IAVCEI *News* 1999 No: 2

INTERNATIONAL ASSOCIATION OF VOLCANOLOGY AND CHEMISTRY OF THE EARTH'S INTERIOR

MAGMATIC PROCESSES AT RUAPEHU VOLCANO

VENUE FOR STATE OF THE ARC 2000

The IAVCEI Commission on Arc Magmatism is planning to hold a second 'State of the Arc' meeting and workshop at Mount Ruapehu in New Zealand's North Island during January of next year. Titled 'State of the Arc 2000', the workshop will aim to explore the time scales and complex processes associated with andesite magma petrogenesis in arc-type volcanoes (see box on page 5).

At 2797 metres, Ruapehu is the highest peak in the North Island and the largest, active, andesite volcano in New Zealand (present day volume 110 km^3). It is also the centrepiece of New Zealand's first national park and a major recreational area. The eruptive history extends over 230,000 years and the present edifice represents several cone-building episodes separated by relatively quiescent and dominantly erosional periods. Much of this history is now preserved only in deposits that form a ring plain around the volcano and the study of tephras in the ring plain, by workers from Massey University, has enabled resolution of fine scale eruptive activity extending back to at least 22,500 years before the present day. The tephrochronology indicates that over the past few thousand years, Ruapehu has averaged one significant ash depositing eruption every 100 years. The most recent eruptions, in 1995 and 1996, are a continuation of this pattern of repetition. Much of the eruptive style of the volcano has been influenced by the presence of a crater lake at the summit and the ring plain deposits record the interplay between ash eruptions, lahars, and major collapse events. Activity over the past 50 years shows that significant 100-year ash forming events have been interspersed with small phreatic and phreatomagmatic eruptions.

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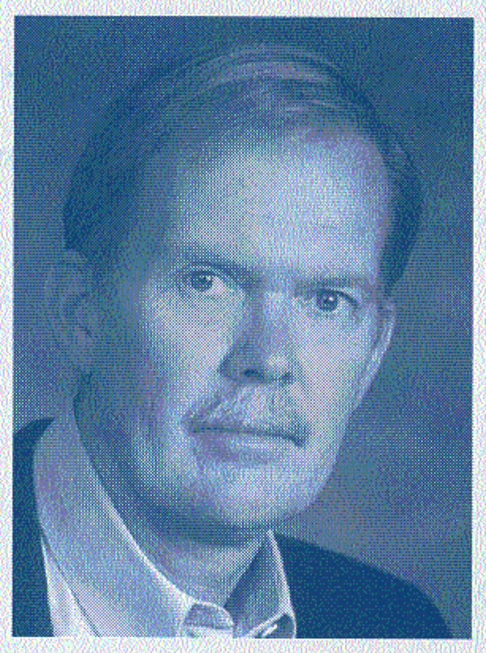
FROM THE PRESIDENT AND SECRETARY GENERAL

Farewell and Thanks!

This will be our last IAVCEI News as President and Secretary General of IAVCEI, so we thought we would write up this first-page column jointly. Steve Sparks (United Kingdom) and Steve McNutt (USA) will be taking over our respective duties in July during the 1999 IUGG General Assembly in Birmingham (see inside this News for further information about the results of the postal vote for 1999-2003 IAVCEI officers). We have had an exciting and privileged time since 1995 when we started our work together for IAVCEI and we are sure that the Association will be able to grow and prosper with the two Steves jumping into our vacating saddles! One of us (Grant), of course, will continue to serve ex officio on the new IAVCEI Executive Committee as Past President.



Grant Heiken

The last four years have been busy ones. IAVCEI personal membership has been introduced (a 'first' for any IUGG Association), a Secretariat established, and our members now have a greater say in how the Association is run than was the case under the pre-July 1995 Statutes and By Laws. IAVCEI members have organised three major international meetings - the 1997 General Assembly in Puerto Vallarta (Mexico), the 1998 International Volcanological Congress in Cape Town (South Africa), and the 1999 General Assembly in Birmingham (United Kingdom). Arrangements are progressing well also for the IAVCEI General Assembly to be held in Bali (Indonesia) in the year 2000. There have been many other important meetings too, mostly organised by the different Commissions of IAVCEI .

Wally Johnson

We have tried to continue the policy (from the 1991-99 quadrennial) of strengthening the CEI part of the Association and we now have active Commissions in Granites, Arc Volcanism, Physical and Chemical Properties of Materials of the Earth's Interior (in association with IASPEI), and Ocean Island Volcanism, as well as on-going geochemical and petrological interests in the Commissions on Volcanic Lakes, Large-Volume Basaltic Provinces (which soon may be renamed Large Igneous Provinces - LIPs), and Chemistry of

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NEW IAVCEI EXECUTIVE AND ANNUAL REPORT

MOUNT CAMEROON ERUPTION: END MARCH - MID-APRIL 1999

The massive stratovolcano Mount Cameroon (4095 m) rises above the coast of West Cameroon. It is the only volcano outside the Mediterranean Sea to have a documented eruption before the time of Christ. Its historical activity has consisted of moderate explosive and effusive eruption from both summit and flank vents. Numerous small cinder cones dot the flanks and surrounding lowlands.

On March 28, 1999, Mount Cameroon went into eruption following a series of widely felt earth tremors. This marked the sixth eruption within this century. Two erupting sites have been identified. The first, which became active on March 28, is located on the southern flank of the mountain along a fissure trending NE-SW at an altitude of 2650 m and was marked by explosive magmatic activity that sent scoriaceous bombs to 500 m laterally from the vents and short aa flows less than 3 km in length. The second site, which appeared two days after, was located along the same trend but much further downslope and closer to the west coast village of Bakingili. This site was at an altitude of about 1400 m. Eruptive activity, was characterised by important lava flows emission from the lower fissure towards the west coast. After about two weeks, the main

lava flow reached and interrupted the coastal road between Batoke and Bakingili. The last glow from the 1400 m vent was seen on 14 April, and lava production probably ended about this time. From Cameroon observers, occasional small earthquakes and possible minor volcanic tremors persisted until 22 April.

Earth tremors that preceded and accompanied this eruption have been felt up to Douala, Kumba and Nkongsamba. The most serious shock occurred on March 28, 1999 which measured about V on the Mercalli Intensity Scale (magnitude about 3.2). Analysis of intensities placed the epicenter closest to Buea Town. Effects of these tremors have ranged from panic, people rushing out of houses, people evacuating the town overnight, simple fractures on structures and complete collapse of walls. Other manifestations included surface fracturation and landslides. Results of seismic events were observed in the water, particularly at the Mutengene source where the water became abnormally muddy.

Explosive activity from the first site ejected volcanic bombs, blocks, lapilli and ashes. Ash, transported southwest in the direction of the prevailing winds, was felt in Bakingili, Batoke, Debundsha and Idenau, people reporting irritation of the skin and the eyes. This eruption and their associated

events have had adverse effects on the environment as well as the local economy. Forest ecosystems (about 1000 hectares), plantations and man-made structures, in particularly many private houses, were destroyed. It is clear that most affected houses had been constructed with disregard to appropriate building codes and along seismogenic zones. First estimates of damage were more than 420 million CFA francs. More than 1000 people were affected by this disaster, some being evacuated, but no human life was lost. A new road has been built along the distal end of the flow to restore normal traffic along the lava-flow-damaged coastal road. As of early May about 400 evacuees from Bakingili were still being housed in a nearby refugee camp, though they expected shortly to be allowed to return to their homes.

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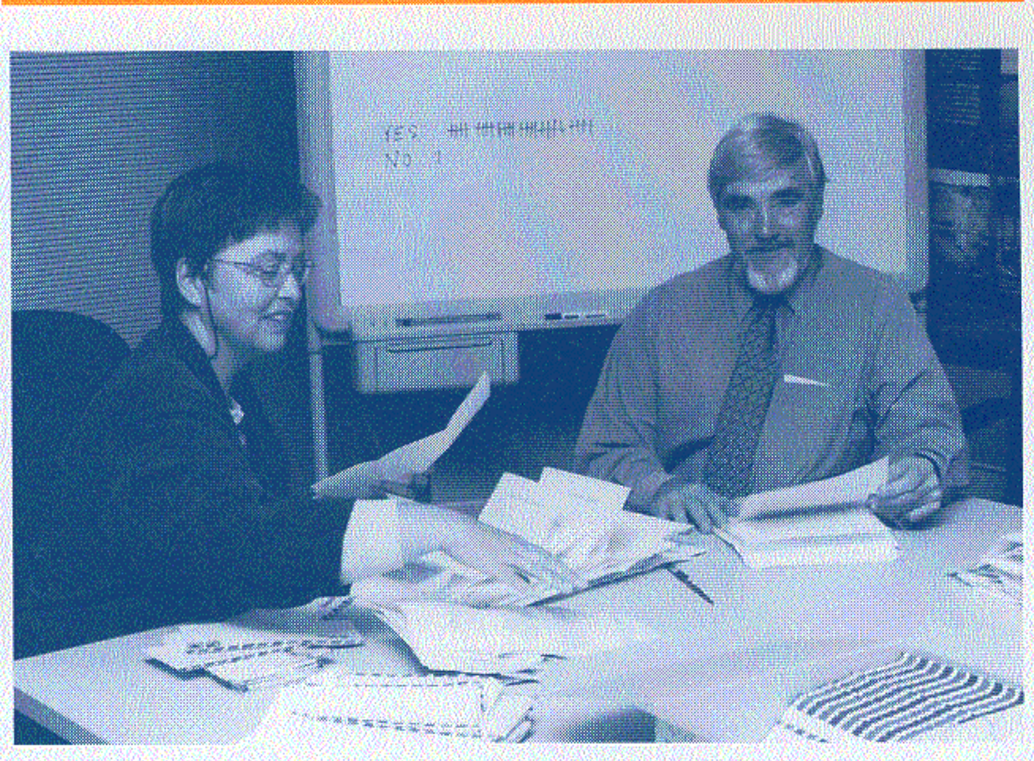

Ian Nicholls and Caroline Giddings counting the postal votes for the Executive Committee members

IAVCEI EXECUTIVE COMMITTEE FOR THE QUADRENNIAL 1999-2003

The first ever IAVCEI member ballot for positions on the Executive Committee went very well, and it has produced a strong group to support the work of the Executive, previously elected on the basis of single nominations.

On 21 May, Nominating Committee member Ian Nicholls met with the IAVCEI Secretariat's Caroline Giddings in Canberra to count voting papers returned for the election of IAVCEI Executive Committee members and for the expression of opinion on proposed changes to Statutes & By-Laws.

Steve Sparks
President Elect

The number of voting papers dispatched to IAVCEI members was 408, with 201 (including 17 from National Correspondents) returned by the due date.

Votes for changes to Statutes & By-Laws were counted first, with an almost unanimous 'Yes' result - Yes: 177, No: 1, Abstention: 3.

Much more effort was required in counting votes for the four Executive Committee members, and this reflected the closeness of the contest. Three candidates - Jocelyn McPhie (Australia), Hugo Moreno (Chile) and Bruce Houghton (New Zealand) - were elected clearly on the first count, but two further candidates - Raden Sukhar (Indonesia) and Toshitsugu Fujii (Japan) - were within one vote of each other. Two additional countings showed that these two candidates had actually gained the same number of votes (101 each).

On the basis of this result, the IAVCEI Secretary-General, Dr. Wally Johnson, recommended that both candidates should be declared elected, producing five regular members on the Executive Committee.

The Nominating Committee very much appreciates the major role played by its Convener, Professor Shigeo Aramaki, in the nomination of a slate of candidates prior to the election. It also warmly congratulates successful candidates.

Ian Nicholls
Member, IAVCEI Nominating Committee

Steve McNutt
Secretary General Elect

NEW EXECUTIVE FOR 1999-2003

Following are the duly elected members of the **IAVCEI Executive Committee** for the quadrennial **1999-2003**:

President:	Steve Sparks (United Kingdom)
Vice President:	Joerg Keller (Germany)
Vice President:	Tadahide Ui (Japan)
Secretary General:	Steve McNutt (USA)
Members:	Toshitsugu Fujii (Japan)
	Bruce Houghton (New Zealand)
	Jocelyn McPhie (Australia)
	Hugo Moreno (Chile)
	Raden Sukhar (Indonesia)
Past President (ex officio):	Grant Heiken (USA)

MAGMATIC PROCESSES AT RUAPEHU VOLCANO

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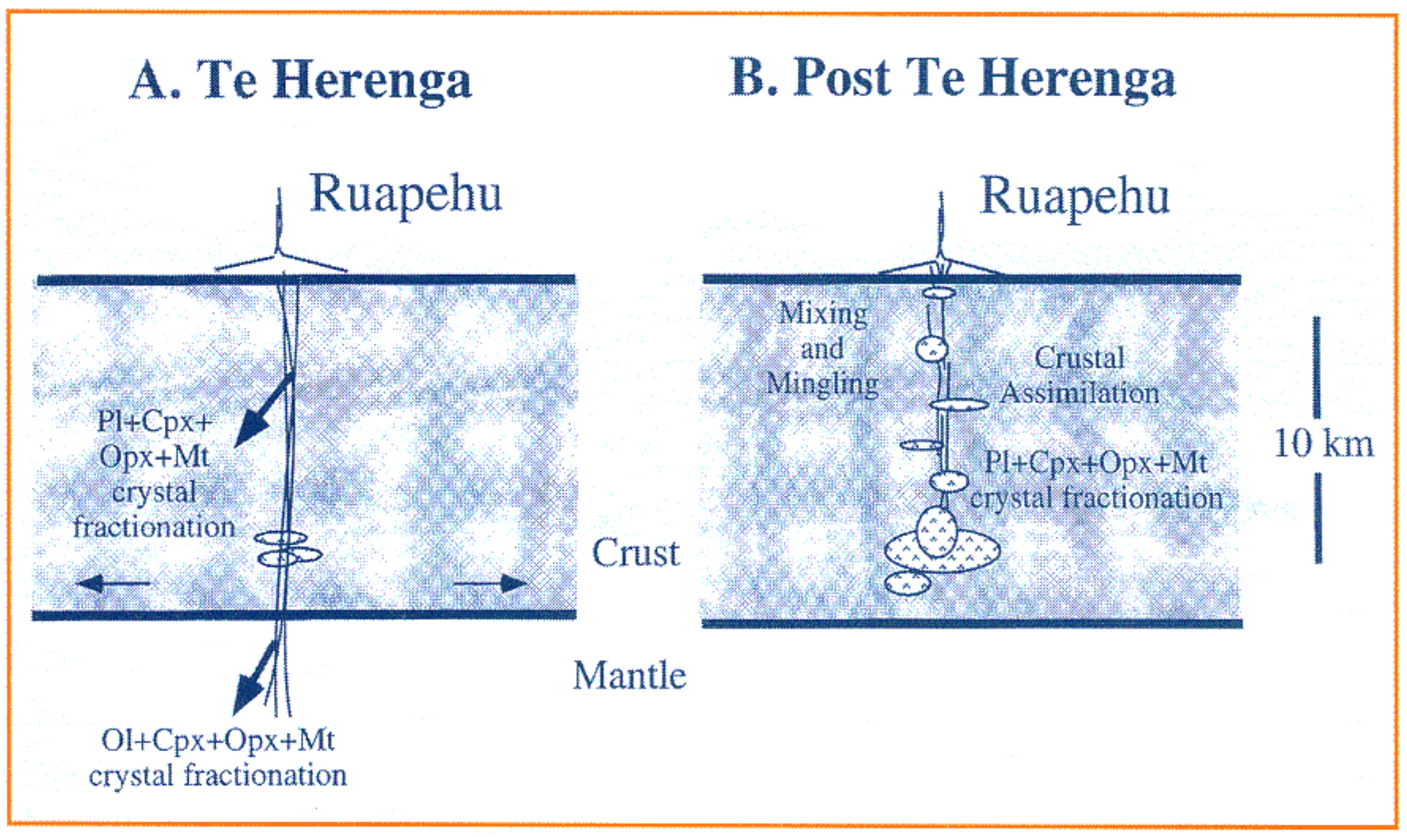
The eruptive activity of the last few thousand years, characterised as it is by small ash emissions and limited lava extrusion, has not been the dominant style at other times in the volcano's history. Ruapehu has also been a site where large volumes (40-50 km^3) of magma have been emplaced in perhaps a few hundred years.

Over the past four years, a research team involving geologists from New Zealand, Australian, USA, and UK universities and New Zealand's Institute of Geological and Nuclear Sciences, has been carrying out detailed mapping and sampling of flow sequences in an effort to understand how the volcanic system beneath Ruapehu has operated throughout the volcano's history. Over 500 samples have now been analysed for major and trace element composition with isotopic compositions being determined on about one third of these samples. Through careful sample selection and preparation, the team is now gaining precise geochronological information based on the $^{40}Ar/^{39}Ar$ method. The integration of detailed analysis of the flow stratigraphy, tephrochronology from the ring plain sequence, and geochemical and geochronological information is providing new insights into the way that andesitic volcanic systems evolve.

Lavas erupted at Ruapehu show complex temporal variation. Overall, there is a broad trend of increasing K, increasing major and trace element variability, and progressively more radiogenic Sr isotopic compositions with time. For example, lavas of the oldest identified flow sequence, the Te Herenga formation (230 ka) are relatively low in K_2O (mean = 0.73%) and SiO_2 (mean = 56.63%), and have lower $^{87}Sr/^{86}Sr$ ratios (mean = 0.70495) than younger flows. The Te Herenga lavas also show relatively limited variability (e.g. K_2O range = 0.55 - 0.92%). In contrast, successively younger lavas show higher K_2O and progressively more variability with relatively evolved (higher SiO_2) lavas becoming more common. For example, lavas of the Whakapapa Formation (<15 ka) have a mean K_2O abundance of 1.52% and the range in SiO_2 content is 55.5 - 61.2% (mean = 58.38%). Younger lava sequences also tend to have more radiogenic Sr isotopic compositions; Whakapapa lavas show a mean $^{87}Sr/^{86}Sr$ ratio of 0.7053.



Magmatic evolution at Ruapehu Volcano, North Island, New Zealand. The early stages of cone development at Ruapehu (Te Herenga Formation) were dominated by relatively less fractionated and less contaminated magmas. Progressively, over the 230,000 years of cone building, magmas became stalled at various levels in the crust producing a range of assimilation crystal fractionation paths of magma evolution. Magmas migrated to the surface through this complex plumbing system, becoming more and more evolved and more contaminated as they moved higher. Mingling and mixing of variously contaminated and evolved magmas throughout the section has meant that eruptive episodes show a wide range of variation. The last 1000 years of activity have been characterised by small volume eruptions with magma compositions reflecting mixing and mingling of highly variable magma compositions during high level recharge events. [Ol = olivine, P = plagioclase, Cpx = clinopyroxene, Opx = orthopyroxene, Mt = magnetite].

In detail, lava sequences show significant short-term fluctuations which, in many cases, contrast with the broader, long-term patterns. In a number of closely studied sections, sequences of 3 - 5 conformable flows have been sampled. Commonly, a sequence begins with flows that are relatively evolved (higher SiO_2 and K_2O, lower MgO) and successive flows become less evolved. However, this pattern is not always observed and the patterns of Sr isotopic compositional variation are not predictable. The most commonly observed variation in isotopic composition is that $^{87}Sr/^{86}Sr$ ratios correlate with SiO_2 abundance. In some cases, however, Sr isotopic compositions do not change significantly and in others, there is an

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NEW IAVCEI COMMISSION ON ARC MAGMATISM

The objective of the Commission is to foster interaction and communication between scientists with an interest in magmatism at subduction zones. This includes, but is not limited to;

Geology and Geochronology: Mapping of ancient and modern arc terranes and determination of their histories through stratigraphy of volcanic, plutonic and associated lithofacies. Evaluation of other important processes associated with magmatism, such as hydrothermal activity and ore deposition.

Geochemistry and Petrology: Identification of source contributions to the petrogenesis of subduction related magmas, mass balancing fluxes across convergent margins, and evaluation of the role of such magmatism in the evolution of crust and mantle. Keen current interest is focused on rates of processes at subduction zones from melt generation to eruption site and on the processes of mixing, mingling, storage and differentiation which accompany their transport to the surface.

Volcanology: Characterisation of volcanic behaviour at convergent margins. Interpretation of volcanic deposits. Hazards evaluation and mitigation (given that many of the world's most dangerous volcanoes are located at subduction zones). Field, theoretical (fluid dynamics) and laboratory consideration of magma behaviour during volcanic eruptions, including the role of degassing on rock compositions, textures and eruptive styles.

Geophysics and Geodynamics: Characterisation of the physics of volcanoes at subduction zones through seismology, gravity, magnetic fields, GPS and other monitoring approaches. Large scale considerations of the dynamics and tectonics of convergent margins and their relationship to magma generation and transport. Observations through remote sensing.

The Arc Magmatism Commission has been established on an informal basis under the auspices of IAVCEI. We anticipate a great deal of overlap with other IAVCEI Commissions, and see this as a benefit. Many researchers are inevitably active in several IAVCEI Commissions. The success of the Arc Magmatism Commission rests only with the degree to which it is able to promote a common interest in various aspects of subduction zone magmatism, as reflected in the enthusiasm and activities of participants. The most effective forum to serve our purposes is arguably the web. We can serve two useful functions here: **1.** Provide an opportunity for discussion or notification of arc-related issues to those interested (the nominal 'members' of the commission). A bulletin board is provided for this purpose, and general information can also be emailed; and **2.** Provide a list of individuals expressing interests in the above ('members') facilitating direct contact among scientists. It has been suggested that the commission can also in future serve to create a database of publications relating to arc topics, organised geographically and/or by topic. A compilation of arc geochemical data may also be possible, but we hope to co-ordinate this with GERM participants.

In addition to the web page as a general means for interaction, we propose to hold occasional workshops and meetings to foster focus on specific issues. We envisage these on occasion being held jointly with other IAVCEI sub-commissions. To this end our inaugural meeting will be in January next year. See box below!

Jon Davidson

COMMISSION ON ARC MAGMATISM WORKSHOP
STATE OF THE ARC 2000: ARC PROCESSES AND TIMESCALES

Building on the very successful 'State of the Arc' workshop held at the University of Adelaide (Australia) during February 1997, 'State of the Arc 2000' will be held on Mt Ruapehu, the 2800 m active andesite composite volcano at the southern end of the Taupo Volcanic Zone, New Zealand. The location on an active volcano is intended to encourage discussion in the field. Formal presentations (posters and a few keynote talks) will be interspersed with extensive discussions. We expect attendance to be around 50.

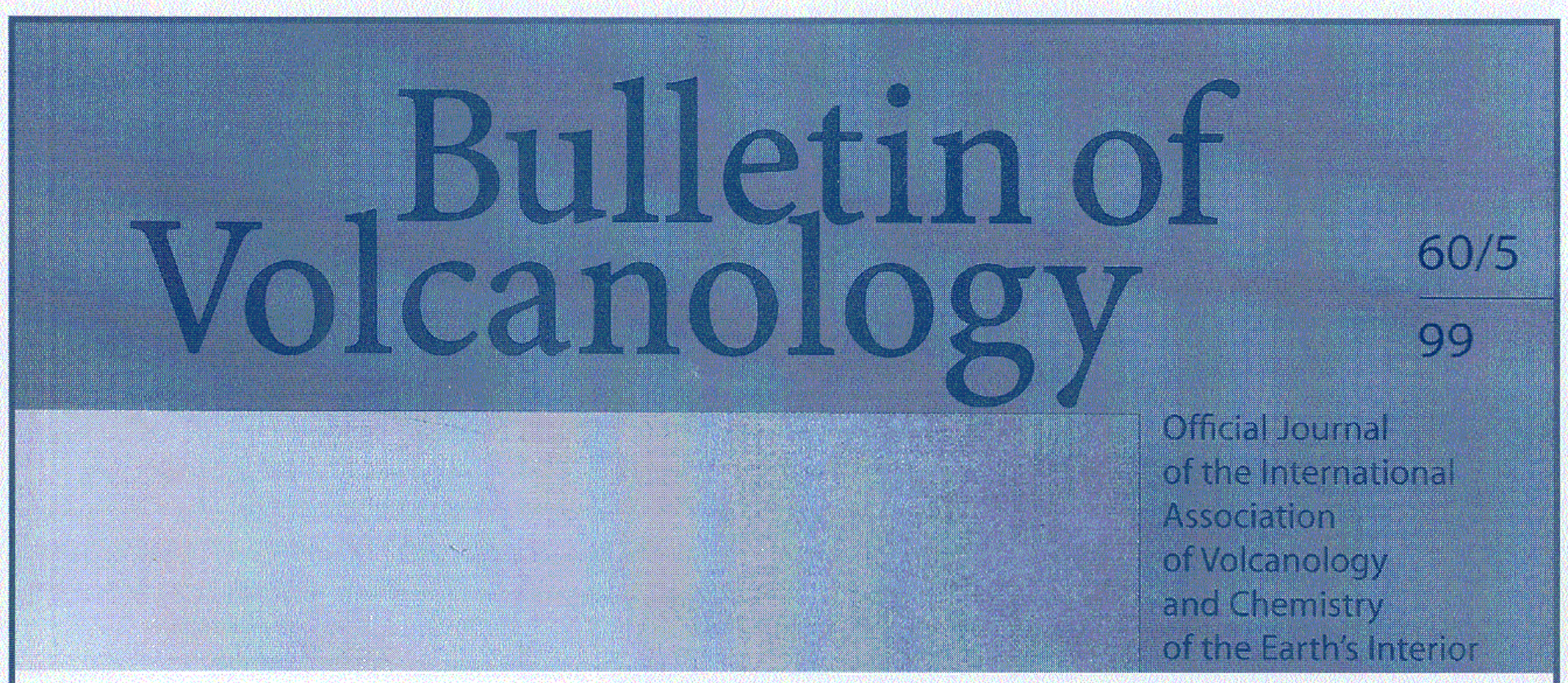
Dates: Sunday 23rd to Friday 28th January 2000
Pick up and finishing at: Auckland International Airport
Location: The Chateau, Ruapehu Volcano
Abstract deadline: October 31 1999
Preferred format: extended abstracts, up to two pages (A4/US letter), submitted electronically
Registration: US$550 includes transportation between the Chateau (Ruapehu) and Auckland Airport; all food and accommodation; conference dinner and field trip expenses.

Submit abstracts and registration fees to: John Gamble, Department of Geology, Victoria University of Wellington, P.O. Box 600, Wellington, New Zealand.

Additional details available on the website: http://center.ess.ucla.edu/iavcei/iavcei_home.html

IAVCEI IS SEEKING A NEW EXECUTIVE EDITOR FOR THE BULLETIN OF VOLCANOLOGY

WANTED -- NEW EDITOR for the Bulletin of Volcanology



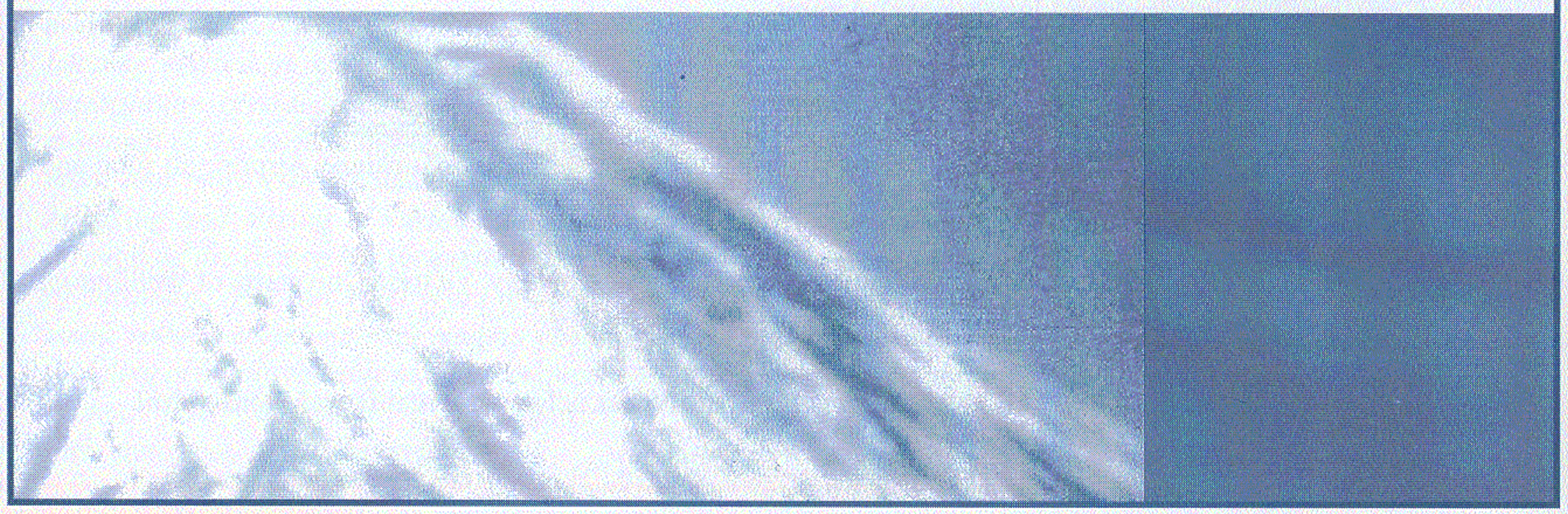
Don Swanson informed IAVCEI recently that he wishes to stand down just as soon as possible from his role of Executive Editor of the Bulletin of Volcanology. Many of you will know that Don now heads the USGS Hawaiian Volcano Observatory, having transferred there in 1997 from the University of Washington, Seattle (USA). Don finds that the new responsibilities of his position are having a major impact on the time he can devote to meeting the high standards of running IAVCEI's premier publication. IAVCEI regretfully now must seek a replacement in the near future. Chris Newhall, Assistant Executive Editor, is helping Don manage the stream of manuscripts, but Chris too has indicated his wish to stand down and has expressed his clear wish not to be considered for the position of Executive Editor. IAVCEI thanks both Don and Chris for the valuable work they have provided in recent years in managing the Bulletin of Volcanology.

IAVCEI therefore is looking for an energetic research scientist who has a wide reputation for international standard research, who is regarded widely as fair and equitable, patient, and well organised, and who is prepared to take on, and devote time to, managing the Bulletin of Volcanology. The position is a high-profile one that clearly would benefit the career of a youthful person who wants to expand their involvement in international VCEI work and to gain the experience, and enjoy the kudos, of being Executive Editor. Alternatively, the new Executive Editor could be a well-respected and well-known, semi-retired or retired person who would be prepared to devote his or her time to undertake the work. Well known figures who are, for example, current heads of university departments or senior managers in government agencies are probably not suitable for the position of Executive Editor. Springer-Verlag, the Bulletin's publisher, provides financial support for travel and secretarial support and perhaps this could be supplemented by an annual grant from IAVCEI (whose financial position at present is quite healthy).

IAVCEI members are requested to advise the Secretary General of the names of people whom they consider would be well qualified to take on the role of Executive Editor.

We also request authors who have submitted papers recently to the Bulletin of Volcanology to bear with us while we get through this difficult period.

Wally Johnson



FROM THE PRESIDENT AND SECRETARY GENERAL

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Volcanic Gases. Strengthening the CEI part of IAVCEI has not taken place without some criticism from the more traditional 'V' parts of the Association. Much more work needs to be done in making the boundary seamless between volcanology on the one hand and petrology and geochemistry on the other (see also the 1998 Annual Report to IUGG on page 11 in this issue of the News about the 'two cultures' still making up IAVCEI).

We have tried also to give full support to the United Nations' International Decade for Natural Disaster Reduction (IDNDR) mainly through our Decade Volcano Project which is managed as a Sub-Commission of the Commission for the Mitigation of Volcanic Disasters. Furthermore, volcano and volcanic-hazard awareness continues to be a dominant theme in IAVCEI. Two videos, calendars, posters, and a book have been sponsored and distributed. Two Sub-Committees have provided recommendations on Safety on Volcanoes and Crises Protocols. The IAVCEI Web Page has been established and developed. There are now, indeed, scores of volcano web pages, including four volcano 'live cams', educational pages, and volcano data sites. Our newsletter, IAVCEI News, desk-topped by the IAVCEI Secretariat, has a new format and never seems to go without a range of articles on different themes (although we still need to establish a continuous flow of spontaneously and voluntarily contributed materials!).

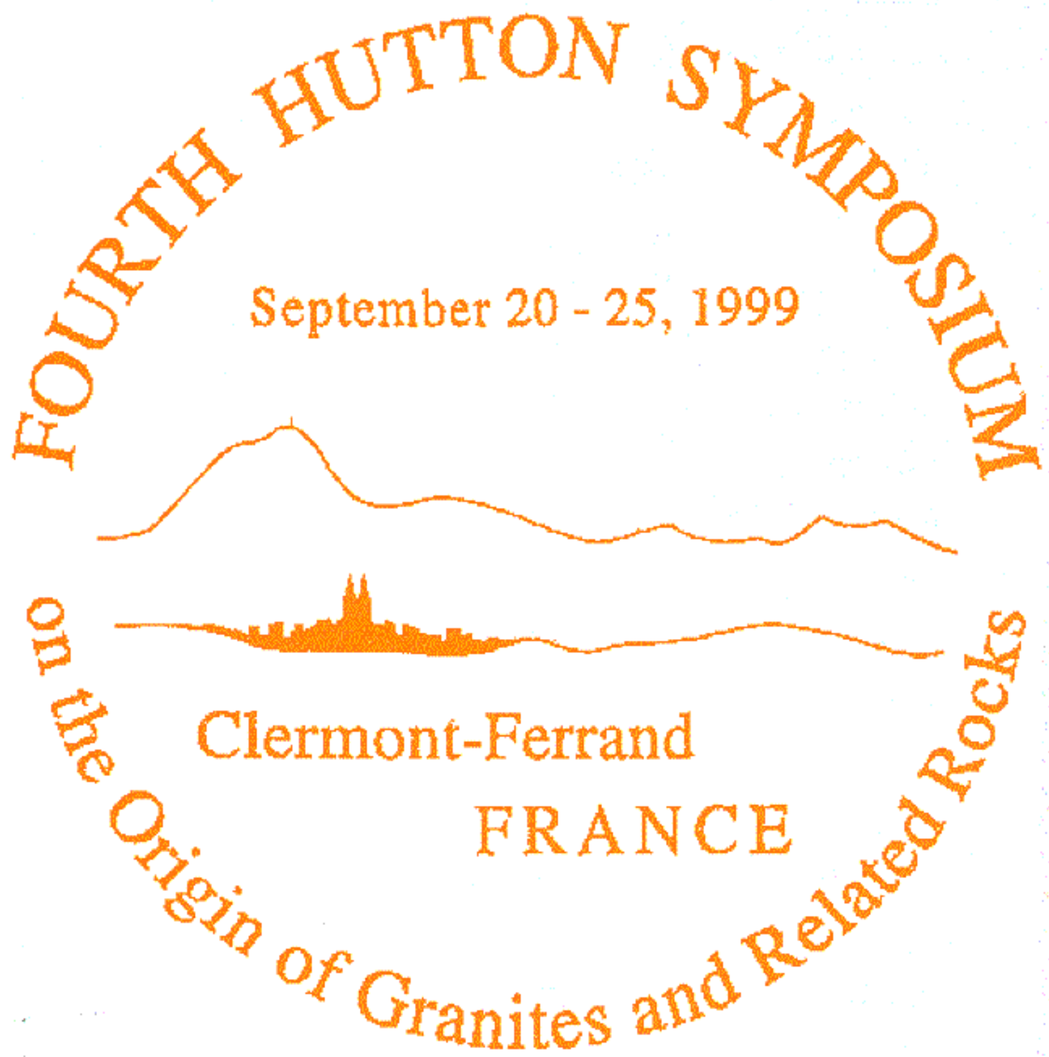
We have tried to work hard also in expanding and cementing IAVCEI's role within the IUGG family of scientific associations. Our aim has been to reach beyond our own field and to establish new collaborations in fields other than VCEI. We need, for example, to continually re-evaluate how we participate in IUGG General Assemblies, as we have done for the upcoming IUGG General Assembly in Birmingham (July 1999). IAVCEI is participating in 23 inter-Association symposia and only three of these are uniquely ours. This 'experiment' is grounded on the premise that we must promote inter-Association technical sessions if we are to participate effectively in interdisciplinary IUGG assemblies. There has been some criticism that this approach will lead to a loss of identity and influence within the Union. We believe that the opposite is the case! By taking the lead with this approach we broaden our horizons and engage new ideas and approaches to the problems of magma genesis, their rise, eruption, and effects on the global environment. There would little need for us to attend IUGG General Assemblies if we were to have only IAVCEI sessions.

The last four years - working within an Association that is based entirely on the hard work and creative participation of its members - have been rewarding and fun for us. Thank you for the privilege and opportunity.

Grant Heiken (President)
Wally Johnson (Secretary General)

COMMISSION ON GRANITES

FOURTH HUTTON SYMPOSIUM ON THE ORIGIN OF GRANITES AND RELATED ROCKS



The Hutton Symposium to be held 20-25 September 1999 is the fourth of a series that began in 1987 with a meeting in Edinburgh, Scotland, to celebrate the bicentenary of the work of James Hutton. These conferences are now the main activity of the IAVCEI Commission on Granites. The objectives of the Hutton series of conferences are to further an understanding of the origin of granites and related rocks through quadrennial interdisciplinary meetings that involve field trips, oral and poster presentations of scientific results, and informal discussions in the different sub-disciplines of the sciences that impinge on granites.

The Fourth Hutton Symposium will be held at the Maison des Congrès in Clermont-Ferrand, France. An intra-conference field excursion to Quaternary volcanoes in the vicinity of Clermont-Ferrand is being organised, and there are pre- and post conference field trips to the Massif Central, Pyrenees, Corsica, and Brittany. Following are the contact details for the conference:

Fourth Hutton Organising Committee
Blaise Pascal University
Department of Earth Sciences
5 rue Kessler
F-63038 Clermont-Ferrand cedex
FRANCE

E-mail: HUTTON@opgc.univ-bpclermont.fr
Facsimile: +33-473346744
Web Site: http://wwwobs.univ-bpclermont.fr/terre/actu/HUTTON.

IAVCEI'S PRINCIPAL IDNDR PR

DECADE VOLCANOES

As the end of the International Decade for Natural Disaster Reduction (IDNDR) draws near, we take stock of progress. Sixteen Decade Volcanoes have been a focus of concerted research and outreach work during the IDNDR. Projects at each volcano involve intensive, international, interdisciplinary work to improve and demonstrate tools for volcanic disaster prevention: intensive, to address urgent problems 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. Here is a small selection of the accomplishments of Decade Volcano projects, to illustrate a range of scientific studies and mitigation efforts. A longer list may be found soon on the IAVCEI Web site (http://www.ees1.lanl.gov/HEIKEN/one/iavcei_home_page.htm)

Avachinsky-Koryaksky: At least 112 eruptions of the past 8000 y, in two stages of activity, were revealed by stratigraphic reconstruction. The volumes and column heights (~ mass discharge rates) were estimated for the larger events.

Colima: Eruption crises of 1991 and of 1998-1999 (continuing) were successfully managed. Larger-than-normal explosions in May 1999 required evacuation of several villages near the foot of the volcano. Exchange visits are planned in 2000 AD for teams from 'twin' volcanoes Colima and Merapi.

Etna: The lava flow of 1991-1993 challenged authorities to find new methods for lava control. Blocks were dropped into a lava tube; explosives were used to breach the tube and divert lava; and a dam was built to pond lava. The last, at least, helped to save the town of Zafferana.

Galeras: Important lessons were learned about build-up of gas pressures in the near-surface. A special issue of Jour. Volcanology and Geothermal Research, 'Galeras Volcano, Colombia: interdisciplinary study of a Decade Volcano' was dedicated to the memory of six volcanologists who were killed in January 1993.

Mauna Loa: Detailed geologic mapping and radiocarbon and paleomagnetic dating of >180 lava flows allowed estimates of recurrence intervals; chemical analyses yielded details of magma plumbing and re-supply. Data are being compiled in GIS format. Also, submersible studies of Mauna Loa's SW rift zone reveal abundant picritic flows and changes in magma source components.

Merapi: Major collaborative program between Volcanological Survey of Indonesia and German GFZ, particularly strong in geophysical monitoring. Some collaborative work continues also with France, USA, New Zealand, Japan, and other countries. Merapi may have more international collaboration than any other Decade Volcano.

Mount Rainier: An educational video, 'Perilous Beauty - The Hidden Dangers of Mount Rainier', was produced

by USGS. Also, as part of a compromise between public safety officials and real-estate developers, an acoustic early warning system was developed for collapse events and lahars.

Nyiragongo: Seismic, tilt, EDM, and thermal monitoring were increased in 1994, when the lava lake began to rise and threaten refugees from nearby Rwanda. Beginning in October 1996, escalating civil strife destroyed all stations and halted monitoring.

Sakurajima: Beginning in 1994, Sakurajima eruptions declined and unerupted new magma was stored beneath nearby Aira caldera. An Asian Active Volcano Summit was held in November 1998, in Kagoshima City, for

sharing of experiences during volcanic crises among local officials and scientists from Japan, Philippines, Indonesia, and Italy.

Santa Maria: A well-attended workshop in November 1993 generated much enthusiasm and many plans. Regrettably, support from higher levels of the government was not forthcoming, and disappointingly few of the plans have been implemented. One village, El Parmar, was evacuated in 1998 before it was destroyed by lahars associated with the Santiaguito dome.

Santorini: A modern network of telemetered seismometers, tide gauges (to detect uplift),

thermometers, and CO_2-flux instruments was established, as was a non-profit organisation, the Institute for the Study and Monitoring of Santorini Volcano (ISMOSAV).

Taal: A broad stratigraphic framework was established, complemented by more detailed studies of ~5ka BP eruptions. Current work is examining sequence of activity within single eruptions, and notable variation from proximal to distal facies. Workshops for scientists and local leaders.

Teide: Teide became the site for a Post-Graduate International Course on Volcanology, sponsored by UNESCO, IAVCEI, and other organisations.

Procedures for preparing and releasing volcanic hazards information were formalised in law. GIS methods were used to assess and portray hazards and risks.

Ulawun: A 1998 workshop developed plans for improved seismic monitoring, a hazard map that reflects common Ulawun activity, and study of the stability of the Ulawun edifice. Unfortunately, a massive civil service cutback in Papua New Guinea in April-May 1999 will require that activities be scaled back or delayed.

Unzen: Unzen's eruption from 1990-1995 was exceptionally well documented, and many scientific lessons have been published (for example, special issue of Jour. Volcanology and Geothermal Research, 1999). Also, debate about whether the eruption had ended led to a useful set of criteria for this purpose - some of which were later applied to Montserrat.

Vesuvius: The first modern evacuation plan for Vesuvius was introduced by Osservatorio Vesuviano, Gruppo Nazionale per La Vulcanologia (GNV) and Protezione Civile. It defines hazard zones, scientific alert levels and civil defense responses, referenced to the 1631 eruption. The plan calls for evacuation of ~600,000 people in 1-2 weeks, if the march of precursors toward an eruption is judged irreversible.

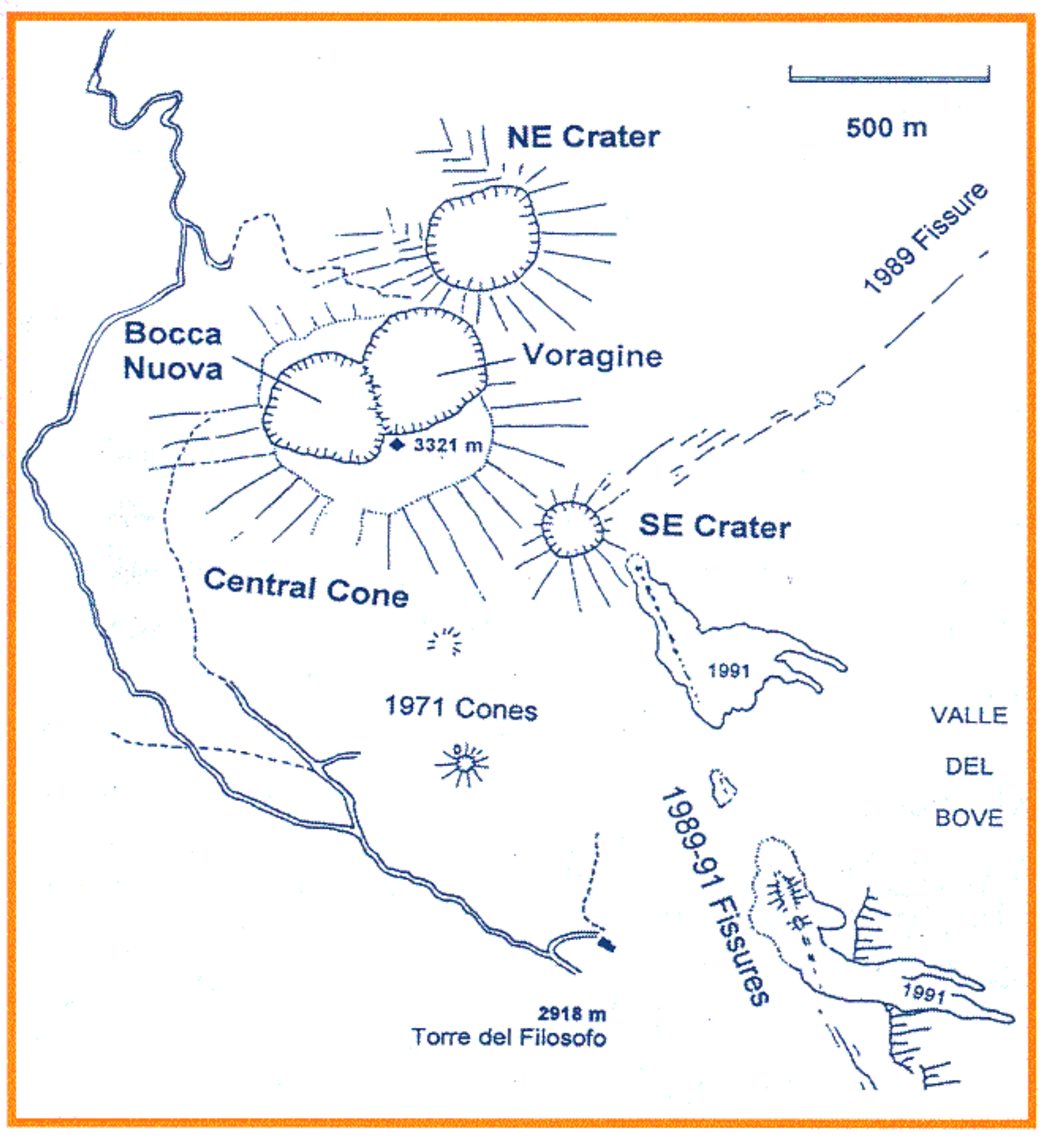
These and many more projects have been undertaken at Decade Volcanoes. No UN or other funding was obtained for the Decade Volcanoes project as a whole, so scientists at individual volcanoes were left to arrange funding for work as best as they could, from national and bilateral sources. Designation of volcanoes as Decade Volcanoes probably helped in some cases, but not in others. Overall, the concept of focused international, interdisciplinary work at selected volcanoes produced substantial dividends of science and volcanic risk mitigation.

Scientists who were able to raise funding for new work, and those who were able to accomplish much even without new funding, deserve hearty congratulations and encouragement to continue their good work. These and other volcanoes will surely not stop erupting at the end of the Decade, nor even at the end of the millennium!

Chris Newhall
IAVCEI Sub-Commission for Decade Volcanoes

PRESENT ACTIVITY OF MOUNT ETNA

During the second half of the 20th century, Mt Etna has displayed an unusually high level of activity, which consists of abundant gas emission from all its four summit craters (see figure below), permanent strombolian explosions sometimes culminating in lava fountains, and high effusion rates from frequent flank eruptions. In the 1971-1996 period, no less than 14 flank eruptions occurred, a frequency about five times greater than that observed for the preceding



three centuries. Accordingly, the average output rate of lava (0.8 m^3s^{-1}) has been almost three times higher than that of the 1868-1970 period, for which there are reliable data on the volume of erupted material. Mt Etna thus appears as one of the most active volcanoes in the world, its effusion rate being exceeded only by Kilauea, which erupts a lesser amount of gas. The Etnean gas output averaged since 1975 (i.e. since there are reliable measurements) is about 2x105 tonnes/day (td^{-1}) of H_2O, 7x104 td^{-1} of CO_2 and 4.6x103 td^{-1} of SO_2. Extrapolation back in time is unsafe however. The present high gas output is obviously linked to the exceptional activity of the last 30-40 years. Photographs taken at the beginning of this century show Mt Etna without a plume.

The present eruptive activity has been accompanied by strong seismicity involving the whole volcanic edifice and the underlying crust to more than 20 km depth. All these phenomena are consistent with the presence of a deep reservoir periodically replenished with basaltic magma coming from the mantle. Indeed, in our opinion, this reservoir appears as the uppermost part of a mantle diapir where melt accumulates beneath the mantle-crust boundary. This view has been substantiated by seismic tomography investigations showing considerable mantle upwelling beneath the Mt Etna area. Subsurface magma transport, however, remains largely a matter of debate, though significant progress in understanding the processes involved has recently been made by means of combined ground deformation and gravity measurements.

Recent eruptive phenomena, 1995-1998

After the 1991-93 flank eruption, Mt Etna has been weakly active for more than two years. Brief episodes of lava fountaining resumed at the north-east (NE) Crater towards the end of 1995, particularly on 9 and 14 November, 23 December, and at the beginning of 1996. Spectacular explosive and effusive activity took place at the same NE Crater from 21 July to 19 August 1996, with lava flows directed eastwards in the Valle del Bove and southwards, cascading into the neighbouring Voragine, or Chasm, of the Central Crater. Weak and sporadic explosions of magmatic material resumed at the SE Crater on 6 November 1996 and continued afterwards. In 1997 all the four summit craters were more or less continuously active, the most significant phenomena coming from the Bocca Nuova and the south-east (SE) Crater where inner cones were built. Furthermore, the SE Crater was almost entirely filled with small lava flows, some of which descended for a small distance the external slopes of the cone.

During the winter 1997-98 the level of activity was high. Explosions in the SE Crater, though irregular in frequency and intensity, have often thrown lava lumps and scoria to 200-300 m above the vent. A continuous glow could be seen almost each clear night above the Bocca Nuova from which was emitted a conspicuous plume of SO_2. From 9 to 12 January 1998 a seismic crisis occurred at shallow depth on the west flank, followed firstly by a reduction of summit crater activity, and then by a considerable increase in the strength of the SE Crater explosions. By late January and throughout February, the summit activity including the Bocca Nuova, was again continuous and moderately strong as before. In March, however, a gradual reduction of activity was observed, though a pulsating glow appeared on 23rd evening at the Bocca Nuova and small lava flows continued to trickle from the SE Crater.

On the morning of 27 March, a considerable increase of the seismic tremor was recorded in relation to strong magmatic explosions at the NE Crater, which gradually diminished in strength and frequency until mid-afternoon. The following night violent explosions started again and culminated over two hours (22h50 to 0h50 local time) in spectacular lava fountains. However little material was ejected outside the large vent, except for a thin mantle of tiny scoria deposited SW of the summit by the prevailing wind. In the following days the general activity was greatly reduced. By late April this crater had returned to its usual moderate activity which continued for months. In June the Voragine renewed its internal strombolian activity which culminated on 1st July in lava fountaining. Less intense explosions continued afterwards, although at a very irregular level. Thus, at this time, three of the four summit craters were continuously active and some weak spatter of lava at the bottom of the fourth, NE Crater, was occasionally observed by the Etnean guides.

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1998 IAVCEI ANNUAL REPORT TO IUGG/ICSU

1998 was another busy year for IAVCEI. Highlights were (1) the IAVCEI International Volcanological Congress held in South Africa; (2) attention being given to the increasing problem of the volcanic vulnerability of urban communities; (3) completion of a set of suggested 'protocols' for the conduct of scientists during volcanic crises; and (4) consolidation of the personal-membership scheme by the IAVCEI Secretariat.

The 1998 International Volcanological Congress (IVC) was held in Cape Town between 11 and 16 July at the University of Cape Town which is set spectacularly at the foot of Table Mountain. The oral presentations and poster sessions reflected well the title of the IVC - 'Magmatic diversity: volcanoes and their roots' - and in the series of superb field trips organised to different parts of southern Africa. Some key topics included carbonatitic and alkalic magmatism, flood basalts, ultramafic magmas, oceanic and arc magmatism, silicic magmas, and peperites. There were just over 300 participants, a number rather lower than expected, bearing in mind the excellent organisation and publicity provided by the South African Organising Committee. The reason for the low number remains unclear, but likely was a combination of factors, not least perhaps being the fundamentally dual nature of IAVCEI. Many of our members still 'identify' with one or other of the two parts of IAVCEI: volcanology (V) on the one hand and chemistry of the Earth's interior (CEI) on the other. Cape Town may have been regarded as the 'turn of the petrologists', even though the field trips and many of the sessions would have appealed greatly to many physical volcanologists. Much work still remains to be done in order to make the V/CEI boundary in IAVCEI a seamless one.

A highlight of the IVC was the presentation by IUGG President, Peter Wyllie (himself a petrologist!), of the inaugural Wager Medal to both Jon Davidson (USA) and Giovanni Macedonio (Italy). IAVCEI awards this medal every four years to an outstanding VCEI research scientist under the age of 40. The award is made in memory of the late Professor L R Wager (University of Oxford, United Kingdom). The award is judged from nominations made to the IAVCEI Awards Sub-Committee which is chaired by the IAVCEI President.

IAVCEI was also a principal sponsor of the international meeting 'Cities on Volcanoes' that was held in Napoli and Roma, Italy, from 28 June to 4 July. This meeting broke new ground in that the aim of the meeting was to bring together a range of relevant disciplines including volcanology, but also civil defence, land management, city planning, sociology, and the media, to address the problem of the increasing vulnerability of many urban communities to the effects of volcanic eruptions. Napoli was chosen as one of the two host cities for the conference because, together with surrounding towns, it forms a conurbation of 'megacity' proportions that is vulnerable to future eruptions from the Campi Flegrei caldera and from the nearby Vesuvius volcano. IAVCEI regarded this conference as a prelude to further discussions to be held during the 1999 IUGG General Assembly in Birmingham, where, following our successful IDNDR Decade Volcano Project, IAVCEI has proposed the initiation of a 'Decade City' project. Each IUGG member nation would nominate an urban centre that would be the focus for the geophysical, atmospheric, hydrologic, and geological sciences on interdisciplinary approaches to solving urban problems of sustainability and vulnerability. IAVCEI is also considering a follow-up meeting to the Napoli/Roma one. Discussions are under way with a view to identifying Auckland, New Zealand, as the host for the second 'Cities on Volcanoes' meeting possibly in 2001.

IAVCEI people spent a good deal of time during 1998 preparing for the 1999 IUGG General Assembly in Birmingham. Our focus was in collaborating with the other IUGG associations in designing a series of joint partnership symposia (very few symposia are being run by IAVCEI alone), as well as arranging a Union Symposium on volcanism and providing a speaker for the Union Lecture series. IAVCEI also gave special attention to planning for a series of special field trips, open to all IUGG99 participants, to areas of volcanological interest in the United Kingdom and elsewhere in Europe. Early planning was completed also for the IAVCEI General Assembly to be held in the year 2000 (18-22 July) in Bali, Indonesia. The theme of the 2000 General Assembly is 'Exploring volcanoes: utilisation of their resources and mitigation of their hazards'.

A Sub-Committee on Crisis Protocols, led by C G Newhall (USA), was established by IAVCEI in 1995. Its 11 members completed its report during 1998 and submitted a manuscript for publication in IAVCEI's 'Bulletin of Volcanology' under the title 'Professional conduct of scientists during volcanic crises'. The discussion is comprehensive, if not exhaustive, and will be of considerable interest to all scientists concerned with the stress generated during natural-hazard crises and with the way that friction between scientists during such crises can distract from both humanitarian and scientific effort. The Sub-Committee's report is scheduled for publication in the Bulletin of Volcanology during 1999 (volume 60, pages 323-334).

The IAVCEI Secretariat was established in 1996 in Canberra (Australia) and has since been developing a process for management of personal membership. The Secretariat was also responsible during 1998 for the publishing and distribution of another three issues of IAVCEI News for

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EDITOR WANTED FOR THE BULLETIN OF VOLCANOLOGY see page 6

1998 IAVCEI ANNUAL REPORT TO IUGG/ ICSU

>>Continued from page 11:

distribution to members. It also planned the process for the nomination of people for the 1999-2003 IAVCEI Executive Committee and for the subsequent postal vote during 1999. A Nominating Committee was established under the Chairmanship of former IAVCEI President, Professor S Aramaki (Japan). The postal vote will also involve a call to vote for changes to the IAVCEI Statutes and By-Laws relating to the role of the Deputy Secretary in IAVCEI - that this position should be by appointment by the IAVCEI Secretary General rather than by postal vote. The Secretariat was also involved in successful discussions with the publishers of the Bulletin of Volcanology, Springer-Verlag (Berlin), in regard to IAVCEI members being able to order the Bulletin on the same renewal form as their annual membership application. IAVCEI also produced a newly formatted volcano calendar for 1999, printed in conjunction with a commercial publisher.

Two new commissions have joined the family of IAVCEI, following approval given at the IAVCEI Executive Committee meetings held during the IVC in Cape Town. These are 'Arc Volcanism' and 'Ocean Island Volcanism'. IAVCEI now has 14 Commissions, all of them active, although in different degrees. The view has been expressed that 14 is too many Commissions, and that there is too much overlap between some of them. However, there is alternative view that overlap between Commissions should be encouraged in order to promote collaboration, and that qualified groups interested in establishing a Commission should be encouraged to join IAVCEI rather than be discouraged with expressions of concern about overlaps and the number of existing Commissions. IAVCEI also established a Task Force on Volcanic Public Awareness and Education during the course of the year.

1999 is the final year of the IAVCEI Decade Volcano Project which represents the Association's contribution to the International Decade for Natural Disaster Reduction (IDNDR). Sixteen volcanoes have been identified world-wide for international study during the 1990s, and specialised workshops have been held at many of the volcanoes with a view to encouraging greater understanding of how these volcanoes work and how vulnerable communities on or near them can cope with the threat of volcanic hazards. A workshop on Ulawun volcano in Papua New Guinea was completed in November 1998, which may represent the last of the workshops for the Decade. IAVCEI regards its Decade Volcano Project as having been successful, to the extent that it had focused research attention on a selected group of volcanoes. However, some disappointment has been expressed about the small amounts of international funding that has been made available for support for the recommendations and proposals generated during the course of the Decade for volcanological work.

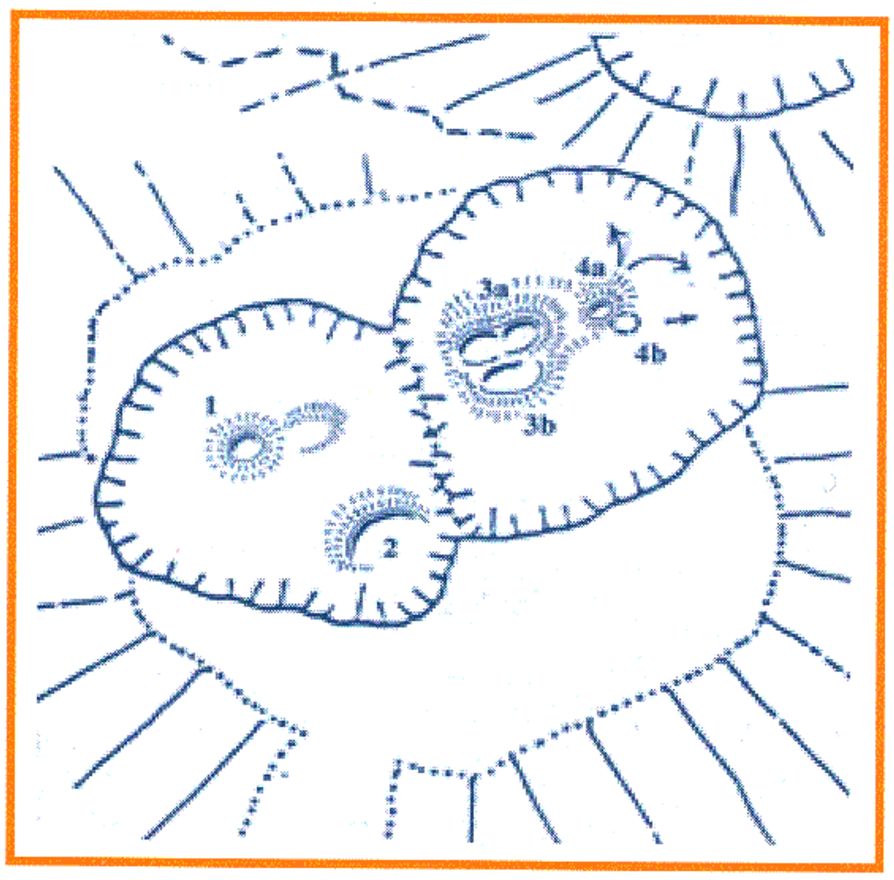
A new IAVCEI Executive Committee will take over the running of the Association during 1999. IAVCEI and IUGG will face new challenges as we enter the new millennium but we are confident that IAVCEI will continue to strive to ensure the validity of volcanology and chemistry of the Earth's interior in the modern geoscientific world.

PRESENT ACTIVITY OF ETNA

>>Continued from page 10:

Visual observations, 10 - 14 July 1998

On 10 July both the Voragine and Bocca Nuova craters (see figure below) showed moderately strong strombolian activity in addition to that of the SE Crater. Compared with the preceding year, the floor of the Bocca Nuova was elevated by the tephra material hurled from the two internal cones, so that the strongest explosions from its NW vent (1) sometimes showered the external slope of the main central cone with bombs. Within the Voragine a large cone (3a and b) developed against the so-called 'diaphragm' which divides this vent and the Bocca Nuova. Near the middle of



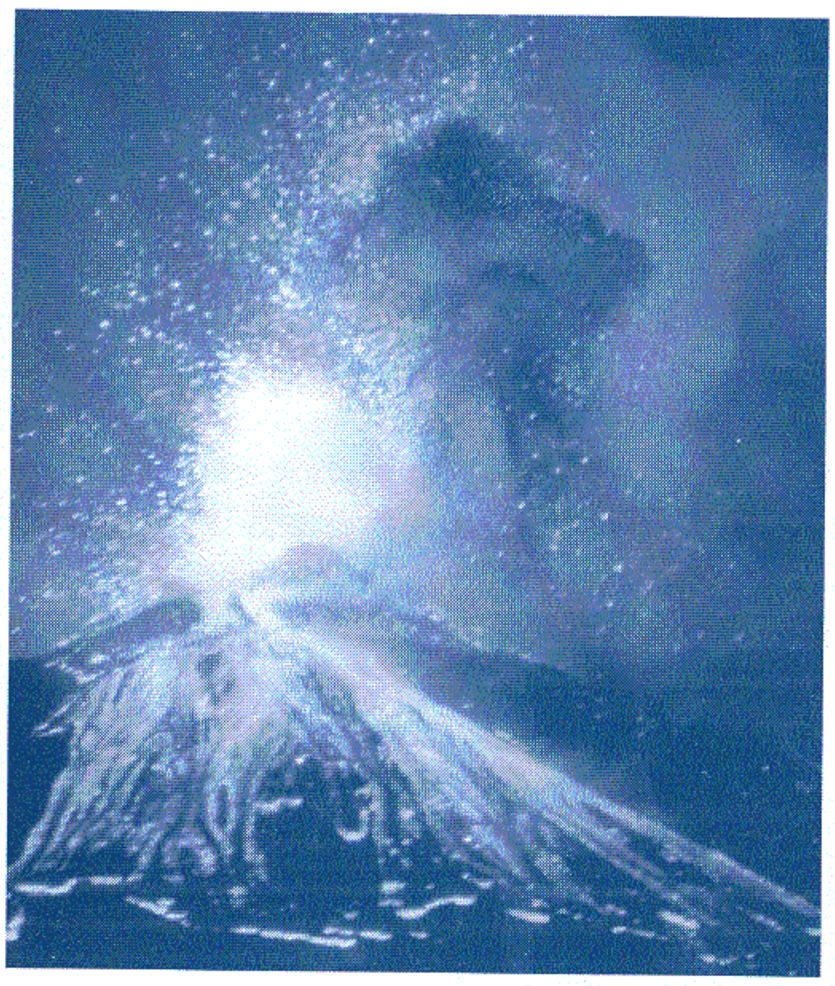
the Voragine, i.e. NE of the diaphragm, a second and more continuously active vent had also built a cone (4).

By 12 July the two vents of the Voragine hurled almost continuously large lava lumps and bombs in a fountain like manner, some of which falling outside the crater rim. On 13th morning this activity was even larger, making very hazardous to approach the Voragine. A fresh lava lump was found in the middle of the track about 250 m west of the crater rim. On the same day in late afternoon, however, this activity was reduced again, but at 19h two lava flows began from a fissure NE of the inner cone 4 which had evolved from two vents (4a on the western and 4b on the eastern side). After a short period of newly reduced activity, explosions from vents 4a and 4b increased again and became nearly continuous, often with strong detonations and large size lava lumps, soon joined by jets of smaller material from vent 3a. The lava effusion started again and took large proportions at about 20h15, rapidly invading the northern, lowest part of the Voragine. During the peak effusive activity the two lava flows erupting from the fissure vent on the NE slope of cone 4a reached a speed estimated to 3-4 ms^{-1}. A third, though very much smaller lava tongue slowly issued from a 'bocca' on the NE slope of cone 4b. By 20h45 the lava effusion had virtually ceased, whereas the two largest flows had merged at the bottom of the Voragine and were superficially congealing. The explosive activity, however, remained at high level, some of the bombs and scoria falling on the south flank of the NE cone up to its summit. On 14 July morning, only vent 3a showed normal strombolian explosions. Vents 4a and 4b were spent and their lava flows had entirely disappeared under a thick

layer of tephra erupted during the night. Owing to the irregular level of activity and the lack of continuous visual observations, it is likely that such brief eruptive episodes are frequent, though unrecorded.

Paroxysmal activity of the Voragine, 22 July and 5-18 August

A period of still larger lava fountaining began at the Voragine crater on 22 July at about 18h15, sending ash on a large SE sector of the mountain from Giarre to Catania, whose airport had to be closed. According to eye-witnesses, the level of activity during the day was high, but not exceptional, probably resembling that described above. The



paroxysmal lava fountain occurred suddenly, burying the N crater rim under several meters of enormous lava lumps and scoria. The column of ash and expanding gases reached a height of more than 10km while a thick, scoriaceous lava flow breached the N rim of the Voragine and the foot of the NE cone, slowly travelling for 400-500 m to the road which connects the south and north flanks of the mountain. Another lava flow overran the 'diaphragm' and descended into the Bocca Nuova. The thickness of the tephra deposits reached 50 cm near the Torre del Filosofo and a few cm to a few mm on the SE flank (1 mm at Catania airport).

This latter eruption, which was accompanied by increased activity at the Bocca Nuova and SE craters, considerably altered the morphology of the central crater region. More or less continuous activity soon resumed within the Voragine. Other episodes of strong explosive activity, sometimes with small intracraterical lava flows, occurred on 5-6 August and 18-20 August and at various times during September. In October, however, the activity of both Voragine and Bocca Nuova decreased.

'Periodic' eruptions from the SE Crater, September-December 1998 and January 1999

On 15 September the SE Crater, which had virtually ceased activity in late July, began a series of large ash explosions observed at close range, followed on 16-19 September by strombolian explosions and a small lava flow on the NE slope of the cone. This was the first of a series of moderately strong eruptions which displayed sometimes an almost weekly periodicity and a remarkable similarity, with a regular increase in the strength of strombolian explosions through a rather narrow (10-15 m diameter) vent. They eventually culminated over a few hours as a fountain-like paroxysm with abundant lava overflows reaching the base of the SE cone. Such eruptions were separated by larger intervals of absolute calm with practically no degassing, though usual degassing continued at the two central (and even NE) craters. The SE Crater eruptions occurred on 25 and 30 September, 5-6, 11-12, 17-18, 24 October and 31 October-1 November. Then, the inter-eruptive intervals increased in length, with eruptions on 6-7, 17-18, 29 November, and 13-14 and 28-29 December. In January 1999, however, strong eruptions occurred on the 5th, 10th, 13t, 18th, 20th and 23rd. The 'weekly' (or 5-6 days?) periodicity emphasised by some authors is not warranted, therefore, if the whole of the eruptive period is taken into consideration. Although most of these eruptions had a strikingly similar behaviour with explosive and effusive activity slowly increasing and stopping abruptly, there were also significant differences. For instance during the 18 October eruption the lava overflows began only after 14 hours of increasing strombolian explosions, while the 24

October event was characterised by beginning with effusive activity and small explosions. The December eruptions had strong detonations and few lava flows and apparently continued into January 1999 (heavy clouds and snow often hampered visual observations during this period).

A preliminary conclusion is that eruptive mechanisms at Etna remained similar in 1998. On 4 February 1999, however, a new paroxysm of the SE Crater was soon followed by the opening of a fissure which nearly reached the SE base of the cone. Here a massive surge of lava was accompanied by brief and violent fire fountaining (16h35 to about 17h), which fed a plume of scoriae and juvenile ash several km in height. Then a quiet outflow of lava continued from the base of the SE cone and is still going on at the time of writing (25 February). This new, long-lived effusive phase seems to have altered the SE Crater behaviour, leading to continuous degassing from its summit and the upper part of the 4 February fissure, without paroxysmal summit explosions.

Jean-Claude Tanguy and **Giuseppe Patanè**
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PENROSE 2000 CONFERENCE ON VOLCANIC RIFTED MARGINS

GEOLOGICAL SOCIETY OF AMERICA
March 27-30, 2000

VENUE CHANGE

- from Yemen to Royal Holloway University of London, Egham, Surrey, UK

FIELD EXCURSIONS

- Deccan Large Igneous Province, India, March 19-26, 2000;
- North Atlantic Large Igneous Province, Scotland, March 31-April 5, 2000.

Conference purpose and objectives

Many rifted volcanic margins (<200 Ma) are in close proximity to mantle plumes but the causal relationship between plumes and rifting remains highly controversial. Do plumes drive continental break-up or are they channelled into areas of thinned lithosphere? Are plumes required to generate flood volcanism? The relative timing of surface uplift, extension and magmatism has been predicted by theoretical plume models, but their validity hinges on actual field examples. The North Atlantic and Red Sea volcanic margins appear to have evolved in a similar way with minimal uplift and much of the flood magmatism pre-dating break-up extension. Why does this differ from theoretical models? This conference will bring together scientists working on theoretical, field and geophysical aspects of rifts. Field and laboratory-based scientists will be invited to the conference with areas of expertise as diverse as: landscape evolution and geomorphology; the chronology and geochemistry of continental volcanism; lithospheric extension; mantle and crustal geophysics; thermochronology; and theoretical modelling of rift settings.

Main topics

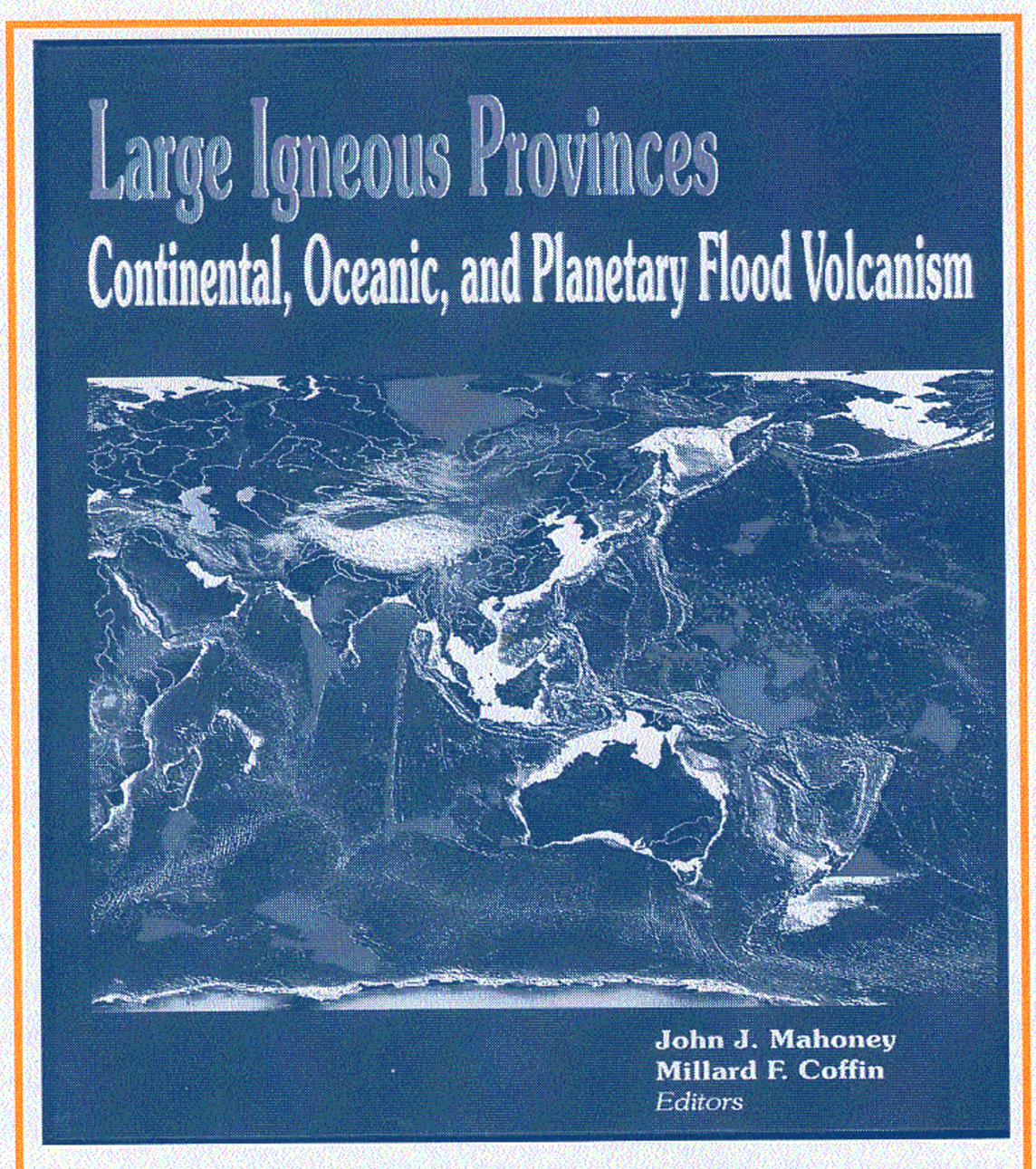
Keynote-led discussion sessions linked to poster presentations will be the main mode of communication. Keynote speakers will present background information and leaders of discussion sessions will be selected from among the participants. Suggested topics for presentation and discussion include: the extent and amount of uplift and subsidence, both in theory and observation; temporal and spatial relationships between extension, magmatism, uplift and exhumation; modification of crust and upper mantle structure during the evolution of volcanic margins; use of volcanic products to understand rift geodynamics; the style of, and mechanisms for, lithospheric thinning; syn- and post-rift exhumation, sediment budgets and basin formation; the thermal history of volcanic rifted margins using dating and modelling techniques. Other topics will be considered for presentation provided they are relevant to the evolution of volcanic rifted margins.

Invited keynote speakers

P Fitzgerald (University of Arizona, USA),
W S Holbrook (University of Wyoming, USA),
C J Hawkesworth (Open University, UK),
H C Larsen (Danish Lithosphere Centre, Denmark),
D Sawyer (Rice University, Texas),
M Summerfield (University of Edinburgh, Scotland),
N White (University of Cambridge, UK)

Field excursions

Two field excursions will illustrate aspects of the evolution of large igneous provinces (LIP) and volcanic rifted margins: a 7 to 8 day pre-meeting excursion (March 19-26) to the Deccan LIP; and a 4 to 5 day post-meeting excursion to the North Atlantic LIP, Scotland (March 31-April 5). For those participating in the Deccan field excursion the Penrose Conference will begin in Bombay and the field group will return to London for the discussion sessions. For those participating in the North Atlantic LIP excursion, the group will go to Scotland from Royal Holloway immediately after the discussion sessions. Preliminary costs for



The authors, Mike Coffin and John Mahoney (both in the USA), of this volume on large igneous provinces (AGU Geophysical Monograph 100) are the former leaders of the IAVCEI Commission on Large-Volume Basaltic Provinces. The new leaders of the Commission (which may undergo a name change to Large Igneous Provinces) are Martin Menzies (United Kingdom) and John Hopper (Denmark). Volcanic rifted margins represent an important subset of the wider topic of large igneous provinces and are the subject of the meeting to be held next year in London.

India: $600 (excludes air fare) and for Scotland $600 (includes London-Inverness air-fare).

Registration & eligibility
The conference is open to anyone undertaking research in the topics outlined. However we are limited to 80 participants and selection will be made on the basis of the information you supply. To allow for maximum interaction all participants will be accommodated on the campus at Royal Holloway for the duration of the Penrose Conference. Daytime and evening venues are planned to extend discussion and to encourage interaction. Costs are currently estimated at around $400 for the conference (including accommodation and meals). Application is strongly encouraged from young researchers (doctoral and post-doctoral) working on volcanic rifted margins and LIPs. Limited funding will be available to help cover the conference and field excursion expenses for young researchers from developing countries. Early application is recommended if you are seeking funding.

Contact Julie Brown (brown@gl.rhbnc.ac.uk) by 31st August 1999 and identify the e-mail as '*Penrose Conference*'. Invitations will be based on your e-mailed application and participants will be notified around 14th September 1999.

Please include in your e-mail: a brief statement of your field of interest; relevance of your research work to the conference theme; title of your poster presentation; title of a topic for discussion (max. 10 minutes; max. 5 overhead projections or slides); interest in the field excursions.

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Sponsors
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MAGMATIC PROCESSES AT RUAPEHU VOLCANO

>>Continued from page 4:

increase in $^{87}Sr/^{86}Sr$ ratio up sequence as SiO_2 abundance falls. The variations can be extreme within relatively short time intervals. For example, samples of magmas from the past fifty years of eruptive activity show variations in isotopic and major and trace element composition that cover most of the range shown by samples of lavas erupted over the entire history of the volcano.

The long-term patterns of variation observed in Ruapehu lava sequences appear to reflect the influence of crystal fractionation and crustal assimilation (ACF) operating together with storage, mixing, and mingling. In the initial stages of cone building, the eruptives show relatively limited crustal influence; although the rocks are fractionated, there is limited variability in major and trace element chemistry and $^{87}Sr/^{86}Sr$ isotopic ratios are low and reasonably consistent. Magmas appear to have migrated more or less directly from mantle sources to the surface. Progressively, magmas became trapped in crustal reservoirs where ACF processes modified original magmas to more evolved and contaminated compositions. Consequently, younger eruptives tend to be more variable, more evolved and have higher $^{87}Sr/^{86}Sr$ isotopic ratios.

The shorter term variations observed in detailed sample sets from lava sequences within particular formations arise from magma mixing and mingling occurring during recharge events within crustal reservoirs higher in the crust. Most probably, magmas migrate in several stages through a complex system of dykes and small magma chambers distributed through the crustal section beneath the volcano. There is limitless scope for mixing and mingling of a wide range of compositions as deeper level magmas migrate towards the surface through the crustal plumbing system. The higher the level, the more variable, more evolved, and more isotopically contaminated the magmas. Eruptive cycles are therefore likely to begin with eruption of evolved magma that is being forced out of the plumbing system by deeper level, less evolved magmas.

Plans for the second 'State of the Arc' workshop include two field excursions on Ruapehu, one of these being to the active crater lake. Workshop participants will have the opportunity to consider the data arising from the Ruapehu project in a field context.

Richard Price and **John Gamble**

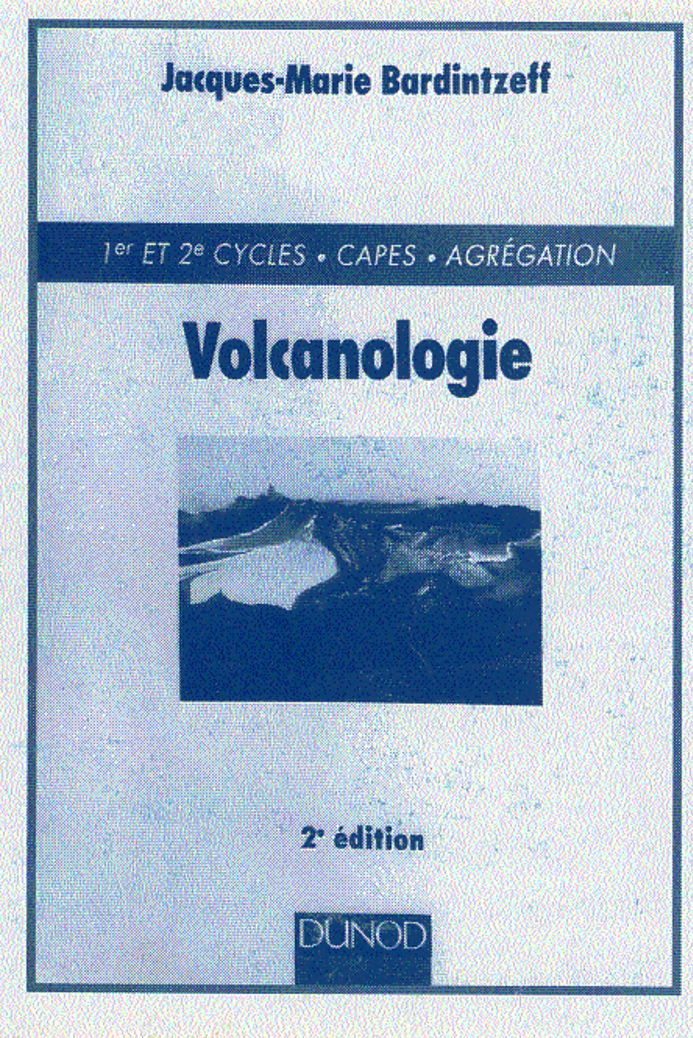
'CITIES ON VOLCANOES' - A FOLLOW-UP MEETING

A write-up of the highly successful Cities on Volcanoes meeting held last year in Napoli and Roma, Italy, appeared in IAVCEI News 98/2. This article demonstrated the current trend of volcanologists becoming more and more involved with applying their science to the issues of vulnerability and risk analysis in communities susceptible to the effects of volcanic eruptions. Now we can announce that IAVCEI will be sponsoring a follow-up meeting to the one in Italy - to be held this time in Auckland, New Zealand, in February 2001 (this is still a tentative date at this stage). Auckland City is built among scores of Quaternary basaltic cones (a 'polygenetic' volcanic field) and the volcanic threat is of a type quite different to that of say, Vesuvius, at Napoli. Yet public safety and being able to manage the volcanic risk are the common themes in both places and in many other parts of the world.

Mt Eden in Auckland City, New Zealand.with views towards the North Shore and Harbour Bridge. Part of a photo by Lloyd Homer from the NZ Institute of Geological & Nuclear Sciences Ltd Poster Series 26.

An Organising Committee for the Auckland meeting has been established. It consists of representatives from the New Zealand Institute of Geological Sciences (IGNS), Auckland Regional Council, Massey University, and the University of Auckland. Further information is being prepared for distribution during the IUGG General Assembly in Birmingham in July. Contact David Johnston at IGNS (facsimile: +64 7 3748211) for further details.

NEW BOOK



VOLCANOLOGIE by Jaques-Marie Bardintzeff
2nd edition, DUNOD, 1998

This second edition, in French, is augmented and improved: 284 pages, numerous black and white photos, figures and tables, 8 pages of colour photos, 600 references, most of them later than 1990. The most recent eruptions are taken into account: Etna (1991-93); Mt Unzen (1991-95); Galeras (1991-92); Rabaul (1994-98); Soufriere of Montserrat (1995-98); Vatnajokull (1996).

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