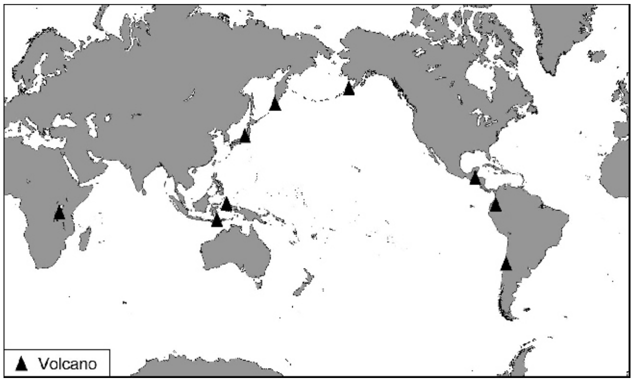
Bulletin of the Global Volcanism Network



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

Pacaya

Guatemala
14.381°N, 90.601°W; summit elev. 2,552 m
All times are local (= UTC - 6 hours)

Our last *Bulletin* report discussed events at Pacaya as late as September 2005 (*BGVN* 30:10). Starting in 2005, lava flows from the active cone (MacKenney cone) substantially altered the local morphology and the consequent risks. The larger Pacaya complex's SW side is marked by an arcuate collapse scarp with relief up to 200 m. In 2005, for the first time, lavas accumulated in sufficient thickness to cross the NE portion of this barrier. If lavas advance substantially N from this point, they would descend steep slopes and could endanger hikers and residents.

Gustavo Chigna, of the Instituto Nacional de Sismologia, Vulcanologia, Meteorología, e Hidrologia (INSIVUMEH), mapped the substantial lava field N of the summit in 2008. In places, the flows that accumulated during 2005-08 reached 100-150 m thick (figure 1). The flows chiefly emerged from a new fissure on the upper NNE flank, constructing a protrusion from the MacKenney cone. As the lavas advanced they curved W, many ultimately reaching the N to NW sides of the active cone. Material venting within that crater sometimes formed small ephemeral cones that reached above the high point on the enclosing crater rim, but they always collapsed later.

About 1,100 years ago Pacaya's SW side underwent a sector collapse, an event where a major part of the edifice collapsed, forming a debris avalanche that reached the Pacific coastal plain (Siebert and others, 2006). The edifice still bears an enormous scarp from this event. Within the horseshoe curve of this scarp, the MacKenney cone subsequently grew. It eventually rose to sufficient height to form the summit of the multi-peaked complex.

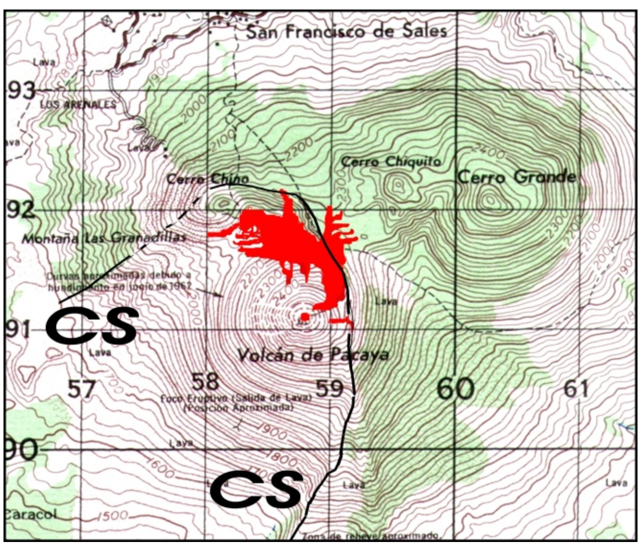

Figure 1. A topographic map of the Pacaya area from 1970 annotated to show lava flows emitted during 2005 through mid-2008. From a new fissure on the upper NNE flank, flows curved W, many reaching the N to NW sides of the active MacKenney cone (labeled "Pacaya"). Lava accumulated in the depression between the MacKenney cone to the S, the Cerro Chiquito and Cerro Grande cones to the N and NE, and the Cerro Chino cone to the NW. Between the latter three cones lies a comparatively flat area informally called *la meseta*; lava flows had crossed substantial portions of this area by 2006. Eruptions also deposited some lava on the cone's E side and in MacKenney crater. The upper margin of the collapse scarp (CS) is also indicated (light line). Ruled squares are 1 km to a side; heavy contours are 100 m. Courtesy of Gustavo Chigna.

Although thick, rough-surfaced lava has emerged for years from the MacKenney cone to flow in various directions downslope, those during 2005-06 advanced in a new and unexpected way. In a manner similar to previous episodes, some of the N-flowing lavas descended into the depression and were confined to curve around the moat. In contrast, other lavas cooled and accumulated sufficiently to fill this portion of depression. The lavas ultimately overtopped the collapse scarp, and flowed onto the ancestral cone (figures 1 and 2).

Since restarting after about 76 years in 1961, the volcano has erupted lavas with only occasional breaks of months to a few years. The latest eruptive pulse began in 2004. The summit elevation of the MacKenney cone has varied due to the cone's repetitive growth and construction.

MODIS thermal alerts from the MODVOLC website were issued frequently for Pacaya during the reporting interval. The only months without alerts took place during the six-month interval of September 2005-February 2006, and December 2006. More precisely, these gaps in alerts spanned 29 August 2005-10 March 2006 and 29 November 2006-23 January 2007 (all local dates).

Figure 2. (top) A view in 2005 from Pacaya's summit (on the MacKenney cone) looking to the N with Cerro Grande the largest peak in view. Heavy tephra fall deposits covered the landscape in the field of view, the result of many years of Strombolian activity. At this stage the collapse scarp (steep ridge across the bottom third of the photo) still formed a significant topographic boundary. Activity during the photographer's visit was only fumarolic. (bottom) Night image of the same scene in December 2007; here the collapse scarp is absent, owing to inundation of the area by viscous rubbly lava. The narrow fingers of lava at distance reside on the *meseta*. Photos courtesy of Richard Roscoe (www.photovolcanic.com).

Figure 3. (top) Steaming MacKenney cone at Pacaya as viewed looking S from the main trail in 2005 from an area just below and S of the *meseta*. Note bending tree and structure(s) along depression in foreground. (bottom) Very similar view taken in December 2007. A large lava cone had formed on the N flank of MacKenney and lava flows had reached the trail during 2006 and 2007. The beleaguered tree still stands. Photos courtesy of Richard Roscoe (www.photovolcanic.com).

Figure 4. Nighttime (time-lapse) views of Pacaya's MacKenney cone as seen looking W in December 2007. (top) Summit incandescence and lava flows emerging from the cone's N flank. The latter constructed a lava cone that supported additional lava flows. (bottom) Flat-topped, antenna-laden Cerro Chino of the Pacaya complex is at lower right, and at distance in background from right to left reside Agua, Acatenango, and Fuego stratovolcanoes. Photos courtesy of Richard Roscoe (www.photovolcanic.com).

Pacaya resides just outside the southern topographic rim of Amatitlán caldera and ~ 30 km S of central Guatemala City (Lima and others, 2000). Maps of the setting and volcano appeared here most recently in *BGVN* 24:02 and 25:01. The National Park that includes Pacaya was created in July 1963 and it is a popular tourist destination (Bohnenberger, 1967). The trail along and to the *meseta* was crossed by lava flows during 2006 and later, hampering access and leading to risk concerns (figures 3-5).

INSIVUMEH reports. Gustavo Chigna (INSIVUMEH) sent a report summarizing activity during 2005 through May 2008. He noted Strombolian activity during 1961-2000, typically with two to three paroxysmal eruptions each year. Those eruptions included falls of both ash and ballistic blocks, production of lava flows, and abundant gases escaping at the vent in the MacKenney cone's central crater. Pyroclastic flows were also mentioned, but without details. This eruptive pattern changed in the year 2000. The paroxysmal eruptions of January 2000, and 29 February 2000, and those continuing until September 2008 all chiefly consisted of steam-rich and ash-poor explosions.

During January-March 2005 a new phase of activity developed where the active cone emitted small batches of lava. This phase accompanied the repeated building and destruction of intracrater cones.

Observers in March-April 2005 saw the growth of N-S oriented cracks on the MacKenney crater, reaching 100-150 m in length and sometimes longer. Many of the cracks were 30-70 cm wide at the surface, and inspection revealed their open portions penetrated downwards about 1-8 m. Associated with these cracks, a depression became established on MacKenney cone's N side.

Figure 5. Daytime view of Pacaya's descending lava flows heading N on the shield area, 4 June 2006. The ribbon of lava trends remained linear, despite the flow field's surface irregularity. The margins appear partly contained by levees. Numerous other zones of glowing lava reside in the distance at lower elevation. Photo by AnaLu de MacVean.

A new vent began emissions during a few days in mid-March and on 1 April 2005. Lava emerged from cracks on the cone's ENE side. In just a few days, the flow field from this vent grew to ~ 800 m long (figure 1). It curved to the W following the moat or valley floor (a comparatively flat area also called *los llanos*). By about 1 August 2005 this venting had sent many lava flows into the adjacent parts of the depression on the MacKenney cone's N flank. The rapid rate of lava accumulation during August filled up much of this part of the depression and eventually overtopped the scarp.

As the flows began to advance over the collapse scarp, alarm spread among residents of San Francisco de Sales, the town 1 km N of the flow front. The flows soon returned to advancing more to the W in the area confined by the collapse scarp and in the depression along *los llanos*.

The following year, after the 29 August 2005 and 10 March 2006 interval without thermal alerts, lava advanced onto a higher part of the *meseta* adjacent to a monument. This event is documented in two photos taken 27 July and 3 August (figure 6). Photos taken in August 2006 of the *meseta* show that the trail largely flow-covered (figure 7).

The lava amassed between the MacKenney cone and *meseta* represented a rapid and remarkable morphologic change. *Meseta* historically provided an elevated viewpoint from which observations of Pacaya could be made. As a result of the new morphology, and assuming similar ongoing eruptions, hazards now confront N-flank villages and the main trail access route. INSIVUMEH plans to review hazard maps and strategies for this area.

Geologic Summary. Eruptions from Pacaya, one of Guatemala's most active volcanoes, are frequently visible from Guatemala City, the nation's capital. Pacaya is a complex basaltic volcano constructed just outside the southern topographic rim of the 14 x 16 km Pleistocene Amatitlán caldera. A cluster of dacitic lava domes occupies the southern caldera floor. The post-caldera Pacaya massif includes the Cerro Grande lava dome and a younger volcano to the SW. Collapse of Pacaya volcano about 1,100 years ago produced a debris-avalanche deposit that extends 25 km onto the Pacific coastal plain and left an arcuate somma rim inside which the modern Pacaya volcano (MacKenney cone) grew. A subsidiary crater, Cerro Chino, was constructed on the NW somma rim and was last active in the 19th century. During the past several decades, activity at Pacaya has consisted of frequent strombolian eruptions with intermittent lava flow extrusion that has partially filled in the caldera moat and armored the flanks of MacKenney cone, punctuated by occasional larger explosive eruptions that partially destroy the summit of the cone.

Figure 6. Cooled lava flows from Pacaya as seen looking along the collapse scarp to the S on (top) 27 July 2006 and (bottom) 3 August 2006. The MacKenney cone is out of the picture to the right. The flows on 27 July had nearly completely filled the depression N and NE of the *meseta*. By 3 August a flow crossed onto the *meseta*. Courtesy of Gustavo Chigna.

Figure 7. Two photos of Pacaya looking SE showing lava flows advancing across the *meseta*. (top) A flow lobe lay across the main trail on 8 August 2006. (bottom) Visitors confronting a new scene on 11 August 2006 at the *meseta* where the former trail was largely covered by rough-surfaced lava flows. Courtesy of Gustavo Chigna.

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Reventador

Ecuador
0.077°S, 77.656°W; summit elev. 3,562 m
All times are local (= UTC - 5 hours)

Eruptions from Reventador (figure 8) occurred between March and May 2007, and an ash plume was reported in October 2007. The eruptions were characterized by steam-and-ash plumes that rose to altitudes as high as 7.6 km, thermal anomalies on satellite imagery, roaring noises, and a small lava flow (*BGVN* 33:03 and 33:04).

MODVOLC thermal alerts were issued on 28 and 31 July 2008 (local dates). Mapping of the MODIS anomaly locations indicated that thermally radiant material was within the crater (no anomalies outside the crater).

According to the Instituto Geofísico-Escuela Politécnica Nacional (IG), seismic activity showed a progressive and constant increase from the beginning of July. The number of earthquakes per day were the greatest on 24 and 25 July. On 27 July continuous seismic tremor was followed by incandescence around the crater. Thermal anomalies were also identified on satellite imagery. In the evening, explosions produced ash plumes and ejected incandescent material that rolled down the flanks. On 28 July ash plumes rose to altitudes of 4-6 km and drifted NW and W; ashfall was reported in Olmedo, ~ 50 km NW. On 29 July, ash-free steam plumes rose from the crater and drifted NW, and a sulfur smell was noted near the volcano. A lava flow directed S from the caldera halted but the location of the flow front was ambiguous in the reporting.

According to the IG, seismicity from Reventador decreased during 30-31 July, and remained low thereafter. A lava flow within the caldera was observed. On 31 July, steam-and-gas plumes with a low ash content were detected on satellite imagery and drifted W and SW. On 1 August, steam-and-gas plumes were emitted and a lava flow in the caldera was noted. Diffuse ash emissions were noted on 2 August. On 3 August, IG scientists observed the lava flow in the caldera and estimated that it advanced at a rate of 100 m per day. They also heard sporadic roaring noises.

Figure 8. Map of Ecuador showing Reventador and selected other volcanoes. Courtesy of USGS.

On 2 August, the Washington Volcanic Ash Advisory Center (VAAC) began to advise that light ash and gas was being emitted. An occasional hotspot was observed on 3 August. By 4 August, the VAAC reported that emissions had ceased and seismicity was decreasing.

According to the IG, during 5-8 August, gas-and-steam plumes were noted. By 7 August the lava flow had ceased. On 8 August, incandescence from the crater was observed at night. There were no further reports through 1 October.

During July-August 2008 the government did not believe the risk to human health was sufficient to increase the alert status or evacuate the residents. However, officials activated some emergency responses in nearby towns.

Geologic Summary. Reventador is the most frequently active of a chain of Ecuadorian volcanoes in the Cordillera Real, well E of the principal volcanic axis. The forested, dominantly andesitic Volcán El Reventador stratovolcano rises to 3,562 m above the jungles of the western Amazon basin. A 4-km-wide caldera widely breached to the E was formed by edifice collapse and is partially filled by a young, unvegetated stratovolcano that rises about 1,300 m above the caldera floor to a height comparable to the caldera rim. Reventador has been the source of numerous lava flows as well as explosive eruptions that were visible from Quito in historical time. Frequent lahars in this region of heavy rainfall have constructed a debris plain on the eastern floor of the caldera. The largest historical eruption at Reventador took place in 2002, producing a 17-km-high eruption column, pyroclastic flows that traveled up to 8 km, and lava flows from summit and flank vents.

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pramon@igepn.edu.ec, URL: http://www.igepn.edu.ec); *Washington Volcanic Ash Advisory Center*, 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/).

Llaima

Central Chile
38.692°S, 71.729°W; summit elev. 3,125 m
All times are local (= UTC - 4 hours)

Our previous report on Llaima (*BGVN* 33:06) described eruptions, tremor, and ash plumes between January-April 2008. This report discusses activity during June-September 2008, including a new eruption beginning 1 July. No reports of activity were received during May 2008.

During 1-20 June 2008, the Southern Andes Volcanological Observatory of the Chile National Service of Geology and Mining (OVDAS-SERNAGEOMIN) reported that sporadic gas-and-ash plumes were observed. More frequent and continuous gas emissions rose from the nested cone in the main crater, and steam plumes rose from the W flank toward the end of this time period.

During 13-16 June, seismicity increased. The National Bureau of Emergency of the Chile Ministry of Interior (ONEMI) reported that, during an overflight on 26 June, bluish gas and ash rose from the top of an active pyroclastic cone and the NE flank no longer was covered with snow.

July 2008 was characterized by several episodic seismic events, followed by periods of relative quiet. On 1 July, a lava flow on the W flank prompted authorities to evacuate about 20-30 people and warn others that additional evacuations might be necessary. The volcano alert level was raised to Yellow (the middle level on a 3-level color system). A lava flow, described as incandescent, descended 800-1000 m along the W flank of the crater, raising concern for lahars in the Calbuca River (figure 9).

During the first week of July, gas-and-ash plumes were emitted from the summit, and the main crater emitted vapor plumes and bluish gas. Fine ashfall was reported in areas nearby, and lahars were generated. On 2 July, an explosion from the summit ejected material to an altitude of 1 km which landed on the SW flank and up to 3.5 km away on the SE flank. OVDAS-SERNAGEOMIN observed incandescence from the 1-km-long lava flow on the W flank. An overflight revealed cooled blocks at the end of the lava flow and a second lava flow (on the SW flank) about 150 m S of the first. The lava flows issued from the base of a pyroclastic cone in the main crater. On 3 July, another overflight revealed that the lava flow on the W flank had advanced and generated a small lahar where lava melted ice on the volcano flanks (figure 10). On 4 July, OVDAS-SERNAGEOMIN characterized the eruptive style as weakly strombolian. A small explosion from the pyroclastic cone in the main crater produced an ash plume that rose 250-400 m and drifted 50 km SE. During 4-5 July, observers reported sporadic explosions and incandescence at the summit. On 6 July seismicity decreased to low levels.

By 7 July the lava emission rate had decreased. At that time, the lava flow on the W flank was about 1.6 km long and the flow on the SW flank was about 2 km long. A new eruptive phase occurred on 10 July (figure 11) when a vigorous Strombolian eruption ejected incandescent pyroclastic material from two vents in the main crater to heights of 500 m above the summit, throwing bombs to the E, NE, and S. Strong activity continued for almost three hours before decreasing. Medium to coarse ash (up to 1.5 mm in diameter) fell in Melipeuco, and lava flows moved toward the W and S flanks. Poor weather prevented observations during the next days.

On 14 July another episode of increased seismicity accompanied an ash plume that rose to an altitude of 5.6 km. Very intense orange and red incandescence was seen near the summit and at the base of the W flank through breaks in the cloud cover. Later that day, a vigorous strombolian eruption ejected incandescent pyroclastic material from the N crater within the main crater to heights of 500 m above the summit. Seismicity and the intensity of the explosions decreased later that day. On 15 July, diffuse ash emissions rose to an altitude of 3.4 km. Ash and tephra covered areas of the SSE flank.

Figure 9. From the far SW of the main crater of Llaima a thin stream of lava emanated at a low emission rate on 1 July 2008. At the same time, emanations of continuous volcanic gases and water vapor came from a pyroclastic cone located in the main crater at the top. Courtesy of OVDAS-SERNAGEOMIN.

Figure 10. A lahar generated from a Llaima lava-flow front that caused ice melting. The lahar expanded into several arms at the front of the wash on the plains of the W flank at an elevation of 1,800 m. Courtesy of OVDAS-SERNAGEOMIN.

Figure 11. The eruptive phase of Llaima of 10 July 2008 as seen from El Manzano (SW). A strong explosion occurred 0555 hr, and three lava flows were observed. Courtesy of Victor Hazeldine.

Seismicity decreased during 16-18 July 2008, but increased again on 19 July. Ash-and-gas plumes rose to an altitude of 3.3 km and drifted SE. The emissions became more intense and frequent. An explosion expelled one ash plume to an altitude of 4.1 km. Ash and tephra fell on the SE flank and in areas near the volcano, and constant explosions ejected incandescent material 500 m above the summit. Steam plumes and lava flows were also observed. Cloud cover prevented observations during 22-23 July.

Another eruptive episode occurred during 26-27 July for a period of 11.5 hours. During that time, Strombolian activity intensified and ejected material 500-800 m above the crater. Rhythmic explosions ejected spatter 1 km above the summit and up to 2 km E. Area residents heard “detonations” from the direction of the volcano. Observers noted gas-and-ash plumes, steam plumes, and a bluish gas emission. One plume rose to an altitude of 10 km. Lava flows emitted at a high rate descended the W and S flanks, producing steam plumes upon contact with ice. This activity prompted SERNAGEOMIN to raise the alert level to Red.

During 28 and 29 July, the volcano was calm, although fumarolic activity and sulfur dioxide plumes were observed. On 31 July, fumarolic activity from the crater was reported in multiple areas around the volcano. Scientists from OVDAS-SERNAGEOMIN observed fumarolic activity from the edges of the nested cones in Llaima’s main crater during overflights on 29 July. Sulfur dioxide (SO_2) plumes rose from an area in the E crater. Tephra deposits covered parts of the SE flank. Cooled lava flows emitted on 26 and 27 July were noted on the W flank. On 31 July, fumarolic activity from the crater was reported in multiple areas around the volcano. Cloudy conditions prevented visual observations during 1-2 August. On 2 August, as a result of decreased seismic activity, SERNAGEOMIN reduced the volcano alert level to Yellow.

OVDAS-SERNAGEOMIN reported during 8-11 August that fumarolic activity from the snow-free pyroclastic cones in Llaima’s main crater was visible during periods of clear weather. Plumes drifted E. A 2-km-long strip on the NE flank was also black in color (snow-free) due to elevated temperatures. On 13 August, gas-and-ash plumes rose to an altitude of 3.3 km and drifted E. Later that day, crater incandescence accompanied the ash emissions.

Steam plumes from the pyroclastic cones in Llaima’s main crater were visible during periods of clear weather on 16 August. Evaporation plumes rose from the W flank where lava flows were active in both February and July

Figure 12. Gas emissions, mainly water vapor, rose from the craters at Llaima during 5-7 September 2008. Courtesy of OVDAS-SERNAGEOMIN.

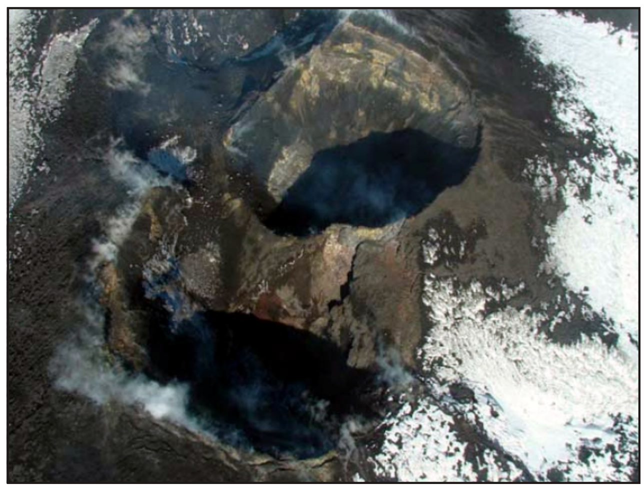

Figure 13. An aerial photograph on 12 September 2008 showed the two nested craters within Llaima’s main crater. Weak emissions of water vapor and gases emanated from the outer edges of the craters. Courtesy of OVDAS-SERNAGEOMIN.

Date	Time (UTC)	Pixels	Satellite
01 Jul 2008	0625	1	Aqua
02 Jul 2008	0355	3	Terra
02 Jul 2008	0530	2	Aqua
02 Jul 2008	1455	2	Terra
03 Jul 2008	0435	3	Terra
03 Jul 2008	0615	3	Aqua
03 Jul 2008	1540	2	Terra
03 Jul 2008	1815	1	Aqua
04 Jul 2008	0340	2	Terra
19 Jul 2008	1815	1	Aqua
27 Jul 2008	0345	3	Terra

Table 1. Thermal anomalies measured at Llaima during July 2008. No anomalies were measured by the MODIS/MODVOLC satellite thermal alert system during June 2008 or from 28 July-1 October 2008. This table is a continuation of the tables from *BGVN* 33:01 and 33:06. Courtesy of HIGP Thermal Alerts System.

2008. On 17 August, sporadic gas-and-ash emissions were observed. Cloud cover prevented observations during 18-20 August. On 21 August, three explosions produced ash plumes that rose to an altitude of 3.6 km and drifted E. Gas and steam was emitted between explosions, and resultant plumes rose to an altitude of 3.4 km and drifted 9 km E. During an overflight, scientists observed steam-and-gas plumes rising from a small crater in the N sector of the main crater. A larger crater, about 100 m in diameter, in the central sector emitted ash. The ash plumes rose to an altitude of 3.4 km and drifted E. A thin layer of ash blanketed the E flank. Ash-and-gas plumes from the main crater drifted W on 22 August. On 23 August, observers reported that incandescent material was ejected less than 1 km above the crater. The next day, an ash plume drifted about 1.5 km SSE. Ash blanketed some areas of the flanks.

Explosions were heard during 25-28 August. On 28 August, seismometer records indicated that gas-and-ash plumes were possibly emitted from the pyroclastic cones in the main crater. Clouds prevented visual observations of Llaima during 29 August-2 September. On 3 September, fumarolic plumes that originated from three points on the pyroclastic cones in the main crater were observed to drift N. An explosion produced an ash plume that also drifted N; ash deposits on the N flank suggested previous emissions. On 4 September gas plumes from the main crater drifted W. Gas-and-steam plumes were emitted during 5-7 September (figure 12).

On 10 September 2008 the volcano alert level for Llaima was lowered to Green due to decreased seismicity and no major emissions. During an overflight on 12 September, OVDAS-SERNAGEOMIN scientists observed diffuse gas-and-steam plumes emitted from the external edges of the nested craters in the main crater (figure 13). During 13-22 September, observers in Melipeuco (about 17 km SSE) reported sporadic gas-and-steam plumes coming from the main crater. During an overflight on 21 September, steam emissions were noted from the NE and W flanks.

Thermal Anomalies. Thermal anomalies at Llaima were measured by satellite-based MODIS/MODVOLC instruments and algorithm (table 1). Anomalies were not observed during the 10 July or 14 July seismic events, perhaps because of poor weather conditions.

Summary of 2007-08 eruptive cycle. In September 2008, OVDAS-SERNAGEOMIN issued a synthesis of the 2007-08 eruptive cycle. The cycle, beginning 26 May 2007, consisted of eight eruptive phases (table 2). Seismic energy was high in phases 5 and 7, but low in phases 6 and 8 (figure 14). Seismic pulses in phase 7 (figure 15) corresponded with lava emissions.

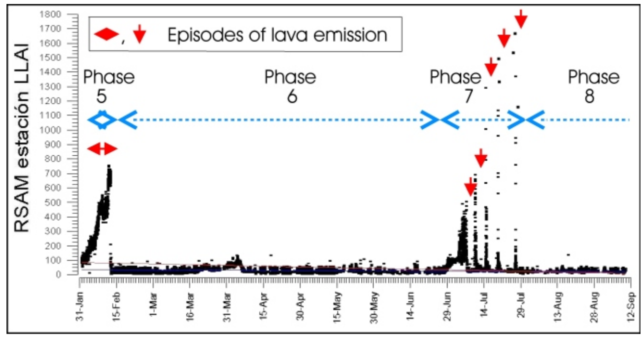

Figure 14. Seismic energy in units of RSAM released by Llaima during 31 January-12 September 2008. Downward facing arrows indicate episodes with lava emission; horizontal lined arrows indicate the duration of four eruptive phases (5-8). [Note: RSAM (Real-time Seismic-Amplitude Measurement) sums up the signals from all seismic events during 10-minute intervals to provide a simplified but very useful measure of the overall level of seismic activity for meaningful communication to the public (Ewert and others, 1993)]. Courtesy of OVDAS-SERNAGEOMIN.

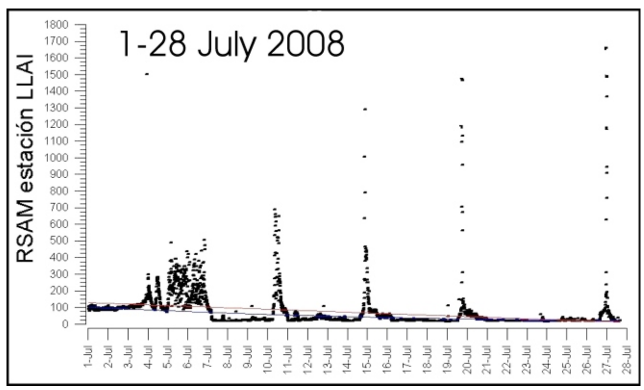

Figure 15. Summary of the released seismic energy in units of RSAM during the five eruptive episodes of Phase 7 of Llaima in July 2008. Courtesy of OVDAS-SERNAGEOMIN.

Eruptive Phase	Date Range	Brief summary of Llaima's behavior
Phase 1	26 May 2007-31 Dec 2007	Characterized by the start of seismic and visual anomalies (*BGVN* 33:01).
Phase 2	01 Jan 2008-02 Jan 2008	Began with a sudden strombolian eruption in the main crater and events that culminated after ~12 hours of intense activity (*BGVN* 33:01 and 33:06).
Phase 3	02 Jan 2008-21 Jan 2008	Consisted of explosions, ash emissions and pyroclastic flows (*BGVN* 33:01 and 33:06).
Phase 4	21 Jan 2008-02 Feb 2008	Included moderate reactivation of the strombolian phase with formation of a small lava lake in the main crater, growth of the internal cone, and formation of several eruptive centers (*BGVN* 33:01 and 33:06).
Phase 5	02 Feb 2008-13 Feb 2008	Characterized by a calm lava emission and some small explosions within the internal pyroclastic cone (*BGVN* 33:01 and 33:06).
Phase 6	13 Feb 2008-01 Jul 2008	Saw noticeable change in the activity of the volcano, characterized by the lack of significant seismic activity and emissions (*BGVN* 33:06).
Phase 7	01 Jul 2008-27 Jul 2008	Included the following five eruptive episodes (figure 15) with brief periods of calm (weak emissions of ash and/or gases): 1) 1-7 July, emissions and small lahars, 2) 10 July, strombolian eruption and lava emission, 3) 14 July, strombolian eruption and lava emission, 4) 19 July, strombolian eruption and lava emission, and 5) 26 July, a vigorous strombolian eruption with a high rate of lava emission.
Phase 8	27 Jul 2008-10 Sep 2008	Characterized by sporadic weak ash ejection, pyroclastic cones nested in the main crater continued to give off weak gas emissions. Seismic energy levels as of August 2008 remained low.

Table 2. Llaima eruptive phases 1-8 and their date ranges as defined by OVDAS-SERNAGEOMIN. The table highly compresses the phases previously described in the *Bulletin* and presents more details for the phases 7 and 8. Courtesy of OVDAS-SERNAGEOMIN.

Reference. Ewert, J.W., Murray, T.L., Lockhart, A.B., and Miller, C.D., 1993, Preventing Volcanic Catastrophe: The U.S. International Volcano Disaster Assistance Program: Earthquakes and Volcanoes, v. 24, no.6.

Geologic Summary. Llaima, one of Chile's largest and most active volcanoes, contains two main historically active craters, one at the summit and the other, Pichillaima, to the SE. The massive 3,125-m-high, dominantly basaltic-to-andesitic stratovolcano has a volume of 400 cu km. A Holocene edifice built primarily of accumulated lava flows was constructed over an 8-km-wide caldera that formed about 13,200 years ago, following the eruption of the 24 cubic km Curacautín Ignimbrite. More than 40 scoria cones dot the volcano's flanks. Following the end of an explosive stage about 7,200 years ago, construction of the present edifice began, characterized by strombolian, hawaiian, and infrequent subplinian eruptions. Frequent moderate explosive eruptions with occasional lava flows have been recorded since the 17th century.

Information Contacts: *OVDAS-SERNAGEOMIN (Observatorio Volcanológico de los Andes del Sur-Servico Nacional de Geologia y Mineria; Southern Andes Volcanological Observatory-National Geology and Mining Service),* Avda Sta María No. 0104, Santiago, Chile (Email: oirs@sernageomin.cl, URL: http://www2.sernageomin.cl/ovdas/); *NASA Earth Observatory* (URL: http://earthobservatory.nasa.gov/); *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/); *Oficina Nacional de Emergencia (ONEMI)*, Ministerio del Interior, Chile (URL: http://www.onemi.cl/).

Egon

Lesser Sunda Islands, Indonesia
8.67°S, 122.45°E; summit elev. 1,703 m

The Center of Volcanology and Geological Hazard Mitigation (CVGHM) indicated that after the 28 January 2004 eruption of Egon, phreatic eruptions often occurred without preceding increases in seismicity. Eruptions reported during July, August, and September 2004, and during February 2005 occasionally resulted in evacuations.

During 4-14 April 2008 visual observations showed daily white plumes rising to an altitude of 1.8 km. This activity was considered to be normal. A peak in seismicity was reached during 6-7 April but then declined significantly through 15 April. On 15 April a phreatic explosion produced an ash plume that rose to an altitude of 5.7 km and drifted ~ 25 km W, reaching Maumere City, the capital of Flores. The emissions were accompanied by thunderous noise. A team of emergency personnel in the closest village to the explosion reported that about 600 people evacuated from three villages. No fatalities were reported.

During 15 April to 10 May, earthquakes declined in number. The altitudes of "eruption plumes" became smaller during the later half of April: on 20, 24, and 28 April, plumes rose to altitudes of 3.7 km, 2.6 km, and 1.8 km, respectively, although the character of the plumes was not described. During 27 April-13 May instruments measuring deformation indicated a return to background rates. Diffuse white plumes rose above the summit on 12 May. Communities on the W flank within 1 km of the peak remained on high alert due to the presence of gasses and the possibility of future phreatic eruptions.

A search of the MODVOLC website found there were no thermal alerts for Egon during this report's time frame.

Geologic Summary. Gunung Egon volcano sits astride the narrow waist of eastern Flores Island. The barren, sparsely vegetated summit region has a 350-m-wide, 200-m-deep crater that sometimes contains a lake. Other small crater lakes occur on the flanks of the 1703-m-high volcano. A lava dome forms the southern 1671-m-high summit. Solfataric activity occurs on the crater wall and rim and on the upper southern flank. Reports of historical eruptive activity prior to explosive eruptions in 2004 were inconclusive. A column of "smoke" was often observed above the summit during 1888-1891 and in 1892. Strong "smoke" emission in 1907 reported by Sapper (1917) was considered by the Catalog of Active Volcanoes of the World (Neumann van Padang, 1951) to be an historical eruption, but Kemmerling (1929) noted that this was likely confused with an eruption on the same date and time from Lewotobi Lakilaki volcano.

Information Contacts: *Center of Volcanology and Geological Hazard Mitigation*, 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), University of Hawai'i, 2525 Correa Road, Honolulu, HI 96822, USA (URL: http://hotspot.higp.hawaii.edu/).

Dukono

Halmahera, Indonesia
1.68°N, 127.88°E; summit elev. 1,335 m
All times are local (= UTC + 9 hours)

Thermal anomalies at Dukono were reported on nine days between 10 August and 27 October 2007 and an ash plume occurred in June 2007 (*BGVN* 32:10). This report discusses activity from late November 2007 through early October 2008.

MODIS-MODVOLC thermal alerts were recorded on 12 December 2007 and 31 January 2008. Between 31 March and 24 April 2008 the Center of Volcanology and Geological Hazard Mitigation (CVGHM) reported incandescence at the summit. On 25 April, incandescent material was ejected 25 m above the summit. Seismicity increased during 30 April-2 May.

On 25 May, an ash plume rose to an altitude of 1.4-2.1 km and was accompanied by thunderous and booming sounds. An ash plume on 29 May rose to an altitude of 2.3 km and again was accompanied by thunderous and booming sounds. The Alert Level was raised to 3 (on a scale of 1-4). Residents and visitors were not permitted within 3 km of the summit. Satellite imagery detected hotspots through 26 May 2008 (table 3).

According to the CVGHM, during 30 May-12 June, seismicity decreased and white plumes were observed at al-

Date	Time (UTC)	Pixels	Satellite
12 Dec 2007	1710	1	Aqua
31 Jan 2008	1700	1	Aqua
06 Apr 2008	1645	1	Aqua
17 Apr 2008	1330	1	Terra
06 May 2008	1700	1	Aqua
26 May 2008	1340	1	Terra
26 May 2008	1635	2	Aqua

Table 3. Thermal anomalies at Dukono based on MODIS-MODVOLC imaging between 27 November and 6 October 2008 (continued from the lists in *BGVN* 32:03 and 32:10). Courtesy of Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System.

Date (UTC)	Plume Altitude	Plume Direction
25-27 Jul 2008	3 km	W
19 Aug 2008	2.4 km	W
24 Aug 2008	2.7 km	NW
26 Aug 2008	1.5 km	W, WNW
02 Sep 2008	Low-level (not specified)	WNW
10 Sep 2008	—	SW
11 Sep 2008	1.5 km	NW
12 Sep 2008	1.5 km	NW
23 Sep 2008	1.8 km	NE
24 Sep 2008	1.8 km	NE

Table 4. Ash plumes reported from Dukono during 25 July-6 October 2008 (UTC). Data from the Darwin Volcanic Ash Advisory Centre.

titudes of 1.4-1.8 km when clouds did not inhibit observations. Because of decreased seismic activity, on 13 June the Alert Level was decreased to 2. Residents and visitors were not permitted within 2 km of the summit.

No further reports were issued by CVGHM through 6 October 2008. However, the Darwin Volcanic Ash Advisory Centre reported that satellite imagery had detected ash plumes during 25 July-6 October (table 4).

Geologic Summary. Reports from this remote volcano in northernmost Halmahera are rare, but Dukono has been one of Indonesia's most active volcanoes. More-or-less continuous explosive eruptions, sometimes accompanied by lava flows, occurred from 1933 until at least the mid-1990s, when routine observations were curtailed. During a major eruption in 1550, a lava flow filled in the strait between Halmahera and the north-flank cone of Gunung Mamuya. Dukono is a complex volcano presenting a broad, low profile with multiple summit peaks and overlapping craters. Malupang Wariang, 1 km SW of Dukono's summit crater complex, contains a 700 x 570 m crater that has also been active during historical time.

Information Contacts: *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/); *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), University of Hawai'i, 2525 Correa Road, Honolulu, HI 96822, USA (http://hotspot.higp.hawaii.edu/).

Asama

Honshu, Japan
36.403°N, 138.526°E; summit elev. 2,568 m
All times are local (= UTC + 9 hours)

Our last report on Asama (*BVGN* 30:02) discussed an eruption on 14 November 2004. Seismicity on 8 August 2008 prompted JMA (Japan Meteorological Agency) to raise the alert level from 1 to 2. Three small eruptions followed in the next few days.

On 10 August, Asama erupted at 0237 and emitted an ash cloud that rose ~ 400 m above the crater and drifted SE. A second eruption occurred on 11 August. An ash plume rose ~ 200 m above the crater rim and drifted S. The Tokyo Volcanic Ash Advisory Center reported that the 10 and 11 August eruption plumes extended to an altitude of 3 km and drifted SE and S, respectively.

On 12 August, scientists from ERI climbed to the summit and collected ash samples at the SW rim of the crater. The thickness was less than 5 cm. Under the microscope the ash contains about 10% black or dark brown glass.

The third eruption occurred on 14 August at 0759; the ash plume rose to ~ 400 m above the crater rim. The Tokyo VAAC again reported that plumes extended to an altitude of 3 km and drifted S.

According to Keisuke Kanda, an official observer in a hut ~ 2 km from the summit, no explosive sounds were heard there during the three eruptions. The hut is maintained by Komoro City for hikers. Kanda, a city worker, stays at the hut almost 365 days a year.

A red glow on the summit crater was occasionally observed by web-cameras during the night. These events did not trigger MODVOLC thermal alerts.

Geologic Summary. Asama, Honshu's most active volcano, overlooks the resort town of Karuizawa, 140 km NW of Tokyo. The volcano is located at the junction of the Izu-Marianas and NE Japan volcanic arcs. The modern cone of Maekake-yama forms the summit of the volcano and is situated east of the horseshoe-shaped remnant of an older andesitic volcano, Kurofu-yama, which was destroyed by a late-Pleistocene landslide about 20,000 years before present (BP). Growth of a dacitic shield volcano was accompanied by pumiceous pyroclastic flows, the largest of which occurred about 14,000-11,000 years BP, and by growth of the Ko-Asama-yama lava dome on the east flank. Maekake-yama, capped by the Kama-yama pyroclastic cone that forms the present summit of the volcano, is probably only a few thousand years old and has an historical record dating back at least to the 11th century AD. Maekake-yama has had several major plinian eruptions, the last two of which occurred in 1108 (Asama's largest Holocene eruption) and 1783 AD.

Information Contacts: *Japan Meteorological Agency (JMA)*, Otemachi, 1-3-4, Chiyoda-ku Tokyo 100-8122, JAPAN (URL: www.jma.go.jp/); *Volcano Research Center, Earthquake Research Institute (ERI)*, University of Tokyo, Yayoi 1-1-1, Bunkyo-ku, Tokyo 113, Japan (URL: http://www.eri.u-tokyo.ac.jp/topics/ASAMA2004/index-e.html).

Chikurachki

Kuril Islands, Russia
50.20°N, 155.27°E; summit elev. 1,816 m

The previous eruption at Chikurachki (figure 16) began in March 2007 (*BGVN* 32:05) and ended in November 2007 (*BGVN* 33:03). According to the Tokyo VAAC, based on observations of satellite imagery, eruptive activity resumed on 29 July 2008. KVERT reported that an ash plume rose to an altitude of 6.1 km and drifted more than 30 km WSW; during 30-31 July ash plumes drifted S.

Seismicity was imperfectly known because Chikurachki is not monitored with a dedicated seismometer. One telemetered seismic station resides on Alaid volcano, 58 km NNW (figure 17).

Eruptive activity continued during 1-8 August (figure 18); ash plumes drifted more than 60 km SE, W, and N. During 1-3 August the plume rose to an altitude of 2.7 km. There were no confirmed ash eruptions after 8 August.

Figure 16. Digital model of the relief of Chikurachki created from a LANDSAT 7 (satellite) image. View is toward the SW. Created by D.V. Melnikov.

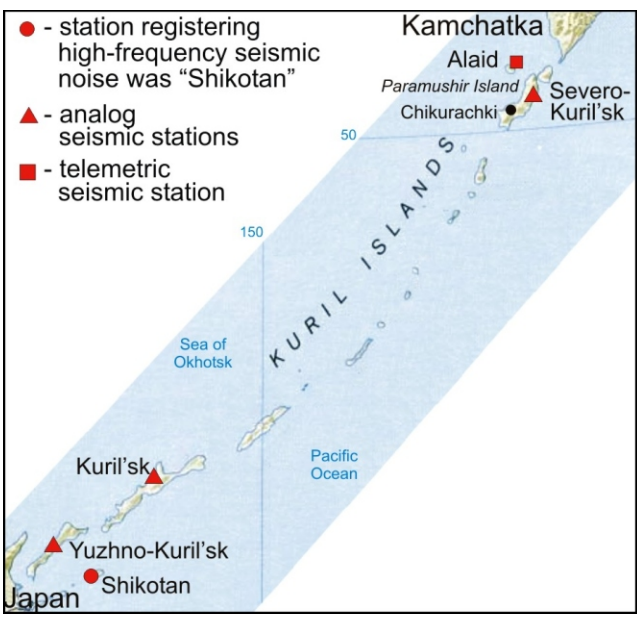

Figure 17. Map showing seismic stations in Kuril islands used to monitor Chikurachki. The terms Severo and Yuzhno mean "North" and "South." respectively. Compiled from multiple sources by *Bulletin* editors.

Figure 18. Explosive eruption of Chikurachki showing an ash plume extending SE on 2 August 2008. Photo by A. Gruzevich (Russian Federal Research Institute of Fisheries and Oceanography).

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

Information Contacts: *Kamchatka Volcanic Eruptions Response Team (KVERT)*, Institute of Volcanology and Seismology (IVS), Far East Division, Russian Academy of Sciences, Piip Ave. 9, Petropavlovsk-Kamchatskii 683006, Russia (Email: kvert@kscnet.ru, URL: http://www.kscnet.ru/ivs/); *Dmitriy Melnikov*, KVERT, Russia; *Tokyo Volcanic Ash Advisory Center (VAAC)*, Tokyo, Japan (URL: http://www.jma.go.jp/jma/jma-eng/jma-center/vaac/vaac%20operation.htm); *Anatoliy Gruzevich*, Russian Federal Research Institute of Fisheries and Oceanography (VNIRO),Federal State Unirtary Enterprise, 17, V. Krasnoselskaya Str., Moscow, 107140, Russia (Email: vniro@vniro.ru; URL: http://www.vniro.ru/en/).

Shishaldin

Aleutian Islands, USA
54.756°N, 163.97°W; summit elev. 2,857 m

Previously reported activity at Shishaldin included the onset of tremor and some unusual earthquakes. For at least one day in July 2004 small ash plumes rose above the summit (*BGVN* 29:06).

Figure 19. Shishaldin and a steam plume at sunset taken from a helicopter on 2 September 2008. Image courtesy of Cyrus Read and Alaska Volcano Observatory / U.S. Geological Survey.

In 2008, only one instance of an ash plume was reported. According to the Anchorage VAAC a pilot reported a small ash plume at an altitude of 3 km on 12 February. The ash plume was not confirmed by satellite imagery or ground observations. AVO did not report any unusual activity during this time. Shishaldin typically emits a relatively steady steam plume, as seen on 2 September 2008 (figure 19).

Information Contact: *Alaska Volcano Observatory (AVO)*, a cooperative program of the U.S. Geological Survey, 4200 University Drive, Anchorage, AK 99508-4667, USA (URL: http://www.avo.alaska.edu/; Email: tlmurray@usgs.gov), the Geophysical Institute, University of Alaska, P.O. Box 757320, Fairbanks, AK 99775-7320, USA (Email: eisch@dino.gi.alaska.edu), and the Alaska Division of Geological and Geophysical Surveys, 794 University Ave., Suite 200, Fairbanks, AK 99709, USA (Email: cnye@giseis.alaska.edu); *Anchorage Volcanic Ash Advisory Center (VAAC)*, Alaska Aviation Weather Unit, NWS NOAA US Dept of Commerce, 6930 Sand Lake Road, Anchorage, AK 99502-1845, USA (URL: http://www.ssd.noaa.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)

Several climbing groups and aviators made observations of the changes at the summit of Ol Doinyo Lengai after the 2007-early 2008 eruptions. The following report presents relevant comments from observers between early April and 1 September 2008. Other observations from May and June were previously reported (*BGVN* 33:06).

Several observers made detailed reports through Belton's website (table 5). We have noted information concerning the volcano; information on climbing routes and other observations may be found on the website.

Activity during 5-8 April 2008. Maarten de Moor observed Ol Doinyo Lengai from 5-8 April 2008 during the onset of explosive eruptive activity after an approximately two-week quiescent period. He made measurements of sulfur dioxide (SO_2) flux and analyzed the volatile chemistry of the deposits. He also has a sample suite available to other researchers.

The 5 April climb along the southern route was abandoned due to unstable steep terrain and bad visibility (with thick clouds above 2,800 m elevation, rain, and equipment failure). At 1530 the summit became visible, revealing weak and diffuse pulses of dark ash emanating from the crater with rhythmic periodicity every 15-60 seconds. The height of the ash cloud varied from barely clearing the crater rim to ~ 100 m above it. Observations from Engare Sero (Lake Natron Tent Camp and Campsite) at 1630 revealed a stronger, more consistent, and denser ash plume (though still relatively weak) drifting NW. Discrete pulses were still discernable, at intervals of 45-120 seconds. Explosive pulses sent ash 150-200 m above the crater rim. Rain caused ash to be washed out of the plume, mostly within 1 km of the vent. A strong, constant ash plume traveled NW with a strong wind, as observed at 1740. The plume was light gray and distinctly different from earlier material. The highest ash plume rose ~ 400 m above the crater rim.

On 6 April clouds obscured the morning view with a ceiling at ~ 2,000 m. By afternoon, cloud cover cleared to reveal that eruptive activity had waned significantly, to lower energy "Strombolian" type activity (similar to that of the early afternoon of 5 April) with pulses of dark gray ash reaching 150-200 m above the crater rim. Periodicity of pulses increased with time, from ~ 1 pulse/2 minutes at around 1330 to 1 pulse/10 minutes at around 1530. Obvious activity ceased by nightfall. Mini-Differential Optical Absorption Spectrometer (DOAS) measurements were conducted to determine if SO_2 was detectable and if so, to estimate SO_2 flux (figure 20).

Dates (2008)	Observer(s)	Brief observation(s)
03, 14 Jul	Ben Wilhelmi (pilot)	(A) no changes; no activity or light smoking of crater
18 Jul	Ben Wilhelmi (pilot)	(A) no changes; white smoke emerging from small area on NE part of former crater rim
23, 25 Jul	Ben Wilhelmi (pilot)	(A) no changes; no activity or light smoking of crater
27 Jul	Thomas Holden	(F) guide witnessed a "small eruption" (no details)
03 Aug	Remi Kahane (via Wilhelmi)	(CV) see text
08 Aug	Ben Wilhelmi (pilot)	(A) mountain quiet; unknown climbers on the rim
23 Aug	Ben Wilhelmi (pilot)	(A) no activity
01 Sep	Hervé Loubieres, Françoise Vignes	(CV) see text
03 Sep	Ben Wilhelmi	(A) no plume visible
01 Oct	Jens Fissenebert	(F) from Lake Natron Tented Camp and Campsite observed a small eruption beginning at 1345 (details not yet reported)

Table 5. Summary of selected observations of Ol Doinyo Lengai from July through September 2008. Continued from list in *BGVN* 33:06. Key: CV=climbed volcano; A= aerial observations/photos from crater overflight; F= flank: S=satellite. Most of list is courtesy of Frederick Belton.

Figure 20. Mini-DOAS scan setup on 6 April 2008 on the W ascent route to Ol Doinyo Lengai. Courtesy of Maarten de Moor.

Figure 22. Pyroclastic flow with rising ash cloud at Ol Doinyo Lengai on 8 April 2008. Courtesy of Maarten de Moor.

On 7 April, observers saw no ash plume during their ascent, but detected an occasional faint sulfur odor. Mini-DOAS measurements were conducted about half-way up the volcano, while the volcano produced a faint, ash-free gas plume. Eight distinct ash layers were identified, described, and sampled ~ 600 m from the crater rim at an elevation of 2,428 m; the layers were sampled from a 51-cm-deep section through the ash deposits (figure 21). The thin, uppermost light gray ash layer was probably deposited from the light gray ash plume on 5 April 2008.

At 1130 on 8 April 2008 activity was first noticed along the road from Lake Natron back to Engare Sero. Ash-rich explosions sent a plume ~ 500 m above the crater rim. Ash color was light to medium gray (lighter colored than ash from 6 April). Occasional ash clouds rose over the crater edge and flowed downslope (figure 22). Eruptions were quite consistent, with occasional 1-5 minute lulls. The ash plume drifted WNW. By 1600 the eruptive activity had decreased to longer lulls and less forceful explosions. Mini-DOAS measurements were conducted in the afternoon from the access road to the W ascent route.

Activity during 3 August 2008. Ben Wilhelmi provided the following information from Remi Kahane about a climb on this day. Severin Polreich and Remi Kahane (of Arusha, Tanzania), and guides Godson (Arusha) and Juma (Maasai from Lake Natron village office), went on the old NE route to the summit. They spent 15 minutes at the rim of the crater at about 1000 and clearly heard strong constant rumbling, but saw no emissions. Fumaroles were present on the external rim and there was a strong sulfur odor.

Sample ID	Depth interval	Description
OL 4-7-08:1	0 - 0.05 cm	Fine,"fluffy" light grey to white ash layer. Probably deposited from light grey ash plume observed on April 5. Deposited on a crust of precipitating salts, probably formed from rainwater leaching from older deposits and reprecipitation
OL 4-7-08:2	0.05 - 8 cm	Finely bedded, well sorted, poorly graded, clast supported ash fall deposit with lithic lapilli clasts up to 0.5cm.
OL 4-7-08:3	8 - 17 cm	Reversely graded, clast supported, moderately sorted deposit with lithic lapilli up to 4 cm. Gradational lower contact
OL 4-7-08:4	17 - 23.5 cm	Fine grained, vaguely stratified fall deposit with lapilli up to 0.3cm. Slightly coarser in center.
OL 4-7-08:5	23.5 - 26.5 cm	Lighter grey, moderately sorted, (salt) cemented fine lapilli ash
OL 4-7-08:6	26.5 - 35.5 cm	Vaguely stratified, moderately sorted lapilli ash layer with interbedded coarser and finer layers. Largest clasts (up to 2cm) concentrated at top and bottom of the layer.
OL 4-7-08:7	35.5 - 43 cm	Finer grained, very poorly sorted, matrix supported, and very vaguely stratified lapilli ash layer, with clasts up to 1 cm.
OL 4-7-08:8	43 - 51 cm	Clast supported, well rounded, well sorted, lapilli deposit with clasts up to 1cm. Layer fills irregularities in underlying pre-eruptive surface.

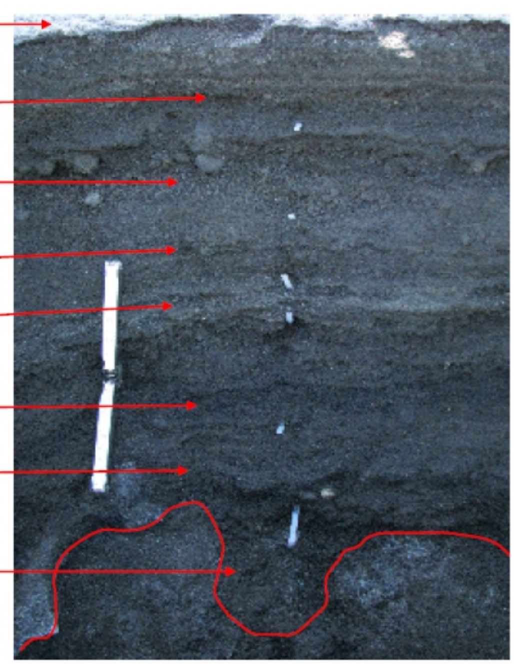

Figure 21. Photograph and description of eight distinct ash layers collected ~ 600 m from the Ol Dointo Lengai crater rim. (Sample location: 2.75664°S, 35. 90729°E; at 2,428 m elevation). Courtesy of Maarten de Moor.

Activity during 1 September 2008. Hervé Loubieres and Françoise Vignes of Toulouse climbed through the NW route with Shiro, their Maasai guide. They reported that this route on ash deposits was hard and long (7 hours), but without any difficulties. They reached the crater summit at 0700. While climbing they heard the roar of the volcanic activity before passing through the Pearly Gates. There were white fumaroles on the external rim of the crater, but with no smell of sulfur. Inside the crater on the S rim were also fumaroles, and on the crater floor there were two active vents erupting lava, one of them was bigger with a diameter around 10 m and permanently active. They descended at 0810 by the same route.

General References: Gilbert, C.D., and Williams-Jones, A.E., 2008, Vapour transport of rare earth elements (REE) in volcanic gas: Evidence from encrustations at Oldoinyo Lengai: Journal of Volcanology and Geothermal Research, v. 176, p. 519-528 (doi: 10.1016/j.volgeores.2008.05.003).

Teague, A.J., Seward, T.M., and Harrison, D., 2008, Mantle source for Oldoinyo Lengai carbonatites: Evidence from helium isotopes in fumarole gases: Journal of Volcanology and Geothermal Research, v. 175, p. 386-390 (doi: 10.1016/j.volgeores.2008.04.001).

Vaughan, R.G., Kervyn, M., Realmuto, V., Abrams, M., and Hook, S.J., 2008, Satellite measurements of recent volcanic activity at Oldoinyo Lengai, Tanzania: Journal of Volcanology and Geothermal Research, v. 173, p. 196-206 (doi: 10.1016/j.volgeores.2008.01.028).

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

Information Contacts: *Frederick Belton*, Developmental Studies Department, PO Box 16, Middle Tennessee State University, Murfreesboro, TN 37132, USA (URL: http://www.mtsu.edu/~fbelton/ and http://www.oldoinyolengai.org; Email: oldoinyolengai@hotmail.com); *Maarten de Moor*, Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM 87131, USA (Email: mdemoor@unm.edu); *Hawai'i Institute of Geophysics and Planetology (HIGP) Thermal Alerts System*, School of Ocean and Earth Science and Technology (SOEST), University of Hawai'i, 2525 Correa Road, Honolulu, HI 96822, USA (URL: http://hotspot.higp.hawaii.edu/); *Jens Fissenebert*, Molvaro-Lake Natron Tented Camp and Campsite, PO Box 425, Arusha, Tanzania (URL: http://www.ngare-sero-lodge.com/).