IAVCEI

Newsletter of the
International Association of Volcanology
and Chemistry of the Earth´s Interior

News

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From the President

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Welcome to this inaugural issue of the new IAVCEI News which is being distributed to all individual members of the Association. This is a newsletter owned by members so your contributions to future issues are welcome, as are your comments on content and style. I hope you will provide members of the Executive Committee, and Hazel Rymer the IAVCEI News Editor, with your suggestions for improvement. I extend our grateful thanks to Hazel for agreeing to take on the task of News Editor for IAVCEI.

IAVCEI is truly a global organization, with representatives from 47 countries, and the way we communicate with each other in a rapidly changing world is important. Until a few years ago, we exchanged data and interpretations only via professional meetings held every two to four years, and by journals, mail, and phone calls – not adequate for a profession where dynamic processes and hazards to population require rapid and dependable communication. To share ideas requires addresses and phone numbers that were often not available except from out-of-date directories. The Global Volcanism Network, begun by Tom Simkin, has long kept us informed about eruptions monthly and more frequently by telephone if necessary. A glimpse of the future was provided by Jon Fink, who started the Volcano Listserv on the Internet, which is still the bulletin board for volcanology. Tom and Jon were, and still are, visionaries.

Inadequate infrastructure made communications with the public and civil defense authorities difficult. IAVCEI's Commission on Mitigation of Volcanic Disasters took early steps to resolve the problem by having a video (Understanding Volcanic Hazards) prepared by the Kraffts, who were masters of communication with the public, and by Steve Brantley and his USGS colleagues. A second video on mitigating volcanic hazards is now being prepared by Steve. These videos have been very successful in educating the public, students, and civil defense officials. However, they must be copied and distributed widely, which is quite expensive.

Communications are rapidly evolving, with better telephone systems, the Internet, and the World-Wide Web. Volcanologists have adapted quickly in applying this new technology: there are now 60 volcanological home pages from 15 countries on the Web. The home pages range from meeting announcements to imagery, movies, and data. Want to find someone? – look in the guide to volcanologists. Where is the plume from a recent eruption in Kamchatka? – open the page for 'volcanic ash advisory center' for close to real-time data. You can register for the upcoming IAVCEI General Assembly in Mexico on the Web. If you want to complain about the way IAVCEI is managed, there are IAVCEI Web-page photographs of the officers to help you run down the miscreant at the next meeting!

Where are we going? We need to be careful with the electronic material that we provide, putting the same effort into available data and documents that we would use for a refereed journal article. At a recent meeting of research officials from 27 countries 'A Global Research Village' was proposed to allow rapid, open exchange of information. The International Council of Scientific Unions (ICSU) is negotiating for an Internet network that would feed lectures to students and professionals in 110 countries. IAVCEI has an opportunity here to transmit videos and lectures from our meetings and workshops to all of our members. However, not everyone in volcanology has access to this new technology and we must take the challenge to make this technology universally available before the end of the century.

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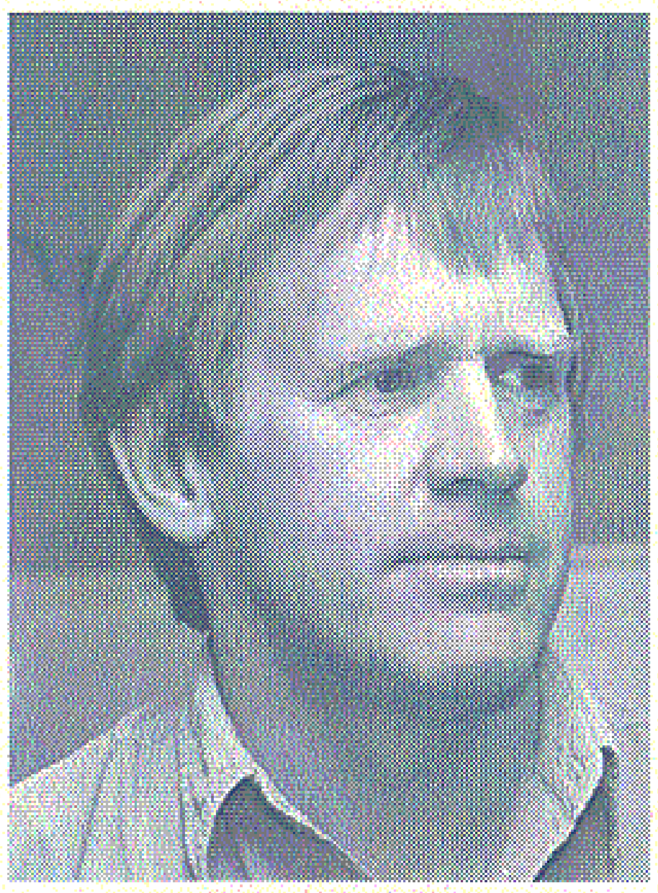
From the Secretary General



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Personal membership of IAVCEI has been available since the beginning of the year and I am pleased to say that satisfactory progress is being made. Batches of the application forms for further distribution have been sent to all members of the IAVCEI Executive Committee, all National Correspondents of IAVCEI, and all Leaders and Secretaries of the IAVCEI Commissions. The form has appeared also on the IAVCEI Home Page. In addition, we have consolidated all the names and addresses of people who registered for IAVCEI General Assemblies in Canberra (1993) and Boulder (1995) and for the International Volcanological Congress in Ankara (1994). I have sent an individual membership form and covering letter to each of those people on the combined mailing list (about 1400 entries) who have not yet become a member and have invited their application.

The total number of members at 31 July is 268 which is quite a good start, and the 'honesty system' (registration fees set at the level of annual income) seems to be working satisfactorily. I have been struck by the large number of younger people joining up, and by the way that VCEI people in some countries having difficult times economically - Russia and Romania in particular - have organised themselves to pay as groups. However, I think we need more members if the Association is to prosper, and I confess to being just a little disappointed that some senior VCEI people (who no doubt are extremely busy - but who isn't?) have still not sent in their application forms. These include even some members of the Executive Committee and some Commission Leaders! There have been only a few minor glitches (that I know of) in managing the receipt of the applications, and these are to be expected I suppose when starting off a new system. I hope that nobody has been inconvenienced too much.

Adoption of personal membership in IAVCEI is changing the character of the Association quite dramatically. Paying members are now empowered to influence the future directions of the Association, and to expect results from the people they elect as members of the Executive Committee. The next round of elections will be completed before mid 1999, in time for the IUGG General Assembly being held in Birmingham, United Kingdom (we hope to provide further news of this meeting in future issues of IAVCEI News). I mention these elections now because I suggest we all need time to think about the kind of people we would like to see serving on the Executive Committee. I raise the issue particularly in relation to my own position of Secretary General.

The job of Secretary General, like those of the other members of the Executive Committee, is undertaken voluntarily, and I am permitted to do so by my current employer. However, the job is becoming very demanding as IAVCEI expands its interests and becomes more robust in its activities. There is, in particular, a strongly 'pro-active' component to being Secretary General and this requires the commitment of a great deal of time (other Associations of IUGG cope with this problem by selecting as their Secretaries General people who are retirees, or semi-retirees, rather than senior people who also have full-time jobs to hold down). In addition, IAVCEI is moving inexorably towards becoming a semi-professional body that will need some sort of Secretariat to act as a focus for all our activities (publications, sale of videos and calendars, membership, and so forth) rather than scattered as they are at present and which will require paid staff. The Secretariat currently is me sitting in front of my PC! May I suggest that members give some attention to these matters by providing comments to any member of the Executive Committee prior to our next meeting in Puerto Vallarta in January. I will ensure that the topic is placed on the agendas of both the Executive Committee meeting and the Information and Discussion Forum that will be held in Mexico and which will be open to all.

Articles

Summary of eruptive events and monitoring procedures at Soufriere Hills volcano, Montserrat West Indies, 18 July 1995, to June 1996

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Soufriere Hills volcano lies in the south-central part of the British colonial island of Montserrat, at the northern end of the Lesser Antilles volcanic arc. Increases in seismic activity and changes to local soufriere (hot spring) conditions have occurred on three occasions within the past 110 years, namely in 1897-98, 1933-37 and 1966-67, but there is no eruptive activity recorded in historical times (ie since western colonisation in the early 17th century). Some increase in seismicity was noted at the Soufriere Hills by the Seismic Research Unit (SRU) at the University of the West Indies in 1992 and this activity increased markedly in November 1994, with a large number of relatively deep (? 10 to 20 km) earthquakes being recorded by the regional seismic monitoring network on Montserrat and surrounding islands.

Eruptive activity began on 18 July 1995 with the opening of a steam and ash vent on the northwest side of Castle Peak Dome, an immediately prehistoric lava dome which partially fills the horseshoe-shaped English's Crater. A number of radiocarbon dates from pyroclastic flow deposits within the Tar River valley, which drains the open, eastern side of English's Crater, give a consistent date for the last phase of dome growth at c. 1600 AD.

Activity between 18 July and 21 August comprised a number of phreatic eruptions of steam and finely comminuted andesitic ash from the initial vent area and from a number of newly opened vents dotted across the Castle Peak Dome and in the moat which surrounds it. Some of these eruptions deposited small

Fig 1: Block and ash flow wth associated ash cloud in the Tar River valley, 3 April 1996, Soufriere Hills volcano, Montserrat. Photo credit Simon Young.

volumes of ash on the capital of the island, Plymouth, which lies 4-5 km west (downwind) of the active crater area.

An evacuation of the southern half of the island was ordered immediately following a large phreatic eruption on 21 August. Ash from the eruption cloud and from a cold ash density current which flowed down the flanks of the volcano caused darkness in Plymouth and surrounding areas for a considerable period, although total ash thickness in the town was only a few millimetres. Explosive seismic signals and fluctuating but generally increasing SO_2 emissions indicated growing unrest at the volcano during this time.

A reduction in the likelihood of a magmatic eruption at the volcano enabled the evacuation order to be lifted soon after the passage of Hurricanes Luis and Marilyn close by the island in early September. An intense swarm of shallow hybrid earthquakes immediately preceded extrusion of a small (c. 40,000 m^3) dome with central spine on the western side of Castle Peak Dome in late September. Any deformation associated with this event was not recorded by the electronic tiltmeters then in place. A return to purely phreatic activity then occurred, with further large phreatic eruptions with ash columns to 8,000 – 10,000 ft (amsl) and associated cold ash density currents occurring on 30 October and 4 and 9 November, each causing 10 to 20 minutes of darkness in Plymouth and surrounding areas and depositing several millimetres of ash.

Fig. 2: Looking west from the air past the new lava dome within the summit crater of Soufriere Hills volcano to the evacuated capital of Montserrat, Plymouth, early June 1996. Photo credit Simon Young.

The onset of major dome extrusion was preceded over a 4 day period by rapid (4 cm/day) shortening of the EDM (electronic distance measurement) line between Tar River and the eastern flank of Castle Peak Dome and is thought to have directly followed a period of intense hybrid earthquake activity on 14/15 November. Poor visibility prevented sighting of the new dome until 30 November, when it was seen to be partially filling the crater formed by numerous phreatic eruptions at the site of the first vent.

Continued elevated seismic activity, especially of hybrid earthquakes, confirmation of growth of a lava dome and rockfalls from it and generally poor visibility prompted the second evacuation of much of the southern part of the island for the whole of December.

Enhanced knowledge of dome growth style, the slow rate of growth (c. 0.2 to 0.3 m^3/sec), the slowing to very low rates of change of EDM line lengths and a marked reduction in seismicity enabled the state of alert to be reduced, and people returned to their homes in the south in early January.

Dome growth continued at a slow rate until late January, when a swarm of repetitive hybrid events lasting around two weeks and representing the most intense period of seismicity in the crisis to date accompanied a significant increase in extrusion rate, which has continued at the same level until the present. This rate is 1.5 to 2 m^3/sec and the dome had a volume of c. 18,000,000 m^3 (DRE) by early June.

A switch in dome growth area in early March prompted build-up of an unstable flank on the northeast side of the dome which eventually produced the first true block and ash flows of the crisis in late March and early April. A small flow on 31 March prompted partial evacuation of eastern villages under most threat, and build-up in seismicity and rockfall activity with a possible explosive component

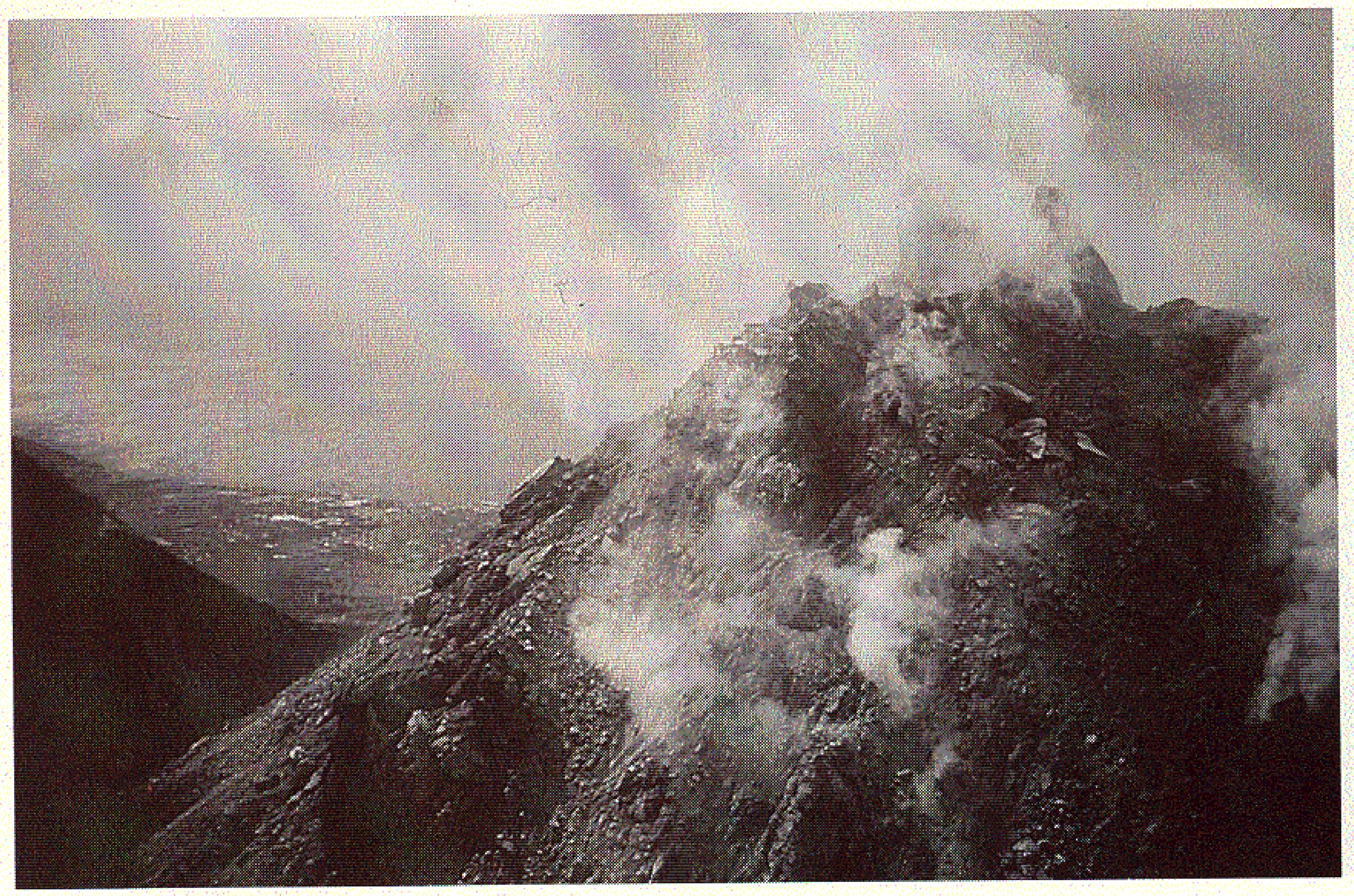

Fig. 3: Looking south at the new lava dome within the summit crater of the Soufriere Hills volcano, Montserrat, early June 1996. Photo credit Simon Young.

early on 3 April prompted a third, rapid evacuation of the whole of the southern part of Montserrat.

12 May saw the most voluminous and extensive block and ash flows to date, several of which reached the sea at the mouth of the Tar River, and flowed for some distance (c. 100 m) across the sea, captured in spectacular footage by MVO. Early June saw the first rockfalls over the lowest point in the crater wall into the upper part of Fort Ghaut, putting Plymouth under direct threat of block and ash flows and surges. The top of the dome is at a height of almost 3100 ft above sea level, about 100 ft taller than the previous highest point on Montserrat (Chances Peak). A slight increase in rate of shortening of the EDM line to Castle Peak accompanied the onset of loading on the western side of Castle Peak itself by the new dome; elsewhere around the volcano, deformation rates have been at or below detection limits since late November 1995.

Monitoring of the Soufriere Hills volcano is being undertaken by the SRU in conjunction with the British Geological Survey (BGS), who are responsible for input from a number of research groups in the UK, IPG Paris via the observatories on Guadeloupe and Martinique, University of Puerto Rico and a number of individual researchers from the USA and elsewhere. The United States Geological Survey (USGS) played a major part in installation of the monitoring network. The seismic network comprises 9 single-component and 2 three-component stations, the closest (Chances Peak) on the crater rim. The seismic data from these stations, along with data from an electronic tiltmeter, are telemetered to the observatory in Olde Towne, immediately to the north of the evacuation zone, and are inspected in real time using both digital and analogue recorders. A new broadband digital seismic network is due for installation in August 1996, and two broadband instruments are already being utilised with the main network.

Four EDM triangles are measured daily to weekly depending on their location; these utilise 4 reflectors placed on the upper flanks of the volcano. A GPS (global positioning system) net of twelve stations records baseline changes on the lower flanks of the volcano; permanent geodetic GPS stations are due for installation in mid-1996. Dry tilt surveys continue to be undertaken at several sites on the flanks of the volcano and a single electronic tiltmeter is also in use. Microgravity measurements have already been made, and weekly re-occupation of stations is planned to track both the growth of the dome and possible changes in the magmatic plumbing system.

Sulphur dioxide production rates have proven low (100 to 200 tonnes per day) during May and June 1996, indicating a magma largely degassed by the time it reaches the surface. This is consistent with gas measurements at the active soufrieres, which have shown no changes in composition during the crisis and continue to indicate groundwater buffering of a degassing magma body.

Extensive petrological and geochemical analysis of samples from all erupted products has been undertaken by a number of research groups; no juvenile material was reported from the eruptions up to 9 November although the new lava is almost identical in composition to the Castle Peak Dome lava (c. 58% SiO_2) and is extremely crystal-rich (75 - 80% crystals) so that juvenile material in fine ash is difficult to detect. The petrological investigations have aided greatly in developing a better understanding of the feeder and plumbing system. The magmatic source is thought to be at a depth of 7 to 10 km (in the hornblende stability field) and ascent times of 30 to 6 days have been estimated from hornblende breakdown rim widths. The abundance of mafic inclusions in dome rock suggests a possible mafic magma influx as trigger for the current eruption.

Visual observation of the crater area remains an important monitoring activity; this is undertaken from the air, from vantage points on the northern and eastern flanks and via remote video cameras. Dome volume estimates are made regularly (visibility permitting) by analysis of fixed point photographs and by more conventional surveying techniques. Only brief sampling visits to new block and ash flow deposits have been made due to safety considerations, and the crater rim and dome area are not accessible at present due to the frequency and unpredictibility of rockfall and block and ash flow activity. Helicopter observations of block and ash flow generation suggest a gravity-driven mechanism and the lack of ballistic clasts around the crater rim indicate a lack of true explosive component. Low vertical columns produced at the source of flows from the dome and major ash generation during flows are thought to be due to autoexplosivity of the stressed dome rocks. Generation of ash clouds to 8 to 10 km above the most voluminous block and ash flows has been due to convection of hot ash rather than any vertical explosive component.

Preparing Naples for Vesuvius

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Introduction

The last eruption of Vesuvius occurred in March 1944. Since that time the volcano has been quiescent and there are no indications at all suggesting a renewal of its activity. However, Vesuvius must be considered a very dangerous active volcano. The history of the volcano suggests that there have been repose periods of hundreds to thousands of years and that the longer the repose, the more violent the eventual eruption. The present senseless urbanization of the Vesuvian area results in a situation of extremely high risk. About 600,000 people live today within 10 km of the summit and the outskirts of Naples itself are just 15 km from the vent. An eruption today would have serious consequences.

The Italian scientific community is well aware of the problem. Since its foundation in 1983, the GNV (National Group of Volcanology, the institution co-ordinating scientific research and monitoring on Italian active volcanoes) has promoted research on the structure and behaviour of Vesuvius and has developed a monitoring system to assess potential hazard.

This report summarizes the efforts to increase the preparedness of the scientific community, of the civil defence organization and of the people living on the volcano to face the next eruption of Vesuvius.

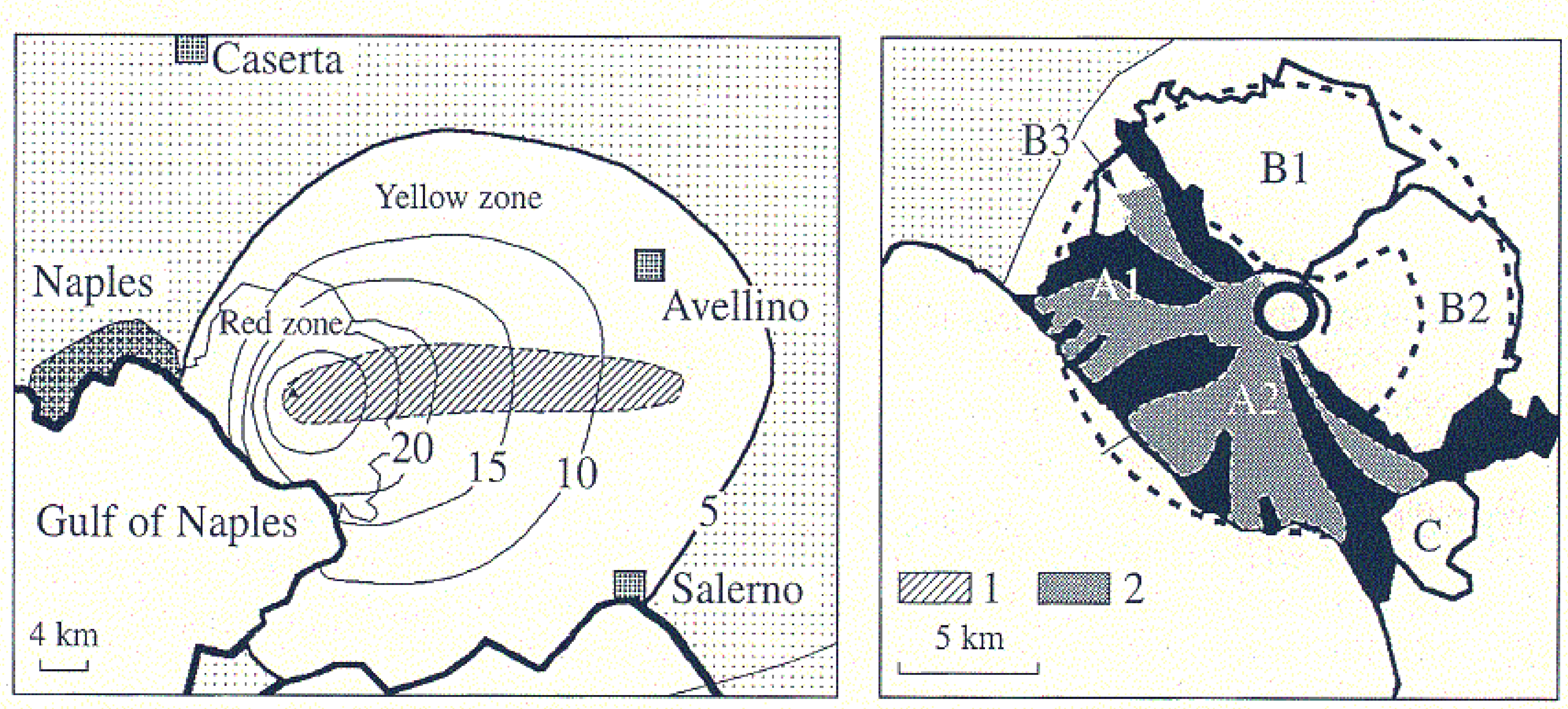
The scenario of the expected eruption

Vesuvius has an extremely variable eruptive pattern. It has been characterized by periods of open conduit conditions [persistent strombolian activity, frequent lava effusions and sporadic more voluminous phreatomagmatic eruptions] followed by long rest periods interrupted by explosive eruptions. The 1944 eruption marked the transition from open to obstructed conduit conditions. In the last 2-3,000 years, the only difference between open and obstructed conduit conditions has been the depth of magma storage. Vesuvius is a sort of steady state volcano, fed by the periodic arrival of K-tephritic magma batches. Surface activity depends

Table 1 - Sequence of events of the Subplinian MEE

eruption phase	phenomena	duration	affected area (km^2)
Phreatomagmatic Opening	Repeated explosions Moderate to strong earthquakes Ballistic ejection of blocks (2-3 km from the vent) Lee-side ash fallout (ca. 10 km from the vent)	minutes to hours	10-20
Sustained Eruption Column	Formation of a 12-20 km high eruption column lee-side lapilli and ash fallout (roof collapse at 10-30 km from the vent) Ballistic ejection of blocks and bombs (3-5 km from the vent) Continuous strong tremor	hours	50-200
Pyroclastic Flow Emplacement	Column destabilisation and collapse(s) Pyroclastic flows and ash cloud surges emplacement Possible structural collapse of the upper portions of the cone Strong istolated earthquakes landslides moderate tsunami waves	hours	50
Phreatomagmatic Waning	repeated explosions due to magma-water interaction in the conduit ash and mud fallout; mud hurricanes heavy rain; mud flows; floods isolated earthquakes	? days to month	50-100

Fig.1: Limit of hazardous zones related to a Subplinian maximum expected event of Vesuvius. Left: the Red zone includes the 18 municipalities of circumvesuvian area, while the yellow zone is defined by the 5% isoprobability curve to have more than 100 kg/m^2 of ash and lapilli fall deposit in case of a Subplinian event with magnitude of 0.2 km^3. Right: The Red Zone is included within the area expected to be affected by pyroclastic flows and surges originated by column collapses (collapse height: 300m [inner dotted line] and 1000m [outer dotted line]). The letters A, B, C define subzones of the Red Zones to be evacuated in the order A-B-C. The areas affected by pyroclastic fall (1) and flow (2) deposits during 1631 eruption are reported for comparison.



on how large and full the magma chamber is and these in turn are controlled by the depth of the obstruction in the conduit. Since 1944, approximately 2 x 10^8 m^3 of magma have entered the Vesuvius system. If this volume were ejected in a single explosive event, it would produce a low magnitude sub-Plinian eruption similar to the one in 1631. This has been taken as the reference for a "mid-term maximum expected event (MEE)" (Table 1).

By combining the areal distribution of the AD 1631 products with the results of computer-assisted hazard mapping for MEE plinian fallout and pyroclastic flow emplacement a hazardous area of about 2,000 km^2 has been identified. Within this area two zones were distinguished (Fig.1) based on type and size of phenomena potentially affecting them:

— the Red Zone (about 250 km^2) could be subject to near total destruction over wide areas due to pyroclastic flow and surge emplacements and very heavy ballistic fallout. During the 1631 eruption, about 20% of this zone was ravaged by pyroclastic flows.

— the Yellow Zone (about 1800 km^2) could be affected by heavy (>200 kg/sqm) ash and lapilli fallout, as well as by mud fall and flows. In 1631 10-15% of this area was severely damaged.

The eruption precursors - The main problem in defining the MEE scenario concerns the characterisation of eruption precursors. This is a very critical and delicate point, since the expected sequence of precursors drives the alert levels and the emergency plan. The historic record mainly refers to the period 1631-1944 in which the volcano was characterized by open conduit conditions and is therefore not a useful source of information on likely precursors. The expected precursors for the MEE have therefore been derived from the chronicles of the 1631 eruption and from recent experiences of eruptions interrupting long rest periods (e.g. 1980 St Helens, 1991 Pinatubo, 1994 Rabaul). To improve the capability of quickly recognizing and interpreting any sign of a change in state of the volcano, an extensive monitoring network has been developed. Cooperative research programs involving a large number of Italian and foreign scientists, are actively increasing our knowledge of the Vesuvius system and the ability to model and forecast future behaviour.

The Monitoring System - The Osservatorio Vesuviano (OV) has been charged, since 1841, with volcano surveillance through the management of monitoring networks. These consist of :

— seismic network: 10 stations (1 three-components); the signals are radioed to the Surveillance Centre, sampled and stored on PC;

— geometric levelling: 287 benchmarks forming 15 closed circuits with a total length of about 220 km, measured once per year;

— planimetric levelling: 21 benchmarks (60 measured base-lines) on the medium-high slopes of the volcano, measured once per year;

— GPS network: 21 benchmarks, connected to the Campi Flegrei network, including EDM networks of both areas;

— tiltmetric network: one automatic station; two others will be installed in the near future;

— marigraphic network: 3 tide gauges;

— gravimetric network: continuous regis-

Table 2 - Scientific alert levels

level	alert state	volcano state	Civil Defense main actions
0 NO ALERT	low	typical background values	none
1 ATTENTION	medium	departure from back-ground values of one monitored indicator	Population is alerted
2 ATTENTION	high	departure from back ground values of one monitored indicator suggesting a possible pre-eruptive state	Prefecture provides logistic support to the scientific community
3 PRE-ALARM	very high	departure from back-ground values of more than one monitored indicator suggesting a possible pre-eruptive state	Cabinet declares a State of Emergency The Civil Defence model of intervention is activated
4 ALARM	maximum	Several indicators are coherent with a pre-eruptive state	Red zone is evacuated (outside Campania region)
5 WAITING	maximum	data indicate pre-eruptive conditions; situation probably irreversible	Civil Defense and scientific operators leave the Red Zone
6 ERUPTION IN PROGRESS	maximum	eruption in progress	That part of yellow zone affected by heavy fallout is evacuated (within Campania region)
7 AFTER THE ERUPTION	maximum	eruption is over; attention has to be payed to possible late phenomena (mudflow, gas emission,...)	The State Department of Civil Defence supervises return of population The State of Emergency is revoked

tration of data from a gravimetric station at OV, and periodic measurements of the gravimetric network (20 benchmarks);
— geochemistry: periodic sampling of fumaroles and water wells.

The Emergency Plan – As a part of the National Emergency Planning of the Vesuvian Area ("Plan"), the OV is responsible for issuing scientific alerts which range through eight levels (Table 2), to be determined on the basis of instrumental (seismicity, ground deformation, fluid geochemistry, gravimetry) and observational data. An exercise was successfully completed in June 1996 simulating a limited emergency situation at Vesuvius (alert level 3) as a first attempt to verify the efficiency of the Plan until the declaration of a state of emergency.

The Plan is a complex document providing the organization of Civil Defense during an emergency. It does not only consist of an evacuation plan, based on the MEE, but includes guidelines for establishing value and vulnerability maps of the territory, for providing information and education for the population, for establishing links between the scientific community and civil defense national and local institutions, and for dynamically adjusting the Plan as events unfold.

Permanent staff including scientists, technicians and administrators, to manage the Plan and promote initiatives to mitigate the Vesuvius risk and also to modify the Plan as necessary was created in February 1996 by the State Secretary for Civil Defence.

The Italian scientific community is fully conscious of the complexity of the Vesuvius problem. The Plan was a necessary and successful first step in the initiative to mitigate the volcanic risk in the Vesuvius area. However, there is much room for improvement. For example, the Civil Defence organization needs 15-20 days advance notice to prevent a chaotic evacuation. The Plan does not fully cater for the consequences of false alarms which may occur if such notice is to be given.

I am fully convinced that we have found the best way of managing the Vesuvius problem. The platform now exists on which we may extend the present emergency management Plan to a more complex emergency prevention and risk mitigation plan.

Decade Volcanoes

The Decade Volcano projects, are an IAVCEI contribution to the International Decade of Natural Disaster Reduction (IDNDR). Each project involves intensive, international, interdisciplinary work to improve and demonstrate tools for volcanic disaster prevention. Intensive, to address urgent problems at 16 high-risk volcanoes before another volcanic disaster can occur. International, to introduce new tools and thought paradigms, complementing those of the local scientific team. And interdisciplinary, to achieve the exciting synergism that results when colleagues with varied expertise work together on a common problem.

Volcanoes that have been nominated by their host countries for Decade Volcano projects, and endorsed by IAVCEI, are:

Avachinsky-Koriaksky (Russia)
Colima (Mexico)
Etna (Italy)
Galeras (Colombia)
Mauna Loa (USA)
Merapi (Indonesia)
Mount Rainier (USA)
Nyiragongo (Zaire)
Sakurajima (Japan)
Santa Maria (Guatemala)
Santorini (Greece)
Taal (Philippines)
Teide (Spain)
Ulawun (Papua New Guinea)
Unzen (Japan)
Vesuvius (Italy)

Each of these designated volcanoes has a combination of population at risk, volcanic unrest, scientific infrastructure, and national commitment that make it a good place in which to focus work. Contact information for each of these volcanoes can be found in EOS, July 26, 1994, or through the Web pages listed below.

We welcome the most recent addition to this list: Avachinsky- Koriaksky, in Kamchatka, added just this year through the initiative of the Institute of Volcanic Geology and Geochemistry (IVGG).

An update on progress

A few representative, recent accomplishments at Decade Volcano projects include:

- Development of GIS software and methodology for risk mapping and crisis preparedness at Teide Volcano. Parallel development of a similar system at Mauna Loa. Most Decade Volcano projects are developing GIS data bases that include topography, hazards, population centres, land use, and lifelines. In Rome, project leaders resolved to share and try to standardize software and approaches.
- Recognition of the utility of unusual, monochromatic, low-frequency „tornillo" seismic events in forecasting explosive eruptions, and new understanding of the eruptive history at Galeras Volcano. Also involving Galeras, a workshop on communication, for observatory chiefs and civil defense leaders from throughout Latin America (1995).
- Recognition of the remarkable extent to which water is involved in eruptions of Taal Volcano, and of the correspondingly great reach of both water-rich and water-poor eruptions into densely populated areas. Work between scientists and regional planners to limit high-density development within Taal Caldera, without discouraging industrial, agricultural, and tourism development outside the caldera.
- Coping with the volcanic threat to Rwandan refugees from Nyiragongo and neighboring Nyamuragira volcanoes. Neither the monitoring infrastructure nor decisions that averted unnecessary evacuations was a direct product of the Decade Volcano project, but international responses to the crisis might have been facilitated by Nyiragongo's Decade Volcano status.
- Development and release of an evacuation plan for parts of Naples and surrounding towns, in the event of serious unrest at Vesuvius. This plan tackles exceptionally difficult problems that have long been recognized but are only now being addressed squarely.
- A major expansion of radio-telemetered monitoring of seismic, geodetic, magnetic, and fumarolic monitoring at Merapi Volcano, with signals being processed in near real-time at a centralized observatory.
- Improved electronic communications between Decade Volcano projects. Most projects now have email access and participate in the VOLCANO Listserv. Also, directly or through friends, most have one or more World-Wide Web pages devoted to their volcano. The Web can be an especially powerful medium for discussing Decade Volcano within the scientific community and, increasingly, also

with those at risk. But, to do so, me must move beyond pretty pictures and increase discussion of problems, work in progress, and results. Good URL's at which to start exploring the rapidly growing number of Decade Volcano Web pages are:

- http://xrfmac.lanl.gov/Heiken/one/decade
- http://www.geomar.de/personal/bbehncke/otherdec.html
- http:/magic.ucsb.edu/~baer/decade/decade.html
- http:/www/geo.mtu.edu/volcanoes/

Concluding note:

In April 1996, the Scientific and Technical Committee of the IDNDR reviewed 39 Demonstration and other IDNDR projects, and recognized 11 as fulfilling the major goals of the Decade, especially as adjusted during the Yokohama Conference to place more emphasis on practical applications of research and local community action. The Decade Volcano activity is among these 11. Congratulations to all project leaders and participants — keep up the good work!
(modified from a report to the IDNDR Secretariat)

New Decade Pair: Avachinsky and Koriaksky volcanoes, Kamchatka

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Avachinsky volcano (53° 15.3' N, 158° 49.8' E; altitude 2751 m asl) is one of the most active volcanoes of Kamchatka, Russia. It is located in the Eastern volcanic belt at a distance of 25-30 km from the large cities of Kamchatka Petropavlovsk-Kamchatsky and Elizovo with populations of about 300,000. Every day some 30,000 people fly over the area on routes Anchorage-Tokyo, Anchorage-Seul, Seattle-Anchorage- Petropavlovsk-Kamchatsky, Anchorage-Khabarovsk.

Avachinsky is a Somma-Vesuvius type volcano. It consists of a Late-Pleistocene stratovolcano destroyed by a large (4.5 x 4.0 km) crater, which formed about 30 000 yr B.P. The active Young cone inside this crater began to form about 3500 yr B.P. The composition of the erupted material has been rather uniform basaltic andesite. Historically recorded eruptions of Avachinsky volcano occurred in 1737, 1772, 1779, 1827, 1878, 1881, 1894-95, 1901,1909, 1926-27, 1938, 1945, 1991. The deposits of the last four eruptions have been studied in detail but only the course of the 1991 eruption was observed by volcanologists. The eruptions of the Young cone both historic and pre-historic resulted in many hazardous phenomena: lava and pyroclastic flows, pyroclastic surges, lahars, ash-falls, blasts, debris avalanches, but their role and magnitude in individual eruptions varied.

Nowadays Avachinsky volcano displays only fumarolic activity. After the 1991 eruption the crater is filled with a lava plug up to 170 m thick with a weight of about 20 million tons. Shallow earthquakes beneath the volcano have been observed since March 1996.
The following hazardous phenomena are likely to be associated with future eruptions of Avachinsky volcano:

1. Lava flows could form during any type of eruption and may be hazardous at the slopes of the Young cone and the nearest adjacent areas.
2. Lahars could form during any type of eruption and may be hazardous in the river valleys for distances up to 30-35 km from the volcano.
3. Pyroclastic flows are likely to be produced during strong eruptions and could be hazardous at the cone and in river valleys at the distances up to 10-12 km.
4. Pyroclastic surges could be dangerous in the case of strong eruptions at the volcano and adjacent areas at a distance up to 20 km from the crater.
5. Tephra-falls from strong and moderate eruptions could be hazardous at the foot of the volcano depending on wind direction.
6. Blasts and failure events could occur only as a result of strong eruptions and could be dangerous for the cone slopes and the foot of the volcano.

Koriaksky volcano (3456 m asl) is a mere 10 km to the NW of Avachinsky. In the course of the XIX-XX centuries Koriaksky volcano produced only weak phreatic eruptions and episodically increased its fumarolic activity. The last weak phreatic eruption took place in 1956-1957. In early 1994 an anomalous growth of seismic activity was registered beneath the volcano. The processing of digital data on this seismic swarm resulted in the identification of specific earthquakes probably indicating magma intrusion. Similar earthquakes were recognized in records of the swarm under St. Helens volcano. Nowadays the fumarolic activity is associated with a sub-terminal crack at the NW slope of the volcano. Koriaksky volcano is seriously hazardous even in the case of a moderate eruption. Considering a 3200-yrs long dormancy since the last strong eruption the next eruption is likely to be rather strong. The morphology of the volcano along with the composition of its rocks suggests a possibility of a directed blast- type eruption similar to Bezymiaanny 1956 and St.Helens 1980. In any case a strong eruption will cause ashfalls and lava flows. The latter will be accompanied by forest fires in summer and by lahars in any season.

Our studies suggest that lahars are the most serious hazard for the populated regions near Avachinsky and Koriaksky volcanoes. The territory of Elizovo and its surroundings and the area around the airport were repeatedly affected by lahars in the past and are likely to be affected by lahars in future.

In the settled areas around Petropavlovsk-Kamchatsky and Elizovo ash deposition would cause overloading of the roofs estimated at 200-400 kg/m^2 in Petropavlovsk-Kamchatsky itself and at 600-900 kg/m^2 in the suburbs closer to the volcano. The maximum ash thickness in the airport area is estimated at 25 cm. Avachinsky and Koriaksky eruptions may produce a serious hazard to aviation safety not only in Kamchatka but in the whole North Pacific region.

To reduce the risk to human lives and property it is necessary to estimate and map the volcanic hazard in the area of Avachinsky volcano. Another important problem is short-term forecasting; underestimating volcanic risk and a lack of funding hamper volcanic hazard assessment. We need the help of the international community to exchange experiences in forecasting volcanic eruptions and hazards mitigation and to draw attention to the volcanic risk problem in our country. In addition Avachinsky and Koriaksky volcanoes serve as excellent natural laboratories to study all the types of volcanic hazards, environmental impact of volcanic eruptions and the methods of volcanic risk mapping. The status of Decade volcano for Avachinsky and Koriaksky volcanoes will promote focused and coordinated investigations of these volcanoes by all the organizations concerned.

News from Commissions

Remote Sensing in Volcanology Commission

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One of the primary objectives of the Remote Sensing Commission is to foster the use of new field, airborne and spaceborne remote sensing techniques for the analysis of volcanoes around the world. Over the last couple of years, there has been a dramatic increase in the number and diversity of space missions that can provide timely information of eruptions. These missions enable quantitative investigations of the topography of volcanoes, gas flux, or lava flow temperatures, that until recently would have been impossible.

A case in point has been the use of the European ERS-1 spacecraft to study the Rabaul eruptions of 1994. The Along Track Scanning Radiometer (ATSR) provided stereo views of the Rabaul plume, enabling its height to be accurately determined. Other satellite data showed that this plume had an unusually large water vapor content. Exciting new techniques have also been recently developed for the measurement of volcanic gases on the ground using Fourier Transform Infra Red (FTIR) methods and from aircraft using thermal infrared imaging data. Both techniques represent significant advances over the more familiar COSPEC measurements of sulfur dioxide; the use of FTIR enables other gases such as HCl to be measured.

Significant progress is also being made in mapping volcanoes using imaging radar, and in the analysis of volcano topography and detection of surface changes due to new eruptions or earthquakes. During 1994, two flights of the Space Shuttle Radar (SIR-C) provided images of dozens of volcanoes. (Examples of these images can be found on the Internet at http://southport.jpl.nasa.gov/volcanopic.html). In addition, interferometric radar data were collected that enable high resolution (12.5 m/pixel) digital topographic maps to be generated. Taal, Pinatubo, the East Virunga Chain (Zaire), Mt. Etna, Rabaul, Kliuchevskoi (E. Russia), Mauna Kea and Kilauea (Hawaii), Isabela Island (Galapagos) and Piton de la Fournaise (Reunion Island) were all imaged in this manner, thereby providing a wealth of new digital topographic data for morphologic analyses.

While there is a significant amount of basic research that remains to be done in order to remove measurement errors, the era of routine analysis of volcano inflation and ground deformation using orbital radar interferometry is rapidly approaching.

An increasing number of spacecraft provide high resolution data in real-time, thereby enabling investigators to detect and quantify eruptions as they are happening. High resolution geostationary spacecraft can provide coverage every 15 minutes for North and South America, while global daily coverage will be available in the next couple of years. The development of low cost ground reception stations to provide local access to these data sets is currently under development in the U.S., and there are plans to place several of these stations in Japan, Central America and Indonesia. With these ground stations comes the opportunity to collect radar data on a regular basis, thereby enabling changes at volcanoes to be detected much more easily.

The use of aircraft instruments to study Pacific Rim volcanoes has also been included in the Commission's activities. In the Fall 1996, there are plans to send the NASA's DC-8 aircraft to the western Pacific, including the Philippines and New Zealand to perform topographic mapping using the TOPSAR interferometric radar, and study volcanic gases using two infrared spectrometers (TIMS and AES). This deployment will be one of the major field validation experiments that will be conducted in preparation for the Earth Observing System (EOS) spacecraft. The first EOS mission is planned for June 1998, and will include the development of a global volcano eruption alert that will be made available over the Internet within minutes of the satellite observations.

In order to keep the international volcanology community aware of all of the developments in volcano remote sensing, there will be a Special Session called 'Remote Sensing of Volcanoes on Earth and the Planets' at the 1997 IAVCEI General Assembly at Puerto Vallarta, Mexico. This session, will be jointly organized by the Commission on Large-Volume Basaltic Provinces and the Commission on Remote Sensing. This promises to be a highly rewarding session, with the topics including volcanic hazards monitoring from space, the use of multispectral images for geologic mapping of volcanoes, and the analysis of volcanic emissions.

Outreach to the volcanology community and the general public is one of the top priorities of the Commission. As part of the Hawaii Center for Volcanology, a news letter is distributed to over 600 individuals worldwide who have expressed an interest in remote sensing in volcanology. If you are interested in getting on this mailing list, please contact:

Dr. Scott Rowland, Hawaii Institute of Geophysics and Planetology, 2525 Correa Road, Honolulu, HI 96822 USA (scott@kahana.pgd.hawaii.edu).

Several NASA funded World Wide Web sites are maintained in the U.S. by members of the Remote Sensing Commission to provide volcanologists with background materials on specific remote sensing techniques and the geology of individual volcanoes. These sites can be found on the Internet at:
http://www.geo.mtu.edu/eos/
http://www.geo.mtu.edu/volcanoes/
http://volcano.und.nodak.edu/
http://skye.gsfc.nasa.gov/

IAVCEI General Assembly, Puerto Vallarta, Mexico, 1997

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The Pacific margin of the Latin American sub-continent accounts for a large proportion of the global seismic energy release and the global magma emplacement and volcanic output. The diversity of volcano landforms and eruptive styles makes this region – more than 10,000 km long – a lively laboratory to test theories and models of volcanic processes. This area has also witnessed some of the worst volcanic disasters of the twentieth century. Santa Maria and Mt Pelee in 1902, El Chichon in 1982 and Nevado del Ruiz in 1985 account for most of the volcano victims world-wide this century.

The tectonics of the Middle-America region including Mexico is particularly complex. Intricate interactions among the NorthAmerican and the Caribbean plates with the Pacific, the Cocos and a number of micro-plates make this region unique in many aspects. From the view point of volcanology, features such as the Mexican Volcanic Belt (MVB), diverging about 30 deg from the active subduction trench, with its huge stratovolcanoes and extensive monogenetic fields, or the lone El Chichon volcano intruding in the middle of a sedimentary massif, represent just a few examples of what makes this region so interesting. For those working in active volcanism, volcano monitoring and the managing of volcanic crises, two volcanoes Popocatepetl and Colima in Mexico are especially appealing.

Popocatepetl volcano is a sizzling issue in more ways than one. Located in the middle of one of the most densely populated regions in the world, this huge stratovolcano has shown increased unrest since 1994. A lava dome started to grow in its crater and, if the current lava production rate maintains, the crater may be filled up with dacitic lava in less than one year. This is about the time at which the IAVCEI General Assembly will be held in Puerto Vallarta, Mexico, in January 19-24, 1997. However, the themes of the conference will be far from limited to the local volcanism. The general scope of the IAVCEI 97 General Assembly is ambitious: the two-way relationships between volcanic phenomena and the environment, understanding the latter in the broader sense of the word. Eleven symposia, eighteen excursions and three short courses will address these issues.

The IAVCEI 97 General Assembly will have some important first-timers: This is the first time that a General Assembly will be attended by personal members of IAVCEI, under the new IAVCEI Statues and By-Laws. It is also the first time that a General Assembly is being held in Latin-America. Mexico is making an effort to provide a proper representation of the Latin- American spirit of growing groups interested in volcano research and surveillance.

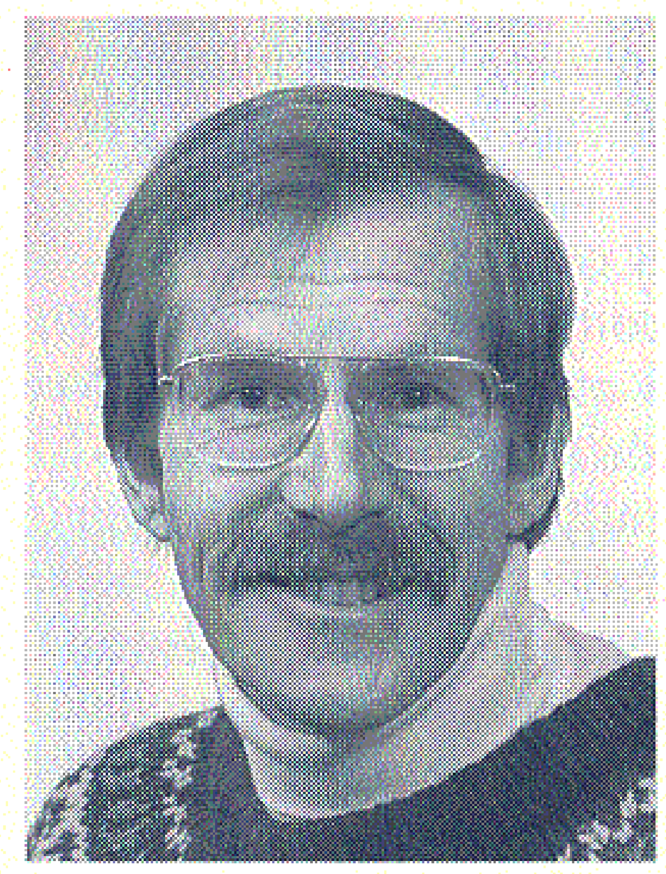
Puerto Vallarta has been chosen to host this IAVCEI meeting in late January for several reasons: It is located near the west end of the MVB, and it is one of the most beautiful places in the world to be in that time of the year. We expect that its smooth beaches and warm sea will provide a great ambiance for relaxed scientific exchange. The international airport is well connected and there is a wide choice of excellent hotels over an ample range of prices. This will also be a good opportunity to bring along family or friends.

Detailed information on the meeting and the registration and abstract forms may be found in the 2nd circular. Any inquiry can be made by mail to :

— IAVCEI General Assembly 9051-C Siempre Viva Road, Suite 37-011, San Diego, CA 92173, USA
or by e-mail to :
iavcei97@tonatiuh.igeofcu.unam.mx

— The 2nd circular and updated information may also be found in the IAVCEI 1997 General Assembly Homepage at the World Wide Web at the address: http://charro.igeofcu.unam.mx/iavcei97/iavcei97.html

Obituary



Dr. Juergen Kienle 1938 - 1996

Juergen Kienle died April 28, 1996, following a long and cruel struggle with mental illness. Although the memory of his suffering is difficult to bear, he will be remembered as an enthusiastic and energetic scientist, explorer, adventurer, and friend.

Juergen was born on December 7, 1938, in Reutlingen, Germany. He earned his diploma in Earth Sciences from the Swiss Federal Institute of Technology in Zurich, Switzerland, in 1964, and his Ph.D. in Geophysics from the University of Alaska in 1969. He joined the Geophysical Institute as a Post-Doctoral Fellow a year later, became an Assistant Professor in 1971, an Associate Professor in 1974, and a full Professor of Geophysics in 1983. He was also affiliated with the Department of Geology and Geophysics at the University of Hawaii at Manoa.

Juergen was a dynamic man who was well known nationally and internationally as a creative scientist. His interests included volcano structure, seismicity, deformation, microgravity and hazard evaluation. Actually, he was interested in almost everything, and his field work was as much devoted to appreciating natural beauty and pondering how science is done as to sampling rocks and recording seismicity. His research focused on the volcanism of subduction zones, and his studies concentrated on active volcanoes in Alaska, the Pacific region, and Antarctica. That is to say, he loved high latitudes and Hawaii. He was co-author of the book, Volcanoes of North America. Probably his greatest published contributions are his work on the relationship of Aleutian Arc volcanism to subduction-zone seismicity and his career-long study of Augustine Volcano. His greatest value to the University was as a very human storehouse of facts, ideas, and excitement about Alaska's volcanoes. He inspired both students and colleagues.

Juergen introduced me personally and generously to the Valley of Ten Thousand Smokes in Katmai National Park and to Augustine Volcano. Though I gradually learned from his example to be at ease in these places, I was and am still amazed by his stories of wild weather, downed helicopters, ferocious bears, explosive eruptions, and fearless exploits. An unusual characteristic of Juergen is that he was a tireless hut-instigator. One must be safe to truly appreciate one's surroundings. Of these huts, his 'Honeymoon Cabin' in the Valley of Ten Thousand Smokes is the most visited and his precariously perched camera station north of Redoubt Volcano the least. Juergen played an important role in the founding of the Alaska Volcano Observatory, and remained a vocal advocate of the scientific rewards and eruption hazards of Alaska's volcanoes. Unfortunately, his illness robbed him of the joy of these accomplishments.

Juergen's full but relatively short life is lengthened by his vivid presence in our memories. He was unique; there will not be another volcanologist like him; his mark on Alaska is indelible. He is survived by Linde, his wife of 30 years; Stefan and Florian, his sons; Gertrude Lutz, his mother; and Hans Kienle, his brother.

John Eichelberger
Fairbanks
July 19, 1996

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Reducing Volcanic Risk video released

In the two months before Mount Pinatubo in the Philippines erupted on 15 June 1991, scientists and officials made use of the video, 'Understanding Volcanic Hazards,' to illustrate the potential danger of the volcano.

Maurice Krafft produced the video for IAVCEI-UNESCO as a way to show people how volcanic activity can be lethal and affect their land and property. The wide use of this video in the Philippines helped avert a volcanic disaster – people in harm's way took Mount Pinatubo very seriously when faced with graphic images of destructive ash flows and mudflows. Thousands of people were successively evacuated before the cataclysmic eruption.

Maurice was working on a second educational video for IAVCEI-UNESCO when he and his wife, Katia, along with 41 others, were killed by an ash flow from Unzen volcano in Japan on June 3, 1991. A rough script had been prepared, and Maurice had assembled some of his film that might be suitable for the program. The video was intended to show what people could do to prepare themselves for future volcanic activity. Now, five years later, 'Reducing Volcanic Risk' is nearly finished.

'Reducing Volcanic Risk' shows how scientists, public officials, and the public can save lives and property from volcanic activity through (1) assessing volcanic-hazard areas; (2) monitoring volcanoes; and (3) developing an emergency plan. The video emphasizes that an emergency plan needs to include three critical activities – informing people of the hazards they face, announcing volcano warnings quickly and widely, and practicing the plan, especially if the plan requires people to evacuate hazardous areas.

As a way to illustrate these basic steps, the video describes several eruptions that have occurred this century and the ways in which people responded to warning signs that preceded the eruptions. For example, two of the world's worst volcanic disasters at Mont Pelee, Martinique, in 1902 and Nevado del Ruiz, Colombia, in 1985 killed more than 50,000 people. In the program, these tragedies are used to emphasize the importance of assessing volcanic-hazard areas and making sure that people clearly understand the hazards they face and what to do during an eruption. The video also describes responses before more recent eruptions at Rabaul caldera in Papua New Guinea, Mount Pinatubo, and Unzen volcano. Steps taken by officials and scientists to prepare for these eruptions saved thousands of lives.

As originally conceived by Maurice and other IAVCEI members in 1987 at a conference in Hilo, Hawaii, Understanding Volcanic Hazards and Reducing Volcanic Risk complement existing educational materials about volcanoes, but they do not lessen the need for scientists to work closely with public officials and the public to develop and implement an emergency plan. Hopefully, images of dangerous volcanic activity and examples of successful responses to an awakening volcano will encourage people and officials to take action to reduce the risk to their communities. 'Reducing Volcanic Risk' is not a detailed *how to* video. Considerable collaboration between scientists, officials, and the public is critical for preventing future volcano emergencies from becoming volcano disasters.

'Understanding Volcanic Hazards' is available and 'Reducing Volcanic Risk' will be available (by early 1997) for $ 19.95 each in English and Spanish (NTSC or PAL format) from the Northwest Interpretive Association; 3029 Spirit Lake Highway; Castle Rock, Washington 98611; (360) 274-2125; fax (360) 274-2101. Add $5.00 for postage in the United States, Canada, and Mexico. For all other destinations, add $13.05 for airmail postage or $5.55 for surface postage.

DECADE VOLCANO PROJECT POSTER FOR HIRE

A poster on the IAVCEI Decade Volcano Project was prepared especially for the May 1994 World Conference on Natural Disaster Reduction in Yokohama, Japan. The poster is available for loan to volcanologists who may have opportunities for displaying it at other workshops, conferences, and other public meetings. Please contact Paolo Gasparini (facsimile 38-81-5527631, Wally Johnson (facsimile 61-6-2499986), or Bob Tilling (facsimile 1-415-3295203) who will arrange to post it to those requesting the poster on a loan basis.

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