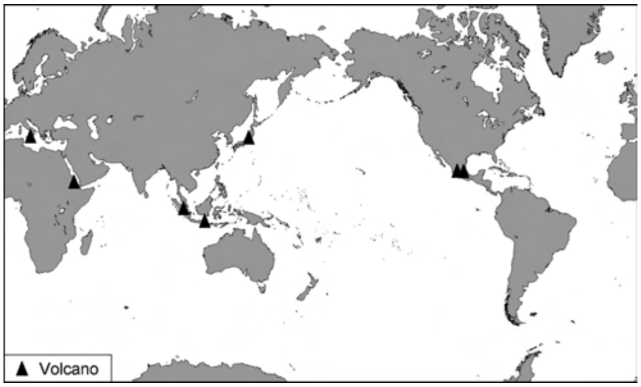
Bulletin of the Global Volcanism Network



Volume 30, Number 1, January 2005

Smithsonian
National Museum of Natural History

Editors: Rick Wunderman, Edward Venzke, and Gari Mayberry

Volunteer Staff: Robert Andrews, Jacquelyn Gluck, William Henoch, and Catherine Galley

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

Asama

Honshu, Japan
36.40°N, 138.53°E; summit elev. 2,560 m
All times are local (= UTC + 9 hours)

At 2020 on 1 September 2004, an explosive eruption occurred from the summit crater of Asama (*Bulletin* v. 29, nos. 8 and 10). As previously reported, the resulting eruption cloud drifted NE, and ash fell ~ 250 km away. A Reuters news report stated that this was its biggest eruption in 21 years (since April 1983). A distinct plume was still discharging on 3 September, when Asia Air Surveys took a vertical aerial photograph (figures 1 and 2).

Setsuya Nakada and Yukio Hayakawa informed *Bulletin* editors of Asama's eruptions by preparing reports and outlines in English, or explaining the significance of several kinds of data that were not otherwise accessible in English. Investigators plan to present data on Asama's 2004 eruptions at upcoming conferences, including *The Joint Geoscience Meeting*, to be held in May 2005 at Makuhari, Chiba (Japan).

A small eruption around 1530 on 14 September (figure 3) produced an ash plume that rose 1-2.5 km above the volcano. A smaller eruption earlier that day around 0328 produced a plume that rose ~ 300 m. A small amount of ash fell in Takasaki, ~ 45 km from the volcano.

Asama erupted almost continuously for a third straight day on 16 September (figure 4), associated with more than 1,000 earthquakes. Incandescent fragments were ejected ~ 300 m from the summit and ash columns rose ~ 1,200 m above the crater. Late that night, winds carried ash as far as central Tokyo, ~ 140 km SE. The frequency of the eruptions appeared to have tapered off by the afternoon of the 17th. Television footage at that time showed gray smoke mixed with ash billowing over the mountain. Minor ash eruptions occurred intermittently until 2103 on 18 September; ash clouds drifted E. Ashfall covered the southern part of the Kanto area, more than 150 km from the volcano.

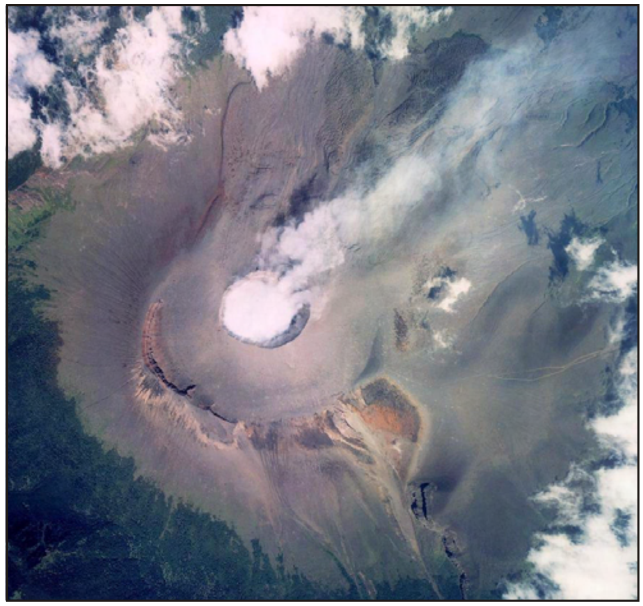


Figure 2. Aerial photo of Asama taken on 3 September 2004; the shot was taken at the point labeled "90" on line C3 on figure 1, in effect, from a point slightly E of the summit crater. Copyrighted photo is used here with permission of Asia Air Survey Co., Ltd. (their photo number C3-9590).

By 18 September, the Japan Meteorological Agency (JMA) was reporting that ash plumes were still rising ~ 1,200 m, but only about 23 small eruptions and nearly 140 tremors had been recorded that afternoon, a significant change from the nearly continuous activity of the previous few days. The hazard status remained at 3 on a scale of 5, suggesting more small-to-medium eruptions might occur.

An analysis of crater morphology based on airborne radar conducted on 16 September confirmed a new lava dome there. According to JMA and the Geographical Survey Institute this was the first dome since 1973. Mid-September radar images showed the growth of a broad (pancake-shaped) layered form reaching several dozen meters high with a radius of ~ 100 m in the NE part of the crater; its volume was ~ 500,000 m^3. Compelling images showcasing the side-looking airborne (SAR) radar method and depicting the dome can be seen on the GSI website (but as of early 2005 almost all the text remained in Japanese).

A moderate explosive eruption occurred at 1944 on 23 September. Small amounts of ash and lapilli were deposited NE of Asama.

Many (not all) parts of the world now have Volcanic Ash Advisory Centers (VAACs) devoted to helping aviators avoid volcanic ash. They operate

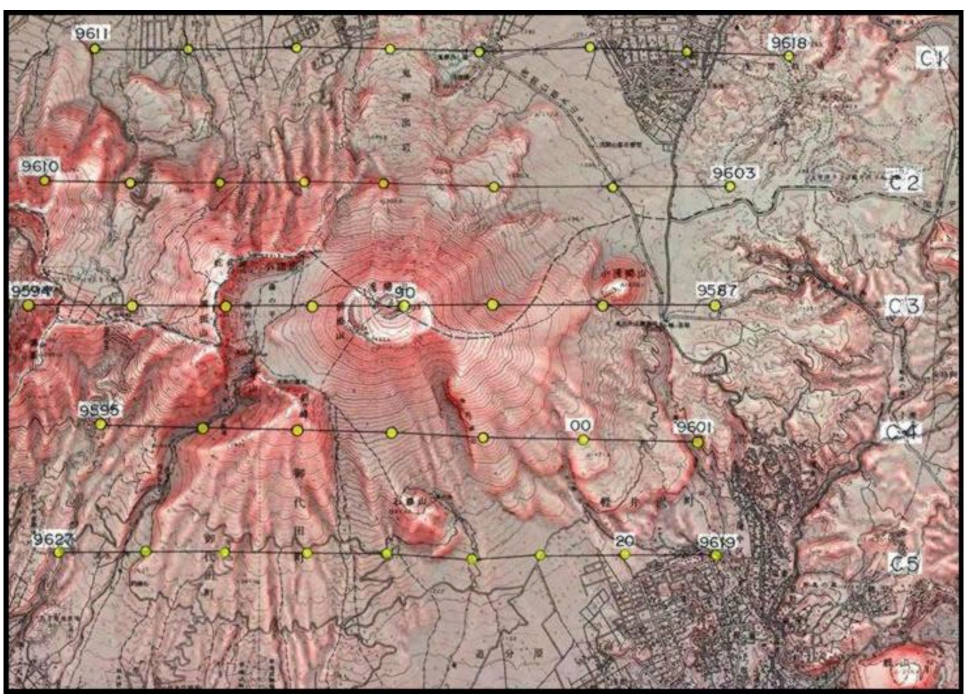


Figure 1. Topographic map showing the flight lines and locations of aerial photos at Asama volcano (N is towards the top), 3 September 2004. Courtesy of Asia Air Survey Co., Ltd.

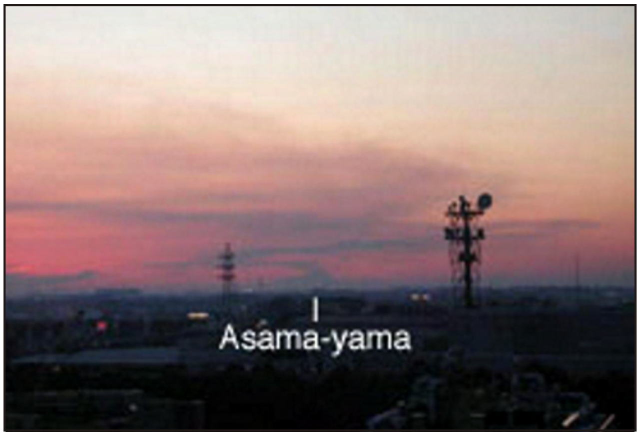


Figure 3. A drifting eruption cloud emitted at Asama, as seen from the Geological Society of Japan office building in Tsukuba, ~150 km E of the volcano. Taken at 1751 on 14 September. Courtesy of A. Tomiya, GSJ.

through agencies closely associated with aviation meteorology. The Tokyo VAAC website presents a diagram showing some fundamental linkages in its information management networks (figure 5). The diagram is only intended to provide an introductory overview (e.g., it is not comprehensive, and it may be outdated); however, it should make the role of the Tokyo VAAC in the Asama eruption more tangible to many in the volcano-monitoring community.

Volcano-monitoring input can pass to the VAAC via the paths labeled *Domestic* (in this case, Japan) and *International* (including the Kamchatkhan Volcanic Eruptions Response Team, the Philippine Institute of Volcanology and Seismology, the Alaska Volcano Observatory, and adjacent VAACs of Washington, Anchorage, and Darwin). In some examples of the latter communications, one VAAC may alert others that an ash plume may soon extend beyond the boundary of VAAC's area of responsibility. Sources of incoming data include that from *satellites* and from *aircraft*. The latter includes both PIREPS, pilot reports, and AIREPs, air reports routed via airlines. The VAAC prepares output to aviators that includes both Volcanic Ash Advisories and SIGMETS. The latter, SIGnificant METeorological messages contain information about hazardous phenomena, including weather, severe icing, turbulence, or volcanic ash that, in the judgment of the forecaster, are hazardous to aviation). The system continues to undergo refinement and exists under the auspices of the International Civil Aviation Organization (ICAO).

Tokyo VAAC reported that eruptions during 23-25 September produced plumes, in some cases to unknown heights; and in one case to "FL 170" (aviation shorthand for 17,000 feet; ~ 5 km altitude; figure 6). In addition, minor ash eruptions occurred twice on 1 October. Afterwards a helicopter flight provided by the Nagano police (Shinshu) was carried out under conditions of clear sky with southerly winds, enabling observers to watch Asama's summit area during the hours of 0930-1100. They saw relatively weak emissions drifting N. A new vent, ~ 70 m in diameter and ~ 40 m in depth lay within the summit (Kamayama) crater. This was in accord with what had been observed on 16 and 17 September by radar (SAR image of GSI) and also photographed by the press (Eg., *Yomiuri Shimbun*). From the eastern rim of the vent a crack of incandescence was observed, from which a jet of volcanic gas issued intermittently. Using an infrared camera, the highest temperature JMA measured was 517°C.

A minor explosive eruption occurred at 2310 on 10 October. Small amounts of ash and lapilli were deposited NNE of the volcano. The Tokyo VAAC reported this eruption produced a plume to an unknown height.

The Tokyo VAAC reported an eruption on 16 October at 1206; it discharged a SE-drifting ash cloud higher than 3. 4 km altitude. On 18 October at 1017, a N-drifting plume rose to ~ 3.4 km altitude.

Asama erupted with a loud explosion on 14 November at 2059. JMA rated the eruption as mid-sized, 3 on a scale of 5, in terms of power of the explosion. The agency issued a warning of falling ash downwind of the volcano, although no ash plume was observed due to cloudy weather conditions. Following the explosion observers did see falling rocks over a large area on the volcano's slopes. There were no immediate reports of injuries or damage. Ash and lapilli were deposited E of Asama and ash-fall covered the N part of the Kanto area, reaching more than 100 km.

Other tilt, GPS, seismic, and gravity data. A tilt anomaly was observed and announced by JMA on 22 February, but no eruption occurred. That inflation took place over about 3 months, beginning 14 November 2004. The series of eruptions in September 2004 was preceded by earthquake swarms and shorter-term tilt changes. The respective anomalies became significant a few days to half a day before the explosive events. Tiltmeters of JMA and ERI are located ~ 3 km N and ~ 4 km E of the summit crater. The former are more sensitive than the latter, probably due to Asama's inferred E- to W-trending (dike-shaped) magma body. The inflationary tilt measured 3 km N of the summit crater was as small as 10^{-6} radians. The smaller tilt episodes remained below the detection threshold for the GPS network surrounding the volcano.

Preceding the Vulcanian explosions on 1, 23, and 29 September, observers noticed frequent B-type earthquakes.

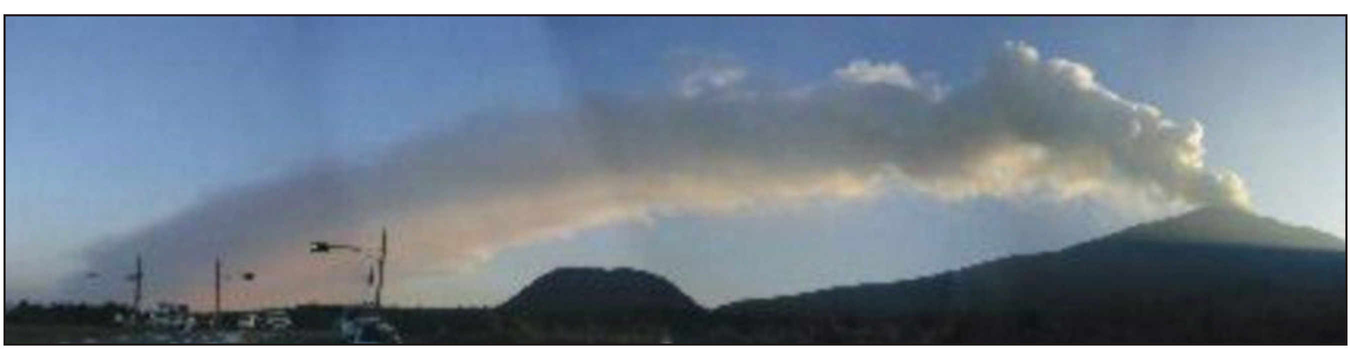


Figure 4. A panoramic photograph of Asama taken 16 September 2004 looking from Asama's NE flank. Courtesy of Michiko Owada, GSJ.

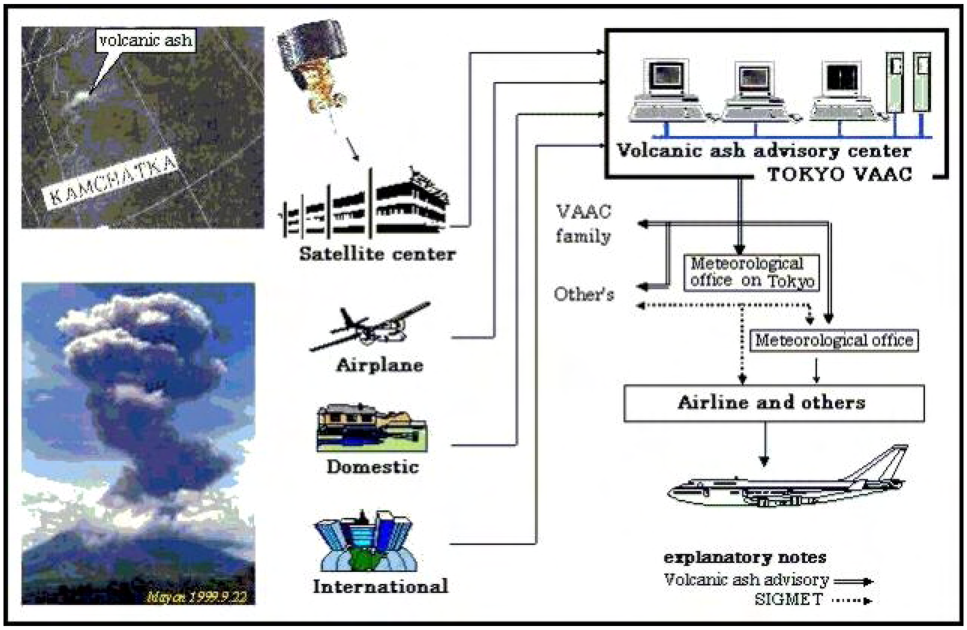


Figure 5. A schematic showing some paths of information flow into and out of the Tokyo VAAC. The real communication patterns are considerably more complex and involve other communication links, such as those of the air carrier, between its aircraft to its own offices, and those directly between local observatories and meteorological offices. Inputs from people monitoring a volcano pass through a system with different conventions and procedures. Modified from a diagram on the Tokyo VAAC website.

They also documented small inflations of the summit area. These inflations occurred about half day to one day before the explosions. On the other hand, the explosive events during 16-17 September followed deflation in the wake of a three-day inflation (10-13 September).

S. Okubo conducted continuous gravity measurements at the Asama Volcano Observatory (AVO) of ERI. Various explosive events of September reportedly occurred a few days after gravity shifted from an increase to a decrease. AVO's gravity station sits at 1,400 m elevation about 4 km E of the summit. Okubo proposed that the gravity changes reflected movement of magma within the conduit. Gravity decreased when the magma head rose above the observation level.

Background. 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 E 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 E 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 and 1783 AD.

Information Contacts: *Yukio Hayakawa*, Faculty of Education, Gunma University, Aramaki 4-2, Maebashi Gunma 371-8510, Japan (Email: hayakawa@edu.gunma-u.ac.jp, URL: http://maechan.net/hayakawa/asama/gankoran/, http://www.edu.gunma-u.ac.jp/~hayakawa/English.html); *Setsuya Nakada*, Volcano Research Center, Earthquake Research Institute (ERI), University of Tokyo, Yayoi 1-1-1, Bunkyo-ku, Tokyo 113, Japan (Email: nakada@eri.u-tokyo.ac.jp; URL: http://www.eri.u-tokyo.ac.jp/topics/ASAMA2004/index-e.html); *Geological Survey of Japan (GSJ)*, National Institute of Advanced Industrial Science and Technology (GSJ AIST) (URL: http://www.gsj.jp/kazan/kazan-bukai/ yochiren/asama040909/ material.html); *Asia Air Survey Co., Ltd.* (Email: info@ajiko.co.jp,ta.chiba@ajiko.co.jp,at.amano@ajiko.co.jp; URL: http://www.ajiko.co.jp/topics/ct/ asama/); *Geographical Survey Institute* (radar and other methods), Ministry of Land,Infrastructure and Transport, Japan (URL: http://www.gsi.go.jp/BOUSAI/ASAMA/SAR/indexsar.htm); *Japan Meteorological Agency (JMA)*, Volcanological Division, Seismological and Volcanological Department, 1-3-4 Ote-machi, Chiyoda-ku, Tokyo 100-8122; *Tokyo Volcanic Ash Advisory Center*, Tokyo Aviation Weather Service Center, Haneda Airport 3-3-1, Ota-ku, Tokyo 144-0041, Japan (http://www.jma.go.jp/JMA_HP/jma/jma-eng/jma-center/vaac/index.html); International Civil Aviation Organization (ICAO), 999 University Street, Montreal, Quebec H3C 5H7, Canada (URL: http://www.icao.int/); *Reuters*.

```
FVFE01 RJTD 250954
VOLCANIC ASH ADVISORY
ISSUED: 20040925/0954Z
VAAC: TOKYO
VOLCANO: ASAMAYAMA 0803-11
LOCATION: N3624E13832
AREA: JAPAN
SUMMIT ELEVATION:2568 M

ADVISORY NUMBER: 2004/35
INFOMATION SOURCE: JMA
AVIATION COLOR CODE: NIL
ERUPTION DETAILS: ERUPTED AT EXTENDED NE
OBS ASH DATE/TIME: NIL
OBS ASH CLOUD: NIL

FCST ASH CLOUD+6H: NIL
FCST ASH CLOUD+12H: NIL
FCST ASH CLOUD+18H: NIL
```

Figure 6. A Volcanic Ash Advisory issued by Tokyo VAAC describing a 25 September 2004 eruption at Asama that sent ash to ~ 5 km altitude (FL 170). Advisories such as this are the messages received on the flight deck of potentially affected aircraft and by the air carriers' dispatchers. Courtesy of the Tokyo VAAC.

Raung

eastern Java, Indonesia
8.125°S; 114.042°E; summit elev. 3,332 m
All times are local (= UTC + 8 hours)

Though frequently active, Raung is seldom the subject of reports from either the news media or the Directorate of Volcanology and Geological Hazard Mitigation (DVGHM). The most recent Darwin VAAC report was issued late on 26 August 2002 (UTC). It noted that aviators had estimated an ash plume at ~ 10 km altitude drifting W (reported 25 August in an AIREP). Ash clouds were not visible on NOAA/GMS satellite imagery. A summary of Darwin VAAC reports of Raung for the period July 1999-August 2002 was given in *Bulletin* v. 29, no. 1.

There were nine anomalous Moderate Resolution Imaging Spectroradiometer (MODIS) observations of volcanic hot spots at Raung during 3 June-8 October 2004 (table 1). The 2004 alerts were the first detected by MODIS at Raung. Minor explosive activity documented intermittently during 1999 to 2002 (*Bulletin* v. 29, no. 1) did not have a thermal component sufficient to trigger alerts.

No ground observations have been reported during 2004, but in a message from Dali Ahmad (DVGHM), he noted the absence of observed emissions during 2004. With respect to the thermal alerts, he speculated that they could conceivably have originated from brush fires. Rob Wright commented that the levels of radiance in the 2004 alerts were both "too weak and too intermittent to be lava flows" and stood near the system's lower threshold. Similar weak anomalies occur at volcanoes such as Villarrica and during intervals at Anatahan, but the source of the alerts at Raung remains uncertain.

Clear aerial photographs of Raung were taken on 26 and 30 July 2001 (figure 7) by Franz Jeker of Singapore Airlines as he flew past in descent towards, or ascent from, the Bali airport. Jeker also included a detailed map of the Raung area (figure 8).

Background. Raung, one of Java's most active volcanoes, is a massive stratovolcano in easternmost Java that was constructed SW of the rim of Ijen caldera. The 3,332-m-high, unvegetated summit of Gunung Raung is truncated by a dramatic steep-walled, 2-km-wide caldera that has been the site of frequent historical eruptions. A prehistoric collapse of Gunung Gadung on the W flank produced a large debris avalanche that traveled 79 km from the volcano, reaching nearly to the Indian Ocean. Raung contains several centers constructed along a NE-SW line, with Gunung Suket and Gunung Gadung stratovolcanoes being located to the NE and W, respectively.

Information Contacts: *Directorate of Volcanology and Geological Hazard Mitigation (DVGHM)*, Jalan Diponegoro 57, Bandung 40122, Indonesia (Email: dali@vsi.dpe.go.id; URL: http://www.vsi.esdm.go.id/); *Darwin Volcanic Ash Advisory Center (VAAC)*, Bureau of Meteorology, Northern Territory Regional Office, PO Box

Date (2004)	Time (local / UTC)	Spectral radiance
15 Apr	2300 / 1500	0.852
16 Apr	0200 / 1800 (15 Apr)	0.847
22 Apr	2310 / 1510	0.814
02 May	0200 / 1800 (01 May)	0.813
03 Jun	0200 / 1800 (02 Jun)	0.677
18 Jun	2300 / 1500	0.729
04 Jul	2300 / 1500	0.795
11 Jul	2310 / 1510	0.814
14 Jul	0155 / 1755 (13 Jul)	0.778
22 Sep	2300 / 1500	0.849
23 Sep	0200 / 1800 (22 Sep)	0.740
29 Sep	2305 / 1505	0.893
08 Oct	2300 / 1500	0.776

Table 1. Thermal anomalies at Raung observed with MODIS during 2004. Some of the UTC times were for the previous date. Spectral radiance for the hot pixels in band 21 (central wavelength of 3.959 µm) are in units of watts per square meter per steradian per micron (W^{-2} sr^{-1} μm^{-1}). Courtesy of the Hawaiian Institute of Geophysics and Planetology.

Figure 7. A photograph taken on 26 July 2001 of a small fumarolic plume from the central crater of Raung looking SW during a fly-by of a commercial airplane across the NNE flank. Courtesy of F. Jeker.

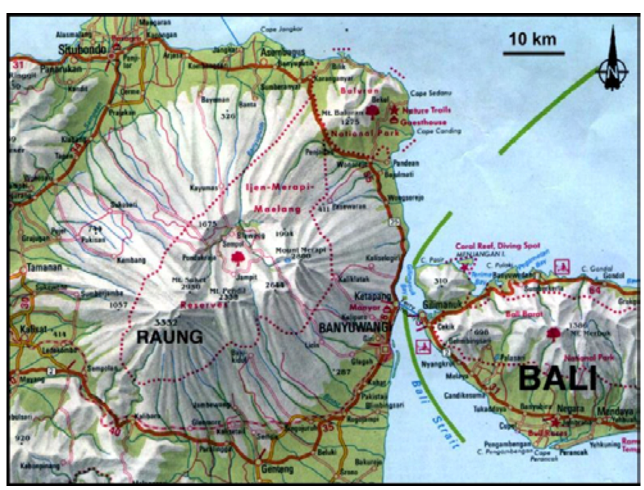


Figure 8. Map showing relative locations of Raung volcano at the SW end of Java, and adjacent Bali. Courtesy of F. Jeker.

40050, Casuarina, NT 0811, Australia (URL: http://www.bom.gov.au/info/vaac/advisories.shtml; Email: Darwin.vaac@bom.gov.au); Hawai'i Institute of Geophysics and Planetology (URL: http://modis.higp.hawaii.edu); *Franz Jeker*, Rigistrasse 10, 8173 Neerach, Switzerland (Email: franz.jeker@swissonline.ch).

Kerinci

Sumatra, Indonesia
1.814°S, 101.264°E; summit elev. 3,800 m
All times are local (= UTC + 7 hours)

Events at Kerinci were previously discussed through 29 August 2004 (*Bulletin* v. 29, no. 8). The following report overlaps slightly, covering 17 July through 24 October 2004. As already reported, on 24 July 2004 a thick plume rose to 100-600 m above the crater rim, ash fell ~ 3 km from the crater forming deposits as thick as 1 cm. Seismicity is summarized in table 2.

There were six Darwin VAAC reports on Kerinci in 2004, two on 21 June and four on 27 September. (Prior to that the VAAC reports were clustered in mid- to late-August 2002.) The 21 June cases discussed a continuous emission with ash to ~ 4 km drifting W. The 27 September cases began with and then repeated an aviator's statement (an AIREP at 0136 UTC 27 September), noting that ash was observed to ~ 6 km, drifting W. For all six cases (June and September), the VAAC staff noted that due to cloud cover, ash was not visible in satellite data.

Kerinci erupted on 6 August 2004 at 0835 hours. Gray ash rose to 50-600 m above the summit. The hazard status was raised to Alert Level II (yellow) at 1030, where it stayed for the remainder of this report period.

During 9-15 August 2004 the number of earthquakes decreased. A white thin plume again rose to 50-300 m above the summit. Volcanic activity remained relatively stable from 15 August through 24 October 2004, with thick gray plumes rising 50-300 m above the summit.

Background. The 3,800-m-high Gunung Kerinci in central Sumatra forms Indonesia's highest volcano and is one of the most active in Sumatra. Kerinci is capped by an unvegetated young summit cone that was constructed NE of an older crater remnant. The volcano contains a deep 600-m-wide summit crater often partially filled by a small crater lake that lies on the NE crater floor, opposite the SW-rim summit of Kerinci. The massive 13 x 25 km wide volcano towers 2400-3300 m above surrounding plains and is elongated in a N-S direction. The frequently active Gunung Kerinci has been the source of numerous moderate explosive eruptions since its first recorded eruption in 1838.

Information Contacts: *DVGHM* (see Raung).

Date (2004)	Volcanic A	Volcanic B	Emission
17 Jul-24 Jul	2	1	0.5-3
24 Jul-31 Jul	5-6	3	0.5-5
02 Aug-08 Aug	5	2	continue
09 Aug-15 Aug	1	1	continue
16 Aug-22 Aug	2	2	continue
23 Aug-29 Aug	—	1	continue
27 Sep-03 Oct	5	1	continue
04 Oct-10 Oct	—	1	continue
11 Oct-17 Oct	—	2	continue
18 Oct-24 Oct	3	2	continue

Table 2. Volcanic seismicity registered at Kerinci during 17 July to 24 October 2004. Courtesy of DVGHM.

Marapi

Sumatra, Indonesia
0.38°S, 100.47°E; summit elev. 2,891 m

The most recent previous explosive activity at Marapi peaked during 13-18 April 2001, when a total of 150 explosions occurred that sent ash plumes to 2 km above the summit (*Bulletin* v. 27, no. 1). This report covers the interval 5 August to 10 October 2004.

On 5 August 2004 Marapi generated a small eruption with a gray to black ash cloud that rose to 500-1,000 m above the summit. Its hazard status was raised to Alert Level II (yellow), where it remained throughout this period.

Total numbers of seismic events from 2 August through 10 October 2004 are listed in table 3. During some weeks in August the number of earthquakes increased markedly. A thin white plume rose to 50 m above the summit on 10 August. During 16-29 August a thin white-gray plume rose to ~ 75-100 m. Similar plumes rose to ~ 50 m during 27 September-3 October and to ~ 300 m during 4-10 October. Seismic signals inferred to be related to emissions were elevated during several weeks of the reporting interval, particularly in August (table 3).

There were no MODIS-MODVOLC alerts at Marapi during 2004.

Background. Gunung Marapi, not to be confused with the better-known Merapi volcano on Java, is Sumatra's most active volcano. Marapi is a massive complex stratovolcano that rises 2,000 m above the Bukittinggi plain in Sumatra's Padang Highlands. A broad summit contains multiple partially overlapping summit craters constructed within the small 1.4-km-wide Bancah caldera. The summit craters are located along an ENE-WSW line, with volcanism migrating to the W. More than 50 eruptions, typically consisting of small-to-moderate explosive activity, have been recorded since the end of the 18th century; no lava flows outside the summit craters have been reported in historical time.

Information Contacts: *DVGHM* (see Raung); *Darwin Volcanic Ash Advisory Center (VAAC)* (see Raung).

Date	Volc A	Volc B	Tremor	Emission
02 Aug-08 Aug	1	11	—	—
09 Aug-15 Aug	2	6	—	20
16 Aug-22 Aug	—	3	—	21
23 Aug-29 Aug	—	3	2	14
20 Sep-26 Sep	—	—	—	—
27 Sep-03 Oct	1	—	—	—
04 Oct-10 Oct	3	—	—	8

Table 3. A summary of volcanic seismicity at Marapi during 2 August to 10 October 2004. Courtesy of DVGHM.

Etna

Italy
37.734°N, 15.004°E; summit elev. 3,350 m

The effusive eruption that started on 7 September 2004 on the W wall of the Valle del Bove continued. Lava escaped at a very low effusion rate from two main vents at 2,620 and 2,320 m elevation. Lava tubes developed downslope of these vents, forming a complex lava-flow field with ephemeral vents at the base of the W wall of the Valle del Bove. After December 2004, effusive vents were mainly located at the lower end of the tube network below 2,000 m elevation. Lava flows were up to 2.5 km long, and the lava-flow field did not change significantly since the end of October 2004 (figure 9).

On 8 January 2005 an ash plume formed above the summit of SE crater and lasted a few hours. Analysis of the ash components revealed that it consisted of lithic material. This episodic ash emission was probably caused by collapse within the crater into the void left after three months of lava output.

On 18 January the INGV-CT web camera located 27 km S of the summit craters revealed a dense, pulsating gas plume rising above the summit of NE crater and lasting a few minutes. This was probably caused by snow vaporization due to hot gas emission from the main crater vent.

During the afternoon of 18 January a new lava flow formed upslope along the 2,620-m-long eruptive fissure, at ~ 2,450 m elevation. The lava flow spread for about 200 m SE on the snow and along the middle wall of the western Valle del Bove. This flow front moved slowly and completely stopped after about 24 hours. The emission of lava from the ephemeral vents below 2,000 m stopped during the effusion from the 2,450-m vent. The lower ephemeral vents again started to emit lava on 19 January. During the afternoon of 22 January two new lava flows erupted from vents at 2,400 m elevation, along the same tube system fed by the 2,620-m-elevation vent. Two parallel, fast-moving flows spread E. They were still evident on 27 January from the images recorded by the INGV-CT webcam at Milo, together with a number of ephemeral vents and small lava flows at the lower end of the lava tube.

The opening of effusive vents upslope along the tube system of a complex lava-flow field has usually indicated the final stages of expansion, an effect observed several times at lava-flow fields on Etna and Stromboli. Decreased effusion from the main vent causes the tube system to drain, so the lava tube walls collapse. Obstruction at the lower end of the tube then causes accumulation of lava farther upslope and the opening of new vents at higher elevations.

Since the start of the eruption on 7 September 2004 (*Bulletin* v. 29, no.9), there has been no significant explosive activity at the summit craters or the eruptive fissures.

Background. Mount Etna, towering above Catania, Sicily's second largest city, has one of the world's longest documented records of historical volcanism, dating back to 1500 BC. Historical lava flows of basaltic composition cover much of the surface of this massive volcano, whose edifice is the highest and most voluminous in Italy. The most prominent morphological feature of Etna is the Valle del Bove, a 5 x 10 km horseshoe-shaped caldera open to the E. Two styles of eruptive activity typically occur at Etna. Persistent explosive eruptions, sometimes with minor lava emissions, take place from one or more of the three prominent summit craters, the Central Crater, NE Crater, and SE Crater (the latter formed in 1978). Flank vents, typically with higher effusion rates, are less frequently active and originate from fissures that open progressively downward from near the summit (usually accompanied by Strombolian eruptions at the upper end). Cinder cones are commonly constructed over the vents of lower-flank lava flows. Lava flows extend to the foot of the volcano on all sides and have reached the sea over a broad area on the SE flank.

Information Contacts: *Sonia Calvari*, Istituto Nazionale di Geofisica e Vulcanologia, Piazza Roma 2, 95123 Catania, Italy (URL: http://www.ct.ingv.it/, Email: calvari@ct.ingv.it).

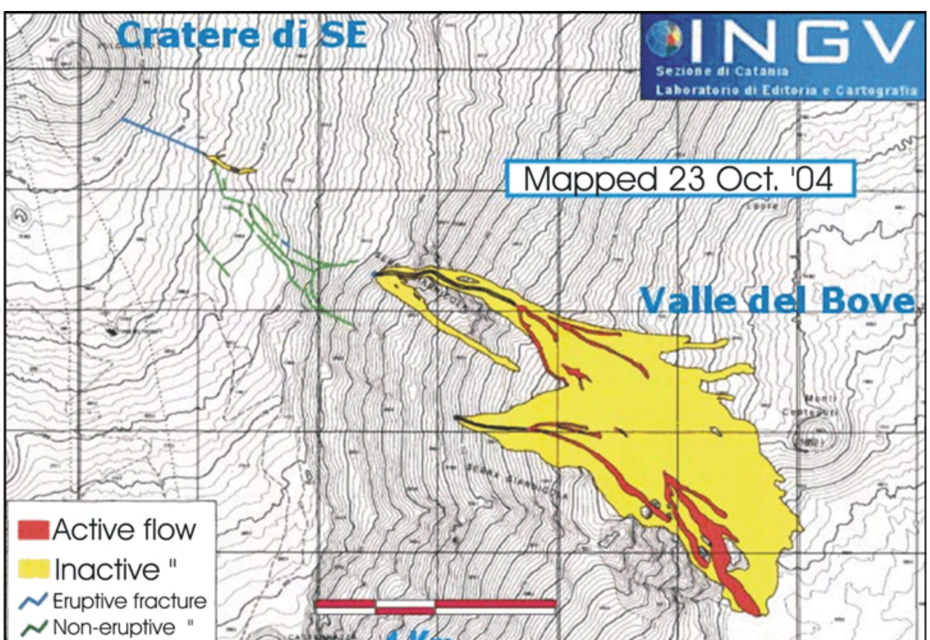


Figure 9. A map of Etna emphasizing features associated with the lava flow field as they appeared 4 October 2004. Courtesy of INGV.

Erta Ale

Ethiopia
13.60°N, 40.67°E
summit elev. 613 m

An expedition led by the volcanology travel group SVE-SVG visited Erta Ale during 22-23 January 2005. The observed eruptive activity was generally unchanged since November 2004 (*Bulletin* v. 29, no. 11). Degassing was still occurring from three of the four hornitos in the SW part of the South crater, but had decreased slightly in comparison with their

December 2004 observations. The hornitos stood ~ 10 m high and represented the only portion of the lava crust covering the crater floor where gas emissions were seen. A window in the upper part of one of the hornitos permitted observation of glowing molten lava.

On 23 January 2005 members of the group descended into the crater and collected recent lava that had poured out from the hornitos during partial collapse. Degassing activity (mainly SO_2) from the North crater had also slightly decreased in comparison with early December 2004 observations.

From a small terrace in the NW part of the crater it was possible to observe degassing from several hornitos (some several meters high in the central part of the 'lava bulge'). Near the NW wall of the crater two small, red glowing areas were visible at the summit of two other hornitos.

Chemical analyses. The following complements a previous Erta Ale report by Jacques-Marie Bardintzeff from November-December 2004 (*Bulletin* v. 29, no.11). He sampled molten lava at 12 m depth in one of the hornitos of the crater on 5 December 2004 using a cable and an iron mass, and subsequently analyzed the chilled glass sample using an electron microprobe (table 4).

Analysis also revealed some plagioclase phenocrysts (An = 80.9-70.4) as well as scarce clinopyroxene microcrysts (Wo = 43.5-44.0, En = 45.8-45.9, Fs = 10.2-10.6). Compared to the matrix glasses shown in table 4, glass inclusions trapped in plagioclase were richer in SiO_2 (50.07-50.41 wt%) and poorer in TiO_2 (1.84-1.95 wt %).

Correction. French scientists led by Jacques-Marie Bardintzeff and Franck Pothé visited the summit of Erta Ale on 13-14 January 2003 (*Bulletin* v. 28, no.4). At that time the lava lake in the S pit crater was 180 m long, not 120 m as previously reported.

Background. Erta Ale is an isolated basaltic shield volcano that is the most active volcano in Ethiopia. The broad, 50-km-wide volcano rises more than 600 m from below sea level in the barren Danakil depression. Erta Ale is the most prominent feature of the Erta Ale Range. The volcano contains a 0.7 x 1.6 km, elliptical summit crater housing steep-sided pit craters. Another larger 1.8 x 3.1 km wide depression elongated parallel to the trend of the Erta Ale range is located to the SE of the summit and is bounded by curvilinear fault scarps on the SE side. Fresh-looking basaltic lava flows from these fissures have poured into the caldera and locally overflowed its rim. The summit caldera is renowned for long-term lava lakes that have been active since at least 1967, or possibly since 1906. Recent fissure eruptions have occurred on the northern flank.

Oxide	Weight percent
SiO_2	48.61-49.64
Al_2O_3	12.99-13.60
TiO_2	2.37-2.66
MgO	6.13-6.39
FeO	11.25-12.20
Cr_2O	0-0.11
MnO	0.03-0.34
CaO	10.63-11.41
Na_2O	2.81-3.08
K_2O	0.54-0.69
Total	97.44-98.71

Table 4. Major-element chemistry of Erta Ale lava resulting from 18 representative glass analyses. Courtesy of Jacques-Marie Bardintzeff.

Information Contacts: *Jacques-Marie Bardintzeff*, Laboratoire de Pétrographie-Volcanologie, Bât. 504, Université Paris-Sud, F-91405, Orsay, France (Email: bardizef@geol.u-psud.fr, URL: http://www.lave-volcans.com/bardintzeff.html); *Franck Pothé*, Terra Incognita, CP 701, 36 quai Arloing 69256 Lyon Cédex, France (Email: ti@terra-incognita.fr); *Henry Gaudru*, *Georges Kourounis*, *Derek Tessier*, *Brian Fletcher*, *Alexander Gerst*, and *Motomaro Shirao*, Société Volcanologique Européenne (SVE)-Societe Volcanologique (SVG), Geneva, C.P.1, 1211 Geneva 17, Switzerland (URL: http://www.sveurop.org/, Email: HgaudruSVE@compuserve.com).

Popocatépetl

central México
19.023°N, 98.622°W; summit elev. 5,426 m
All times are local (= UTC 6 hours)

During 2004, Popocatépetl showed an overall low level of activity. Apart from a few low-intensity exhalations, no significant seismicity, deformation, or geochemical changes in spring waters were detected. The crater (figure 10) did not show significant morphological changes other than hydrologic effects, and no evidence of lava dome emplacements were observed. During December, relatively low-level volcanism prevailed, including low-intensity steam-and-gas emissions (table 5). An aerial photograph taken on 10 December showed subsidence in the inner crater and no external lava dome at the bottom of the crater. The Alert Level remained at Yellow Phase II.

At the end of December 2004, however, a slight increase in seismic activity was detected (table 5). On 20 and 29 December 2004 two exhalations, small yet exceeding the average for the year, were followed in early January 2005 by a series of phreatic explosions. The major events were detected on 9 January at 2245 and on 22 January at

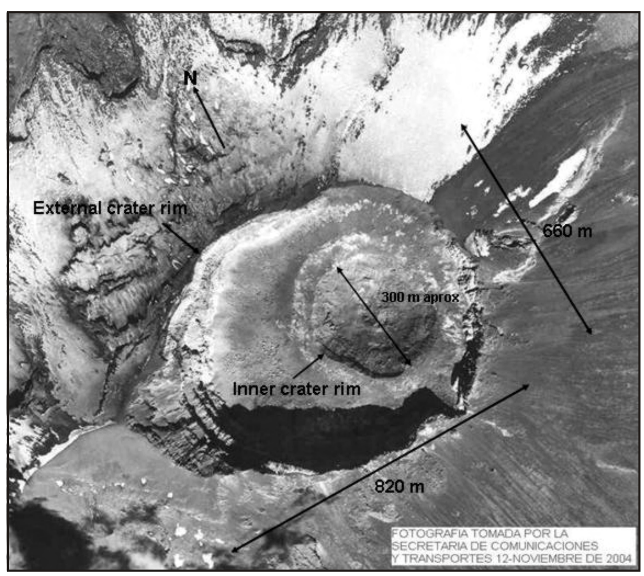


Figure 10. Annotated aerial photograph of Popocatepétl's summit area taken 12 November 2004. Courtesy of CENAPRED; the Mexican Secretary of Communications and Transportation; and Servando De la Cruz, UNAM.

Date (2004)	Exhalations	Other Observations
01 Dec-04 Dec	Low-intensity (9-13 per day)	Light steam-and-gas emissions
05 Dec-07 Dec	Low-intensity (16-19 per day)	Light steam-and-gas emissions
08 Dec-09 Dec	Low-intensity (7-10 per day)	Light steam-and-gas emissions
10 Dec	Low-intensity (11)	Aerial photograph showed subsidence in the inner crater; no external lava dome at the bottom of the crater can be distinguished
11 Dec-16 Dec	Low-intensity (3-10 per day)	Light steam-and-gas emissions
17 Dec-21 Dec	Low-intensity (2-5 per day)	Light steam-and-gas emissions
22 Dec-27 Dec	Low intensity (6-10 per day)	Light steam-and-gas emissions
28 Dec	Low-intensity (19)	Light steam-and-gas emissions
29 Dec-31 Dec	Low-intensity (9-11 per day)	Light steam-and-gas emissions

Table 5. Summary of various observations at Popocatépetl during December 2004 (chiefly visual confirmations of ongoing emission). Courtesy of CENAPRED.

2358. These were the largest events detected in the past 15 months. In both cases, light ashfall was reported on the towns of Cuautla (< 40 km SSW of the volcano), and San Martín Texmelucan (37 km NE of the crater). In an aerial photograph taken on 14 January 2005 the inner crater appears deeper than previously shown, with no evidence of magmatic activity (figure 11).

Background. Volcán Popocatépetl, whose name is the Aztec word for smoking mountain, towers to 5,426 m 70 km SE of Mexico City to form North America's 2nd-highest volcano. The glacier-clad stratovolcano contains a steep-walled, 250-450 m deep crater. The generally symmetrical volcano is modified by the sharp-peaked Ventorrillo on the NW, a remnant of an earlier volcano. At least three previous major cones were destroyed by gravitational failure during the Pleistocene, producing massive debris-avalanche deposits covering broad areas south of the volcano. The modern volcano was constructed to the south of the late-Pleistocene to Holocene El Fraile cone. Three major plinian eruptions, the most recent of which took place about 800 AD, have occurred from Popocatépetl since the mid Holocene, accompanied by pyroclastic flows and voluminous lahars that swept basins below the volcano. Frequent historical eruptions have occurred since precolumbian time.

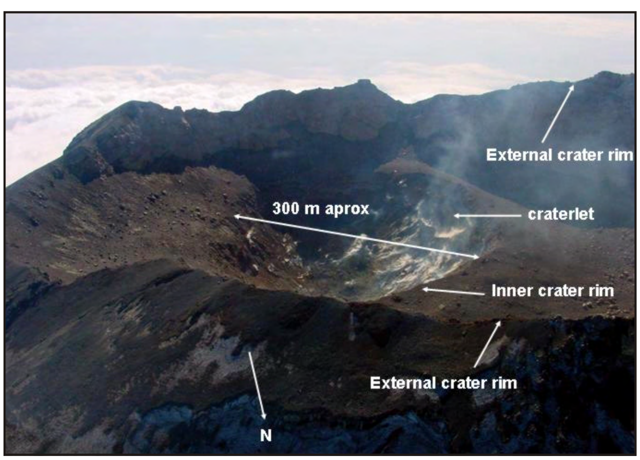


Figure 11. Annotated photograph of Popocatepétl's summit area taken 14 January 2005. A label identifies a small craterlet on the southern inner wall of the inner crater. These type of craterlets have been repeatedly formed by moderate explosions or exhalations. They have tended to be ephemeral, lasting only until the next event. Courtesy of CENAPRED; the Mexican Secretary of Communications and Transportation; and Servando De la Cruz, UNAM.

Information Contacts: *Alicia Martinez Bringas*, *Angel Gómez Vázquez*, *Roberto Quass Weppen*, *Enrique Guevara Ortiz*, *Gilberto Castelan Pescina*, and *Cesar Morquecho Zamarripa*, Centro Nacional de Prevención de Desastres (CENAPRED), Av. Delfín Madrigal No.665. Coyoacan, México D.F. 04360. Email: amb@cenapred.unam.mx gvazquez@cenapred.unam.mx; URL:http://www.cenapred.unam.mx/); *Servando De la Cruz-Reyna,* Instituto de Geofísica, UNAM Cd. Universitaria. Circuito Institutos, Coyoácan, D.F. 04510, México (Email: sdelacrr@tonatiuh.igeofcu.unam.mx, URL: http://www.geofisica.unam.mx).

Colima

western México
19.514°N,103.62°W; summit elev. 3,850 m

New emissions of block-lava flows began on 30 September 2004 after 19 months of intermittent explosive activity. During February 2002-February 2003 the lava dome extruded effusively, but it was destroyed by the July-August 2003 explosions (*Bulletin* v. 28, no. 6; and v. 29, no. 5). Thus, beginning in September 2003 the upper crater lacked a visible dome.

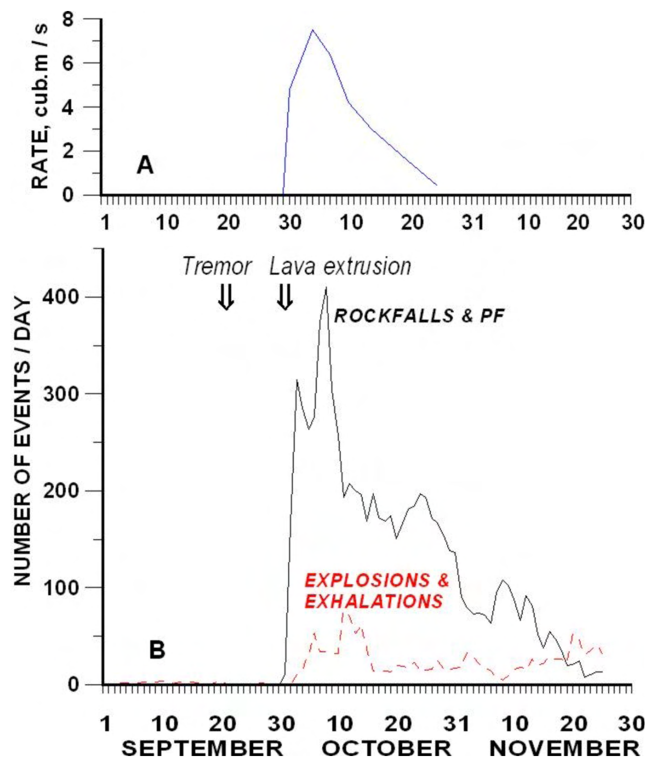


Figure 12. Plots of Colima activity during September-November 2004: (A) Lava emission rate; and (B) Number of earthquakes produced by rockfalls and pyroclastic flows (PF) (heavy line) and by explosions and exhalations (dashed line). Arrows show the tremor episode and the start of the eruption. Courtesy of Colima Volcano Observatory.

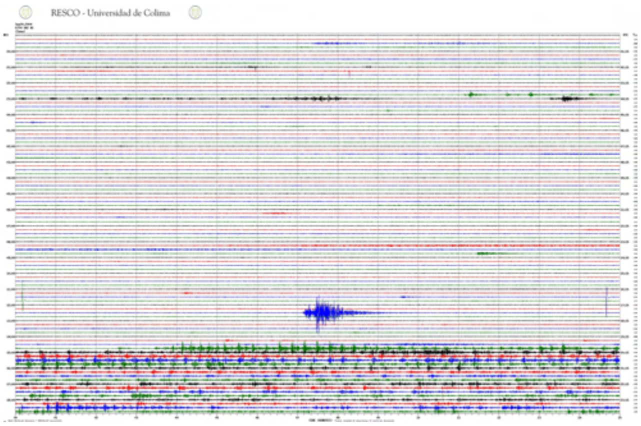


Figure 13. Seismic record showing the start of the tremor episode (towards the bottom) as registered at station EZV4 situated at a distance of 1.4 km from the crater. Courtesy of Colima Volcano Observatory.

The new lava effusions that began on 30 September took place without either premonitory swarms of volcano-tectonic earthquakes or significant deformation of the volcanic edifice. A 6-hour episode of volcanic tremors was observed on 20 September (figures 12 and 13).

On 28 September, intensive fumarolic activity began in the crater, forming a 500-m-high column of white gas. An overflight that day permitted observation of a new lava extrusion that practically filled the crater. An intensive swarm of seismic events produced by rockfalls and pyroclastic flows began at about 0600 on 30 September. The seismic events indicated the overflow of lava from the crater and heralded the formation of two andesitic block-lava flows. These flows began to develop along Colima's N and WNW slopes.

During October and November, lava emission continued at a decreasing rate (figure 10). The lava emissions were effusive and accompanied by frequent small explosions and exhalations. Numerous block-and-ash flows extended ~ 4.5 km from the summit (figure 10). Seismic intensity closely tracked with variations in the lava emission rate.

By 1 December, the two lava flows stretched ~ 2,400 m long and ~ 300 m wide on the N flanks, and ~ 600 m long and 200 m wide on the WNW flanks (figure 14). The total volume of erupted material including lava and pyroclastic-flow deposits was ~ 8.3×10^6 m^3.

Background. The Colima volcanic complex is the most prominent volcanic center of the western Mexican Volcanic Belt. It consists of two southward-younging volcanoes, Nevado de Colima (the 4,320-m-high point of the complex) on the N and the 3,850-m-high historically active Volcán de Colima at the south. A group of cinder cones of probable late-Pleistocene age is located on the floor of the Colima graben west and east of the Colima complex. Volcán de Colima (also known as Volcán Fuego) is a youthful stratovolcano constructed within a 5-km-wide caldera, breached to the south, that has been the source of large debris avalanches. Major slope failures have occurred repeatedly from both the Nevado and Colima cones, and have produced a thick apron of debris-avalanche deposits on three sides of the complex. Frequent historical eruptions date back to the 16th century. Occasional major explosive eruptions (most recently in 1913) have destroyed the summit and left a deep, steep-sided crater that was slowly refilled and then overtopped by lava dome growth.

Information Contact: *Observatorio Vulcanológico de la Universidad de Colima*, Colima, Col., 28045, México (Email: ovc@cgic.ucol.mx).

Figure 14. An oblique aerial photo showing a new lobe of blocky lava emplaced on Colima's N flank. Photo was taken on 27 October 2004. Courtesy of Colima Volcano Observatory.

Subscriptions: The *Bulletin of the Global Volcanism Network* (ISSN: 1050-4818) is available by subscription from the American Geophysical Union (2000 Florida Avenue NW, Washington, DC 20009, phone 202:462-6900 or 800:966-2481, fax 202:328-0566, Email: service@agu.org). Annual subscription price (2005) is $26 to US addresses and $43 to all other countries. Back issues can be ordered through AGU Separates; contact AGU for current pricing information. Orders must be prepaid; make checks payable to AGU; VISA/MC are accepted. The Smithsonian does not handle any *Bulletin* orders.

Email Access: The text of the *Bulletin* is distributed through the VOLCANO Listserv (volcano@asu.edu) maintained by Jonathan Fink at Arizona State University (subscribe via listserv@asu.edu).