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Support needs of scientific efforts in the event of an eruption from the Auckland Volcanic Field

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Support needs of scientific efforts in the event of an eruption from the Auckland Volcanic Field

PREPARED FOR

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EXECUTIVE SUMMARY

The city of Auckland is built on a basaltic volcanic field which has erupted at least 49 times during the last 150,000 years, most recently within the last 1000 years. Assessment of the trends within the field suggests that it has erupted more frequently in recent times and that future eruption are to be expected.

This report considers what would be required to establish and maintain a scientific advisory group in the event of a volcanic eruption in the Auckland volcanic field. It also considers the role of such a group before, during and after such an emergency.

At the present time in Auckland, the nucleus of a scientific advisory group exists in the form of the Auckland Scientific Advisory Group convened by the Auckland Regional Council. With the identification of a state of volcanic unrest, this group could advise on the formation of a scientific advisory team to work with the authorities during the emergency. Sources of scientific personnel are the Crown Research Institutes, the Earth Science Departments in New Zealand universities and overseas volcanological institutes and universities. The scientific advisory group will form the interface between equipment and personnel acquiring scientific data and the authorities managing the response to the emergency.

1. INTRODUCTION

The city of Auckland is built on a basaltic volcanic field which has erupted at least 49 times during the last 150,000 years, most recently within the last 1000 years. Assessment of the trends within the field suggests that it has erupted more frequently in recent times and that future eruption are to be expected.

In the event of an eruption in the Auckland volcanic field there will be a need for an advisory group with the function of monitoring the physical aspects of the eruption and providing scientific advice to appropriate authorities.

2. SCOPE

This report investigates the requirements of a scientific advisory group established to provide advice to the authorities in the event of a volcanic emergency in the Auckland volcanic field. It considers the following aspects:

1. The nature of a volcanic emergency in Auckland.
2. The constitution of a scientific advisory group.
3. The role of a scientific advisory group in a volcanic emergency.
4. Logistic and material requirements.

3. THE NATURE OF A VOLCANIC EMERGENCY IN AUCKLAND

A volcanic emergency in Auckland will be signalled by a change in the normal patterns of seismic activity in the area. Although such a change will not necessarily lead to volcanic activity it should result in the initiation of volcanic contingency plans.

Volcanic eruptions are relatively rare in New Zealand and it is easy to ignore their potential. However, the geological record shows that the northern part of New Zealand has an active volcanic history and has a greater concentration of different types of potentially active volcanos than any other similarly sized area in the world.

Prediction of likely eruption styles and of associated hazards in New Zealand is based almost entirely on interpretation of the deposits of past eruptions. Only Tarawera (1886), Ruapehu, Tongariro, Ngauruhoe and White Island have provided direct observations. Only in the cases of Ruapehu, Ngauruhoe and White Island do the observations have good scientific basis. Considering the variety of New Zealand's volcanoes this is a very narrow sampling. Eruptions of the type which formed the volcanoes in the Auckland volcanic field have not been observed in New Zealand.

A basic assumption is that renewed volcanic activity in the Auckland volcanic field will be preceded by the rise of basaltic magma from its source in the mantle about one hundred kilometres beneath the Earth's surface. This assumption is based on observational and experimental evidence on the nature of the mantle and the conditions under which it can melt to yield magma with the chemical composition of the magmas in the Auckland field.

Two parameters can be used to assess the speed with which magma rises from its source to erupt at the surface. Firstly, magmas which have entrained material from their mantle source must have ascended rapidly enough to keep the relatively dense solid fragments in suspension. Values of the order of 5 km/hr have been estimated which would imply an ascent time (and therefore a potential warning time) of about 24 hours. Secondly, geochemical evidence can be used to assess how much the composition of magmas has been modified by processes below and within the crust during its ascent. These processes are time dependant so that the degree of modification can be used as an indication of how long the magma stayed at crustal depths (less than about 20 kilometres).

Inclusions of source material are rare in the rocks of the Auckland volcanic field whereas most of the volcanoes do show a range of compositions which indicates that magmas accumulate in the crust for a period rather than rise directly from their source. The importance of this observation is that in most cases magmas in the field appear to haven risen in two stages and therefore the period during which seismic activity may be recorded is likely to be longer than a minimum of twenty four hours. Although there are no real constraints on the likely period during which volcanic tremors will be recorded prior to an eruption, intervals of several days to several weeks are reasonably assumed.

Geophysical measurements, mainly of seismicity, can detect the rise of magma and provide evidence of volcanic unrest. Once the magma is near or at the surface, direct observations can be used to assess theoretical models and identify specific hazards.

4. STAGES IN A VOLCANIC EMERGENCY

Stages in a volcanic emergency are distinct from but interrelated with, scientifically based volcanic alert levels. Volcanic alert levels are essentially descriptions of the perceived state of a volcanic system.

Four stages in a volcanic emergency can be recognised:

1. A build up stage from the time that volcanic unrest is first identified up until the beginning of volcanic eruptions.
2. The eruption, beginning with the emergence of magma at the earth's surface.
3. The waning period when activity ceases but there remains the possibility of further activity.
4. A clean up phase.

5. FORMATION OF A SCIENTIFIC ADVISORY GROUP

At the present time in Auckland, the nucleus of a scientific advisory group exists in the form of the Auckland Scientific Advisory Group convened by the Auckland Regional Council. With the identification of a state of volcanic unrest, this group could advise on the formation of a scientific advisory team to work with the authorities during the emergency. Sources of scientific personnel are the Crown Research Institutes, the Earth Science Departments in New Zealand universities and overseas volcanological institutes and universities.

There is likely to be widespread interest in volcanic activity from the Auckland volcanic field and it is probable that there will be numerous offers of personnel and equipment. An important task of the advisory group at an early stage will be to manage the offers as efficiently as possible.

The scientific advisory group will form the interface between equipment and personnel acquiring scientific data and the authorities managing the response to the emergency.

6. MONITORING EQUIPMENT

The Auckland seismic network will be the main source of information during the pre-eruption stage. This will be complemented by portable seismometers. Once volcanic activity has become established other types of equipment will be deployed. Additional types of equipment are likely to include equipment for the measuring of gases in the eruption plume, measuring temperatures, collecting gas samples and making geodetic measurements. There is also likely to be aerial observation and the collection of data via remote sensing,.

While some of these observations can be made from remote stations there will also be the need for field parties to work in close proximity to the eruption site.

7. THE ROLE OF SCIENTISTS IN A VOLCANIC EMERGENCY

The role that a scientific advisory group will perform is basically that of providing the authorities who are managing the emergency with the advice needed to mitigate the effects of the eruptions as far as possible.

The type of advice provided by the scientific advisory group at each stage in the emergency is different The nature of volcanic activity is that it is typically episodic and it may not be possible to predict its precise course from day to day or even over periods of weeks to months.

Scientific advice to decision making authorities is vital during phases 1-3.

STAGE 1

- Confirm the identification of volcanic unrest.
- Monitor the evolving situation and provide volcano status reports in terms of volcanic alert levels.
- Provide advice on likely eruption sites.
- Provide advice on likely nature of hazards and the likely extent of hazards.

STAGE 2

- advise on the status of the eruption
- predict changes in hazard zones
- forecast patterns of activity

STAGE 3

This is potentially the most difficult period scientifically as volcanic activity wanes and becomes intermittent and pressure grows for life to return to normal. At this stage a scientific advisory group has to:

- continue active monitoring
- determine when eruption indicators have diminished to the point where renewed activity is unlikely.
- Advise on residual potential hazards, for example, the presence of potentially toxic substances in volcanic deposits or the existence of unstable deposits.

STAGE 4

At this stage the need for a scientific advisory group is greatly diminished. The main function would be to:

- Advise on residual potential hazards. Eg the presence of potentially toxic substances in volcanic deposits. The existence of unstable deposits.
- Advise on working with the products of the eruption.

7.1 WORKING MODES

Scientists in a volcanic emergency will have two modes of working referred to here as base activities and field activities.

7.1.1 BASE ACTIVITIES

Base activities are:

- managing the collection and recording of scientific data
- collation and interpretation of scientific data
- communication of scientific interpretations to authorities
- interaction with the media

7.1.2 FIELD ACTIVITIES

- collecting observations of volcanic activity
- deploying equipment

An essential aspect of the scientific work is communication between the base group and the field parties. This requires radio and cell phone contact when field parties are deployed. It also requires briefing and conference sessions on a daily basis. The base group will need to interact closely with the authorities and will probably also need a daily conference with the media. However the nature of base scientific activity means that a working area separate from the main emergency response area is needed. In the latter parts of stage 1 and during stage 2 phases of the emergency scientific work will need to be a 24 hour activity.

7.2 INTERACTION WITH THE MEDIA

A major problem which has arisen in a number of overseas volcanic emergencies is confusion and conflicting information when differing scientific views are communicated to the media. Volcanoes are unpredictable and there are often a number of ways to interpret scientific data. It is to be anticipated that the advisory group will debate differences in interpretation of data. While this process is an essential part of scientific methodology it can be extremely damaging for apparent

differences of opinion to leak to the media because it causes confusion and uncertainty. The scientific advice offered to the authorities and the media will represent that agreed to by the scientific group as a whole. Therefore it is important that all scientists involved with the emergency work through the scientific advisory group.

It will probably be appropriate for a spokesperson from the scientific to interact directly with the media.

7.3 VISITING SCIENTISTS

Offers of help from scientists from New Zealand and overseas institutions are likely in the event of an Auckland eruption. These will help swell the numbers of people and the range of experience of the scientific group helping in the eruption. Such offers are to be welcomed. However it extremely important that visiting scientists work as part of the scientific team so that their contribution is effective and also so that differing scientific opinions do not emerge to confuse the situation.

A role for the scientific advisory group will be to manage offers of help from external agencies and integrate their efforts in to the overall scientific effort.

8. REQUIREMENTS OF A SCIENTIFIC GROUP

A scientific advisory group is likely to require the following types of equipment and services.

- access to various types of monitoring equipment.
- access to a workshop to repair equipment.
- communication equipment
- field transport
- computers
- meeting room
- work stations
- accommodation and ablution facilities.
- catering services.

It would be reasonable to expect the scientific group to provide its own equipment for monitoring so the main requirement is for space, accommodation and access to the Auckland seismic network