Bull Volcanol (2000) 62:59–61

FORUM

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Role of science and independent research during volcanic eruptions

Received: 13 September 1999 / Accepted: 28 September 1999

Sirs,
The recent article in the *Bulletin of Volcanology* on "Professional Conduct of Scientists During Volcanic Crises" prompts our concern that the role of scientific inquiry during volcanic eruptions was not adequately weighed. Moreover, the document may foster an artificial distinction between volcanic monitoring, hazards assessment, and basic science. We think that any protocol for IAVCEI members should have focused much more on promoting participation in the study of eruptions. Also, the contributions and roles of scientists not affiliated with the hazards team were unjustifiably, and perhaps unintentionally, slighted. The article focuses on the important management aspects of volcanic crises but neglects the irreplaceable scientific opportunities that eruptions present. We believe that the document is potentially divisive, portraying outside scientists as "burdensome" and their presence as an indication to "officials and the media that the local team lacked the needed expertise and tools." In fact, outside researchers can contribute to both hazards evaluation and research science, which both need to be pursued during volcanic eruptions. The members of IAVCEI should critically evaluate this new code before it becomes the de facto constitution of our profession.

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Many of the recommendations of the crisis protocol subcommittee should be manifest, especially that during volcanic crises scientists must act civilly and responsibly and be aware of potential problems in communicating with other scientists, public officials, and the press. Scientists working on independent research need to recognize the different priorities of the hazards team and fully cooperate with them. The clauses in the article addressing communication, civility, and leadership are well supported by the cited case studies, so the reader is able to study examples of why such behavior is important.

Other parts of the protocol are far less obvious or unsupported by evidence. The avoidance by the IAVCEI subcommittee of citing specific examples of problems at volcanic crises leaves one wondering whether some of the generalities are based on isolated instances that may have been rooted in personality conflicts. The absence of evidence renders many of the clauses refutable, or at least impossible to assess critically. Such nonconsensual and vague clauses should not have been included in the protocol. Rather than digressing into a point-by-point argument of these clauses, we prefer to focus on a few central issues that are critical for promoting science at volcanic eruptions, which we believe were under-emphasized in the article:

1. *Eruptions are the primary venues for gathering data on volcanic processes.*

Eruptions present the most important opportunity to gather data on the basic processes of volcanology. They are the ultimate trial for hypotheses developed by study of ancient volcanoes or modeling. Many volcanological, geophysical, geochemical, and petrological techniques require real-time data gathering or observation during an eruption that may not have direct applicability to the hazard at hand. Therefore, promoting scientific inquiry should be a major part of any strategic plan for managing volcanic eruptions. As pointed out in the guide under "Leadership problems" but neglected elsewhere, those who manage scientific teams during eruptions need to appreciate the legitimate role that

scientific research by many investigators can play in better understanding and predicting volcanic eruptions. The payoff of such research will be a long-term reduction of hazard on a worldwide basis. To be accepted and appreciated during volcanic crises, "outside" volcanologists need to take the opportunity during non-crisis times to introduce public officials and the news media to the contributions that science can make to both hazards reduction and to learning more about volcanoes. In facilitating this goal, the code should be modified to encourage, rather than discourage, collaboration with scientists outside of the hazards team.

Certainly there is the potential for the outsiders not to "be sensitive to the intellectual and emotional investment of long-time workers" on a particular volcano, but this should not be used as a basis for excluding outsiders. We contend that the benefits to volcanic hazards assessment and science will outweigh the burdens that the involvement of outsiders will cause, provided that the outsiders clearly recognize the safety limitations that must be imposed on them and the need for timely sharing of their results with the hazards team.

2. *The importance of serendipity in science and the need for open scientific opportunities during eruptions.*

As important as foresight and strategic planning are to developing a hazards assessment, one cannot predict or even anticipate where or when new scientific discoveries will be made. Many important discoveries based on observation of natural phenomena are the result of converging fortuitous events. Thus, it is not possible for managers of hazards teams to know in advance which scientific studies will lead to new insights into volcanic processes and hazards assessment. The advance of volcanology depends on study of eruptions by as diverse a group of scientists as possible.

The 1980 Mount St. Helens experience is perhaps the best-known example of serendipity. Many important observations and photographs of the sector collapse were made by scientists unaffiliated with the hazards team and non-scientists, who simply happened to be at the right place at the right time. These "accidental" events aided the study of giant avalanches and debris flows and contributed to their recognition as a major hazard on a worldwide basis.

The recommendations of the crisis protocol that projects be approved prior to an eruption, that funding by independent agencies be tied to permission of the hazards team, and that an "enthusiastic" response be received to a request for participation during an eruption are unreasonable expectations. Furthermore, they may work against the hazards assessment by removing different expertise and diverse views. These requirements also assume that the managers of the crisis team would understand the details of all studies to be conducted on volcanic eruptions. Managers or members of the crisis team should not be put in the position of judging the merits of scientific studies unless they happen to be experts on the subject. Of course, it is the responsibility of independent researchers to demonstrate the value of their work to the hazards team, if they expect to receive logistic and other support from them.

Given the demands on the manager and team during the actual crisis, it is prudent for managers of volcanic crises to be prepared for scientists who want to perform scientific investigation during an eruption and plan in advance how their work might be accommodated. Clearly, the volcanology community needs to design a balance between the short-term goals of the hazards team and the longer-term goals of research scientists, and both parties need to work to promote and support the work of each other.

3. *The benefits of different points of view.*

In several places, the article stresses the need for a consensus opinion on volcanic hazards for public statements. Different opinions may indeed confuse or embarrass public officials who may have a limited scientific background with which to evaluate these differing opinions. However, these differing opinions may arise from legitimate differences of interpretation. Inviting "outside" researchers to participate in the discussion of volcanic hazard issues with the local team would be the appropriate forum to express alternative opinions and would likely dissuade these researchers from speaking independently with the press. Discussion with the local team would also lead to the researchers' appreciation of the perspectives of the team and would allow the researcher the opportunity to share their observations and interpretations. Frank and regular discussions should minimize the potential for mixed messages being given to the local officials and the public. Furthermore, the inclusion of researchers in the discussions of the hazards team is clearly desirable, as different expertise and a different perspective may be brought to a crucial issue or unforeseen outcome.

Dealing with the public and press brings about its own special problems that most volcanologists recognize. Clearly, scientists who are not directly involved with the crisis team should not be issuing predictions or warnings, and they should be cautious of attempts by the media to sensationalize disagreements. However, much opportunity to educate the public arises with each eruption, and volcanologists should promote awareness and understanding of volcanic phenomena and their hazards even if they are not part of the hazards team.

4. *Crises and eruptions.*

Part of our concern stems from the poor definition of what exactly constitutes a "volcanic crisis." Are all eruptions and potentially active volcanoes "volcanic crises," or must lives be directly at risk to qualify for this status? The code should provide clear safety or political reasons for excluding scientists from potentially hazardous zones; otherwise, there should be no reason to prohibit competent volcanologists from pursuing their field studies.

Conclusion

In summary, we believe that the article outlining professional conduct during volcanic crises contains some ideas that, if adopted, would hinder the long-term goals of both the science of volcanology and efforts at crisis management. Members of IAVCEI should review this article carefully and weigh its potential impact on the field of volcanology. As suggested by the authors of the code, the conduct guidelines serve as a starting point for discussion among the volcanological community as to how to balance the responsibilities of those involved in hazard assessment and those in pursuit of scientific knowledge. There is, after all, the common goal of understanding all phenomena associated with volcanic events. We should promote cooperation in the interest of scientific inquiry as well as hazards reduction, and find ways to facilitate both.

Acknowledgements We thank our many friends and colleagues with whom we have discussed these issues since the protocol was published. In particular, reviews by D. Swanson, S. Sparks, and K. Cashman helped us to appreciate better the intent of the code and to work toward a positive approach.