General Certificate of Education
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Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

GEOGRAPHY (SPECIFICATION B) **GGB5/PM**
Unit 5 The Synoptic Unit
Advance Information Booklet

Date of Issue: 1 December 2004

Instructions

- This Advance Information booklet will be issued on 1 December 2004 in advance of the examination for Unit 5. You should make yourself familiar with the information in the booklet.
- This material must be kept **unmarked** for use in the forthcoming examination.
- In order to demonstrate your synoptic ability and your decision-making skills, you should, in each of your answers, wherever possible, use a range of information, ideas and examples from other modules you have studied to show your understanding of the connections between different aspects of your course and the topic in question.

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STUDY ALL THE INFORMATION IN THIS BOOKLET

This exercise is based on section 13.2 of the Specification.
The information in this booklet comprises the following:

Item 1 **Extracts from vulcanologists' reports on Mount Soufrière, Montserrat – Summer 2003**

Map 1 **Montserrat – Selected features of physical geography**

Map 2 **Montserrat – Selected features of human geography**

Map 3 **Plate margins around the Caribbean**

Map 4 **Volcanoes in the Eastern Caribbean**

Item 2 **Montserrat – recent history**

Item 3 **Preparing a society to deal with hazardous volcanoes**

Item 4 **Comments from local people**

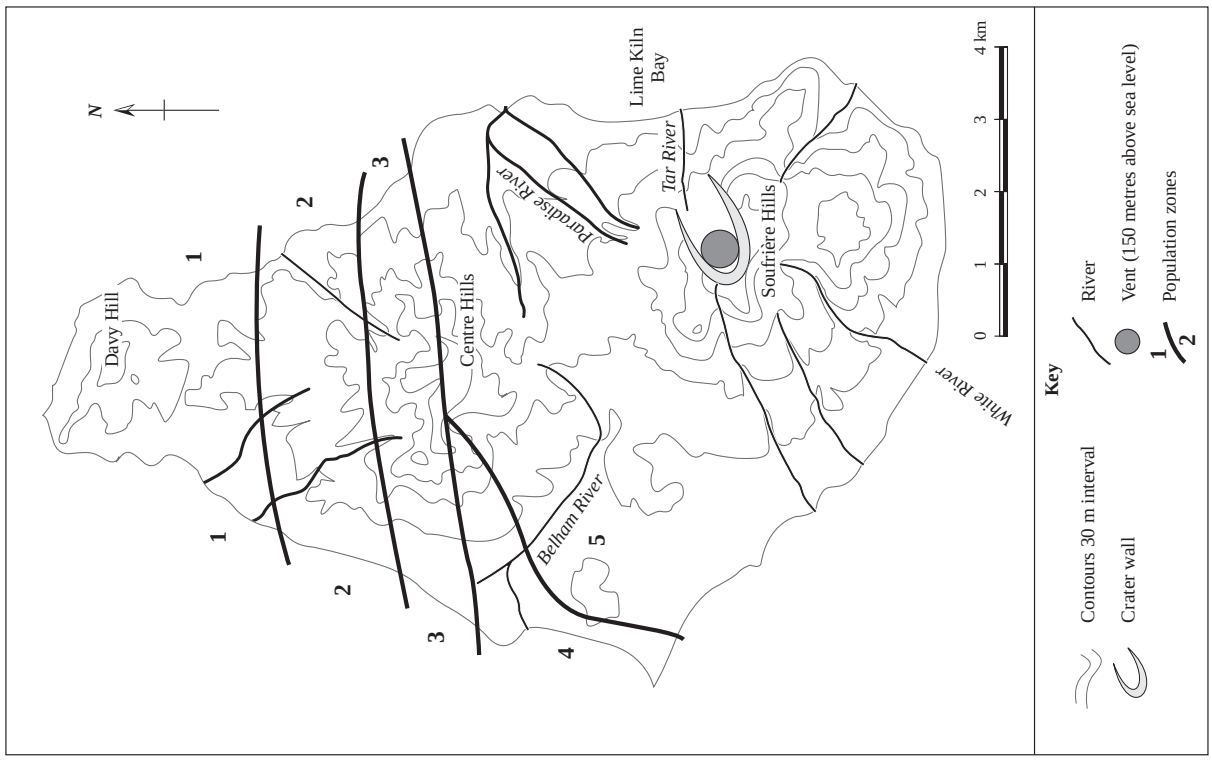
Item 5 **Extracts from UK Government Report**

Item 6 **Sustainable development in Montserrat**

Item 1

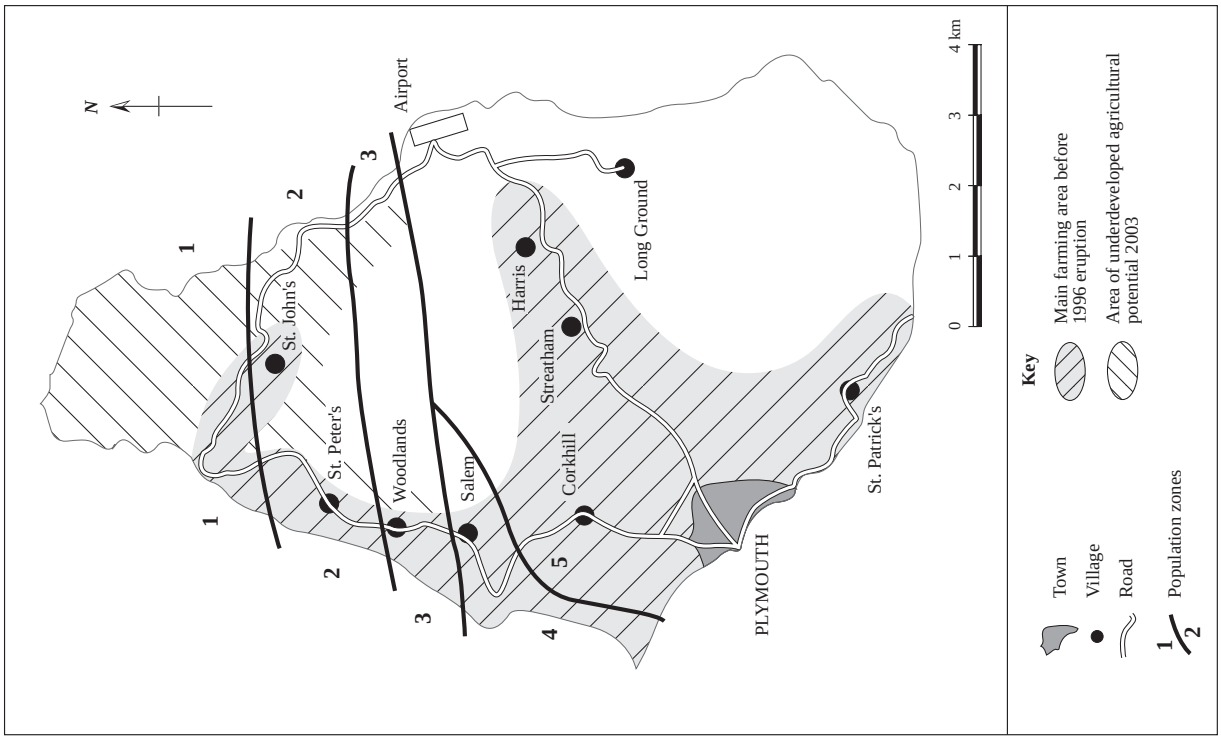
Item 1, weekly volcanic activity report - Montserrat, has not been reproduced here due to third-party copyright constraints.

Montserrat - Selected features of physical geography



Map 1

Montserrat - Selected features of human geography



Map 2

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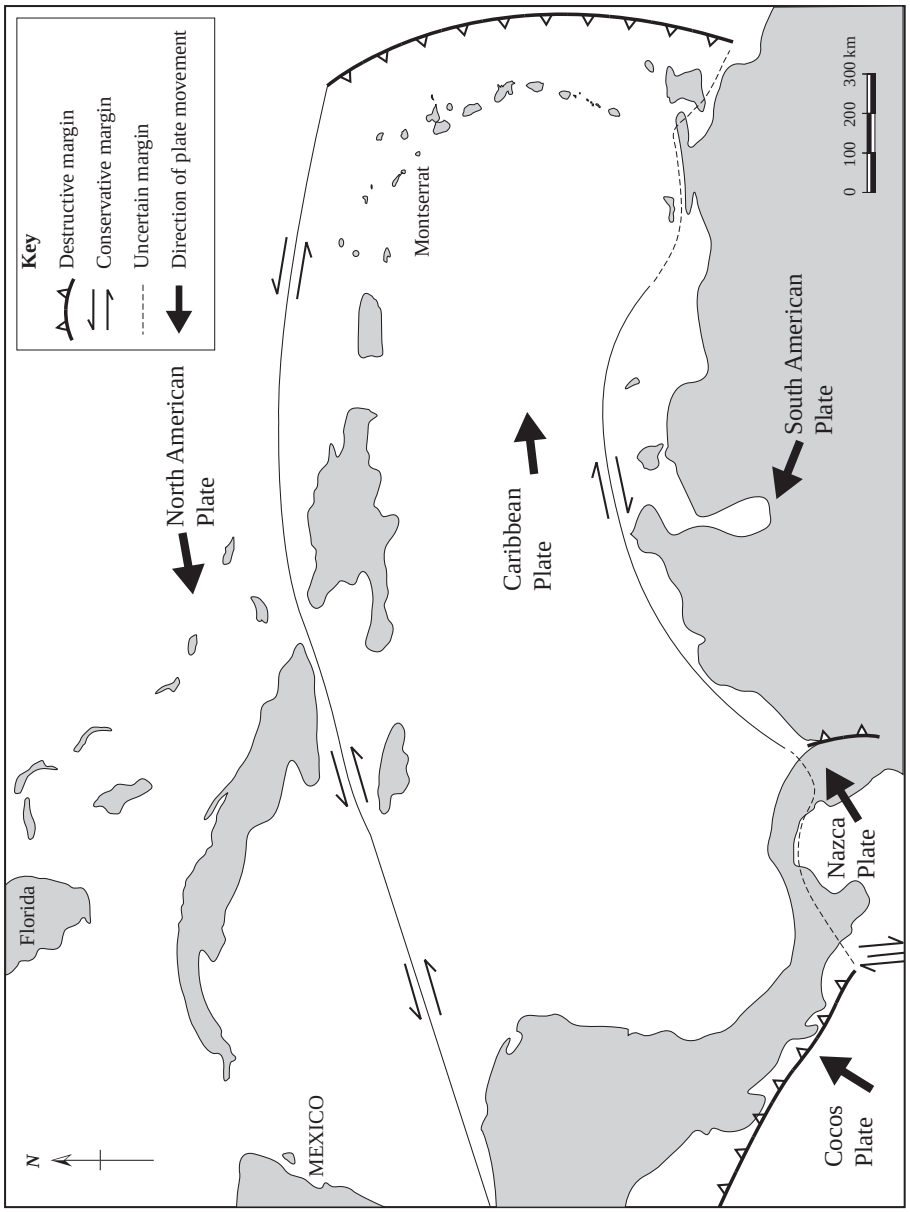
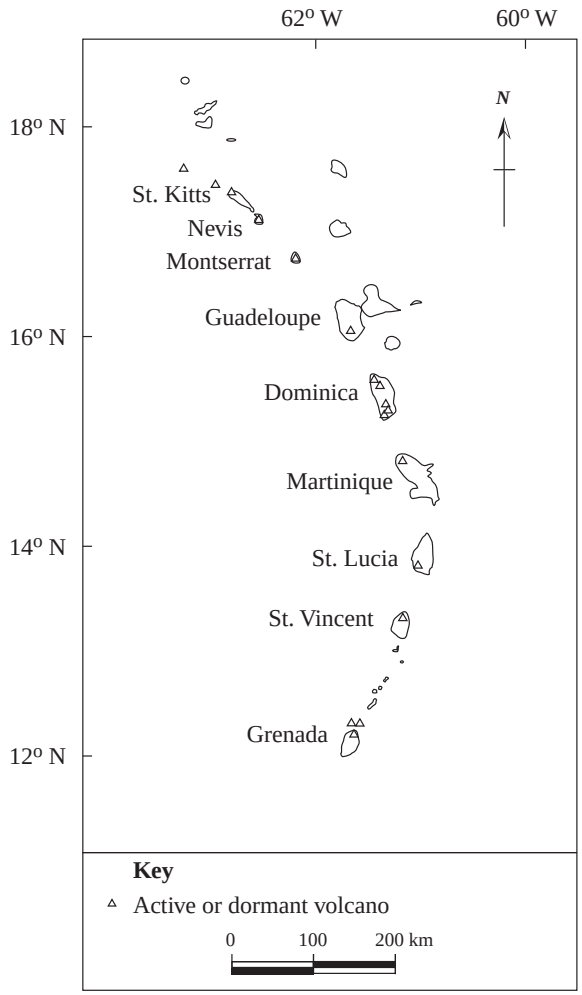
Plate margins around the Caribbean



Map 3

Volcanoes in the Eastern Caribbean



Map 4

Item 2 Montserrat – recent history

The island of Montserrat was a UK colonial possession. It became independent in 1958 and joined the Federation of the West Indies. Following the dissolution of the Federation in 1962, the inhabitants voted to become a UK Dependent Territory.

By the late 1980s the island's population was around 12 000, mostly depending on subsistence fishing and farming. There was also tourism and some light industry, mainly located in Plymouth. The American Medical University was also located in Plymouth.

Hurricanes are common. The most serious recent event was in 1989 when Hurricane Hugo hit the island, killing 10 people, damaging or destroying 98% of the island's houses and causing $240 million of damage.

The Soufrière Hills volcano became active in July 1995. By June 1996 it had become clear that a major eruption would occur in the very near future. In fact, the eruption came on 25 June 1996, with major pyroclastic flows travelling down the Paradise River valley. These were followed by ash falls that affected most of the island, but which were heaviest in the southern half of the island.

Fortunately, most people had been evacuated from the danger area and many people had left the island. However, 20 people were killed and five were injured; several villages were totally destroyed and much of the most fertile land was made unusable.

For several months afterwards repeated eruptions ejected lava, projectiles, ash and gases, turning most of the south of the island from a green fertile area into a grey, lifeless wasteland. Poisonous gases were carried by the wind in whatever direction it blew, often affecting neighbouring islands. During periods of heavy activity, islanders had to wear protective masks. In the mornings, before driving, they often had to wipe several inches of ash off their windscreens.

Population change

Before the eruptions started, the main population concentrations were:

- on the coastal plain in the west and south of the island, with about half the total population living in and around Plymouth
- in the Belham valley, and across the central lowland, to the airport on the east coast.

The island's limited infrastructure was concentrated in these areas: that in the north of the island was poor and in a state of disrepair.

Population estimates, made for the UK's Department for International Development (DfID) were:

January 1996 total population approx.	12 000
June 1996	8000
August 1996	4000.

In the period between January and June, when an eruption seemed to be likely, many children and old people were evacuated along with non-essential foreign residents. Most Montserratians took refuge on neighbouring islands. Then in late June and early July many working people left (although some were replaced by relief workers and geologists who came to monitor the eruption). Many of these refugees were taken to the UK, along with other family members who had left the island earlier in the year.

As soon as the worst eruption was over, people started to drift back, at first from the neighbouring islands and then from the UK. After the eruption more detailed monitoring took place, so that evacuation plans could be developed more fully. Five Population Zones were identified (see **Map 2**). Zone 5 was classed as uninhabitable. The population estimates for Zones 1–4 are given in **Table 1**.

	Dec 1997	**Apr 1998**	**Jul 1998**	**Feb 1999**	**Jan 2002**
Pop Zone 1	1088	1355	1403	1700	1750
Pop Zone 2	2248	1199	1286	1600	1650
Pop Zone 3	619	493	544	750	875
Pop Zone 4	134	92	105	360	750
Total	4089	3139	3338	4410	5025

Table 1

When the volcano erupted in 1996, almost all the light industry closed, as did the American Medical University. The airport is still inoperative, although helicopters can land at a number of places. A new form of tourism has become important to the island's economy – science-based tourism. There are many geologists who are employed to monitor the volcano, but many more come on study visits and also just to see the volcano. Many biologists and ecologists also visit to monitor the wildlife and to see how it is adapting to the changed circumstances.

Although most of these visitors are prepared to 'live rough', they do need services, particularly from guides and drivers; and supplies need to be grown on the island or shipped in, usually by the local fishermen. So students of the aftermath of the eruption are helping to start the rebuilding of the island's economy.

Table 1, (above) Population estimates table from volcano hazard report. Data prepared by Statistics Department, Development Unit, Ministry of Finance and Economic Development, Montserrat, West Indies.

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Item 3 Preparing a society to deal with hazardous volcanoes

Volcano forecasting remains uncomfortably inexact according to *Scientific American*, January 1997. There are three stages in any assessment of the ways in which society has to be managed when a volcano poses risks to human life and economic well-being. These are:

1. scientific observation, and comparison of the present circumstances with past events, to gain an understanding of the volcano's behavioural characteristics;
2. the use of these data to assess the type and degree of hazards and to identify the areas where those hazards are most likely to occur;
3. the development of plans for the care and protection of society when the hazards occur.

Both vulcanologists and the authorities then develop their protection plans by calculating the risk to society. These methods have been shown to enhance the preservation of life, but are not often applied due to two fundamental problems:

- lack of money, *and*
- lack of human resources.

A further problem is that most vulcanologists are more concerned with stages 1 and 2 above, and assume that someone else will take responsibility for developing and carrying out plans for responses to volcanic emergencies. The wealth and stability of the nation concerned also play a major role in volcanic hazard management. For example, the Sakurajima volcano in Japan is well managed and fatalities are at a minimum. In Italy, on the other hand, there is a wealth of good data on Vesuvius; however, many people feel that corruption and poor infrastructure in the surrounding region mean that planning to cope with eruptions is poor. The potential for loss of life is high.

<u>How are volcanic hazards managed on Montserrat?</u>

After the 1996 eruption it was obvious that further eruptions of Soufrière would occur in the future. An ongoing assessment of the risks is in place, and plans have been in place since 1997, including monitoring, zoning, health implications, public education and responses.

The Montserrat Vulcanology Observatory (MVO) consists of scientists from UK, USA and West Indies universities. A spokesman said "We now know that the dome grows in pulses ..... as magma rises towards the surface ..... then the dome collapses ..... followed by periods of explosive activity ..... then pyroclastic flows ..... We have precisely the right equipment in place to monitor the changeover from a steady magma flow to one that is cyclical .... so we can predict about 11 hours beforehand when a collapse-generated ash hurricane will occur and which general direction it will probably move in".

However, the preliminary risk assessment report states that providing warnings would become increasingly difficult as any crisis continued due to:

- population fatigue and increasing cynicism if warnings are given too often
- destruction of infrastructure because of volcanic activity
- damage to monitoring equipment around the crater.

The MVO has set up a number of strategies to cope with the hazards. These include:

- zoning of the island
- setting up a search and rescue infrastructure
- drawing up a mass casualty plan
- plans for off-island evacuation
- plans for on-island evacuation
- construction of underground, airtight bunkers for shelter from pyroclastic flows
- distribution of ash masks to all islanders
- rebuilding house roofs with steeper slopes, so that ash will slide off rather than accumulate and cause collapse
- education and publicity, primarily using:
  - ♦ a thrice-weekly newsletter published by MVO
  - ♦ publication on the internet
  - ♦ press releases to the local newspaper.

Item 4 Comments from local people

Police sergeant

I do a lot of jobs for the MVO. Mainly I have to try and enforce the Zoning Plan and make sure that people keep out of Zone 5, the exclusion zone. That is always easy right after an eruption because folk remember the danger ..... but then in the months that follow they start to drift back because it's home ..... and they remember that was where their crops did well and where they could fish.

They soon find it has all changed. The soil is covered with ash ..... and so are the reefs where the best fishing used to be ..... but people see signs of life coming back even a few months after an eruption and so there is hope for them ..... and any way of making a living for themselves would be better than living off handouts up in the north.

So when the scientists give warnings, I have to get down south and try to make those stubborn settlers move out – fast! In 1996 it was difficult. For one thing they knew that a siren test was due round about then ..... so they did not believe me. For another thing, they did not feel any great sense of urgency. Remember this is the Caribbean, man! In 2003 it was much, much easier. They knew from experience, and they had grown to trust the geologists because they had been right before. When the sirens went that time, people ran.

Finally, I'm part of the search and rescue team. We have strict rules about not putting our own lives in danger unnecessarily. The geologists tell us where it is probably safe to go, but in 2003 we did have to go near the crater, even when we were warned not to. We did not go to rescue islanders – they had listened to the warnings. It was two geologists we had to get out. They had stayed in the danger zone too long and their vehicles weren't good enough to get them out. We've got a big half-track vehicle, which will go almost anywhere. We all got in trouble for that .... the geologists and the rescue team .... but we thought 'they are here to help the islanders, and they are really just crazy kids' so we went and brought them out. But never again!

United Nations volunteer

I was an architectural engineer in the UK and I took early retirement in 2002. I had always wanted to do some development work, so I came out here as a volunteer to use some of my skills for the islanders. I've been looking at two separate engineering solutions to volcanic problems. It is immensely fulfilling, even though my sets of results are fairly negative so far.

First, they asked me to look at the possibility of building underground bunkers for people to shelter from the ash, which is so dangerous in the big eruptions. Our trials show that we can build the bunkers, make them airtight and provide air conditioning so that people can survive for several days. Preliminary cost estimates suggest it would cost about $10 million to provide shelters for the islanders ..... and we have grave doubts as to whether people would use them. The islanders are open-air people; they don't really like being indoors. Imagine how they would react to hiding underground whilst a volcano is erupting above them.

I would recommend that people are given ash masks, and trained really well in their use. They would not save someone caught in the full force of a pyroclastic flow, but if the evacuation plans work efficiently, they should not be. What is more important is that the masks offer long-term protection. The doctors who are studying the population fear that breathing in the ash can lead to long-term lung problems – like the silicosis and such problems that miners and asbestos workers suffer.

Then they asked me to look at roof slopes. Again, it's easy to calculate the roof angle that is needed to make most ash slip off, although such roofs are a lot more expensive to build. But when we discussed the work with the islanders, they told us that they have always had flat roofs because of the hurricanes. Unless your roof is flat, or nearly flat, it blows off in even a moderately severe hurricane. Now we are working on building flat roofs that are easy to keep clear. This means that people could easily sweep their roof every few hours, if necessary, during an ash fall.

Returnee islander

We are farmers and fishermen from the Belham valley, near Salem. We grow and catch most of our own food, and there is usually some extra to sell in the markets. I used to sell to tourists when they came here, and now sell to the geologists – when I can get to my land to harvest crops.

In 1997 my family were evacuated and moved to Manchester, England. I stayed here, living as a refugee in St John's and helping my cousin who has a boat and some land up there. I started going back to my farm in late '97. Some of my trees had been destroyed, some of my crops were ready for harvesting, and some of my land had a thin layer of ash lying on it that was going to make it a lot more fertile. The fishing was poor, because clouds of ash on the reefs had cut out the light and killed much of the marine life, but there weren't so many boats out there so I still did OK.

My wife came back in 2000. She had not settled in England, but the children stayed on with her sister. More people were drifting back and life was returning to normal. Then in 2003 the volcano erupted again. This time we were much better prepared. A lot of islanders had made plans to evacuate to nearby islands. It was a lot easier and less hassle than going all the way to the UK, and they will be able to get back easily when the crisis is over. The rest of us had made arrangements to go to friends and family in the north.

The UK government still helped us with food and blankets and so on, but it must have been a lot cheaper for them than evacuating thousands of people all the way to England.

Item 5 Extracts from UK Government Report

(a) From report to Parliament by the Chief Scientific Officer (December 1997)

The total volume of dome material in the crater was reported by Montserrat Vulcanology Observatory (MVO) to be 77×10^6 metres^3. The triggering of dome collapses by external events such as major regional earthquakes is thought to be the most likely cause of significant new flows of ash. There is a 5% chance of a dome collapse occurring in the next six months.

If such an ash flow does occur, the most likely direction of flow will be to the east, along the Tar River valley. Other directions of flow cannot be ruled out, but the potential for a really big ash flow along the Belham River valley is now reduced to a negligible level.

There is estimated to be a 5% chance of an eruption of magma, which will affect population Zone 5 in the next six months. The possibility of a bigger eruption, affecting the population beyond Zone 5 is seen to be 0.7%.

The chances of a new eruption of magma in the next five years are seen as 14%.

The chances of a new eruption in the next thirty years are seen as 25%.

(b) From UK Department for International Development documents (1999)

From 1985–1998 the DfID spent a total of £59 214 193 on aid to Montserrat. This included normal budgetary aid to a Dependent Territory and emergency funding and evacuation expenses.

This works out at approximately £25 000 per resident over the three-year period.

Arguments arose within the Department when it was realised that only eleven pence per person is given to people in India who are described as living in ‘extreme poverty’ and whose living conditions are far worse than those of the people of Montserrat before the crisis.

Item 6 Sustainable development in Montserrat

(Adapted from a paper given by Dr Deborah M Brosnan: Sustainable Ecosystems Institute, USA)

Montserrat has many unique features. The island is underdeveloped and has a rich resource base. Prior to the 1997 eruption, many patches of land were farmed, but not intensively. Generally, farming techniques conserved the soil, although some land had been abandoned and had subsequently suffered from soil erosion. The surrounding coral reefs were pristine and harboured many fish.

The island also had many native species. The Montserrat Oriole (an endangered species of bird) is famous amongst bird watchers. Several species of lizard are widespread and unique to the island. Other native species are edible, such as the land crabs and the Mountain Chicken (a species of crab).

Tourism was one of the main commercial activities on the island before the 1996 eruption. Over 90% of visitors came to engage in recognised ecotourism activities, particularly bird watching, botany and geology. When the threat of eruptions has passed the potential for these activities will still be there ..... and the potential for geology will be much increased. Heat and pyroclastic flows from the volcano seriously damaged the vegetation over large parts of the south of the island, but it is regenerating naturally. In some ways, this regeneration adds to the potential for ecotourism.

The evacuation that followed the eruption forced the population that stayed into the north of the island. This had been much less densely settled than the south, but it has considerable agricultural potential. This movement of people could have disastrous consequences for the ecosystem in the north, or it could be managed sustainably.

With careful management, conflicts over farmland, fisheries and forests can be avoided. However, we consider that if development is to be sustainable, the planning of the economy must make use of the detailed local knowledge of the population. We see it as essential that their expertise is respected by those who plan the island's future. Local people need to be consulted about development of housing, hotels, communications, infrastructure, agriculture, coral reef conservation and enhancement, ecotourism activities and support for the local culture.

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