Reef pumice in 1964, from the first report of the eruption to the first arrival in Fiji and later arrival in Suva, pumice could reach the site in the North Fiji Basin from that part of the Tonga Ridge in about 75-85 days, giving a possible date in late July (or earlier if farther farther S -- if Monowai Seamount, about 95-105 days, or early to mid July).

"Four reply-paid telegrams sent in late October to the agents at 4 Postal Agencies in S Fiji brought no replies. The radio-telephone to Vunisea, Post Office for Kadavu Province [about 19°S, 178.5°E] is out of order, so no information about the arrival of pumice there can be obtained quickly. Questionnaires have been posted." By mid November, pumice had been reported from Koro Island (about 17.3°S, 179.4°E), and questionnaires were being sent to locations throughout the Lau Group (E of Fiji's largest islands) and elsewhere.

Information Contacts: Trevor Jones and Peter Rodda, Mineral Resources Department, Private Mail Bag, Suva, Fiji.

Volcanic Activity in Vanuatu

The Vanuatu arc was visited by an ORSTOM mission 5-18 September. The following is modified from their report in the *L.A.V.E. Bulletin.*

Yasur

Tanna Island (19.51°S, 169.43°E).

Volcanic activity, consisting of block and ash emissions, and bubbling lava lakes, seemed slightly decreased since visits during 1988 (see *Bulletin* v. 13, no. 12). The configuration of the main crater and its 3 principal sub-craters (A,B,C; figure 16) remained relatively unchanged. The depth from the summit to the base of the crater was estimated at >350 m, placing activity at or below sea level.

In sub-crater A, a new lava lake (about 20-25 m in length) was visible; strong turbulence in the lake due to rising gas bubbles caused lava to move N-S. Explosions at other vents (notably one in the S part of sub-crater B) corresponded with increased intensity of lava lake activity. Two other vents in sub-crater A had explosions that ejected ash and incandescent blocks. The blocks had loud detonations on impact.

Projectiles and night glow were visible from a lava lake in sub-crater B, hidden from view by a ridge. Explosions were identified from at least 3 vents, with frequencies of 1 explosion/5 minutes to 1/hour. Sub-crater C was less active, occasionally emitting puffs of ash or gas following explosions in sub-crater B.

There were no visible shock waves or ejecta being deposited outside of the crater, as there were in 1988, suggesting a decrease in the intensity of activity.

Concentrations of 5-10 ppm SO_2 were measured in the plume, 1 ppm from the ash plain below the plume, and 0.5 ppm, 3 km from the volcano. The SO_2 flux was estimated to be 1200 ± 600 metric tons/day (t/d), based on the measured concentrations and a visual estimate of the plume volume. This is greater than the flux usually registered at other volcanoes in the Vanuatu arc (100-600 t/d). During 1987-1988, vegetation in areas downwind from the volcano was affected by gas, ash, and acid rain, causing damage to gardens and coffee plantings.

Continuous Strombolian and Vulcanian activity from Yasur has been reported since before 1774, when it was observed by Captain Cook.

Ambrym

Ambrym Island (16.25°S, 168.08°E).

Thick puffs of ash rose several hundred meters, and scattered blocks were ejected, from a vent 200 m below the rim of Niri Tamo, which formed adjacent to Mbuelesu crater in 1989 (see Bulletin v. 14, no. 10). The approach to the crater was sprinkled with blocks 10 cm to 1 m in diameter. One block, 2 m in diameter, was located near a possible new crater (Niri Taten) that was S of Mbuelesu, near the source of the 1988 lava flows and about 1/2 km from Niri Tamo. A zone of intense degassing, with temperatures of at least 625°C, occurred within Niri Taten. Mbuelesu appeared more elongate to the NE than represented on 1989 maps and no longer contained a lava lake. One vent, sounding like a reactor, violently emitted ash, gas, lava blocks, and fragments. The plume rose vertically at 30 m/second, and projectiles frequently landed beyond the rim of the crater. Benbow crater emitted a strong bluish plume, suggesting a significant SO2 content.

Ambrym has been almost continuously active since its discovery by Captain Cook in 1774. During that time it has had Strombolian and Plinian activity, standing lava lakes, and produced numerous lava flows.

Information Contacts: M. Lardy, ORSTOM, B.P. A5, Nouméa Cedex, New Caledonia; B. Marty, CNRS, U.A. 736, Laboratoire MAGIE, Université de Paris 6, France; L'Association Volcanologique Européenne, 7 rue de la Guadeloupe, Paris 75018, France.

Atmospheric Effects

No new volcanic aerosols were detected in the stratosphere by November lidar measurements from Hawaii and Virginia (table 5). Although a substantial aerosol cloud, probably from the 10 February eruption of Kelut (Indonesia), was detected by lidar on the RV *Akademik Korolev* between

LOCATION	DATE	LAYER ALTITUDE IN KM (peak in parentheses)		BACKSCATTERING COEFFICIENT	RATIO	INTEGRATED
Mauna Loa, Hawaii (19.5°N, 130.35°W)	28 Nov	16	(21.9)	0.07×10^{-7}	1.2	0.08×10^{-3}
Hampton, Virginia (37.1°N, 76.3°W)	15 Nov	13-25	(17.1)		1.23	0.10×10^{-3}
	26 Nov	14-25	(17.3)		1.24	0.06×10^{-3}

Table 5. Ruby wavelength lidar data showing altitudes of aerosol layers. The month's single observation at Mauna Loa was made through low clouds, so values are less reliable than usual. Upper limits of layers remain difficult to define at Mauna Loa, so only layer bases are reported. Hampton measurements were with a hybrid system using a smaller telescope, reducing sampling area and data consistency. Integrated values show total backscatter, expressed in steradians^{-1}, integrated over 300-m intervals from 16 to 33 km at Mauna Loa and from the tropopause to 30 km at Hampton.

15°N and 2°S (see *Bulletin* v. 15, no. 8) and from NASA's SAGE II satellite between 16°N and 51°S (see last *Bulletin*), ground-based lidar stations have not measured significant increases in stratospheric aerosols.

Information Contacts: Thomas DeFoor, Mauna Loa Observatory, P.O. Box 275, Hilo, Hawaii 96720 USA; Mary Osborn, NASA Langley Research Center, Hampton, Virginia 23665 USA.

EARTHQUAKES

At least 22 people were killed, 100 injured, and 21,000 left homeless by the Iran earthquake (table 6), which damaged 18 villages in the Darab area, 800 km SSE of Tehran.

The shock in the Komandorskiye Is. region was felt on the western Aleutian islands of Attu and Shemya. No damage was reported.

The Indonesia event caused injuries, landslides, and structural damage in the Blang Kejeran-Kutacane-Medan area of N Sumatra.

The earthquake in W-central Yugoslavia injured 10 and caused significant damage in the epicentral area.

Information Contacts: National Earthquake Information Center, U.S. Geological Survey, Mail Stop 967, Denver Federal Center, Box 25046, Denver, CO 80225 USA; IRNA news service, Tehran, Iran; Antara news service, Jakarta, Indonesia.

FIREBALLS

object was very bright-green, changing to red, and illuminated the interiors of automobiles. A luminous trail was observed.

Scientists at the Abrams Planetarium believe that any meteorite fragments are most likely to have landed in a 80-km area extending from N of Chelsea, MI (42.19°N, 84.01°W), to S of Flint, MI (43.03°N, 84.04°W). Three women in an automobile N of Chelsea reported seeing a dark fragment land near them.

Information Contact: Douglas Murphy, Abrams Planetarium, Michigan State University, East Lansing, MI 48824.

Only one report for each of the following fireballs has been received at this time. Persons having additional information about them should contact the Global Volcanism Network.

Oklahoma, USA, 10 November, 1990, about 0000 GMT (9 November, 1800 Central Standard Time).

Observer: Kate Adams

Location: Purcell (35.02°N, 97.37°W)

Information Contact: Wayne Wyrick, Kirkpatrick Planetarium, 2100 NE 52, Oklahoma City, OK 73111.

Kansas, USA, 16 November, 1990, 1230 GMT (0630 Central Standard Time).

Observer: James Williams

Location: Belle Plaine (37.43°N, 97.28°W)

Information Contact: José Olivarez, Omnishpere Director, Wichita Omnisphere and Science Center, 220 S Main, Wichita, KS 67202.

Virginia, USA, 26 November, 1990, about 2300 GMT (1800 Eastern Standard Time).

Smithsonian Institution

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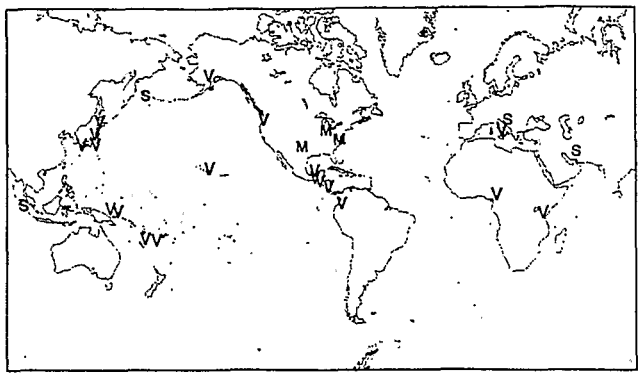

M = Meteoritic S = Seismic V = Volcanic

VOLCANOES

EARTHQUAKES

FIREBALLS

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Data are preliminary and subject to change; contact the original source or us before using.

Santiaguito Dome

W Guatemala (14.76°N, 91.55°W).

The following is a report by Otoniel Matías and Michael Conway.

"Interpretation of telemetered seismic data by volcanologists at INSIVUMEH indicates a general increase in volcanic activity (pyroclastic eruptions, rock avalanches, and lava flows) at Caliente vent from June 1988 through August 1990 (figure 1). Five periods of increased lava flow activity have been documented, with the most recent beginning in July 1990 and continuing as of early December. The number of explosions ranges from about 5 to 90 daily, while rock avalanches are more abundant, with 100 to as many as 600/day. Explosions, rock avalanches, and lava flow flux at the dome were greatest from June through September 1988, 1989, and 1990, corresponding to the rainy season. Small decreases in explosions and avalanches were noted during mid-October through March 1988–89, 1989–90, and from October through November 1990, and are roughly correlative with the dry season in Guatemala, suggesting a link between eruptive and climatic patterns at Santiaguito.

"Beginning in April 1990, more than 20 powerful pyroclastic eruptions, similar in magnitude to the 19 July 1989 eruption (see *Bulletin* vol. 14, no. 7), have occurred at Caliente vent (table 1). Direct observation of pyroclastic eruptions is often impossible because of weather conditions, but reports from 4 events indicate that they are characterized by large eruption columns rising 4–5.5 km above the vent, durations on the order of 7–15 minutes, and are heard as far away as Retalhuleu (21 km S). Simultaneous collapse of a small plug dome atop Caliente generates pyroclastic flows and lateral blasts. Block and ash flows accompanied by ash cloud surges typically sweep 4–7 km down the Río Nimá II km^2 E of Caliente, stripped away or blown down all vegetation, and buried it in ash and lapilli-sized debris. On 19 July 1990, exactly 1 year after the onset of major pyroclastic eruptions at the dome, 4 hikers climbing along the E rim of Santa María's 1902 explosion crater, roughly 1 km E of the dome, were killed by a lateral blast. Tephra fallout (to 4 cm thick) blanketed the dome and surrounding area, and measurable airfall deposits (<1 cm thick) occurred as far away as San Martín, 20 km SW of the dome. Numerous smaller explosions accompanied major explosions at Caliente, and continuous explosive activity of up to 3 hours has been reported.

"Periods between major explosions have been characterized by passive fuming of Caliente and by minor phreato-