On 19 July *BBC News* reported that hundreds of villagers fled their homes on the slopes in response to the above-mentioned seismic swarm, fearing an imminent eruption. A BBC correspondent reported that lava flowing down a flank was causing panic among villagers. The *East African Standard* indicated that products of the 19 July eruption had entered inhabited areas, stating that " . . . . more than 1,500 people, most of them Maasai families, vacated their homes in Ngaresero, Orbalal and Nayobi villages following the tremors that triggered the volcanic eruption . . . . Villagers are reported to have heard roaring . . . . before the volcano started discharging ash and lava." There were also reports of a damaged school and two injuries, but no deaths. Subsequent inquiries about the incident have cast doubt on these earlier claims.

Volcanologist Gerald Ernst contacted aviators, guides, scientists, and local inhabitants in the region; they had seen no dramatic eruptive events at the mountain during late July 2007. Overall, the compiled comments indicated that the summit crater was intact and eruptions were confined to the summit area. Keith Roberts was reported to have observed that a landslide kicked up a lot of dust, which could have been confused from a distance with ash from a large flank eruption.

Greg Vaughan of the Jet Propulsion Labs subsequently took a preliminary look at some ASTER satellite imagery and concluded that in mid-June through late July the summit crater was likely to have continued to emit lava. The 20 July thermal emissions supported summit lava eruptions but failed to document any lava that had spilled over the crater rim. In addition, no thermal anomalies were measured by MODIS instruments as reported by the Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System from 7 July through 22 August (UTC).

Belton's website contained a report by Lindsay McHenry, who had climbed Lengai on 22-23 July 2007. She reported: "There were frequent minor earthquakes in the days preceding the climb. There were two active spatter cones, one on the far eastern side of the crater and a small one just to the east of the central spire. Both were throwing small blocks … locally, and occasionally raining ash over the entire crater. Our guides directed us to an aa flow on the northern side of the crater that they claimed was only 4 days old. The interior was still warm and showed no signs of alteration. The flow was confined to the crater."

MODIS (MODVOLC) measurements. Data from MODIS satellites and analyzed with the MODVOLC algorithm revealed no thermal anomalies for the period 7 July-22 August 2007. Instead, multiple thermal anomalies were measured at and around the crater particularly during 23 August-3 September and 10-20 September 2007 (table 3). It is plausible that a brief ash-bearing eruption like the alleged 19 July event could have been missed by the MODIS satellites or not detected by the MODVOLC algorithm.

Observations during early August 2007. The European Association of Volcanologists (LAVE), a group that visits many volcanoes and publishes an informative and colorful newsletter, ascended and camped in the active crater on 3-5 August 2007 (Machault, 2008). Machault (2008) discussed a crater still strewn with multiple hornitos. Many of their observations concerned the emissions at these hornitos and abundant still fresh lava flows of small volume seen spread-

Date (2007)	Observer(s)	Brief Observation(s) (CV= climbed volcano; A=aerial observations/ photos from crater overflight; F = flank observation; S = satellite)
31 Jan-02 Feb	Tom Pfeiffer	(CV) (see *BGVN* 32:02)
03 Mar	Annette Loettrup	(CV) no activity; no significant changes to crater
04 Mar	Janet Davis	(A) no activity; no significant changes to crater
24 Mar	unnamed	(CV) no activity; no significant changes to crater
17-20 Jun	Rohit Nandedkar, Hannes Mattsson, Barbara Tripoli	(CV) high but variable activity of the inner crater (see text)
22-23 Jul	Lindsay McHenry	(CV) activity in inner crater (see text)
03 Aug-05 Aug	Julie Machault and the group "Aventure et Volcans"	(CV, A) Small lava flows and an open vent cradling lava (see text)
15 Aug-16 Aug	Gaston Gonnet	(CV) mild strombolian activity from 3 cones
23 Aug	Gwynne Morson	(A)
21, 23 Aug	Christoph Weber	(CV) active eruption with lava flows (see text)
1-2 Sep	Chiara Montaldo	(CV) eruption (see text)
03 Sep	Gwynne Morson	(A) newly formed and erupting cinder cone (see text)
04 Sep	Sian Brown (pilot)	(A) large ash plume above Lengai
04 Sep	NASA satellite	(A) ASTER image on NASA's Terra Satellite (more in text)
06 Sep	Gwynne Morson	(A)
10 Sep	Jens Fissenebert, Sandra Kliegalhoefer	(F) high ash plume photographed from Lake Natron Camp
11-13 Sep	Leander Ward	(F) eruption (see text)
13 Sep	Gwynne Morson	(A) heavy ash plumes
19-21 Sep	Jelle Schouten, Stan Brouwer	(A) plumes flowing from Lengai
22-23 Sep	Roger Mitchell, Barry Dawson	(A) continuous activity (see text)
24 Sep	Jen Schoemburg	(F) continuous activity (see text)
23-30 Sep	Roger Mitchell, Barry Dawson	(F) continuous activity (see text)
27 Sep	Jen Schoemburg	(A) continuous activity (see text)
1st week in Oct	unnamed pilot	(A) ash plumes rising to 3 km above summit
05 Oct	message forwarded from Louise Leakey	(F) ash plume to 3 km
12 Oct	Colin Church	(F) ash falls on W side of Lengai
mid-Oct	L. Dudley	(A) heavy ash plume blowing to NW
09-16 Oct	Graham Wickenden	(F) ash plumes viewed from Lake Natron Camp
16 Oct	Leander Ward	(F camp N of Lengai on lower slopes of Gelai) lightning in ash clouds
16 Oct	unnamed	(A) ash cone now dominates entire active crater
19 Oct	Kathy Moore (pilot)	(A) eruption at 0830, plumes of smoke and ash to altitude of >7.6 km
21 Oct	Leander Ward	(F) dark and light ash clouds being erupted from the ash cone
23 Oct	Gwynne Morson	(A) dark ash clouds; cone (possibly T49B) still exists
25 Oct	Benoit Wilhelmi	(A) "extremely aggressive" activity
29 Oct	Gwynne Morson	(A) pause in eruption
31 Oct	Gwynne Morson	(A) dark ash clouds
04 Nov	Tim Leach	(F Lake Natron Camp) daily ash eruptions, some lava eruptions at night
07 Nov	Toulouse VAAC	(S) Lengai remained active, but ash not identified on satellite imagery
10 Nov	Michael Dalton-Smith	(F) activity continues, constant 'smoke' rising 300-600 m above summit, drifting WSW toward Gol Mountains
11 Nov	Tim Leach	(F Lake Natron Camp) activity seems to have decreased
21 Nov	Toulouse VAAC	(S) Lengai remained active, but ash not identified on satellite imagery
27 Nov	Tim Leach	(F Lake Natron Camp) activity "off and on"; heard report of large "lava eruption" about a week ago

Table 2. Summary of observations made of activity at Ol Doinyo Lengai during 2007. Observations for 2006 were reported in *BGVN* 32:02. Much of list courtesy of Frederick Belton. For most of the contributor's contact information , see Belton's website.

Date (2007)	Time (UTC)	Pixels	Satellite
02 Jun	745	1	Terra
23 Jun	2025	3	Terra
23 Jun	2320	1	Aqua
25 Jun	2015	1	Terra
29 Jun	1950	1	Terra
29 Jun	2245	1	Aqua
30 Jun	2030	1	Terra
30 Jun	2330	1	Aqua
02 Jul	2315	1	Aqua
06 Jul	1955	1	Terra
06 Jul	2250	1	Aqua
23 Aug	1955	1	Terra
23 Aug	2250	1	Aqua
25 Aug	1940	2	Terra
26 Aug	2320	1	Aqua
28 Aug	2310	1	Aqua
30 Aug	2000	2	Terra
30 Aug	2300	1	Aqua
31 Aug	825	2	Terra
31 Aug	1120	2	Aqua
31 Aug	2045	2	Terra
31 Aug	2340	2	Aqua
01 Sep	1950	10	Terra
01 Sep	2245	2	Aqua
02 Sep	810	2	Terra
02 Sep	1105	2	Aqua
03 Sep	1935	2	Terra
10 Sep	1940	1	Terra
10 Sep	2240	2	Aqua
19 Sep	2235	1	Aqua
20 Sep	800	4	Terra
17 Oct	2000	2	Terra
31 Oct	2310	1	Aqua
30 Dec	815	1	Terra

Table 3. MODIS/MODVOLC thermal anomalies measured at Ol Doinyo Lengai during 2007. No anomalies were detected during 1 January-1 June, 7 July-22 August, 21 September-16 October, 18-30 October, and 1 November-29 December 2007. Anomalies measured by MODIS during 2006 were reported in *BGVN* 32:02. Courtesy of the Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System.

ing over the crater floor. They departed the crater at 0700 on 5 August at which point they saw no activity.

In more detail, one vent at a hornito was particularly active on 3-4 August. The active vent was open and cradling molten lava. It was located well up on the cone of a hornito to the near E of T49B. This vent emitted lapilli on 4 August and the next day it emitted lava. On 4 August the same vent E of T49B discharged a lava flow on the crater floor, 100 m long with several arms. The afternoon of 4 August the same vent issued black "smoke" and clouds. A 'black geyser' rose above the hornitos in the center of the crater but the exact source vent was uncertain.

Eruptions of late August and September 2007. Matthieu Kervyn analyzed MODIS data with the MODLEN algorithm (tailored to the lower temperature lavas at Lengai) and recorded multiple and repeated thermal anomalies at and around the crater after 21 August 2007. This indicated a new eruptive event during 21-23 August, with a peak on 23 August (MODVOLC data in table 3 show anomalies starting 23 August). Anomalies at that time

Figure 12. Photo showing the Ol Doinyo Lengai crater with recent lava flows (black) on the morning of 23 August 2007. Note the lava overflow (possibly the E overflow) of the crater's rim in the foreground. Courtesy of Gwynne Morson.

seemed to be restricted to the crater, but moved out to the flanks on 31 August and 1 September. On 23August, pilot Gwynne Morson photographed the recent lava flows (figure 12), which, when freshly cooled are black in color (later altering to white due to weathering).

Ashley Davies reported that thermal emissions were detected on 27 August 2007 from the NASA Earth Observing-1 (EO-1) spacecraft, which combined both the Hyperion hyperspectral imager and the ALI multispectral imager, yielding coverage of both visible and short-wavelength infrared (SWIR). Hyperion data (30 m/pixel resolution) showed two very bright sources in the summit crater with spectra consistent with erupting lava. There was also an indication of a short lava flow to the NW. Based on a preliminary analysis of the Hyperion data, effusion rate was estimated at ~ 0.5 m^3/s. [Note: As part of the JPL Volcano Sensor Web, the EO-1 observation was triggered autonomously by an alert from the MODVOLC system. This in turn triggered a series of data transmissions and rapid processing at JPL. Notification was received at JPL within 2 hours of data acquisition. JPL processed the Hyperion data within 36 hours of acquisition.]

Figure 13. Incandescence on the W flank of Ol Doinyo Lengai sometime during 1-3 September 2007. Courtesy of Chiara Montaldo.

Chiara Montaldo and her husband climbed Lengai on the night of 1-2 September. Lava started to come out of the crater on the afternoon of 1 September and flowed down the flank all night (figure 13). At 0500 on 2 September, the crater was erupting; the noise and smell was very strong. From time to time there was an explosion sound (like fireworks) and a column of ash and lapilli could be seen. The column was not continuous, and it was incandescent with black smoke and ash. They felt very strong earthquakes on the top. A few hours after they climbed down on 2 September, the column and the noise were higher and the wind changed direction, blowing the ash toward them. On the following night (2-3 September) another group tried to climb the volcano, but retreated about halfway up because the eruption was getting more intense.

According to Burra Gadiye, a mountain guide, an ash eruption began during the night of 3-4 September 2007. On 3 September pilot Gywnne Morson observed a new erupting cone in the central to E side of the crater. Thomas Holden relayed a pilot's account of a large ash plume on 4 September. The ash plume and strong thermal activity in the crater and probably lava flows to the W and NW may have spawned fires that burned large areas of the W and NW flank, as can be seen in a 4 September 2007 ASTER image (figure 14). Kervyn observed that the volcano erupted on 4 September, first at midnight and then at 0500, causing significant ash clouds. Ash fallout was observed at Engare Sero village, 18 km N of the summit. Ashfall lasted for over 12 hours. The ash cloud was imaged by ASTER on the morning of 4 September drifting SSW. Roger Mitchell attributed the large burned areas on figure 14 as due to fires ignited after the ash eruption of 3-4 September.

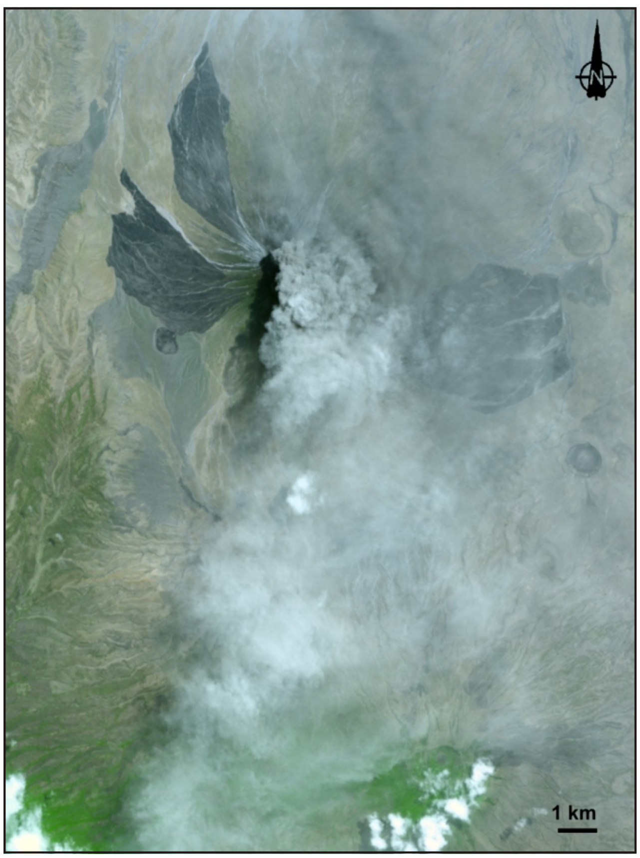

Figure 14. ASTER image of Ol Doinyo Lengai taken 4 September 2007 at 0422 UTC (0722 local time) showing a plume of ash and steam blowing S. This eruption sent ash downwind at least 18 km. The large dark lobes on the NW, W, and E flanks extend to inhabited areas. The lobes are not lava flows, but areas burned by fire. The gray volcanic plume appears distinct near the summit, and more diffuse to the S. Image created by Jesse Allen, using data provided courtesy of National Aeronautics and Space Administration/Goddard Space Flight Center/Japan's Ministry of Economy, Trade, and Industry/Japan's Earth Remote Sensing Data Analysis Center/Japan Resources Observation System Organization (NASA/GSFC/METI/ERSDAC/ JAROS) and the U.S./Japan ASTER Science Team.

Chris Weber reported that during the night of 3-4 September, lapilli- and ash-bearing eruptions rose about 3 km above the vent. Pictures taken from a plane on 5 September indicated that the hornitos and other crater morphology remained without dramatic change. Satellite images around this time showed vast areas of burned vegetation on the S, W, and NW slopes. The charred area at the S was caused by a bush fire that started before 20 August (observed by Weber), while he attributed such areas to the W and NW as caused by lava flows. A sketch of the inner crater was drawn on 23 August by Weber (figure 15).

At about 1100 on 24 September, Jen Schoemburg reported seeing ash rising to an altitude of ~ 4 km, drifting NW. A local safari vehicle driver said that there had often been a 'mirage' visible above the volcano (from gases), but that for the previous two weeks or so the volcano had been emitting ash. He also said that people in surrounding villages had reported skin rashes on themselves and their animals. Additionally, 2-3 weeks prior, there had been earthquakes felt in the region. Near noon on 27 September, Schoemburg flew over going N, with the volcano passing on the W side of the plane (figure 16). The pilot said that in

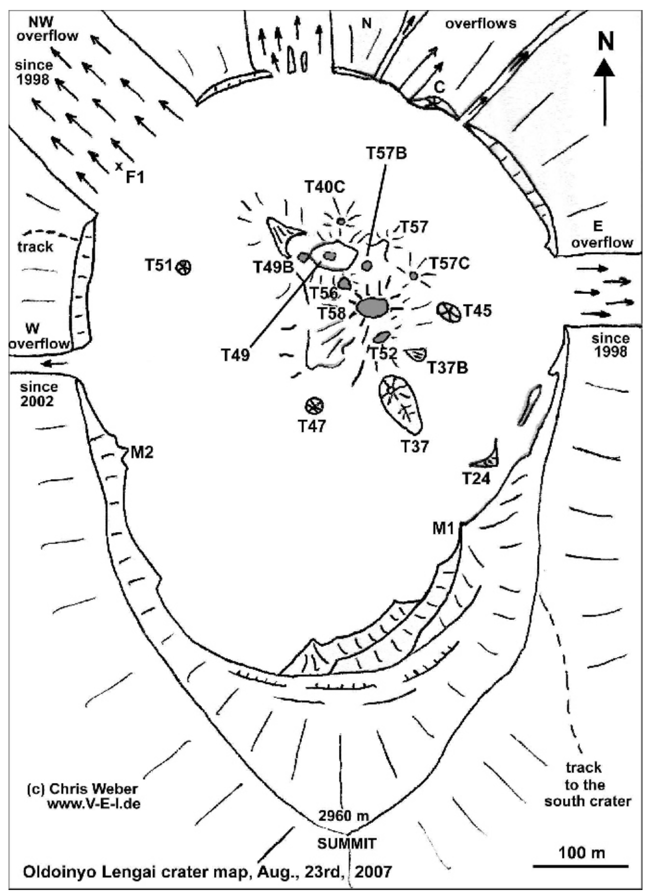

Figure 15. Sketch map of the crater of Ol Doinyo Lengai as of 23 August 2007. Note lava overflows and trail to S crater. Courtesy of Chris Weber.

Figure 16. Aerial photo of Ol Doinyo Lengai looking W on 27 September 2007. S crater is shown in the foreground. Courtesy of Jen Schoemburg.

Figure 17. Eruption of Ol Doinyo Lengai at 1100 on 24 September 2007, viewed from the lower W slopes. Courtesy of Barry Dawson.

recent weeks ash rose to 6 km altitude; during the fly-over, it was rising to about 4.6 km, still drifting NW.

Observations during late September and ash petrology. Barry Dawson and Roger Mitchell reported on activity during 22-30 September 2007 and their petrologic investigations. During an overflight on 22 September, Dawson observed that there had been a complete collapse of the area around former T49 hornito/ash cone area, with the formation of an ash pit surrounded by new black ejecta. A large hornito (T40) between the pit and the N wall of the crater was still in existence. Small emissions of ash, probably less than 100 m high, were drifting N. There was much new whitened ash around the whole summit area, but with most to the S where the S crater and the higher parts of the S slopes were most thickly blanketed, possibly from the plume recorded on the ASTER image (figure 14) of 4 September 2007.

As observed from the foot of the volcano on 23 September and on the early morning of 24 September, there were small, intermittent ash eruptions. At about 0900 on 24 September a strong eruption started, giving rise to a black eruption column that quickly built up to a height estimated to be ~ 6 km (figure 17), where it spread out into a typical Plinian-type cloud. From the lower W slopes, explosions were distinctly heard. This strong eruptive phase lasted till around 1300 with the ash cloud drifting NW and lapilli falling on the NW slopes; lapilli were gathered for a comparative study with lapilli from the 1966 eruption (Dawson and others, 1992). Smaller, intermittent lapilli-bearing eruptions continued until nightfall (around 1830).

On 25 September there was minor activity until about 1300, when new eruptions ejected white material. A lapilli cone could be seen from the lower S slopes, and subsequently fountaining took place from two distinct centers within the crater. Activity continued for about four hours. On 26 September there was only minor activity with fine ash drifting to the NW, but in the late afternoon an ash column with a whitened head rose ~ 3 km. In the evening, the atmospheric dust resulted in the sun having a halo, being red in color. The moon that night also had a halo.

On 27 September, the volcano was quiet, but at 0900 on 28 September it erupted again, though no plume developed. There was fountaining from three centers over the next hour, with regular migration of the fountains from N to S; black lapilli was ejected to ~ 200 m above the vent. Activity recommenced at 1330 and lasted all afternoon, with an eruption column up to 2 km high. After this event, the prominent hornito near the N rim of the crater that was previously visible from the lower slopes was no longer visible.

There was no sign of activity on 29 September until 1200, when large eruptions sent material up to 3 km above the volcano. Initially black, the billowing top of the eruption column became white at and above the level of the surrounding atmospheric clouds. This could be interpreted as due to either (1) a higher albedo of finer material at the top of the eruption column, (2) dust forming nucleation sites for condensing atmospheric water, or (3) a combination of the two. In the late afternoon and early evening, dark material from the eruption plume, now much reduced in height, continued to spill down the NW slopes rather like a density flow. On 30 September, when last observed by Dawson, there were only minor ash eruptions that drifted NW.

Dawson noted that up to 30 September, the volume of material erupted and the height of the eruption column appeared smaller than the last major phase of ash eruptions in 1966-67, when plume heights of ~ 10,000 m were estimated, and ash distribution was as far as Seronera (130 km to the W) and Loliondo (72 km to the NW) (Dawson and others, 1968). For comparison, on 27 September 2007 when Dawson visited Sale (a Wasonjo settlement 45 km NW of Lengai), there were no signs of ashfall; during the July 1967 eruption, there was ashfall at Arusha (110 km SE) and at Wilson airfield, Nairobi (190 km NE) (Dawson and others, 1995). Natrocarbonatite lava in the gully immediately S of the climbing track (the overflow from the crater extruded roughly 25 March-5 April 2006, *BGVN* 32:02) was of two types; (a) a pahoehoe flow containing entrained blocks of wollastonite nephelinite, that was overlain and mainly buried beneath (b) a later aa flow that extended 3 km from the crater. On the upper SE slopes, ~ 200-300 m below the rim of the S crater, there had been extrusion of a short, thin, then-whitened natrocarbonatite flow; flank eruptions are unusual at Lengai.

Mitchell and Dawson collected ash samples on 24 September and subsequently described them as follows. "The lapilli contain nuclei of nepheline, clinopyroxene, Ti-melanite and wollastonite, collectively wollastonite ijolite, probably xenocrystic. Wollastonite and clinopyroxene are replaced by combeite. However the mantling ash consists of nepheline, melilite, combeite ($Na_2Ca_2Si_3O_9$), a Na-Ca carbonate-phosphate, Mn magnetite, and a K-Fe sulphide in a volumetrically-insignificant (less than 5%) sodium carbonate matrix. In lacking clinopyroxene the mantling ash is not nephelinite or melilitite, and is unlike any other magma type previously recorded from the volcano. The mantling ash is interpreted as a hybrid magma formed when nephelinite interacted with natrocarbonatite magma, forming combeite and melilite at the expense of clinopyroxene. The resulting decarbonation reaction released the CO_2 that drove the eruption." Mitchell added that the ash seemed to be an extreme variant of the 1996 ash.

Activity during October-November 2007. On his website, Belton reported that Leander Ward saw lightning in some of the ash clouds in the early morning of 16 October 2007. Ward observed that the ash cone then dominated the entire active crater and appeared to have grown significantly in diameter; no other cones were visible. Charter pilot Kathy Moore reported an eruption on 19 October around 0830, sending plumes of smoke and ash into the atmosphere to an altitude of ~ 7.6 km. The plume was visible for ~ 160 km, but the eruption (one large blast followed by a smaller one) lasted only for a few minutes. Within half an hour the large cloud of ash had dispersed and only smaller clouds remained close to the mountain.

Tim Leach, owner of Lake Natron Camp on the S shore of Lake Natron, reported on 4 November that the ash eruption continued on a daily basis. His crew had occasionally seen night-time "lava eruptions." Leach advised against climbing the active crater and stated that they were working on developing safer routes terminating in the inactive S Crater. One difficult route that has been climbed twice from the Kerimasi side was vegetated in September, but by the end of October it was ash covered.

Michael Dalton-Smith reported that as of 10 November activity continued. From a distance he saw constant "smoke" rising 300-600 m above the summit. At one point it appeared that a light colored but strong ash cloud formed a column, but it was difficult to tell for sure due to clouds. Jean-Claude Tanguy sent an aerial photograph (figure 18) taken by Maxime Le Goff on 23 November 2007 that showed pronounced changes in the active crater. A large crater had clearly developed in the center of the N crater and the complex array of hornitos nearly all buried in ash were not in evidence.

Figure 18. Aerial photograph of Ol Doinyo Lengai looking S toward the volcano's summit. A new crater sits amid the tephra-mantled N crater. Gone are the array of hornitos present for years. Taken 23 November 2007 by Maxime Le Goff. Provided by Jean-Claude Tanguy.

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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 S 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.

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