

IAVCEI News 2004 No: 1

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

Message from the President



Oded Navon
President

Coming from the field of experimental and theoretical volcanology, I lack extensive experience in monitoring volcanoes, mitigating volcanic hazards, or managing volcanic crises. Looking from the outside, I have always been full of admiration. Volcanologists should be proud of the major advancements of hazard mitigation over the past 20 years. Many lives have been saved thanks to the acts of experienced volcanologists in a number of volcanic crises.

Examining the subject somewhat closer, mostly by talking to specialists, I can tell that there is still room for improvement. A lot

of work is already underway, and part of this effort is carried out by various bodies within IAVCEI. Compared to other scientific associations, the practical side of our science has always been at the center of IAVCEI activity. The association is committed not only to the advancement of volcanology, but also to its application for the immediate benefit of those that are threatened by volcanoes.

My letter today is a call, asking: What are the main needs and the main areas where improvement is essential? What should be the role of IAVCEI? What are the right ways for IAVCEI to act in order to further improve the situation? Can IAVCEI (or its commissions) contribute in new ways to improve the management of future crises? In answering these questions we have to remember that IAVCEI is very limited in its financial resources. Our main resource is the goodwill and the spirit of our member volcanologists and the willingness of many to volunteer their time and work for a good cause.

Most of IAVCEI commissions are involved in volcanic hazards, and a few deal directly with mitigation of hazards, e.g., WOVO - the World Organization of Volcano Observatories, the Commission on Mitigation of Volcanic Disasters, The Commission on Cities and Volcanoes, the Commission on Volcano Seismology and the newly formed commission, The International Volcanic Health Hazard Network. Other members participate in working groups, e.g., the group on Modeling Volcanic Tephra-Fall Hazard. Together, this rich activity covers a wide range of

research and professional work related to monitoring and forecasting of volcanic hazards and improves our ability to manage and mitigate future volcanic crises.

I see the above issues as central to IAVCEI. I plan to encourage actions in order to enhance the coordination between the various groups within IAVCEI and to strengthen the ties with the other national and international bodies, e.g. the Volcano Disaster Assistance Program (VDAP) run by the USGS, or the UN Office for the Coordination of Humanitarian Affairs (OCHA). This should be done with involvement of members from all countries threatened by volcanoes.

At the same time, we should not forget the broader scientific goals of IAVCEI. These were reviewed recently, along with the goals of the other associations of the IUGG (International Union of Geodesy and Geophysics), by a group of young scientists nominated by Uri Shamir, the current president of IUGG. The group was asked to review the present situation and point out future directions. The results were summarized in a report "Geosciences: the Future" (www.IUGG.org/geosciences.pdf). I take this opportunity to thank Emily Brodsky for writing the chapter about IAVCEI. I share Dr. Brodsky's optimistic assessment that some key questions in volcanology could plausibly be answered by focused efforts in the next 10-20 years. We are not far from major breakthroughs in understanding the physics that underly our main monitoring tools such as deformation, seismicity, and gas emission. The combination of improved measurements of multi-parameter time-series at active volcanoes, detailed field work of both active and older volcanoes, and sophisticated modeling should lead to significant results. This new understanding should improve not only the monitoring of volcanic hazards; it will also allow us to use all the data in order to draw an accurate picture of the processes in the hidden interior of volcanoes.

The report concentrates on volcanology of active volcanoes. IAVCEI goals must go beyond that and include many other fields. In the broadest sense, we must seek understanding of the magmatic phenomena on Earth as well as on other planetary bodies. We should encourage the exploration of Earth's last frontier - the interior. We should also bridge the gap between the community that studies active volcanoes and related communities that study older systems such as kimberlitic volcanism, or hydrothermal processes.

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IAVCEI Homepage: <http://www.iavcei.org>

2003 Report to IUGG



Steve McNutt
Secretary General

IAVCEI ended the year with over 700 paid individual members. Twenty-six members have chosen to become Life Members, plus three members were awarded Life Membership as Honorary Members in 2003. The IAVCEI web page is frequently revised and updated. The web site url is www.iavcei.org. The volcano listserver administered by Arizona State University remains the official IAVCEI listserver. It has >2500 people listed, which far exceeds the IAVCEI membership. Thus we hope to further boost the membership in IAVCEI. Two issues of the newsletter "IAVCEI News" were mailed to members in 2003.

A highlight of the last year was the very successful conference "Cities on Volcanoes 3" in Hilo, Hawaii. Approximately 350 people attended the meeting from July 12-16, 2003. The five-day meeting brought together scientists and multidisciplinary experts from around the globe to discuss many aspects of volcanology with an emphasis on hazards assessment and mitigation. The meeting was organized by representatives of the Commission on Cities on Volcanoes, the University of Hawaii, and others. The meeting consisted of 305 abstracts presented in four theme sessions on Emergency Management, Hazards, Science, and Health. IAVCEI travel grants helped pay expenses for several young scientists or scientists from developing countries.

Another highlight was the IUGG meeting held in Sapporo in June-July. This was the best attended IUGG General Assembly ever, with 4151 total attendees and 378 from IAVCEI. The amount of money raised for travel assistance from all sources (50 M Japanese yen from the LOC, \$70,000 from the IUGG budget, and additional funds provided by the Associations) exceeded \$630,000, which is the most ever raised for a General Assembly. 67 IAVCEI individuals claimed travel assistance grants. 13 IAVCEI Symposia were convened, and 12 Union Symposia and 59 inter-Associations Symposia. The four Union Lectures, each followed by a Union Symposium, were well-attended and have set a high standard for excellence for future General Assemblies. A monograph based on all of the Symposia under the Union theme "State of the Planet: Frontiers and Challenges," is in preparation (Dr. R.S.J. Sparks (IAVCEI), coordinator).

In addition to the usual scientific symposia, the Local Organizing Committee arranged an Outreach Program consisting of 34 special events such as public lectures, panel discussions, and presentations to and by school children. These took place not only at the Assembly venue, but also in Sapporo City and towns spread throughout Hokkaido. Masaru Kono, outgoing President of IUGG, commended the program by saying " In the times when there are so many difficult problems of worldwide scale which are crucial to human society (global warming, natural hazards, water crises, just to name a few), it is very important that the academic society can talk to the public directly. The Outreach program in Sapporo showed one way of opening up such communication."

An extraordinary memory of the General Assembly was that the Emperor and Empress of Japan accepted the invitation of the LOC to participate in the Welcome Ceremony. Everyone appreciated their warm presence and sincere interest in the work of IUGG.

Three outstanding volcanologists were awarded with new IAVCEI Honorary Memberships at Sapporo: Prof Hans-U. Schmincke (Germany), Prof Shigeo Aramaki (Japan), and Dr Robert Tilling (USA).

The next IAVCEI General Assembly has been scheduled for November 14-19, 2004 in Chile. In 2003 the first and second circulars were printed and distributed to all members. Over the next few years, IAVCEI will also focus its efforts on several smaller meetings, including the IAVCEI sponsored "Cities on Volcanoes IV" conference to be held in Quito, Ecuador in January 2006.

The IAVCEI Executive Committee met in Sapporo and conducted a half day meeting covering many aspects of IAVCEI business.

Officers of IAVCEI for 1999-2003 were:

President	Steve Sparks (UK)
Vice-President	Joerg Keller (Germany)
Vice-President	Tadahide Ui (Japan)
Secretary-General	Steve McNutt (USA)
Members of Executive Committee	Toshitsugu Fujii (Japan)
	Bruce Houghton (NZ)
	Jocelyn McPhie (Australia)
	Hugo Moreno (Chile)
	Raden Sukhar (Indonesia)
Past President	Grant Heiken (USA)
Editor Bull Volc	Tim Druitt (France)

IAVCEI thanks these people for their work during the 4 year term just ended. Certificates of appreciation were awarded in July at the Sapporo IUGG meeting.

A Nominations Committee was formed, chaired by Wally Johnson (Australia) and certified candidates for election to the new IAVCEI Executive Committee. Because the number of nominated candidates exactly equaled the number of slots, no postal vote was necessary. IAVCEI thanks the members of the nominations committee for their work.

Officers of IAVCEI for 2003-2007 are:

President	Oded Navon (Israel)
Vice-President	Jocelyn McPhie (Australia)
Vice-President	Toshitsugu Fujii (Japan)
Secretary-General	Steve McNutt (USA)
Members of Executive Committee	Anita Grunder (USA)
	Renato Solidum (Philippines)
	Hugo Moreno (Chile)
	Jean-Christophe Komorowski (France)
Past President	Steve Sparks (UK)
Editor Bull Volc	John Stix (Canada)

The Commission of Mitigation of Volcanic Disasters has begun a new Atlas series, the first volume of which will cover the Caribbean region and is being prepared under the leadership of Jan Lindsay. The IAVCEI Executive Committee authorized \$4000 to support the first volume of the series in 2002. Draft versions of portions of the first report were prepared in 2003.

The Commission on Subduction Zone Magmatism held a highly successful workshop on the State-of-the-Art (SOTA) in the Cascades in September, 2003. IAVCEI was also a co-sponsor of a Penrose Conference on PLUME IV: Beyond the Plume Hypothesis, held in Iceland in August, 2003. The Commission on Explosive Volcanism is continuing to work on compilation of a comprehensive database of all eruptions with volume >10 km³ for the last 2 million years.

IAVCEI was co-applicant for a 2002 ICSU grant to support training in volcanology for Latin American scientists. The grant provides \$12,000 per year for three years. The first year's funds were spent to support attendance at a workshop on volcanic gases held in Nicaragua in March 2003.

IAVCEI sold several educational products in 2003. Two videos on 1) understanding volcanic hazards and 2) reducing volcanic risk were produced professionally under contract with IAVCEI. Over 70 videos were sold in 2003. Also, a volcano calendar was produced by IAVCEI members and was printed and marketed by a professional calendar company. Over 5,000 calendars were sold and an additional 800 were distributed by IAVCEI to various scientific, educational, and governmental organizations. IAVCEI received a small royalty payment for the calendars.

IAVCEI recognizes that its activities could be significantly expanded by improved fundraising. Towards this end, President Steve Sparks wrote a series of articles on fundraising for IAVCEI News in 2002, and the issues were discussed in detail at the July 2003 meeting of the Executive Committee. Secretary-General Steve McNutt worked with a lawyer and submitted forms for incorporation as a non-profit corporation in fall 2003; the non-profit status was granted in December. After meeting with a consultant, McNutt also submitted a full application for tax exempt status under section 501(c)3 with the Internal Revenue Service of the US. The application is being reviewed by IRS and IAVCEI's tax exempt status is pending. This status is important so that contributions may be received with a tax benefit to contributors.

2003 was an unusually active and productive year for IAVCEI. The 1999-2003 Executive Committee completed a strong record of achievement and left the organization in good shape for the 2003-2007 team.

IAVCEI Fundraising: Gifts of Rare Volcano Books

Many IAVCEI members are book collectors, focusing on "classic" material such as the Royal Society Report on the Eruption of Krakatoa (worth \$1000.00 for a copy in decent shape). If we all went through our libraries and checked prices with rare book dealers who have web sites, we would be locking up some of our reference material. It is amazing how valuable some (though not all!) of those old books in your office might be.

Some of the older IAVCEI members will be giving their volcanology books to a university library as a gift or as a bequest in their wills. Another option is to consider bequeathing your library to the IAVCEI fund for travel grants and scholarships. If you consider this, have your collection appraised for value, and be specific in your will as to who will pick up the books and where they will be shipped. Your lawyer can help you with the wording of your bequest.

Another option is to give your collection to IAVCEI for auction before your death or deal directly with a reputable auction house. In the US (I'm not sure about other countries), there are tax advantages related to gifts to non-profit organizations such as IAVCEI.

You should be specific as to the purpose of your gift. For example, "to be used as travel grants for students or volcanologists from developing countries to attend IAVCEI meetings."

I did it. It is not as complicated as you may think. Please write or email me and I will tell you how to do it, or, I will send you the paragraph that I put in my will.

There is a huge demand for rare books in any field. There are buyers out there and IAVCEI can use this demand as a source of much-needed funds.

Grant Heiken
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IAVCEI is pleased to announce new life members

Dr Hideyuki Itoh
Prof Stephen Self
Dr S Adam Soule
Prof Stephen McNutt
Dr Hiroshi Shinohara
Dr Jean-Claude Tanguy

Please consider becoming a life member — it is good for you and for IAVCEI.

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The world is becoming increasingly litigious, and legal cases involving scientists as expert witnesses, or even as targets of civil or criminal proceedings, are becoming more commonplace and more contentious. This has been highlighted in Britain recently, where the evidence of a prominent medical specialist, who had participated as an expert witness in a large number of cases involving sudden infant death within a family, was found to be scientifically flawed. In many of the cases concerned, charges of murder were successfully brought against a number of mothers who had lost more than one baby in this way. Eventually, the statistical basis of the expert's evidence about multiple infant deaths was recognised as unsound, and some of the convictions quashed. A major review of other, similar cases is now underway, and we wait to see what action, if any, is taken about the expert.

With a 'blame culture' growing in many societies, volcanologists are unlikely to escape from involvement in legal issues, since their scientific advice can have profound implications for governmental decisions that affect people's lives. Such decisions may involve matters of life and death, severe disruption to people's lives in a volcanic crisis, or major costs associated with compulsory evacuations. Here we illustrate some of the important issues from experiences in Montserrat, where the law has been brought into a number of matters relating to the eruption of the Soufrière Hills Volcano. It seems likely that volcanologists will need to become much more aware of the possible legal ramifications of their work, and there are also some difficult professional and ethical issues that arise for IAVCEI.

The most obvious situation that can lead to legal proceedings concerns evacuation, which is inevitably based on the scientific advice of volcanologists. If any deaths occur in an area that was not evacuated in time, or was not identified as being dangerous, then the volcanologists' advice could be called into question in civil or conceivably criminal proceedings. If an area is evacuated but nothing then happens, there may be claims that the evacuation was unnecessary, and again the validity of any scientific advice could be called into question. These issues are all illustrated in some recent legal proceedings on Montserrat.

On 25th June 1997, nineteen Montserratians tragically were lost, presumed dead, and several others were badly injured when pyroclastic flows or surges from a major dome collapse inundated the northern flanks of the volcano. Several villages were buried and many homes destroyed or heavily damaged. One of us (WPA) was Chief Scientist at the time and inevitably became involved in an inquest in the Coroner's Court, together with other colleagues from the scientific team. The people who died or were injured were amongst perhaps sixty or more who were all inside an official Exclusion Zone, against clear advice from the local government and in breach of entry restrictions that had been imposed

earlier. The boundaries of the zone itself were based on scientific advice, and information on the hazards was provided to the public through printed reports, repeated radio interviews with scientists, newspapers, and other means. An in-depth analysis of interviews of survivors by Loughlin et al. (2002) indicates that the majority of those in the area were aware of the dangers and were prepared to take the risks. Nevertheless in the time leading up to the inquest, questions of whether the scientific advice was appropriate and whether the Montserrat Volcano Observatory (MVO) had done enough to alert the public to the changing conditions at the volcano were exhaustively scrutinized. For instance, the journal *Nature* aired some selective criticisms of the volcanologists in a "News" article (*Nature*, 23rd April 1998, p743), which were later refuted in two letters published on the anniversary of the tragedy (*Nature*, 25th June 1998, p728). Some of the issues involved were also addressed in the volcanological literature (Voight, 1998).

When the inquest was completed, the jury found that the fatalities were caused by "the natural catastrophe of volcanic eruption/pyroclastic surge". Other contributory factors, mainly related to difficult living conditions on the island during the crisis - such as the poor quality of emergency accommodation or constraints on earning a livelihood by farming - were also identified in certain cases as having influenced some people to re-occupy the Exclusion Zone. While there was an added rider, questioning whether more could have been done in the "process of public information", the scientific advice itself was not challenged. Nevertheless, the episode succeeded in concentrating the minds of volcanologists on the seriousness of their professional work.

Subsequently, three further sets of legal proceedings have been initiated recently on Montserrat in which the role of scientific advice has the potential to take centre stage in the evidence. The first of these concerns a Judicial Review in the Eastern Caribbean Supreme Court into the legality of an evacuation order made under Emergency Powers, that was put into place by the Governor of the island, with the agreement of the Government of Montserrat, which took effect on 9th October 2002. The evacuation zone was extended to include residential areas along the margins of the lower part of the Belham Valley, situated about 6 km north-west of the active dome, and directly affected several hundred people. At the time, the Montserrat Volcano Observatory had advised that the volcano was dangerous with a large and partly unconfined lava dome growing above valleys that led to the populated area. The state of the volcano became particularly hazardous when the dome started to extrude growth lobes towards the north and northwest, and some rockfalls and small pyroclastic flows had started to flow down the gullies that fed directly into the Belham Valley itself. The area in question was kept evacuated until a few weeks after 12th July 2003, when the threat was removed by a major collapse that was directed eastward, rather than westward toward the populated region. While this possibility had been considered by the MVO to be the most likely outcome, a westward collapse could not be excluded.

The owners of several properties in the extended area were resolved to challenge the Governor's decision to evacuate them and, by implication at least, to call into question the scientific advice on which his by the MVO, formed a basis for guiding policy decisions on the provment

decision was based. They successfully sought leave to request a Judicial Review, which eventually took place in November 2003; ironically this Review had had to be postponed from 14th July when the Judge was prevented from reaching Montserrat because of the heavy ash fall on a neighbouring island that resulted from the massive dome collapse two days earlier. Staff at MVO were required to provide affidavits pertaining to the scientific evidence and advice that had been given, leading up to the evacuation. Importantly the complaint in this case was made against the Governor and Attorney General of Montserrat, and involved mainly non-scientific issues relating to the Governor's legal authority to order an evacuation, and the manner in which this had been implemented in practice. There were allegations that the evacuation had been inhumane and degrading, and an infringement of people's human rights. It was also alleged that the evacuation was unnecessary and too risk averse; legal arguments were presented to the effect that the purpose of the evacuation was the *personal safety* of the evacuees, not *public safety*, and that these individuals themselves therefore had a right to decide what risks to accept. The Governor's principal defence was, of course, that ultimately he had the legal authority to make the decision that had been taken and had acted reasonably in doing so. But, behind this, the scientific advice he had received would have been at the core of his defence, in that he had no choice but to take heed of any views provided by the professional organization (the MVO) responsible for assessing volcanic hazards and risks. At the time of writing, the decision of the Judicial Review is still awaited (in January 2004).

authorities against the constitutional right of an individual to occupy his home. Given the important implications for both sides in this case, with the prospect of the government having to face substantial claims for compensation if the decision is upheld, it is unlikely that the matter will be left to rest as it stands at the moment.

In a third case, proceedings have been started against the British Government, again in the persons of the Governor and Attorney General of Montserrat, in which they are being sued for damages by an individual who was injured in the Exclusion Zone on the same day the fatalities occurred (25th June 1997). The essence of this claim is that the steps taken to warn him of the dangers (from the volcano) were not adequate, and that he suffered pain, injury, loss and damage, as a consequence. This case, too, is on-going. Thus, the civil authorities are confronted simultaneously with claims of being over-cautious in one case, and not cautious enough in another.

Thus far, none of these legal proceedings has resulted in any formal criticism, censure or adverse consequences for the volcanologists working on Montserrat. However, they do give us all food for thought about our legal status as scientists, and about our exposure to personal or professional liability in such circumstances.

As part of the efforts to support the population to remain on island and live with an erupting volcano, a Risk Assessment Panel (RAP) of scientific advisers was set up formally in December 1997. The remit of this panel was to make regular hazard and risk assessments of the volcano for the Government of Montserrat and the British Government. The team issued reports every six months or so and the advice contained in these reports, together with the day-to-day advice provided by the MVO, formed a basis for guiding policy decisions on the management of the crisis. Initially, issues of personal liability or professional indemnity and the possibility of becoming involved in litigation never really occurred to most of us. As far as we were concerned, serving on the panel was one part of a civic responsibility to apply our knowledge of volcanology to a pressing societal need. However, it became increasingly clear that our legal positions were uncertain and that under the terms of our involvement we might be vulnerable to claims by third parties, for example. Moreover, attempts to gain liability protection from the UK government agencies funding the work of the panel were rejected, it being suggested that individual experts who wished such protection should obtain their own insurance which, needless to say given the circumstances, would have been prohibitively expensive or impossible to find.

This situation was partly ameliorated when the Office of Science and Technology in the UK issued formal guidelines for the provision of scientific advice to Government and the operation of Scientific Advisory Committees. These guidelines include a clause that appears to indemnify individual members of such a Committee against having to meet out of their own personal resources any personal civil liability which is incurred in execution or purported execution of their Committee functions, provided they have "...acted honestly, reasonably, in good faith and without negligence...".

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The SeismiCity News - a newsletter printed and circulated in Montserrat during the eruption to provide public information on the volcanic activity. Some articles from this informal publication were later produced as important evidence in a major insurance case (see text).

In another matter relating to this Evacuation Order, there has been the case of a resident who, in 2002, was arrested, charged and found guilty of being in the Exclusion Zone without authorization, but whose conviction was later overturned on appeal. In effect, the Appeal Court judges ruled that the relevant Regulation was too vaguely worded and not sufficiently specific regarding evacuation of an "unsafe area" for its powers to be lawful, and thus did not provide immunity to the au-

Meeting Report Eighth Volcanic Gas Workshop

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The Eighth Field Workshop on Volcanic Gases was held in Central America from 25 March to 2 April, 2003 and sponsored by the Commission on the Chemistry of Volcanic Gases (CCVG) and the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI). Workshops have been held every three years at different locations around the globe. With the collaboration of the Instituto Nicaragüense de Estudios Territoriales (INETER) and the Observatorio Vulcanológico y Sismológico de Costa Rica (OVSICORI-UNA), the workshop attendees converged at Masaya, Cerro Negro and Momotombo volcanoes in Nicaragua and at Póas volcano in Costa Rica (Figure 1). The workshop attracted over 80 researchers from 20 countries, making it the largest volcanic gas field workshop to date. The overall goals of the workshop not only included perfecting techniques and fostering international collaborations, but also comprised a newer focus of developing a more integrated approach to volcanic gas monitoring.

Traditionally, volcanic gas geochemistry has focused on samples collected from high-temperature fumaroles and is still an essential part of volcanic gas studies. At the same time, methods such as soil gas measurements and remote sensing technologies are equally important. The Central American volcanoes selected for the workshop provided ample opportunities to employ the different monitoring techniques and facilitated an integrated approach to volcanic gas monitoring. In addition to the field activities, the workshop also included a poster session accompanied by keynote presentations.



Figure 1. The Central American volcanic zone in Nicaragua and Costa Rica. Cerro Negro, Momotombo and Masaya volcanoes in Nicaragua and Póas volcano in Costa Rica were the field locations chosen for the 8th Volcanic Gas Workshop.

Some of the keynote speakers covering the topic of fumarole, spring and crater lake gas studies included presentations by Yuri Taran (UNAM) who examined magmatic and hydrothermal interactions, Hiroshi Shinohara (GSJ) who discussed recent work at Miyakejima volcano and Maria Martinez (OVSICORI-UNA) who gave an overview of the degassing history of Póas crater lake. Remote sensing studies included presentations of satellite-based work by Simon Carn (Univ. Maryland), studies using aircraft by Jorge Diaz (CENAT) and ground-based remote sensing by Andrew McGonigle (Cambridge Univ.). Ken McGee (USGS) covered the topic of diffuse degassing and Paul Wallace (Univ. Oregon) discussed melt inclusion studies.

Once the participants converged on Masaya volcano, in Nicaragua, it was evident that the most interesting development in volcanic gas monitoring was the use of the miniaturized UV spectrometer. At least five different research groups arrived with their own version of this instrument which employs the use of an Ocean Optics 2000 spectrometer and the DOAS technique for data reduction. These instruments are comparable to the COSPEC, which has been the most widely used ground-based remote sensor for several decades. The advantages of the new miniature systems are their small portable size and much lower cost. Having a number of these instruments not only allowed a chance to compare the different versions but also the opportunity to try experiments involving more than one instrument. Using two instruments simultaneously, for example, it is possible to ascertain plume dimensions and wind speed (Galle et al., 2003) or do traverses under the plume at different locations to estimate SO₂ loss rates. Most of the instruments were designed to measure SO₂ but Nicole Bobrowski and her instrument focused on BrO measurements in the gas plume (Bobrowski et al., 2003). In addition to its constant degassing, Masaya had some wonderful advantages for these types of plume studies, as the crater rim is easily accessible and several roads lie perpendicular to the dominant plume direction. Figure 2 shows the crater rim of Masaya that is accessible by vehicle.

Diffuse degassing of CO₂ is also an area of growing interest in volcanology. Some volcanoes can release significant amounts of CO₂ via diffusive flank emissions. This form of degassing can also give clues about subsurface characteristics and structure. Six different research groups conducted measurements at Masaya, Cerro Negro and Póas volcanoes. On the Comalito cinder cone at the northeast flank of Masaya, soil gas CO₂ measurements were conducted on a grid system by each of



Figure 2. The rim of Santiago crater at Masaya volcano, Nicaragua. An active vent at the bottom of the crater is the source of the persistent gas plume. Easy access to the crater rim makes Masaya volcano an excellent site for remote sensing of volcanic gases. (Photo



Figure 3. The crater of Póas volcano, Costa Rica. The pH of the crater lake was approximately 0.4 during the workshop. Fumarolic degassing can be seen on the left side of the crater lake. (Photo by W. Morrow)

the six research groups to compare variations in measurements and area flux calculations. The experiment was conducted in both the morning and afternoon to check for any temporal variations at the site. This area is known for its anomalously high CO₂ degassing which was marked by dead vegetation and elevated soil² temperatures. At Póas volcano, a grid was laid out to search for anomalous soil degassing on a terrace inside the crater (Figure 3).

Fumarole sampling also was conducted on Momotombo, Cerro Negro, and Póas. Momotombo offered the best conditions, with fumarole temperatures near 800½ C. The high temperatures indicate that the gases are more likely to have come directly from the magma, with less chance of significant interaction with hydrothermal systems. Such opportunities are rare. One researcher commented on the high temperature conditions as being “almost like paradise to me”. Researchers had the opportunity to compare sampling and analytical techniques, as well as compare the different fumaroles and volcanoes. These high-temperature gases also contain stable organic compounds. Researchers therefore sampled the fumaroles to explore the wide array of organic compounds present. In addition to fumarole sampling, other complementary techniques such as gas filtration and crater lake samples were also used.

The workshop concluded in San Jose, Costa Rica. During the final day, the attendees broke into their respective research groups that covered remote sensing, fumarole sampling and soil gases, to summarize and present some of the accomplishments and future goals. The idea of a web-based data repository was discussed to allow easy access to each other’s data and further the idea of using a more integrated approach to interpreting geochemical data. An additional workgroup met to discuss the current and future approaches to volcanic gas monitoring in Central America and northern South America as a way of strengthening cooperation within these regions. Previous workshops resulted in peer reviewed publications (Giggenbach and Matsumo, 1991; Giggenbach et al., 2001), and similar efforts will result from this workshop. The Workshop was supported by IAVCEI, the US National Science Foundation MARGINS Initiative, the Central American Volcanic Hazard Project (ICSU/IAVCEI), and the NASA Solid Earth and Natural Hazards Program. We are most grateful to these organizations for their financial support.

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**Invite a colleague
to join IAVCEI!**

IAVCEI Workshop Mexico

Report on IAVCEI Workshop: Neogene-Quaternary Continental Margin Volcanism in México: The Mexican Volcanic Belt

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A five-day IAVCEI-sponsored field workshop to volcanoes in the central part of the subduction-related Mexican Volcanic Belt took place during 18-22 January 2004. The field workshop was ably led by three volcanologists from the Universidad Nacional Autónoma de México (UNAM) who have long experience in this region: Gerardo J. Aguirre-Díaz, José Luis Macías, and Claus Siebe. The field workshop followed directly upon a very successful Penrose Conference titled Neogene-Quaternary Continental Margin Volcanism that was organized by the same team and held in the town of Metepec, on the southeast flank of Popocatepetl volcano during 12-16 January. About half of the 30 participants on the field workshop were from México, including a majority of students, and the other half were volcanologists from Canada, England, Germany, Italy, Japan, New Zealand, and the United States.

The unseasonably cold and rainy weather that dominated during the Penrose Conference brought the reward of some exceptional views of snow-clad Popocatepetl (5,465 m), Iztaccíhuatl (5,230 m), and Nevado de Toluca (4,680 m) against clear blue skies once the field workshop began. The first day was spent traveling WNW across the south flank of Popocatepetl and the recently dated Holocene lava flows of the Chichinautzin Volcanic Field south of Mexico City, where Siebe showed examples of major tephra-fall layers erupted from Popocatepetl, some 60 km to the east. Siebe also led the group to the Cuicuilco archaeological site, whose unusual circular pyramid was surrounded by basaltic pahoehoe lava flows erupted from Xitle volcano about 1670 years ago.

The large andesitic-to-dacitic stratovolcano Nevado de Toluca was the focus of the second day's excursion, led by Macías. The heavy snowfall of the previous week prevented a planned visit to the summit crater. Any disappointment was offset by the opportunity to see more of the curiously widespread block-and-ash flow deposits that mark the lower flanks of Nevado de Toluca to the N and E. Macías and colleagues have deduced that despite their similar appearance, these deposits actually represent at least 5 different events ranging in age from 37 ka to 14 ka, with those at 37 ka and 28 ka most widespread. These block-and-ash flow deposits are interpreted as products of partial to total destruction of dacitic domes in the summit region. In the field these deposits contrast sharply with the collapse-related debris-avalanche deposits at Toluca and many of México's other large stratovolcanoes: Popocatepetl, Iztaccíhuatl, Colima, and Citlaltépetl. The latter deposits are characterized by variable coloration (reflecting juxtaposition of different source lithologies and different stages of hydrothermal alteration),

blocks with jigsaw-puzzle textures, and hummocky surface topography. The Nevado de Toluca block-and-ash flow deposits, in contrast, contain fresh gray dacitic clasts with little vesiculation or alteration, and display neither jigsaw-puzzle textures, nor hummocky topography. Outcrop discussion on this topic was animated and revolved around these differences and their causes.

Siebe led the day-3 trip to Jocotitlán Volcano (3,950 m), which rises 1,300 m above the northern Toluca basin. The primary focus was the debris-avalanche deposit, characterized by numerous hummocks, that extends north and east of Jocotitlán. A prominent horseshoe-shaped escarpment, open to the northeast, is associated with this ~10 ka collapse event. It was accompanied by an explosive eruption that left an obsidian-rich, dacitic Plinian pumice-fall deposit. The youngest available radiocarbon age (680 a) indicates that Jocotitlán is still active. The most remarkable outcrops were left to the end of day 3: spectacularly deformed lake deposits that were plowed outward by the debris-avalanche, acting like a bulldozer.

Day 4 was led by Aguirre-Díaz to the Amealco Caldera (11 km diameter), the focus of his dissertation work, and one of the Plio-Pleistocene caldera complexes that run across the northern end of the MVB, from Sierra La Primavera in the west through to Los Humeros in the east. Three moderately welded large-volume ignimbrites erupted at Amealco ~4.7 Ma. These were associated with unwelded ignimbrite facies and pumice fall, surge, ash-flow, and mud-flow deposits, most of which we observed. The Amealco magmas are trachyandesitic-trachydacitic in composition. Accordingly, the rocks lack sanidine or any other potassic mineral, which has made it impossible to distinguish the ages of the three major Amealco ignimbrite eruptions based on K-Ar or even $^{40}\text{Ar}/^{39}\text{Ar}$ techniques. We visited a quarry where local workers saw and then hand-hew bricks of the ignimbrites, earning inadequate wages for their back-breaking efforts. Ignimbrites erupted from Amealco and Huíchapán caldera (75 km NE) are important building materials for a wide zone of central México.

To be escorted through these wonderful volcanoes by Mexican volcanologists with such depths of understanding was a great pleasure for us all. The Penrose conference and the IAVCEI field workshop were two more signs of the incredible advancement during the past decades of the science of volcanology in México generally, and at UNAM (Mexico City and Juriquilla Campuses) in particular. Judging by the abundance, quality, and diversity of interests represented in the pool of local talented professionals, as well as the great wealth of nearby volcanological problems to study, UNAM must now be considered among the upper tier of undergraduate and graduate institutions for volcanology in the world.

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In Memorium Don Peterson (1925—2003)

Donald W. Peterson, Scientist Emeritus with the Volcano Hazards Team, passed away peacefully on December 12, 2003, following a stroke at his home in Albuquerque, New Mexico. He is survived by his wife of 55 years, Betty Peterson, 2 children and 5 grandchildren.

Don received his B.S. degree in geology from the California Institute of Technology in 1949 and his M.S. degree in geology from Washington State University in 1951. In 1952, he joined the USGS Mineral Deposits Branch. His first USGS project involved the geologic mapping of the Inspiration and Haunted Canyon quadrangles in one of the state's major copper districts. From 1954 to 1961, he worked part-time for the USGS on various mapping projects while completing his Ph.D. research at Stanford University. Immediately thereafter, Don became a project chief in the USGS Branch of Base and Ferrous Metals where he studied ore deposits and volcanic rocks in the Teapot Mountain quadrangle of Arizona.

Don's career-long fascination with young volcanic rocks and active volcanoes began in 1966 with his temporary assignment to the Branch of Field Geochemistry and Petrology, a predecessor to the current Volcano Hazards Team. During a six-month assignment, Don mapped the Kilauea Crater quadrangle in the summit area of Kilauea Volcano on the Big Island of Hawai'i. From that time on, his interests never strayed far from active volcanoes or the hazards they pose to society.

Following a brief stint at USGS Headquarters (then in Washington, D.C.) as staff geologist in the Office of Mineral Resources, Don returned to Hawai'i as Scientist-in-Charge at the Hawaiian Volcano Observatory (HVO) in August 1970. It was an exciting time at HVO, with a long-lived eruption in progress at Mauna Ulu along Kilauea's East Rift Zone. Don spearheaded an intensive, multidisciplinary effort to better understand volcanic processes and associated hazards. Even while supervising as many as 25 HVO staff members, Don somehow still managed to stay fully involved in field research. It was during this period that Don conducted his pioneering studies of lava-flow processes and products, including: the transition of pahoehoe to a'ā lava; the dynamics of active lava lakes; the development and evolution of lava-tube systems; and the construction of lava shields and lava deltas. These pivotal studies have provided the context and stimuli for subsequent, more detailed investigations. Upon reassignment to Menlo Park, from 1975 to 1980, Don again worked on much older volcanic rocks in the Superstition Wilderness of Arizona as a member of the Branch of Western Mineral Resources.

The next turning point in Don's long and productive career as a field geologist and volcanologist came in 1980 with the reawakening of Mount St. Helens. In the aftermath of the cataclysmic May 18, 1980, eruption, the Branch of Field Geochemistry and Petrology (subsequently Branch of Igneous and Geothermal Processes) and the reinvigorated



Volcano Hazards Program turned to Don to serve as the first Scientist-in-Charge at the fledgling Cascades Volcano Observatory (CVO) in Vancouver, Washington. His tenure was critical to the early success of CVO during a challenging period of frequent eruptions and intense public visibility. Even before CVO was formally established on May 18, 1982, Don already had helped to formulate its future role by adroitly identifying those who would become CVO's first staff members. That CVO was properly launched and prospered is testimony to his dedication and skillful administration during those critical early years. Later, Don served as Advisory Volcanologist to the Volcanological Survey of Indonesia (VSI) in 1983, a year in which he also received the Department of Interior's Meritorious Service Award.

Don rotated out as Scientist-in-Charge but remained on the CVO staff from February 1985 to September 1986, when he prepared several important papers based on his work in Hawai'i, at Mount St. Helens, and on the complex relationships between hazardous volcanoes and society. While serving two tours of duty as a Consulting Volcanologist to VSI for the Asian Development Bank, he was instrumental in upgrading volcano monitoring and research infrastructure in Indonesia.

From October 1986 to his retirement and becoming Scientist Emeritus in October 1992, Don returned to his earlier studies of the Tertiary volcanic rocks of Arizona. However, he continued to maintain a keen interest in active volcanoes and the threats they pose to society, and in 1988 he was elected Secretary of the IAVCEI Commission on the Mitigation of Volcanic Disasters. In the mid 1990s, he and Betty moved from Palo Alto to Albuquerque to enjoy the Southwest countryside and climate they had come to love during Don's fieldwork in the region, which intermittently spanned nearly four decades. In July 2003, they returned to Hawai'i for the Cities on Volcanoes 3 conference in Hilo, where they renewed many friendships from around the world that sprang up during Don's far-reaching career.

Don was an insightful field geologist, a passionate and dedicated volcanologist, a loving husband and father, a true gentleman, and a scholar. As many of his associates and co-authors know well, Don was an incisive reviewer, excellent writer and meticulous editor; first drafts of manuscripts would be infused with his perceptive observations and constructive edits. His quiet and unassuming approach—often combined with subtle wit and humor—to the resolution of contentious issues had a calming effect on those around him, to the betterment of all concerned. His down-to-earth personality and quiet demeanor, however, did not hinder him from assuming a leadership role in the international volcanological community, where he was highly influential on the subject of volcano hazards and their mitigation. Indeed, he served as mentor to

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However, there may be an important limitation here in connection with the wording “*and without negligence*”. It is our understanding that, while the law offers a certain level of protection for professional people with respect to negligence, there is no absolute test, and in most cases any question of negligence that is not “*fanciful on the facts*”, if pursued, will ultimately end up being decided in court. Usually, before such a claim can succeed, the claimant has to prove on the balance of probabilities that the act(s) of the professional fell below the standard which any reasonable member of that profession could consider acceptable. For volcanological issues, however, there is little or no case law or precedent on negligence (as there is, say, in civil engineering), and any disputes are likely to be less amenable to settlement without going to court for a definitive resolution. Also, with the kind of hazard and risk assessment issues that volcanologists might become involved in, there is probably a much greater element of scientific uncertainty present than in most other areas of professional practice, and this will, almost inevitably, generate room for doubt and argument.

In 2003, the Montserrat Risk Assessment Panel was changed to a formal Scientific Advisory Committee and so an increased (but not necessarily total, as discussed above) measure of protection was provided to members working on the Montserrat eruption issues. This experience highlights the need for all volcanologists to examine carefully their terms of engagement for carrying out scientific work in a volcanic crisis, and what legal protection is offered to them as individuals. No doubt many colleagues may be adequately protected, if they are employed by a **national** body or agency with the official mandate for scientific work in a volcanic emergency.

Civil litigation has arisen over the eruption in Montserrat in a commercial context, as well. We became involved two years ago when we were retained as expert witnesses in an insurance case. Some property owners on Montserrat went to court because their insurance company refused claims under a standard household insurance policy for damage to their properties by volcanic ash. ‘Volcanic activity’ was an excluded peril under the policy, but ‘explosion’ (along with earthquake, and fire) was not. The question at issue was whether a volcanic explosion was an explosion within the meaning of insurance wording, and then whether the damage, which it was not disputed arose because of the presence of the ash, owed its origin to an explosion, and that this was the primary causation for the ash that fell on the property.

There were some intriguing aspects to the case that illustrate major differences between the worlds of science and the law. Prominent in evidence presented to the Court were an assortment of posters, daily observatory reports, informal newsletters for schoolchildren, pamphlets for the general public and newspaper articles, many of which had been prepared for the public by Observatory staff. Peer-reviewed scientific articles in *Nature* or the *Bulletin of Volcanology* were of no interest to the Court. It probably does not occur to a volcanologist preparing simplified outreach material, or being interviewed for a newspaper article to be written by a journalist, that illustrations and explanations for beginners (and verbatim quotes, or misquotes) might eventually be scrutinized in fine detail by lawyers. In the UK, the legal system is adversarial. Questions to witnesses are those that the lawyers choose, and may be more designed to support or destroy a case than reveal truth. We thus found ourselves initially on opposite sides in a legal joust, and a long way from the open, free-ranging discussions of normal scientific debate. Eventually, the Court ruled that the two of us should work together to amalgamate all the scientific evidence into a single joint report to the Court.

In the end, it was the very basic concept of a volcanic explosion, as the man or woman in the street might judge it from their understanding of the phenomenon, that provided the key in this case. A volcanic explosion was deemed to be an “explosion” within the meaning of the insurance policy wording, and these particular householders won their claim. It has to be said, however, that many hundreds or thousands of other property owners in Montserrat lost out with their insurance policies.

It seems to us that it is inevitable that one day, probably soon, volcanologists will end up in court on the “wrong end” of litigation. Of all the natural perils, such as earthquakes, storms and floods, the forecasting of volcano hazards likely carries the greatest potential for creating acute legal liability problems for scientists. What are the legal responsibilities of a volcanologist in a crisis? What comparisons can be made with other areas of professional liability? Under what circumstances might a volcanologist be held accountable for deaths in an eruption? What methods for hazard or risk assessment would be acceptable in court, and what standards of scientific evidence are required? The answers to some of these questions will depend to a certain extent upon the national jurisdiction involved, and the way the law works in a particular country, but in a major incident (say, involving the crash of a civilian airliner ingesting volcanic ash), several different legal systems may become involved.

Some clarification of issues such as these would help prepare the volcanological community for the legal contests which, sooner or later, will emerge in the wake of a volcanic disaster, or in an economic disaster involving a volcano which fails to erupt as expected. However, this poses considerable difficulties for IAVCEI. What after all is a “professional volcanologist”, and how would one satisfy a court as to one’s professional standards and competence? Professions with similar kinds of responsibilities to volcanologists have professional bodies and require certain standards of academic qualification and experience and, more often than not, some form of certification. This applies almost anywhere in the world to medical doctors and engineers, for instance: they are required to reach high standards to be recognised and to practice. Individual doctors and engineers can be disqualified for incompetence, malpractice or negligence, but they also benefit from being able to demonstrate that they have professional qualifications that are universally accepted. In the UK and Europe, it is possible that a volcanologist may be a Chartered Geologist, but of course not all volcanologists are geologists, and some scientists are actually ineligible for this status - for geology, mathematics is deemed a non-cognate subject, so innumerable modellers might be excluded! Thus, no recognised standards or qualifications exist for volcanologists, as such.

Whilst it is the only international scientific organisation for volcanologists, IAVCEI is in a situation which, as a consequence of its history and mission, makes it difficult for it to act like a professional body. IAVCEI was created to promote volcanology as a science, and so it has a strong tradition of academic endeavour and research-driven activities. That said, it has tentatively dipped its toes into societal responsibilities

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of the volcanologist in recent years, for example with the publication of professional conduct guidelines for volcanologists during a crisis (IAVCEI Subcommittee for Crisis Protocols, 1999). Judging from the lively response to that exercise it is quite likely that any suggested move towards making IAVCEI into a Professional Association would be resisted by the 'intellectual free-wheelers' who make up our largely academic membership. Nevertheless, IAVCEI should at least open up a debate on this. Could a voluntary system work, for example? IAVCEI might decide on minimum standards of academic qualifications and experience that would serve to recognize an individual as a "volcanologist". Individuals could submit their profiles, competences and CV to a committee or board for validation. Likewise a Code of Practice (like the Hippocratic Oath) could be developed which individuals would be encouraged to sign on to, on a voluntary basis. We do not expect such a scheme to be uniformly welcomed. However, it maybe an instructive for IAVCEI to investigate just how difficult it would be to find a scheme that would gain some measure of widespread support.

Ultimately, we suspect that our small community will have its hand forced when a high profile case comes to court and colleagues are successfully sued, or even end up in jail. The corollary to this happening, without professional safeguards in place, is that many good, competent colleagues would then be disinclined to get involved in the all-important role of contributing their expertise to volcanic disaster mitigation.

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Future Meetings

2nd International Symposium on Volcanic Ash and Aviation Safety

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http://www.ofcm.gov/homepage/text/spc_proj/volcanic_ash/volash2.html

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contact: www.iugs.org

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Cities on Volcanoes 4

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IAVCEI 2006 China, Continental Basalt Volcanism (tentative)

IAVCEI 2012 Alaska, Centennial of 1912 Katmai Eruption

June 2012

Fairbanks, Alaska, USA

Further information may be found on the IAVCEI web site at www.iavcei.org

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many aspiring volcanologists (ourselves included) in Hawai'i, Vancouver, Menlo Park, and outside the United States. Just as Don inspired numerous colleagues on a professional level, he and Betty enriched the lives of countless friends through their unending commitment to one another, zest for life, and gentle humanity. Don Peterson will be missed by his many friends and colleagues throughout the broader volcanological community.

—Dan Dzurisin (CVO) and Bob Tilling (Menlo Park)

Message from the President-Continued from page 1

Lastly, I would like to remind us all that the deadline for registration and abstract submission for the 2004 IAVCEI General Assembly in Pucon, Chile is May 15, 2004. During this meeting we should start planning the next main meetings: The IUGG meeting in Perugia Italy (July 2-13, 2007) and the next IAVCEI general assembly in 2008 (location to be decided soon). We can plan sessions that start at Perugia 2007, gather momentum and reconvene at the 2008 GA.

I wish us all a productive and joyful general assembly and look forward to meeting you all at Pucon.