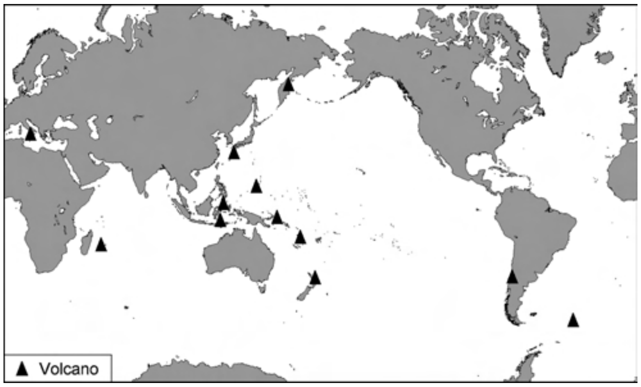
Bulletin of the Global Volcanism Network



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Smithsonian
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Shiveluch

Kamchatka Peninsula, Russia
56.653°N, 161.360°E; summit elev. 3,283 m
All times are local (= UTC + 12 hours [+ 13 hours in March-June])

Unrest at Shiveluch continued from 1 January through 9 April 2004, including above-background seismicity and lava-dome growth with associated pyroclastic flows. Gas-and-steam plumes rising as high as 4.5 km altitude and ash plumes rising to 4-6 km altitude were frequent. Plumes were noted as far as 175 km from the volcano. During the period, US and Russian satellites repeatedly detected thermal anomalies. For viewers on the ground the volcano was obscured by clouds throughout much of the period.

Earthquakes occurred at depths of 0-5 km with local magnitudes (M_l) of 1.25-2.6. About 70 shallow earthquakes with M_l over 1.75 occurred during the week ending 16 January. These were exceeded the following week by 206 earthquakes with M_l of 1.75-2.6 and about 40 ash explosions. Intermittent spasmodic volcanic tremors of 0.5-1.0 μm/s were also recorded that week. These events caused the level of concern to raise from Yellow to Orange, where it remained throughout the remainder of the report period.

Accompanying these events were pyroclastic flows with run-out distances of 1-2 km. Ash plumes rose as high as 6 km, extending in various directions for several kilometers. Gas-and-steam plumes rose to 3.5-4.5 km. One extended 50 km to the SE on 22 January while another, on 26 January, extended over 75 km to the SW.

Events and activities similar to those described above were noted throughout the report period. Shallow earthquakes were recorded almost daily through February, >10/week was typical except for the period in late January noted earlier. However, during late February and through March and April, strong earthquakes occurred, numbering 14-24 per week. Spasmodic volcanic tremor was registered throughout this latter period, attaining a maximum velocity of 0.8 μm/s during 4-6 March.

Gas-and-steam plumes, some containing ash and extending as far as 175 km, were noted throughout the period. During the beginning of April, one ash-gas explosion delivered ash up to 9.0 km while 13 other explosions sent plumes up to 4.0-7.2 km and spasmodic tremor with velocities of 0.2-0.7 μm/s was recorded.

Background. The high, isolated massif of Shiveluch volcano (also spelled Sheveluch) rises above the lowlands NNE of the Kliuchevskaya volcano group. The 1300 cu km Shiveluch is one of Kamchatka's largest and most active volcanic structures. The summit of roughly 65,000-year-old Strary Shiveluch is truncated by a broad 9-km-wide late-Pleistocene caldera breached to the south. Many lava domes dot its outer flanks. The Molodoy Shiveluch lava dome complex was constructed during the Holocene within the large horseshoe-shaped caldera; Holocene lava dome extrusion also took place on the flanks of Strary Shiveluch. At least 60 large eruptions of Shiveluch have occurred during the Holocene, making it the most vigorous andesitic volcano of the Kuril-Kamchatka arc. Widespread tephra layers from these eruptions have provided valuable time markers for dating volcanic events in Kamchatka. Frequent collapses of dome complexes, most recently in 1964, have produced debris avalanches whose deposits cover much of the floor of the breached caldera.

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Bezymianny

Kamchatka Peninsula, Russia
55.978°N, 160.587°E; summit elev. 2882 m
All times are local (UTC + 12 hours)

Bezymianny volcano was last reported in *Bulletin* v. 28, no.10, when a decrease in activity was noted over the period from a 26 July 2003 eruption to 22 August. Kamchatkan Volcanic Eruptions Response Team (KVERT) reports, through the Alaska Volcano Observatory (AVO), indicate that a weak thermal anomaly registered on satellite images following the 26 July 2003 eruption and continuing until an eruption on 14 January 2004.

January 2004 eruption. A shallow earthquake of local magnitude (Ml) 2.2 was reported at Bezymianny on 9 January. The eruption itself began at 1053 on 14 January, sending ash plumes to 6-8 km altitude to the ENE, decreasing to 3.5 km altitude later in the day. KVERT reported that a large pyroclastic flow probably formed on the ESE flank. On 15 January, gas-steam plumes rose to 100 m above the lava dome, increasing to 500 m on 16 January. A 2- to 8-pixel thermal anomaly registered on these days. Satellite images on the morning of 14 January showed ash clouds about 30 km wide extending 150 ENE km, increasing to 250-300 km ENE that afternoon. Meaningful seismic monitoring was thwarted during the eruption period due to high-level volcanic tremor at nearby Kliuchevskoi volcano. The eruption caused the hazard status to temporarily rise to the highest level (red).

KVERT weekly reports for the period from the 14 January eruption to 16 April indicate continuing unrest at Bezymianny. The lava dome was reported to be growing, with no detectable seismicity, gas-steam plumes were rising ~ 3-4 km and dispersing in the wind (generally to the S), and the number of pixels in thermal anomalies reduced from 1-4 early in the period to 1-2 late in the period.

25 December 2002 eruption. A substantial eruption at Bezymianny on 25 December 2002 was not reported in the *Bulletin*. That eruption followed a 1-pixel thermal anomaly on 23 December that increased to 7-10 pixels on 24-25 December, with seismicity slightly above background levels. Weak intermittent spasmodic tremor occurred on the 25th, when a very hot plume that probably contained ash was visible, and moderate explosive activity began around 1900. Seismic data revealed a large explosive eruption on 26 December at 0715. The resultant ash cloud rose to 5 km altitude. and deposited ash in Kozyrevsk, 55 km NW of Bezymianny. The eruption continued through the 27th, but activity decreased. On 1 January 2003 a weak thermal anomaly was noted over the volcano, probably reflecting a viscous lava flow on the dome.

Background. Prior to its noted 1955-56 eruption, Bezymianny volcano had been considered extinct. The modern Bezymianny volcano, much smaller in size than its massive neighbors Kamen and Kliuchevskoi, was formed about 4700 years ago over a late-Pleistocene lava-dome complex and an ancestral volcano that was built between about 11,000-7000 years ago. Three periods of intensified activity have occurred during the past 3000 years. The latest period, which was preceded by a 1000-year quiescence, began with the dramatic 1955-56 eruption. This eruption, similar to that of Mount St. Helens in 1980, produced a large horseshoe-shaped crater that was formed by collapse of the summit and an associated lateral blast. Subsequent episodic but ongoing lava-dome growth, accompanied by intermittent explosive activity and pyroclastic flows, has largely filled the 1956 crater.

Information Contacts: *Olga Girina*, Kamchatka Volcanic Eruptions Response Team (see Shiveluch); *Alaska Volcano Observatory* (see Shiveluch).

Suwanose-jima

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

Suwanose-jima volcano was last reported in *Bulletin* v. 28, no. 4, when activity was noted in September and December 2002, with thermal anomalies continuing into January 2003. HIGP MODIS thermal imagery revealed only one alert in the year to 13 April 2004, that being on 4 July 2003. NASA Terra and Defense Meteorological Satellite Program imagery dated 7-8 November 2003 showed an ash plume rising from Suwanose-jima to an estimated height of 2,400 m (figure 1) on those days.

According to Tokyo VAAC reports, using information from the Japanese Meteorological Agency, explosions also took place at Suwanose-jima on 15 December 2003 at 1946, and 21 December at 1828, each of which produced plumes to an unknown height. The VAAC reported several small emissions on 27 and 28 December, again rising to unknown heights and an eruption on 28 December at 0820 rising to ~ 1.5 km altitude and extending E. On 2, 4 and 21-22 January 2004 small explosions produced ash plumes to unknown heights.

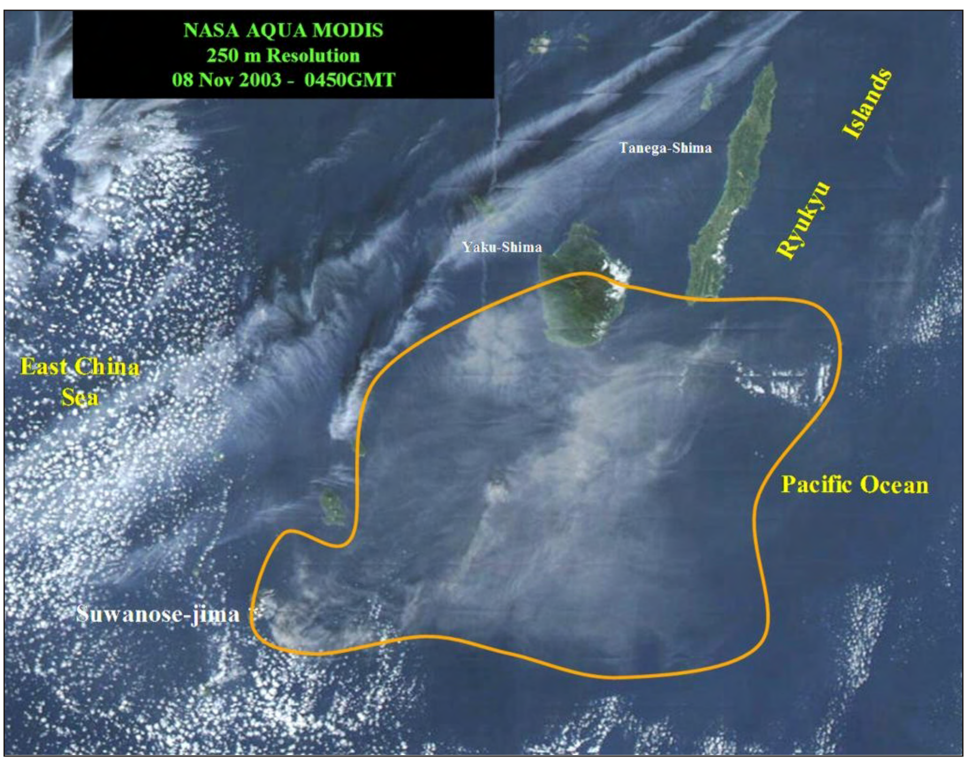

Figure 1. Ash plume from Suwanose-jima on 8 November 2003 imaged by the MODIS instrument on the NASA AQUA satellite. Courtesy Defense Meteorological Satellite Program (DMSP) and Charles Holliday.

Background. The 8-km-long, spindle-shaped island of Suwanose-jima in the northern Ryukyu Islands is occupied by a stratovolcano with two historically active summit craters. Only about 50 persons live on the sparsely populated island. The summit of the volcano is truncated by a large breached crater extending to the sea on the E flank that was formed by edifice collapse. Suwanose-jima, one of Japan's most frequently active volcanoes, was in a state of intermittent strombolian activity from On-take (Otake), the NE summit crater, that began in 1949 and lasted until 1996, after which periods of inactivity lengthened. The largest historical eruption took place in 1813-14, when thick scoria deposits blanketed residential areas, after which the island was uninhabited for about 70 years. The SW crater produced lava flows that reached the western coast in 1813, and lava flows reached the eastern coast of the island in 1884.

Information Contacts: *Japan Meteorological Agency (JMA)*, Volcanological Division 1-3-4 Ote-machi, Chiyoda-ku, Tokyo 100, Japan (URL: http://www.kishou.go.jp/english/), *HIGP MODIS Thermal Alert System*, Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa (http://modis.higp.hawaii.edu/); *Charles Holliday*, Air Force Weather Agency (AFWA), Satellite Applications Branch, Offutt AFB, NE 68113-4039, USA (Email: charles.holliday@afwa.af.mil).

NW Rota 1

Mariana Islands, Southern Seamount Province
14.601°N, 144.775°E; summit elev. -517 m

The research vessel *Thomas G. Thompson* conducted a survey of the Mariana Arc in the Commonwealth of the Northern Mariana Islands from 9 February to 5 March 2003 (Embley and others, 2004). That survey identified a number of hydrothermal systems (plumes) on the arc volcanoes. One volcano, detected in 2003 and named "NW Rota 1," was revisited in 2004 and again found to be actively venting (figure 2). That submarine volcano sits ~ 64 km NW of the island of Rota, with its summit at 14°36.048’ N, 144°46.519’ E (14.601°N, 144.775°E). Another volcano visited in 2003-2004 was an apparently quiet, non-erupting caldera lacking eruptive age constraints called "West Rota" (discussed at the end of this report). Most of the information gleaned from the 2004 cruise remains preliminary, coming from scientists still at sea.

The ship towed a conductivity-temperature-depth (CTD)/rosette system to map and sample hydrothermal plumes over NW Rota 1. The 2003 tow data detected a vigorous, 200-m-thick layer of hydrothermal plumes above the volcano’s summit. Chemical analysis of the 2003 plumes found high concentrations of particulate aluminum, sulfur, iron, and manganese, along with elevated ^{3}He, a helium isotope considered diagnostic of a magmatic source and associated hydrothermal discharge. The active crater’s summit depth was ~ 517 m.

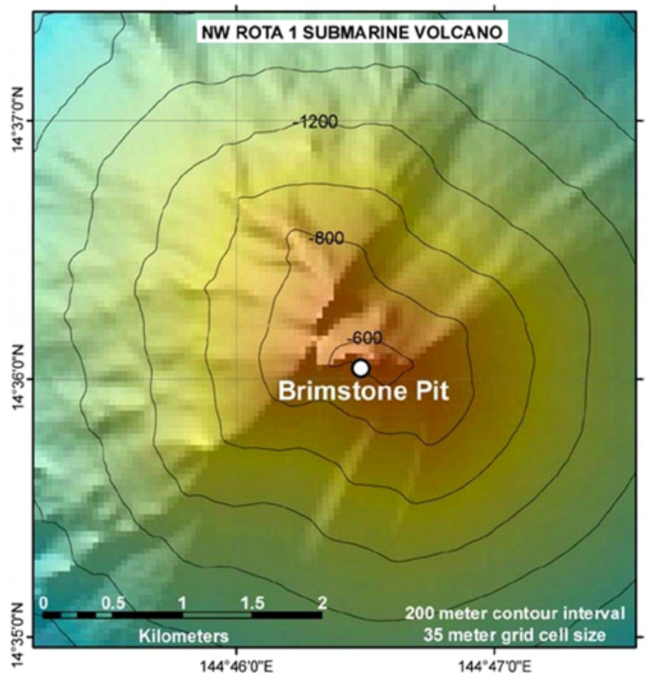

Figure 3. Bathymetry of NW Rota 1 showing the location of Brimstone Pit, April 2004. Courtesy of Bob Embley, NOAA.

In early April 2004, the *R.V. Thompson* revisited the Mariana Arc and found NW Rota 1 still vigorously active. William Chadwick and Robert Embley, National Oceanographic and Atmospheric Agency (NOAA), members of the cruise scientific staff, notified GVN that some video images from NW Rota 1 were taken with a ship-deployed remote vehicle (ROPOS-Remotely Operated Platform for Ocean Science). Videos posted on their web page showed views of the so-called “Brimstone Pit” (figures 3 and 4). Brimstone Pit represents a S-flank vent at a depth of 555 m, a spot ~ 40 m below the summit in rocky terrain. The videos and photos showed ash and sulfur bursts from the crater and a vent whose rim was covered with spatter (but probably not from this specific event). Water samples taken in a plume rising from the vent had temperatures of 30°C. Although incompletely mapped, the vent was roughly 20 m across and elliptical in outline; in the vertical dimension the vent appeared ~ 12 m deep and funnel-shaped.

During the ROPOS dive, the activity at the crater was variable. At the beginning of the dive there was only a wispy plume escaping, allowing the observers to see into the crater. Later in the dive, the crater returned to pulsing activity with bigger, more vigorous plumes and small rocks raining down on the crater rim. Over the

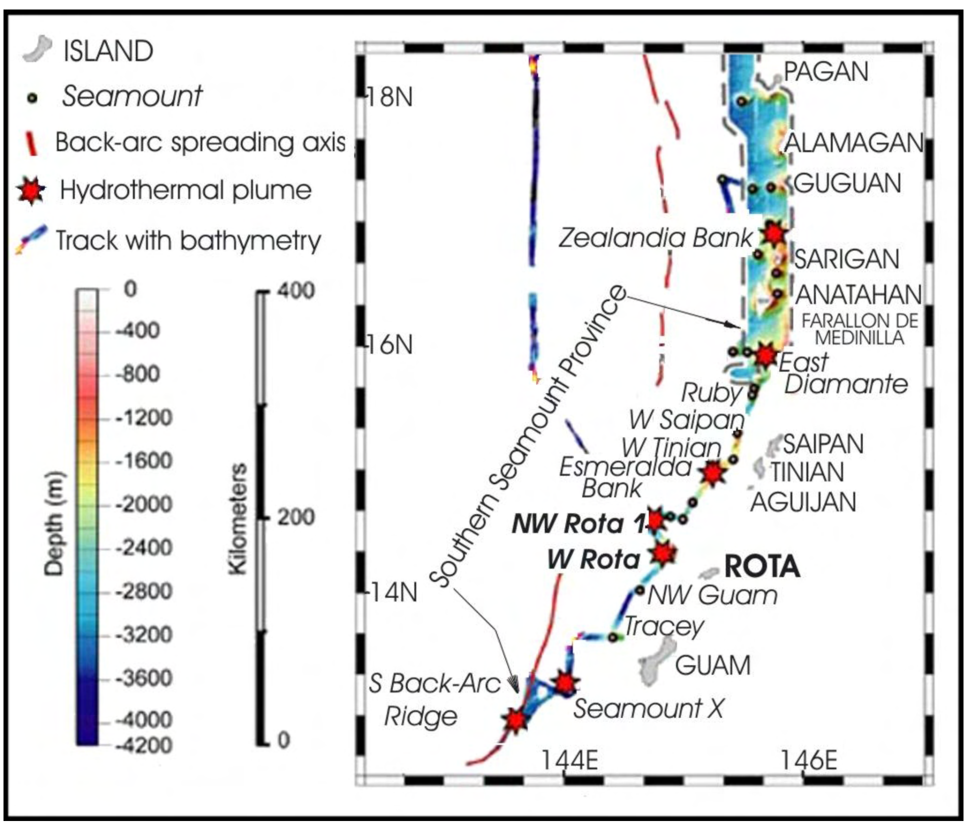

Figure 2. A map showing part of the Northern Mariana Islands and vicinity (an area roughly midway between the main island of New Guinea on the S, and Tokyo, Japan on the N). The islands shown include Guam, Rota, Saipan, and others. The map emphasizes the location of the active submarine volcano *NW Rota 1* and the currently quiet submarine caldera *West Rota*. After Embley and others, 2004; courtesy of the American Geophysical Union.

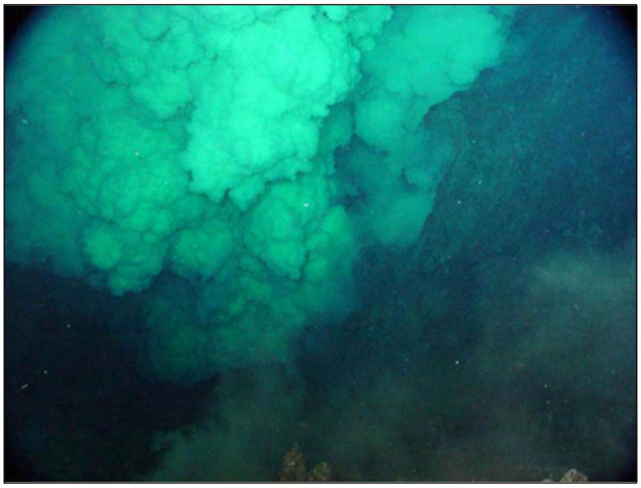

Figure 4. At NW Rota 1, the 555-m-deep submarine crater called Brimstone Pit discharged a dense, yellowish, particle-laden plume. This April 2004 photo was taken from a remote submarine vehicle, which captured the plume from the submarine vantage point, a relatively rare circumstance for shallow-depth submarine eruptions. At other times during the exploration, venting slowed or ceased, allowing views of the vent itself. Courtesy of W. Chadwick, NOAA.

summit, which was still at a depth of ~ 517 m below sea level (as it was in 2003), the ROPOS images depicted a lot of diffuse venting of clear fluids. Intense geyser-like discharges flowed from the vents with jets rising to several ten's of meters. Cloudy water rose to form a plume several hundred meters above the summit. The pulsating jets carried sand- to gravel-size particles (a few centimeters across), ejecta that rained down on the crater rim out to a distance of ~ 10 m. Droplets of molten sulfur in the jets gave a yellowish cast to the billowing clouds, suggesting a temperature of at least 100°C (figure 4). The ROPOS came up from the last dive covered in sand and gravel, and in sulfur droplets, which had solidified and adhered to the submersible's body!

In overview, the April 2004 dives with ROPOS documented NW Rota 1 in a magmatic phase of activity. The active vent showed time-varying behavior that included precipitation of sulfur droplets from the venting fluids, pulses of ejecta from the vent, and large amounts of fresh, glassy ejecta surrounding the crater. In addition, the study identified a turbid plume extending ~ 0.7-2.0 km from the volcano, reflecting an intensity unseen in 2003, and presumably the result of the vigorous summit activity.

The large amount of sulfur was believed to be forming by interaction of magmatic SO_2 with water to form elemental sulfur and sulfurous acids. Bob Embley suggested that this magmatic event was in the early stages, as evidenced by negligible alteration of glassy lavas in spite of incredibly corrosive hot fluids. Team biologists noted that biota had only begun to colonize the impacted area.

Volcanic seismicity may accompany this event, although its detection may require a network of near-source ocean-bottom seismometers. At least from initial looks at their data, geophysicists at the NOAA Vents Program failed to detect any T-phase hydroacoustic signals coming from this vicinity. It should be noted, however, that their real-time hydrophones are located in the NE Pacific at a great distance from the volcano.

In an effort to enlist other seismic and acoustical instruments, Olivier Hyvernaud (Laboratoire de Détection et de Géophysique, CEA/DASE/LDG; with access to the French Polynesian network), and Roderick Stewart (CTBTO, the Preparatory Commission for the comprehensive nuclear-test-ban treaty, with access to Juan Fernandez island data) have been contacted. Thus far it appears that their systems lacked signals clearly attributable to NW Rota 1.

West Rota. During early April 2004 the *Thompson* also visited another newly identified submarine volcano that the 2003 survey group named "West Rota" (~ 56 km W of the island of Rota). It appeared inactive, and lacked a strong hydrothermal plume in the waters above it. However, it contained features indicative of a violent explosive eruption at some unknown time in the (geologically) recent past; namely, felsic volcanic rocks and the formation of a big caldera. The West Rota caldera is comparable in size to Crater Lake, Oregon (figure 5). The cruise scientists suspect that this volcano erupted violently a few thousand, to ten's of thousands, of years ago.

References: Embley, R.W., Baker, E.T., Chadwick, Jr., W.W., Lupton, J.E., Resing, J.A., Massoth, G.J., and Nakamurs, K., 2004, Explorations of Mariana Arc volcanoes reveal new hydrothermal systems: EOS-Transactions of the American Geophysical Union, v. 85, no. 4, p. 37 and 40.

Information Contacts: *William W. Chadwick, Jr.*, Cooperative Institute for Marine Resources Studies (CIMRS), NOAA Pacific Marine Environmental Laboratory (PMEL), 2115 SE OSU Drive, Newport, OR 97365 USA (Email: bill.chadwick@noaa.gov); *Robert W. Embley*, NOAA Pacific Marine Environmental Laboratory (PMEL), 2115 SE

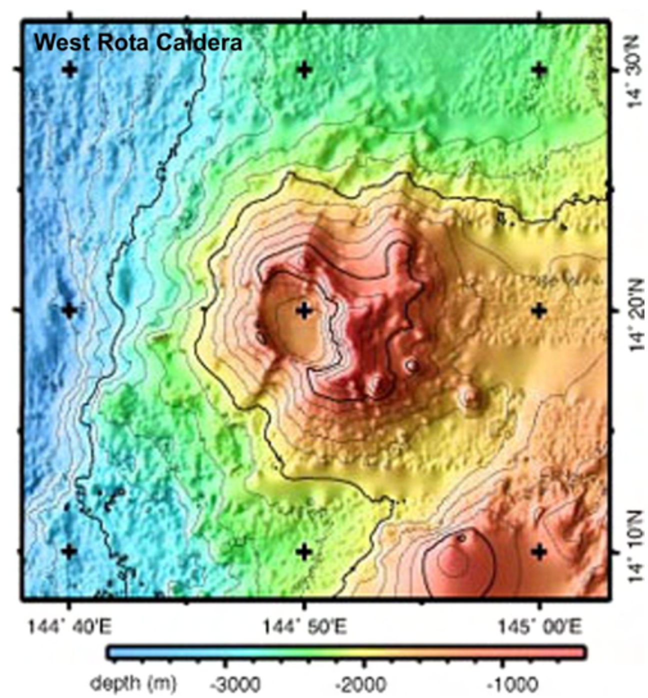

Figure 5. Although the erupting submarine volcano NW Rota 1 sits ~ 64 km NW of the island of Rota; slightly more to the W of Rota lies the recently identified and apparently quiet submarine caldera named West Rota. West Rota is elongate in the NW-SE direction and bears approximate size resemblance to the scenic lake-filled, 10-km-diameter caldera in the Cascade range of Oregon (USA), Crater Lake. West Rota's caldera floor lies at ~ 1.6 km depth below sea level. Courtesy of NOAA.

OSU Drive, Newport, OR 97365 USA (Email: robert.w.embley@pmel.noaa.gov; URL: http://oceanexplorer.noaa.gov/explorations/); *Douglas Wiens*, Department of Earth and Planetary Sciences, Washington University, Campus Box 1169, One Brookings Drive, Saint Louis, MO 63130-4899, USA (Email: doug@wustl.edu, URL: http://epsc.wustl.edu/seismology/).

Egon

Lesser Sunda Islands, Indonesia
8.67°S, 122.45°E; summit elev. 1,703 m
All times are local (= UTC + 8 hours)

This first *Bulletin* report discussing Egon describes the sudden appearance of volcanic activity there in January 2004. Heavy rains fell over Egon and its surrounding area on 28 January. At 0400 on 29 January, local people heard the sound of the E crater wall collapsing inward. That was followed at 1700 by an explosion and a black ash cloud rising ~ 750 m above the summit. On 30-31 January further noise was followed by gray ash clouds and the odor of highly concentrated sulfur every 50-60 minutes. Visual observation on 31 January revealed a new solfatara.

Volcanic earthquakes were detected on 30 January (intensity III on the Modified Mercali (MMI) scale), and a seismometer installed on 31 January recorded a type-A deep-volcanic earthquake at 1610 and two harmonic tremor events (amplitude 0.5 mm) at 1800. At 2227 an explosion was heard and instrumentally recorded for about 70 seconds. On 1 February, instruments recorded two tremor events and one type-A volcanic earthquake. Egon was placed on Alert level 3 (on a 1-4 scale) on that day.

United Nations reports and news reports from around 31 January indicated that up to 6,400 people were being evacuated from near Egon volcano as a precautionary measure due to "smoke," ash, and other possible emissions. The news cited evacuations from the mountain villages of Hale, Hebing, Lere, Natakoli, Pedat, Bau Krengat, and Kelawair, with refugees going to Maumere (the island's main town, 25 km W of the summit). There were reports of 1 or 2 deaths, but it is not entirely clear that they were related to volcanic activity, evacuations, or other causes.

The European Volcanological Society (SVE) posted this report on the UN's *Relief Web* website: "One person has been reported killed from smoke and ash inhalation from the eruption of Egon volcano. Thick clouds of smoke and a great discharge of hot ash, large chunks of sulfur and volcanic rocks were seen nearby. The eruption caused panic among residents nearby, and they fled the mountain villages . . . . Eyewitnesses said the lower part of the crater was seen bursting and that was believed to be the main outlet for the hot lava that spewed from the volcano.."

Agence France-Presse published a photo (by Romeo Gacad) with a distant aerial view of Egon's summit as it appeared around sunset on 1 February. A thin plume rose gently above the summit. Lower portions of the photo were in cloud.

A 2 February 2004 United Nations (OCHA) report stated that "Volcanologists continue monitoring the activity of Mt. Egon closely. Since the beginning of February, a decrease in seismic activity and emissions has been registered." This and another UN report noted, as of 13 February ~ 5,000 people had been evacuated and had been accommodated in 14 temporary government shelters. The report went on to note "A gradual return of the evacuated population has already begun and is expected to continue if current conditions remain unchanged. As of 4 February some 600 people have already returned to their villages."

Background. 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 1,703-m-high volcano. A lava dome forms the southern 1,671-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 2004 are 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: *Dali Ahmad*, *Hetty Triastuty*, *Nia Haerani*, and *Suswati*, Directorate of Volcanology and Geological Hazards (formerly VSI), Jalan Diponegoro No 57, Bandung 40122, Indonesia (email:dali@vsi.esdm.go.id; URL http://www.dpe.go.id.); *Dan Shackelford*, 3124 E. Yorba Linda Blvd., Apt. H-33, Fullerton, CA 92831-2324, USA (Email: danshack@ix.netcom.com); *United Nations, Office for the Coordination of Humanitarian Affairs (UN OCHA)*, S-3600, New York, NY 10017, USA (URL: http://www.reliefweb.int/); *Henry Gaudru*, Société Volcanologique Européenne (SVE), C.P.1-1211 Geneva 17- Switzerland (Email: HgaudruSVE@compuserve.com; URL: http://www.sveurop.org/).

Karangetang [Api Siau]

Siau Island, Indonesia
2.47°N, 125.29°E; summit elev. 1,784 m
All times are local (= UTC + 8 hours)

This is an update to *Bulletin* v. 28, nos. 7, 9, 10, and 11, which discussed activity at Karangetang volcano over the period June-November 2003. A Darwin Volcanic Ash Advisory Centre report stated that at 0630 UTC (1430 local time) on 18 July 2003 pilots saw a thick ash plume rising from the volcano to ~ 8.5 km altitude.

HIGP MODIS thermal-alert reports for the year to 13 April 2004 showed, subject to the limitations of thermal imaging (e.g. in times of heavy cloud), thermal activity at the volcano on 26 April, 7 and 30 May, 1 and 6 June, 21 July and 11 August 2003, and 2 April 2004.

Background. Karangetang (Api Siau) volcano lies at the northern end of the island of Siau, north of Sulawesi. The 1784-m-high stratovolcano contains five summit craters along a N-S line. Karangetang is one of Indonesia's most active volcanoes, with more than 40 eruptions recorded since 1675 and many additional small eruptions that were not documented in the historical record (Neumann van Padang, 1951, *Catalog of Active Volcanoes of the*

World). Twentieth-century eruptions have included frequent explosive activity sometimes accompanied by pyroclastic flows and lahars. Lava-dome growth has occurred in the summit craters; collapse of lava-flow fronts has also produced pyroclastic flows.

Information Contacts: *HIGP MODIS Thermal Alert System*, Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa (URL: http://modis.higp.hawaii.edu/); *Darwin Volcanic Ash Advisory Centre (VAAC)*, Commonwealth Bureau of Meteorology, Northern Territory Regional Office, PO Box 40050, Casuarina, NT 0811, Australia (URL: http://www.bom.gov.au/info/vacc/; Email: darwin.vaac@bom.gov.au).

Bagana

Bougainville Island, Papua New Guinea
6.140°S, 155.195°E; summit elev. 1,750 m

Bagana was last reported in *Bulletin* v. 28 no. 1, when MODIS data indicated almost continuous activity during 2001-2002. Continued MODIS thermal alerts during March 2003-February 2004 (table 1) suggests that activity continued over the year ending February 2004. No corroborative reports of activity have been received from the Rabaul Volcano Observatory or the Darwin Volcanic Ash Advisory Centre.

Background. Bagana volcano, occupying a remote portion of central Bougainville Island, is one of Melanesia's youngest and most active volcanoes. Bagana is a massive symmetrical lava cone largely constructed by an accumulation of viscous andesitic lava flows. The entire lava cone could have been constructed in about 300 years at its present rate of lava production. Eruptive activity at Bagana is characterized by non-explosive effusion of viscous lava that maintains a small lava dome in the summit crater, although explosive activity occasionally producing pyroclastic flows also occurs. Lava flows form dramatic, freshly preserved tongue-shaped lobes up to 50-m-thick with prominent levees that descend the volcano's flanks on all sides.

Month	Days with Thermal Alerts
Mar 2003	13, 19, 26, 31
Apr 2003	2, 11, 18, 25
May 03	18, 20
Jun 2003	19, 26
Jul 2003	21, 23, 25
Aug 2003	4, 6, 8, 13, 24, 29
Sep 2003	16
Oct 2003	2, 4, 07, 13, 18, 27
Nov 2003	5, 10, 12
Dec 2003	3
Jan 2004	13, 15, 20, 24, 31
Feb 2004	5

Table 1. Nights on which MODIS thermal alerts were recorded for Bagana, for the year ending February 2004. Thermal alerts recorded in daylight hours have been omitted for data reliability reasons (one case on 23 October 2003). Data courtesy HIGP MODIS Thermal Alert System.

Information Contact: *HIGP MODIS Thermal Alert System*, Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa (URL: http://modis.higp.hawaii.edu/).

Ambrym

Vanuatu
165.25°S, 168.12°E; summit elev. 1,334 m

Ambrym was last reported in *Bulletin* v. 28, no. 9, when details of activity observed during September 2003 visits were published. A daily summary of MODIS thermal alerts for the year ending February 2004 (table 2) suggests, subject to the limitations of thermal imaging (e.g. in times of heavy cloud), regular activity over the course of the year. No corroborative reports of activity have been received from the Rabaul Volcano Observatory or the Darwin Volcanic Ash Advisory Centre.

Background. Ambrym, a large basaltic volcano with a 12-km-wide caldera, is one of the most active volcanoes of the New Hebrides arc. A thick, almost exclusively pyroclastic sequence, initially dacitic, then basaltic, overlies lava flows of a pre-caldera shield volcano. The caldera was formed during a major plinian eruption with dacitic pyroclastic flows about 1900 years ago. Post-caldera eruptions, primarily from Marum and Benbow cones, have partially filled the caldera floor and produced lava flows that ponded on the caldera floor or overflowed through gaps in the caldera rim. Post-caldera eruptions have also formed a series of scoria cones and maars along a fissure system oriented ENE-WSW. Eruptions have apparently occurred almost yearly during historical time from cones within the caldera or from flank vents. However, from 1850 to 1950, reporting was mostly limited to extra-caldera eruptions that would have affected local populations.

Information Contact: *HIGP MODIS Thermal Alert System*, Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa (URL: http://modis.higp.hawaii.edu/).

Month	Days with Thermal Alerts
Mar 2003	7, 21, 30
Apr 2003	15, 17
May 2003	1, 3, 17, 19, 20, 28
Jun 2003	9, 15, 16, 29
Jul 2003	29
Aug 2003	21, 25
Sep 2003	13, 15, 24
Oct 2003	1, 3, 8, 10, 22, 24, 31
Nov 2003	2
Dec 2003	25, 27
Jan 2004	7, 9, 12, 28
Feb 2004	1, 3, 4, 10, 17, 19, 22, 28

Table 2. Nights on which MODIS thermal alerts were recorded for Ambrym, for the year ending February 2004 . Thermal alerts recorded in daylight hours have been omitted for data reliability reasons (4 cases). Data courtesy HIGP MODIS Thermal Alert System.

Yasur

Vanuatu
19.52°S, 169.425°E; summit elev. 361 m

Activity from the summit crater at Yasur continued through 2002 (*Bulletin* v. 28, no. 1). While similar comprehensive reports are not available for 2003, MODIS data (table 3) indicated activity continuing over the year to 16 March 2004. No corroborative reports of activity have been received from the Rabaul Volcano Observatory or the Darwin Volcanic Ash Advisory Center.

Month	Days with Thermal Alerts
Mar 2003	23
Apr 2003	15
May 2003	3,10
Jun 2003	4
Sep 2003	8,17
Oct 2003	17, 24, 26
Nov 2003	5, 10, 12
Mar 2004	13

Table 3. Nights on which MODIS thermal alerts were recorded for Yasur during the year ending 16 March 2004. Data courtesy HIGP MODIS Thermal Alert System.

John Seach reported continued eruptions at Yasur during March 2004. He suggested that there was an average of about 500 explosions per day, which is typical of the volcano's normal state of activity.

Background. Yasur, the best-known and most frequently visited of the Vanuatu volcanoes, has been in more-or-less continuous strombolian and vulcanian activity since Captain Cook observed ash eruptions in 1774. This style of activity may have continued for the past 800 years. Yasur, located at the SE tip of Tanna Island, is a mostly non-vegetated 361-m-high pyroclastic cone with a nearly circular, 400-m-wide summit crater. Yasur is largely contained within the small Yenkahe caldera and is the youngest of a group of Holocene volcanic centers constructed over the down-dropped NE flank of the Pleistocene Tukosmeru volcano. Active tectonism along the Yenkahe horst accompanying eruptions of Yasur has raised Port Resolution harbor more than 20 m during the past century.

Information Contact: *HIGP MODIS Thermal Alert System* (see Bagana); *John Seach*, PO Box 4025, Port Vila, Vanuatu (Email: john@volcanolive.com, URL: http://www.volcanolive.com/).

White Island

New Zealand
37.52°S, 177.18°E; summit elev. 321 m
All times are local (= UTC + 12 hours [+ 13 hours early October to mid-March])

An April 2004 note from New Zealand geothermal geologist Ashley Cody noted that White Island had essentially ceased its eruptive episode since about 2002, when it began to emit only very weak gas (lacking ejecta). Accordingly, compared to several years ago, there has been little to report about it. However, the Institute of Geological & Nuclear Sciences (GNS) still monitors White Island seismically, and with the Geonet web camera (visible real-time on the net). This report contains a summary of their brief reports. An issue of current interest is the continued growth of the crater lake. Crater lake growth was previously reported in February and August 2003 (*Bulletin* v. 28, nos. 2 and 8).

GNS reports warned that "should there be no significant eruptive activity within the next 18-24 months and the lake continues to fill, it may reach overflow level. In this situation water may overflow into drainage channels on Peg 12 Flat, S of the 1978/90 Crater Complex, and these channels may further erode . . . ."

Steve O'Meara of Volcano Watch International visited White Island on 8 February 2004 (figure 6) and noted considerably weaker fumarolic activity than during an earlier trip in 2000 (figure 7). Hydrothermal activity, though diminished, was still taking place in the crater and steam often lifted off the lake's surface, which effervesced. Scum was weakly present, especially around the lake's edges, but he did not see as much as during his 2000 visit. Volcanic bombs and explosion debris surrounded the crater. Al-

Figure 6. The rim of White Island's main crater taken looking W on 8 February 2004, showing the crater lake and the top of the E rim. Observers noted a small fresh landslide in the far crater wall (to the right of the fumaroles). Courtesy of Steve and Donna O'Meara, Volcano Watch International.

Figure 7. A wide-angle aerial shot of White Island taken 5 January 2000 amid much more vigorous degassing than present in February 2004. The then smaller, but more steam-covered crater lake appears in the center of the photo, directly behind the high point along the crater rim in the foreground. Courtesy of Steve and Donna O'Meara, Volcano Watch International.

though O'Meara's professionally-guided tour was conducted skillfully and with genuine regard for safety, he expressed concern about a sudden eruption from the lake catching onlookers off guard.

A 13 February 2004 report from the GNS stated that heavy rainfall on White Island during the past few weeks triggered many small landslides inside the crater rim. They went on to note that the lake continued to fill steadily and last week all of the temporary marker posts were submerged or had washed into the lake. This week, GNS volcanologists had visited the island to install six more survey posts inside the main crater, so changes in the lake's level could continue to be monitored. The lake temperature was 57°C, similar to values measured during the last six months. A 26 March report noted a decrease in the rate of rainfall and consequent drop in the rate of filling of the crater lake. GNS reports on 2 April and 26 March also mentioned minor seismic activity, which was described in more detail in a 19 March report as "including a few very small, discrete earthquakes but no volcanic tremor."

The GNS report for 30 April 2004 stated that "seismic and hydrothermal activity at White Island remain at a low level. The crater lake was then [12-]13.6 m below the level at which it will overflow. White Island also remains at Alert Level 1 (some signs of volcano unrest)." An overview of late 2002-early 2004 GNS data appears on table 4. There were no HIGP-MODIS thermal alert warnings for White Island over the 12 months to April 2004.

Background. Uninhabited 2 x 2.4 km White Island, one of New Zealand's most active volcanoes, is the emergent summit of a 16 x 18 km submarine volcano in the Bay of Plenty about 50 km offshore of North Island. The 321-m-high island consists of two overlapping andesitic-to-dacitic stratovolcanoes; the summit crater appears to be breached to the SE because the shoreline corresponds to the level of several notches in the SE crater wall. Volckner Rocks, four sea stacks that are remnants of a lava dome, lie 5 km NNE of White Island. Intermittent moderate phreatomagmatic and strombolian eruptions have occurred at White Island throughout the short historical period beginning in 1826, but its activity also forms a prominent part of Maori legends. Formation of many new vents during the 19th and 20th centuries has produced rapid changes in crater floor topography. Collapse of the crater wall in 1914 produced a debris avalanche that buried buildings and workers at a sulfur-mining project.

Information Contacts: *Institute of Geological & Nuclear Sciences (GNS)*, Private Bag 2000, Wairakwi, New Zealand (URL: http://www.gns/cri.nz); *GeoNet*, a project sponsored by the New Zealand Government through these agencies: Earthquake Commission (E.C.), Geological & Nuclear Sciences (GNS), and Foundation for Research, Science & Technology (FAST). Geonet can be contacted at the above GNS address (their URL: http://www.geonet.org.nz/contact.htm); *Steve and Donna O'Meara*, Volcano Watch International, P.O. Box 218, Volcano, HI 96785 (Email: someara@interpac.net).

Nevados de Chillán

Chile

36.863°S, 71.377°W; summit elev. 3,212 m

Nevados de Chillán was active from 1973 through 1983; after that, phreatomagmatic eruptions were reported to have almost ended. A small (VEI 1) eruption, the first since 1986, was noted by local inhabitants and tourists in August-September 2003. Low magnitude explosive events occurred over the week ending 27 August 2003, sending brown-gray to white gas-and-ash columns up to heights of 500 m for periods of up to 25 minutes. Resulting deposits were ~ 1 cm deep over a sharply defined 2.2 km wide zone to the SSE. Prevailing winds were strong around the time of the eruption (figure 8). Explosions then became more sporadic, occurring at 2-3 day intervals, until ceasing in mid-September.

An inspection of the eruption site on 22 January 2004 by Servicio Nacional de Geoligica y Mineria scientists revealed a new compound, fissure-like, double crater in the saddle between the cones Nuevo (which erupted during 1906-1945) and Arrau (which erupted during 1973-1986) (figure 9). This new ~ 64 m long double crater consisted of a NW situated, 25 x 14 m crater and a SE situated, 39 x 28 m crater. These craters lie to the NW of Arrau cone and become surrounded by an area of intense fumaroles towards Nuevo cone. The fumaroles are water-vapor rich but give off a weak sulfur odor. On Nuevo's E side they had temper-

Month	Seismicity	Emission levels	Comment
Oct 02	—	63 metric tons of SO2 / day (t/d)	—
Nov 02	Minor weak volcanic tremor	Weak steam / gas emissions	—
Dec 02	Minor weak volcanic tremor	Weak steam / gas emissions; 112 t/d SO_2	—
Jan 03	Moderate / weak volcanic tremor	Weak steam / gas emissions	—
Feb 03	Low / minor volcanic tremor	Minor weak steam / gas emissions; 269 t/d SO_2	Increased tremor (with exception of 17 Feb)
Mar 03	Low levels of weak tremor	Low steam / gas emissions; 267 t/d SO_2	—
Apr 03	Low / negligible	Weak / very weak steam / gas plumes	Active vent flooded, reducing emissions and seismicity
May 03	Very low	Unchanged	—
Jun 03	Intermittent low level activity	Minor steam / gas plume	—
Jul 03	Very low	Plume no longer visible	Light green water, 30 m below rim; 58°C. Fumaroles 101-114°C
Aug 03	Low	—	Water 53°C, 300 m long lake. Active monitoring of water level begins.

Table 4. A summary of the Institute of Geological & Nuclear Sciences (GNS) reports discussing White Island, October 2002 to April 2004. Blank area signify lack of substantive new data. Courtesy of the GNS and their HazardWatch.co.nz website.

Figure 8. Strong prevailing winds blowing over the Nevados de Chillán complex caused the resulting plume to remain at low altitude. This photo was taken in early September 2003. The plume blew towards the SSE. Courtesy Servicio Nacional de Geoligica y Mineria.

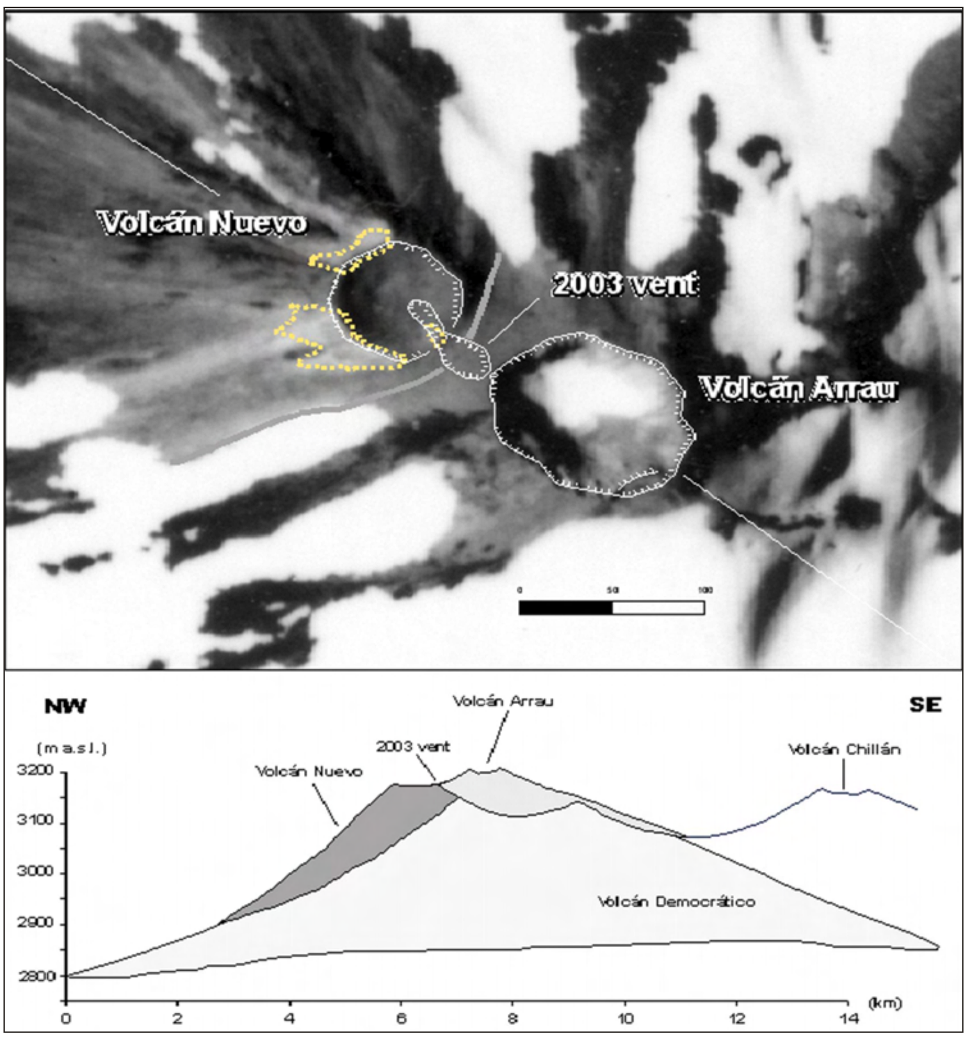

Figure 9. Aerial view and cross section of the Nevados de Chillán complex, showing the new crater in relation to Nuevo and Arrau cones, and indicating SSE-oriented ash dispersal. Courtesy Servicio Nacional de Geoligica y Mineria.

atures of up to 88°C (table 5). While no previous measurements were available, this area showed more intense fumarolic activity than seen during a January 1994 visit and 1998 air photographs. During the recent visit the local heat-flow appeared concentrated adjacent to Nuevo cone, rather than Arrau cone. This, and the fissure-like form of the 2003 crater, were taken as evidence for possible future eruptions closer to Nuevo cone.

In addition to dispersal and deposition of loose ash, the January inspection noted agglutinates forming a series of 2 m long ridges or 'dunes' (figure 10). The agglutinates consisted of wet black clusters of ash spheres with 0.5- to 1-cm diameters. A large number of dead insects in the agglutinated ash suggested extreme conditions such as the presence of toxic gasses. When dry, the ash was dark gray with a lithic-rich polymodal composition. Particle sizes ranged from dust to 4-5 mm, of which 5-10% was coarse-grained, lithic-rich lapilli composed of black, gray, and red aphyric andesites and ~ 60% was fine- to medium-grained lapilli composed of lithic clasts, quartz, and plagioclase crystals. Below the 1 mm size range, black glassy shards appeared with cleaved vesicle surfaces and blocky or plate-like shapes. The remnant fraction was light-gray fine ash.

Background. The compound volcano of Nevados de Chillán is one of the most active volcanoes of the Central Andes of Chile. Three late-Pleistocene to Holocene stratovolcanoes were constructed along a NNW-SSE line within nested Pleistocene calderas, which produced ignimbrite sheets extending more than 100 km into the Central Depression of Chile. The largest stratovolcano, 3,212-m-high Cerro Blanco, is located at the NW end of the group, and 3,089-m-high Volcán Viejo (Volcán Chillán), which was the main active vent during the 17th-19th centuries, occupies the SE end. The new Volcán Nuevo stratovolcano formed beginning in 1861 between the two volcanoes, and has been the most active

Site	UTM N	UTM W	Temperature (°C ± 0.5)
SW Nuevo flank	288.086	5916.963	87.2
E Nuevo rim	288.138	5917.522	87.9
Between craters	288.263	5917.547	57.4

Table 5. Site names, locations (as UTM coordinates), and fumarole temperatures describing conditions at Nevados de Chillán on 22 January 2004. The fumaroles were located near the 2003 vent. Courtesy of J.A. Naranjo and L.E. Lara, SERNAGEOMIN.

Figure 10. January 2004 view of dried ash deposits from Nevados de Chillán's 2003 eruption. The darker deposits lay atop remnant snow pack. Courtesy Servicio Nacional de Geoligica y Mineria.

vent since, growing to exceed Volcán Viejo in altitude.

Reference: Naranjo, J.A., and Lara, L.E., 2004, August-September 2003 eruption in the Nevados de Chillán Volcanic Complex (36°50'S), Southern Andes (Chile): Revista Geologica de Chile (February 2004).

Information Contact: *Jose A. Naranjo* and *Luis E. Lara*, Servicio Nacional de Geoligica y Mineria (SERNAGEOMIN), Av. Santa Maria 0104, Santiago, Chile (Email: jnaranjo@sernageomin.cl; lelara@sernageomin.cl).

Michael

South Sandwich Islands
57.78°S, 26.45°W; summit elev. 990 m

The only previous report on the remote Michael volcano was in *Bulletin* v. 28 no. 2, which commented on a lava lake detected by satellite imagery over the period 1995-2002. A review of MODIS data for the period from that report (end 2002) to 16 March 2004 (UTC) reveals one thermal alert, on 7 May 2003 (UTC). No corroborative report is available, although previous alerts were interpreted as possibly representing lava lake activity.

Background. The young constructional Mount Michael stratovolcano dominates glacier-covered Saunders Island. Symmetrical and 990-m-high, Mount Michael has a 700-m-wide summit crater and a remnant of a somma rim to the SE. Tephra layers visible in ice cliffs surrounding the island are evidence of recent eruptions. Ash clouds were reported from the summit crater in 1819, and an effusive eruption was inferred to have occurred from a N-flank fissure around the end of the 19th century and beginning of the 20th century. A low ice-free lava platform, Blackstone Plain, is located on the N coast, surrounding a group of former sea stacks. A cluster of parasitic cones on the SE flank, the Ashen Hills, appear to have been modified since 1820 (LeMasurier and Thomson 1990). Vapor emission is frequently reported from the summit crater. Recent AVHRR and MODIS satellite imagery has revealed evidence for lava lake activity in the summit crater of Mount Michael.

Information Contact: *Rob Wright*, *Luke Flynn*, and *Eric Pilger*; MODIS Thermal Alert System, Hawaii Institute of Geophysics and Planetology (HIGP), School of Ocean and Earth Science and Technology, University of Hawaii at Manoa (URL: http://modis.higp.hawaii.edu/; Email: wright@higp.hawaii.edu, flynn@higp.hawaii.edu, and pilger@higp.hawaii.edu).

Stromboli

Aeolian Islands, Italy
38.79°N, 15.21°E; summit elev. 926 m
All times are local (= UTC + 1 hour [+ 2 hours late March-late October])

Explosive activity at the summit craters of Stromboli volcano resumed in early June 2003, before the end of the effusive eruption that finished between 21 and 22 July 2003. Eruptive activity at this volcano is monitored by Istituto Nazionale di Geofisica e Vulcanologia (INGV-CT). They have installed two web cameras at an elevation of 920 m on Il Pizzo Sopra la Fossa and at an elevation of 400 m along the E margin of the Sciara del Fuoco, the depression on the N flank of the volcano. Additionally, a web thermal camera is located at the 400-m elevation site noted above, and a web infrared camera is positioned at Il Pizzo Sopra la Fossa. The 2 cameras (thermal and video) at the 400-m elevation site give important insights when visibility is insufficient at the more distant cameras. The infrared camera at Il Pizzo provides both a continuous view of the activity at the summit craters and a quantification of the energy released by the explosions at the three summit craters through an automated system called VAMOS (Cristaldi and others, 2004).

According to aviation reports from the U.S. Air Force, the web camera at Stromboli captured shots of light ash emissions on 7 and 11 November 2003. In both cases plumes rose to ~ 2.5 km altitude. According to the Toulouse VAAC the Stromboli Web video camera showed a small explosion on 10 December that produced a plume to a height of ~ 1 km above the volcano. No ash was visible on satellite imagery.

According to the INGV-CT, explosive activity at the three summit craters increased after 10 February 2004, leading to a significant growth of the cinder cones inside the craters. Several powerful explosions, especially from crater 1 (the NE-crater) and crater 3 (the SW-crater) carried scoriae 200 m above the craters. These explosions led to fallout of fresh bombs and lapilli on Il Pizzo Sopra la Fossa (the top of the volcano, ~ 100 m above the crater terrace) in early March. Samples of lapilli and scoriae collected on Stromboli by local guides have been analyzed with the scanning electron microscope and microanalysis instruments of INGV-CT (Corsaro and others, 2004). Measurements of glass compositions indicated that products erupted until 25 February 2004 are related to the black scoriaceous volcanics normally erupted during Strombolian activity. Golden basaltic pumices were absent from available samples; such pumices at this volcano have been generally associated with paroxysmal explosive events (Bertagnini and others, 1999) such as that of 5 April 2003. Analysis of components carried out on several ash samples allowed scientists at INGV-CT to recognize sideromelane and tachylite as the main components, making up ~ 80% of the erupted ash (Andronico and others, 2004). The activity of this volcano as of 8 March 2004 can be described, fittingly, as Strombolian with variations in the number and frequency of explosions within normally observed limits, and intensity of explosions at the higher limit of commonly observed activity.

References: Andronico, D., Caruso, S., Cristaldi, A., and Del Carlo, P., 2004, Caratterizzazione delle ceneri emesse dallo Stromboli nel Gennaio-Febbraio 2004: INGV-CT Internal Report, Prot. int. n° UFVG2004/034.

Corsaro, R.A., Miraglia, L., and Zanon, V., 2004, Caratterizzazione dei vetri presenti nei prodotti emessi dallo Stromboli durante il mese di febbraio: 2004 INGV-CT Internal Report, Prot. int. UFVG2004/033.

Cristaldi, A., Contelli, M., and Mangiagli, S., 2004, Rapporto settimanale sull'attivit eruttiva dello Stromboli: 22-29 Febbraio 2004. INGV-CT Internal Report, Prot. int. n° UFVG2004/031 [download at http://www.ct.ingv.it].

Bertagnini, A., Coltelli, M., Landi, P., Pompilio, M., and Rosi, M., 1999, Violent explosions yield new insights into dynamics of Stromboli volcano. Eos, American Geophysical Union Transactions, 80, 52: 633-636.

Background. Spectacular incandescent nighttime explosions at Stromboli volcano have long attracted visitors to the "Lighthouse of the Mediterranean." Stromboli, the NE-most of the Aeolian Islands, has lent its name to the frequent mild explosive activity that has characterized its eruptions throughout historical time. The small, 926-m-high island of Stromboli is the emergent summit of a volcano that grew in two main eruptive cycles, the last of which formed the western portion of the island. The active summit vents are located at the head of the Sciara del Fuoco, a horseshoe-shaped scarp formed as a result of slope failure that extends to below sea level and funnels pyroclastic ejecta and lava flows to the NW. Essentially continuous mild Strombolian explosions, sometimes accompanied by lava flows, have been recorded at Stromboli for more than a millenium.

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Etna

Sicily, Italy
37.73°N, 15.00°E; summit elev. 3,315 m
All times are local (= UTC + 1 hour)

Since the cessation of the last eruption of Mount Etna on 28 January 2003, no further eruptive activity has been observed. Summit activity has been limited to pulsating gas emissions from the Northeast Crater (NEC) and from one of the two vents within Bocca Nuova (BN). The other central crater vents and the Southeast Crater (SEC) were essentially blocked and only producing extremely weak gas emissions.

The first significant variation from this very low level of activity was seen between 12 and 14 February 2004, when a weak ash emission was observed within the summit crater plume. A fresh ash sample was collected in Pedara, a village about 10 km SE from the summit. Del Carlo and Andronico (2004) reported that the sample was made up of material with a grain-size less than 0.125 mm. Components comprising the sample consisted of sideromelane (41.5%), tachylite (24.7%), loose crystals of clinopyroxene, olivine, and plagioclase (4%), and lithics (29.7%). The clasts of sideromelane were very vesiculated and made of light-brown, transparent and shiny glass. There were also a few strands of Pele's hair. Tachylites were black or gray, shiny, sub-angular clasts. Lithics comprised fragments of weathered scoria, lavas, or secondary minerals. The high amount of juvenile components within the ash were taken to suggests an uprise of magma into the summit feeder conduit, the first to occur since the end of the 2002-2003 flank eruption.

The INGV-CT Geochemistry group performed regular remote-sensing measurements of volcanic gas flux and chemical composition on Etna using COSPEC and FTIR instruments. Such measurements demonstrated that the upper conduit system of Mt Etna has been weakly supplied with magma since the end of the 2002-2003 eruption, an observation supported both by relatively low fluxes of SO_2 and low molar ratios of SO_2/HCl. Occasional discrete injections of magma into the upper conduit system have been observed, however, as sharp increases in both SO_2 flux and SO_2/HCl ratios. These inputs occurred in August 2003, December 2003, and in late January 2004.

The INGV-CT permanent seismic network consisted of ~ 40 stations, 10 of which were installed in October 2003 and have broad-band, 40-second-period sensors. After the end of the 2002-2003 flank eruption, seismicity was mainly concentrated along Etna's E and NE flanks, appearing in two main phases. Until the end of May 2003, earthquakes were localized along the same structures that were activated during the 2002-2003 eruption, suggesting a relaxation phase. During this phase, several swarms occurred mainly between 3 and 7 km depth, showing a progressive decrease in seismic energy. After June 2003, several shallow earthquakes were recorded along the upper eastern part of the volcanic edifice near Zafferana, and along the Pernicana fault on the NE flank. This second phase was characterized by a renewal of seismic activity, with several seismic swarms characterized by progressive release of seismic energy. In particular, during the last two months, the Pernicana Fault has been very active (UFS Weekly Reports, 2003 and 2004).

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 stratovolcano, whose edifice is the highest and most voluminous in Italy. The Mongibello stratovolcano, truncated by several small calderas, was constructed during the late Pleistocene and Holocene over an older shield volcano. 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.

References. Del Carlo, P., and Andronico, D., 2004, Rapporto cenere Etna del 13-14/02/04: INGV-CT Internal Report, Prot. Int. no. UFVG2004/024, p 1.

UFS INGV-CT Weekly Internal Reports, 2003 and 2004.

Information Contact: *Sonia Calvari*, INGV (see Stromboli).

Piton de la Fournaise

Reunoin Island, Indian Ocean
21.229°S, 55.713°E; summit elev. 2631 m
All times are local (= UTC + 4 hours)

Bulletin v. 28, no. 9 reported a seismic crisis and new SSW-flank fissure at Piton de la Fournaise on 30 September 2003. The Volcanological Observatory monitoring Piton de la Fournaise and the local press reported a further seismic crisis that developed on 7 December 2003 at 1429 beneath the summit. Following around an hour of seismicity, an eruption began on 7 December at 1535 in the Dolomieu crater, with lava fountaining to ten's of meters from two fractures on the SE crater floor. Two new fractures were also observed on the S crater rim that did not produce lava. The eruption decreased rapidly over the night of 7-8 December. By 8 December at about 1400 small incandescent lava flows and rock falls on the S crater wall were observed. By the night of 8 December the eruption ceased but strong degassing and fluctuating seismicity continued. New lava covered ~ 40% of the Dolomieu crater floor.

The eruption was preceded by a seismic swarm on 6 November that was followed by ~ 30 cm of steady uplift and 10-20 earthquakes recorded per day. As of 16 December, significant seismic activity continued, and hikers were permitted only limited access. Press reports indicated three quite active cones within the S rampart of the Dolomieu crater, surrounded by ejecta found more than 200 m N, noisy degassing, lava covering the bottom of the crater up to 5 m thick, and zigzag cracks crossing the crater's S exterior.

A further seismic event with significant surface deformation occurred over 7-9 January 2004.

Background. The massive Piton de la Fournaise basaltic shield volcano on the French island of Réunion in the western Indian Ocean is one of the world's most active volcanoes. Much of its >530,000 year history overlapped with eruptions of the deeply dissected Piton des Neiges shield volcano to the NW. Three calderas formed at about 250,000, 65,000, and less than 5000 years ago by progressive eastward slumping of the volcano. Numerous pyroclastic cones dot the floor of the calderas and their outer flanks. Most historical eruptions have originated from the summit and flanks of Dolomieu, a 400-m-high lava shield that has grown within the youngest caldera, which is 8 km wide and breached to below sea level on the eastern side. More than 150 eruptions, most of which have produced fluid basaltic lava flows, have occurred since the 17th century. Only six eruptions, in 1708, 1774, 1776, 1800, 1977, and 1986, have originated from fissures on the outer flanks of the caldera. The Piton de la Fournaise Volcano Observatory, one of several operated by the Institut de Physique du Globe de Paris, monitors this very active volcano.

Information Contact: *Thomas Staudacher*, Observatoire Volcanologique du Piton de la Fournaise Institut de Physique du Globe de Paris, 97418 La Plaine des Cafres, La Réunion, France (URL: http:\\volcano.ipgp.jussieu.fr:8080\reunion\stationreu2.html; Email: Thomas.Staudacher@univ-reunion.fr).

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