## Chapter 5

# THE DEVELOPMENT OF VOLCANIC EMERGENCY PLANS

## 5.1 Introduction

It will be assumed in this chapter:

(*a*) That in any community exposed to volcanic hazards there is general awareness of the hazard and of the attendant risks to life and property, and a general desire to take collective action to reduce these risks;

(*b*) That a legislative framework exists within which it is possible to plan, organize and put into effect, at the national and at the local level, appropriate protective measures, including if necessary the evacuation of threatened areas and assistance to evacuees;

(*c*) That scientific knowledge of the potentially dangerous volcanoes is sufficiently advanced to permit the elaboration of "scenarios" of possible eruptions, their destructive effects and their social and economic consequences;

(*d*) That it will be possible to have some warning of impending eruptions, either from visible signs of volcanic activity or from scientific monitoring of the volcanoes, and that this warning will be given in time for appropriate action to be taken;

(*e*) That, if the above conditions are fulfilled, an emergency plan of action in case of eruption will be prepared for each potentially dangerous volcano.

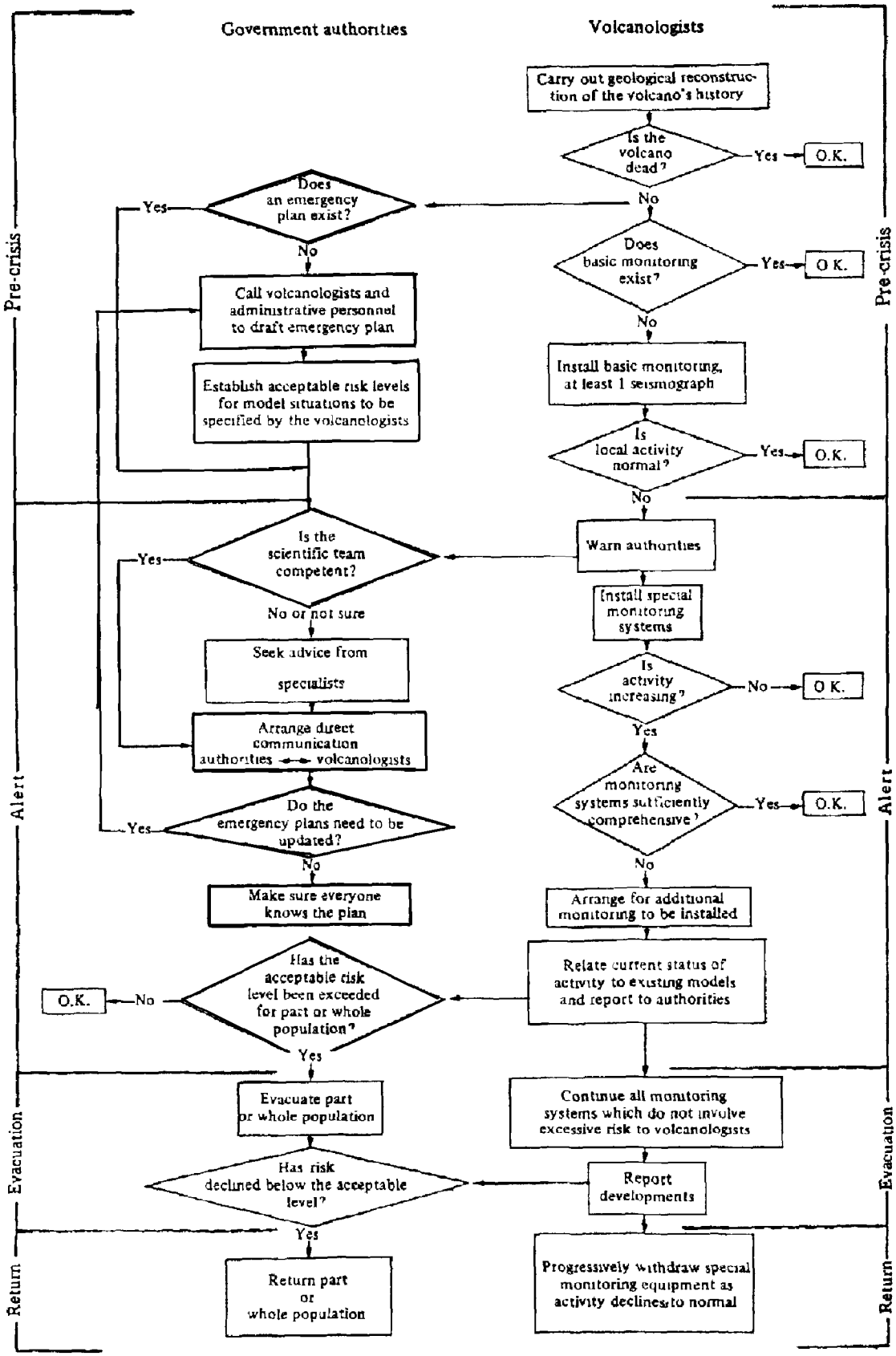
A summary of the overall planning requirements, including their chronological sequence and indicating the responsibilities of planning authorities and volcanologists respectively, is given in table 2.

## 5.2 Basic elements of the plan

The emergency plan for each volcano normally contains the following elements:

TABLE 2

**Volcanic emergency planning: a flow diagram***




* After J. Tomblin, *Impact of Science on Society*, vol. 27, No. 1,

Identification and mapping of the hazard zones; register of valuable movable property (excluding easily portable personal effects);

Identification of safe refuge zones to which the population will be evacuated in case of a dangerous eruption;

Identification of evacuation routes; their maintenance and clearance;

Identification of assembly points for persons awaiting transport for evacuation;

Means of transport, traffic control;

Shelter and accommodation in the refuge zones;

Inventory of personnel and equipment for search and rescue;

Hospital and medical services for treatment of injured persons;

Security in evacuated areas;

Alert procedures;

Formulation and communication of public warnings; procedures for communication in emergencies;

Provisions for revising and updating the plan.

### 5.3 Time scales

One important question, which must be examined at the outset, is the relation between the time-scale of volcanic events and the time needed to put various protective measures (i.e., on-site protection and/or evacuation) into effect.

Experience has shown (see chapter 2) that the interval between the onset of an eruption, or of significant precursory phenomena, and a violent climax, eruption, may range from a few hours to several days, weeks or months. On the other hand, the time required to put emergency protective measures into effect depends on the size of the area at hazard, the density of population and settlement, the degree of mobility of the population, the transport and communication facilities available, and the general technological level of development. It will generally be measured in hours or days.

In practice, it will usually be appropriate to plan for two types of action:

(i) *Phased response* to a gradually developing volcanic crisis, during which one may expect to have warning of potentially dangerous volcanic events at least 24 hours before they occur;

(ii) *Immediate response* to a situation calling for the fastest possible evacuation of people by whatever means are immediately available.

The more that is known about the history of a volcano, and the greater the effort that has been devoted to scientific studies and monitoring of its behaviour, the easier it will be to foresee how much time may be available to take protective action when an eruption does occur.

## 5.4 Identification of hazard zones

The first element of a volcanic emergency plan is a map showing the hazard zones around the volcano which are liable to be affected by one or more destructive phenomena (pyroclastic flows, mudflows, lava flows, heavy ash falls, etc.) during an eruption. Such maps normally include the subdivision of the area exposed to each type of hazard into two or three subzones corresponding to eruptions of different magnitudes.

The map of hazard zones will be based upon the maps drawn by volcanologists, showing the areas devastated during previous (historic, or geologically reconstructed prehistoric) eruptions. A detailed review of how these maps are prepared is given in a separate manual (Crandell *et al.*, 1984). It is worth noting, however, that these hazard maps are based on purely geological criteria. For practical purposes, e.g. evacuation plans, etc., the local authorities responsible for emergency management may be obliged to extend the limits of some zones in order to take account of available escape routes, the boundaries of settlements, etc.

## 5.5 Population census and inventory of property

In order to plan for evacuation it will be necessary to compile a census of the population in the hazard zones and to update it at least once every five years, or whenever there are signs of abnormal volcanic activity. This census will include not only the people permanently resident in the zones but those who enter them regularly, for instance for their daily work. It may also be useful to establish an inventory of animal livestock in each zone, so that arrangements can be made for their removal if time and facilities permit.

Special note should be made of any property or facilities in the hazard zones whose loss or destruction would have immediate effects outside these zones (e.g., power stations, radio transmitters, telephone exchanges, water supplies, etc.).

## 5.6 Identification of safe transit points and refuge zones

If the evacuation of a hazard zone is to proceed in an orderly manner, it is essential that each person in the zone knows where to go when evacuation starts.

For each hazard zone (or part of each zone), the nearest easily accessible point outside the zone may be identified, to which the people should go or should be taken, as quickly as possible, and where they may assemble in safety while arrangements are made for their reception in a refuge zone.

At each such safe transit point, arrangements will be made for evacuees to be identified so that, if necessary, a search can be made for any persons who may be missing. If several such transit points are set up, there should be good facilities for telephone or radio communication between them. All evacuees, including those proceeding to their own alternative accommodation in a safe area, should register their departure from the danger zone at one or other of the transit points.

The safe transit points will probably have only minimal facilities for the shelter and feeding of the evacuees. They should nevertheless be selected on the basis of a survey of buildings outside the hazard zones but easily accessible from them, to provide the best possible temporary shelter for the anticipated maximum number of evacuees. In volcanic eruptions, tents are not suitable as temporary shelter, especially if sited close to a high-hazard zone, because they can be easily damaged by falling ash or lava lumps. Schools, community centres, warehouses or other large buildings will be preferred.

The plan will also specify the arrangements for the transfer of evacuees as quickly as possible from transit points to temporary accommodation in refuge zones elsewhere.

## 5.7 Identification of evacuation routes

The next element in emergency planning will be to carry out a survey of the number of people to be moved to safety, the number of vehicles (and, if appropriate, boats and aircraft) available, and the serviceability and traffic capacity of each of the roads leading out of the hazard zones to be evacuated. There may need to be several alternative plans according to the location, type and magnitude of the eruption, and according to the direction of the wind at the time. The main objective will obviously be to distribute the expected traffic flow as evenly as possible along all the escape