Q1.

Figures 1 – 4 show information about volcanic eruptions.

Figure 1

Figure 2

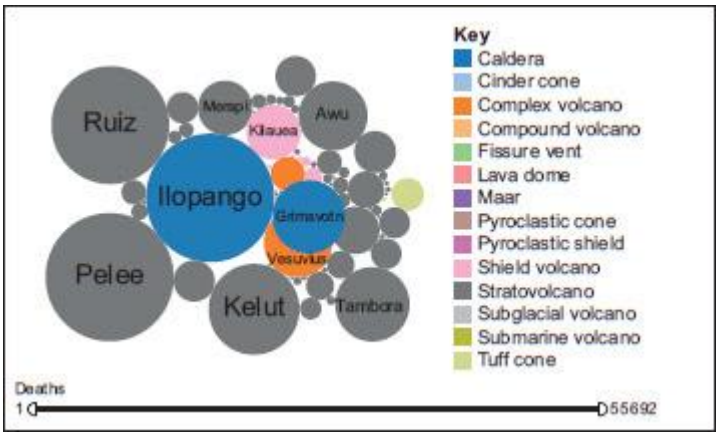


Figure 3

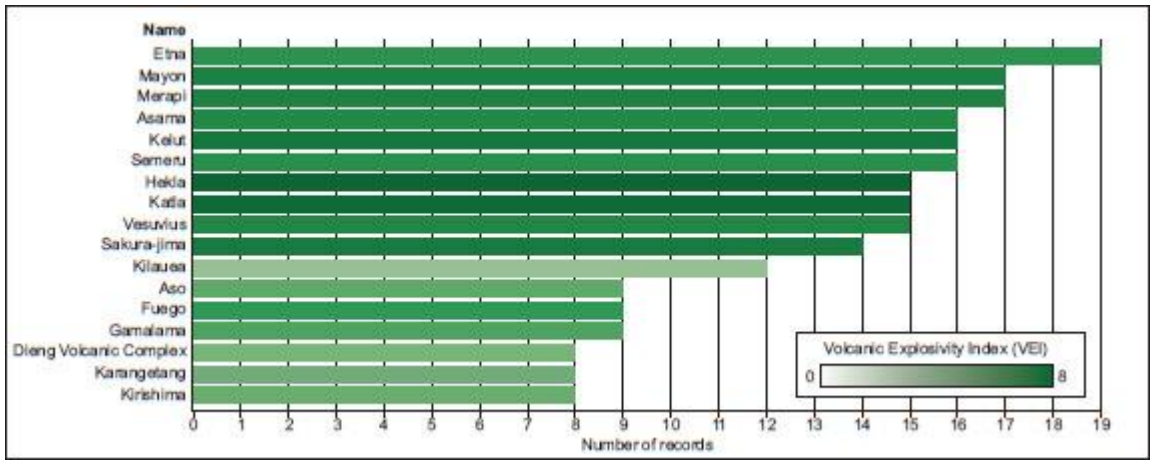
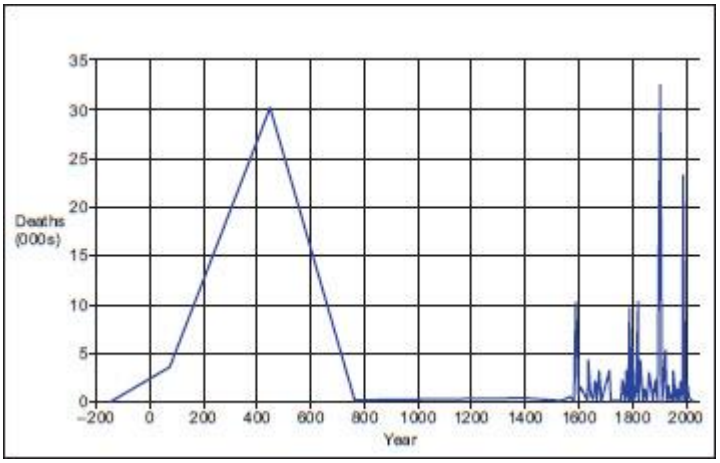


Figure 4



Assess the usefulness of **Figures 1 – 4** in presenting information on volcanic eruptions.

[6 marks]

Q2.

Figure 1 and **Figure 2** show information about an ash cloud following the eruption of an Icelandic volcano in 2010.

Figure 1

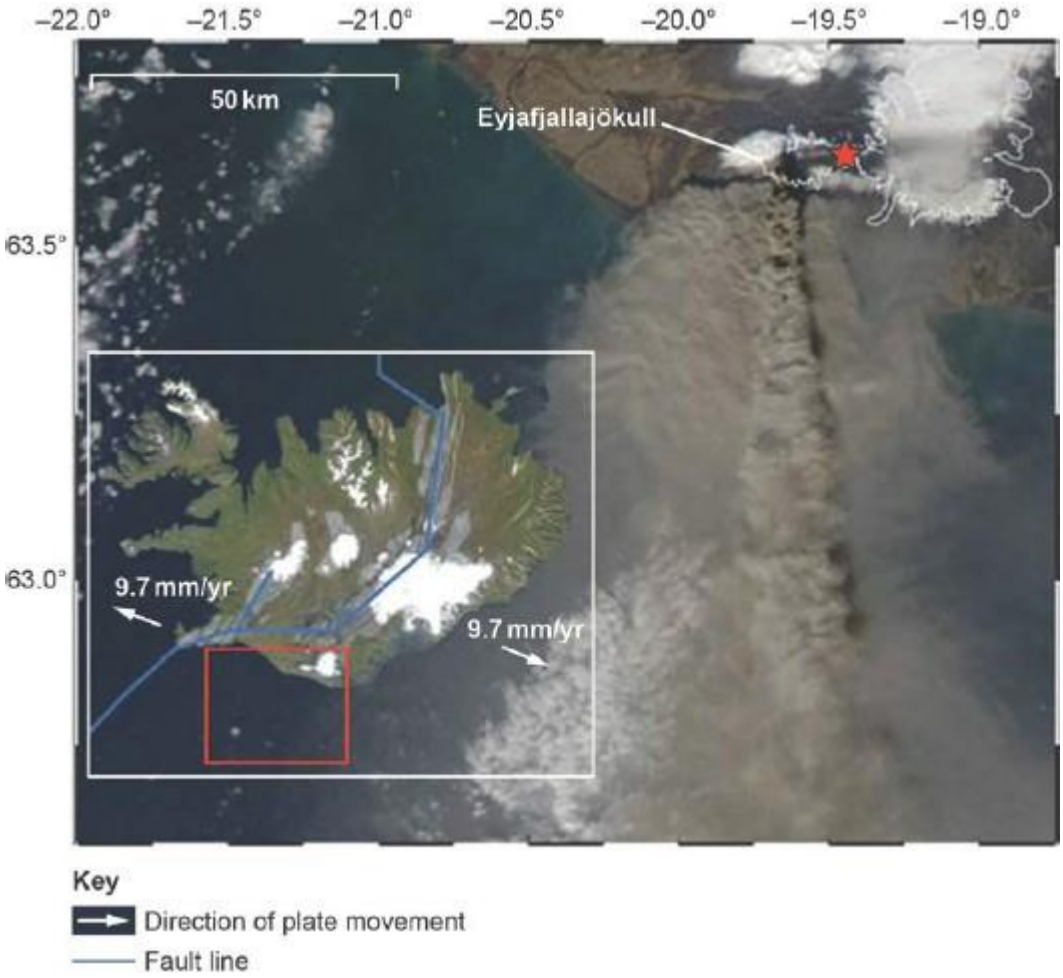
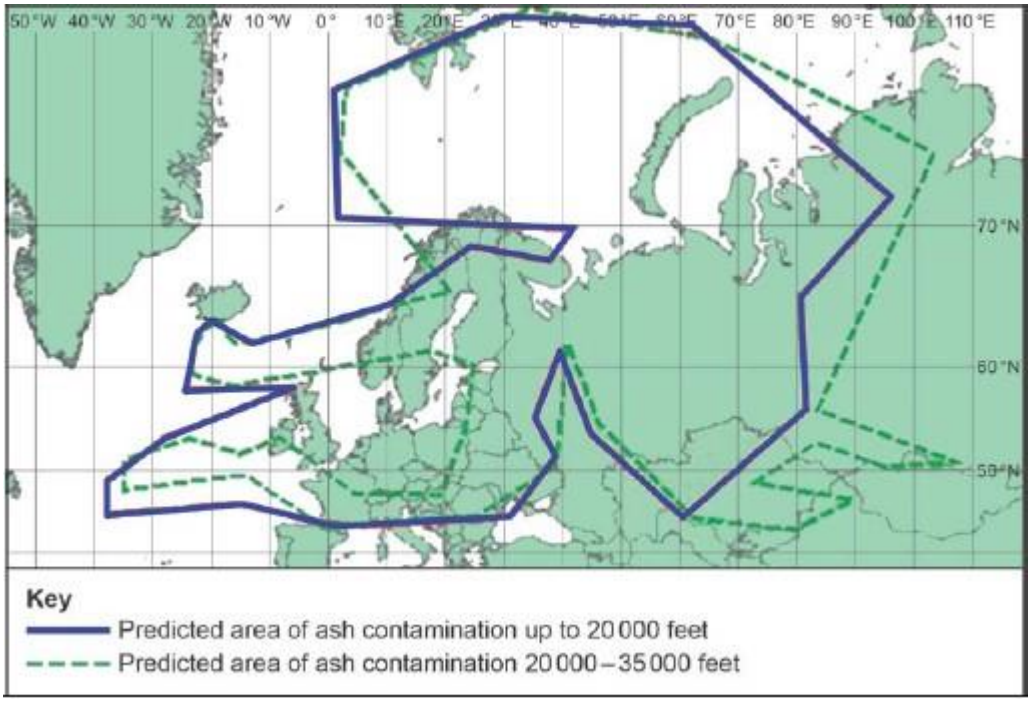


Figure 2



Using **Figure 1** and **Figure 2**, assess the scale of the eruption.

[6 marks]

Q3.

To what extent do you agree that seismic events will always generate more widespread and severe impacts than volcanic events?

[9 marks]

Q4.

Outline factors which lead to the formation of mudflows, a volcanic hazard.

[4 marks]

Q5.

'Seismic hazards will always be harder to manage than volcanic hazards due to their unpredictability and scale.'

To what extent do you agree with this view?

[20 marks]

Q6.

Assess the extent to which the frequency and magnitude of volcanic activity is more predictable at some plate margins than others.

[9 marks]

Q7.

Volcanic hazards will always have a greater impact than storm hazards.

To what extent do you agree with this view?

[20 marks]

Q8.

What is tephra?

[1 mark]

A	Ash, dust and rock fragments ejected during a volcanic eruption.	⬭
B	Destructive fast-flowing mudflows down the slopes of a volcano.	⬭
C	Large waves generated by seismic activity.	⬭
D	Rapidly moving clouds of hot ash, gas and lava erupted from a volcano.	⬭

Q9.

Outline the characteristics of **one** hazard associated with volcanic eruptions.

[3 marks]

Q13.

With reference to a place which has experienced a recent volcanic event, assess the importance of exogenous factors (links with other places) in responding to the event.

[9 marks]

Q14.

Figure 1 shows data related to the eruption of Kīlauea Volcano, Hawaii, USA, on 24 May 2018.

Figure 1

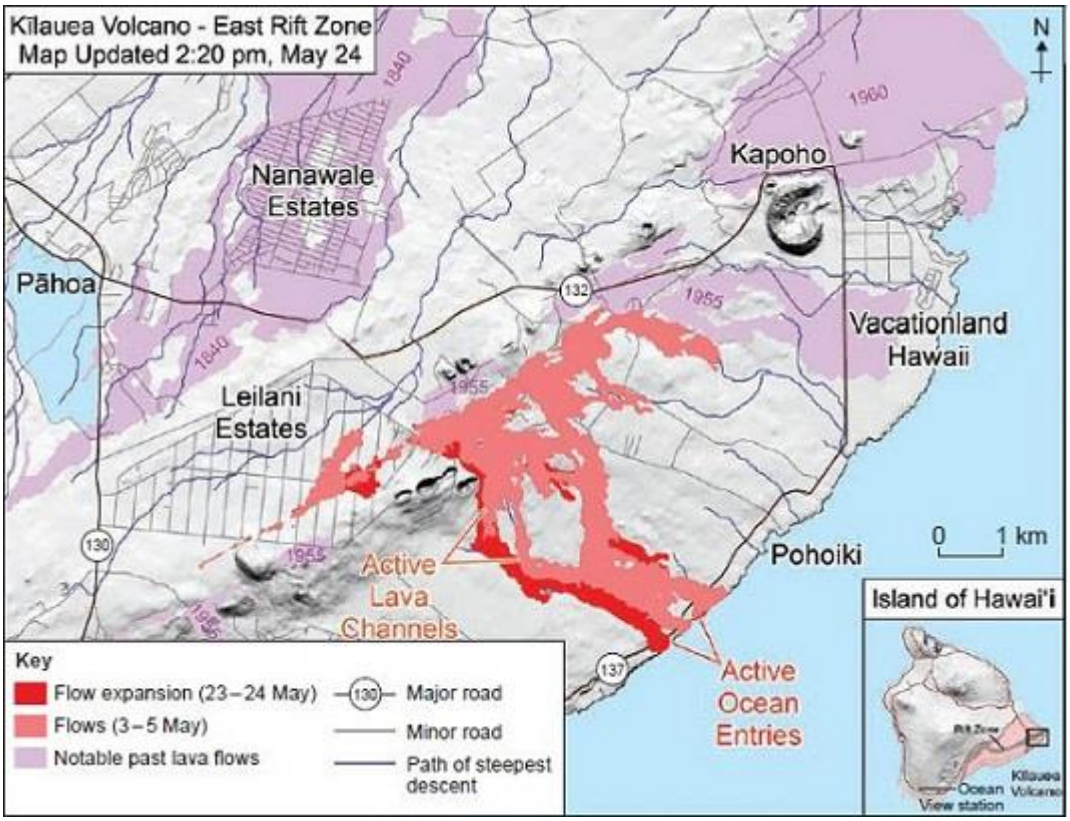
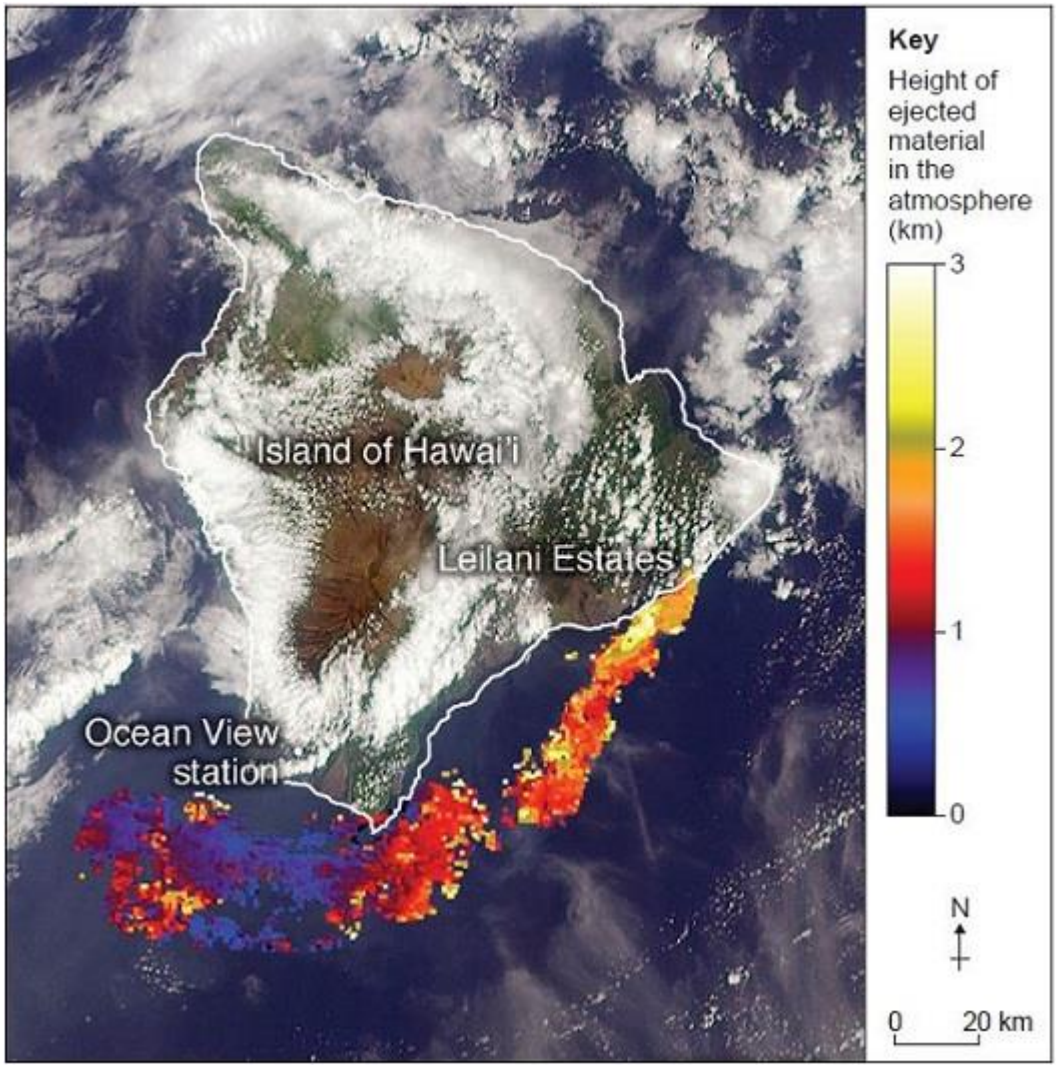


Figure 2 shows a satellite image of the same eruption.

Figure 2



Using **Figure 1** and **Figure 2**, analyse the data shown.

[6 marks]

Q15.

What is a nuée ardente?

[1 mark]

A A type of tephra associated with a volcanic eruption, often referred to as volcanic bombs or lava bombs. These are often yellow in colour and are shaped as they fly through the air. ⬭

B A secondary cone on the side of a large volcano. A separate line of weakness is broken through by the magma. ⬭

C A glowing, superheated mass of gas, ash and dust which is emitted from a volcano. It moves at great speed and is associated with mass casualties where it strikes settlements. ⬭

D A thick layer of ash which falls to the ground gradually over a series of days. It can block out the sun locally and lead to localised climate change. ⬭

Q16.

With reference to a multi-hazardous environment that you have studied, assess the view that the underlying cause(s) leading to the hazards is human activity rather than physical factors.

[20 marks]

Q17.

How far do you agree that secondary impacts of volcanic eruptions present a greater long-term threat to people than primary impacts?

[9 marks]

Q18.

Figure 1 shows data related to seismic activity and vertical motion in the Yellowstone caldera in the USA. Sour Creek (SC) is a resurgent dome in the Yellowstone caldera in the USA. A resurgent dome is formed by swelling or rising of a caldera floor due to movement in the magma chamber beneath it.

Figure 2 shows a map of Yellowstone: volcanic vents active since the last caldera collapse 640 000 years ago; earthquakes recorded between 2003 and 2008; faults; and ground deformation between 2004–2006.

Figure 1

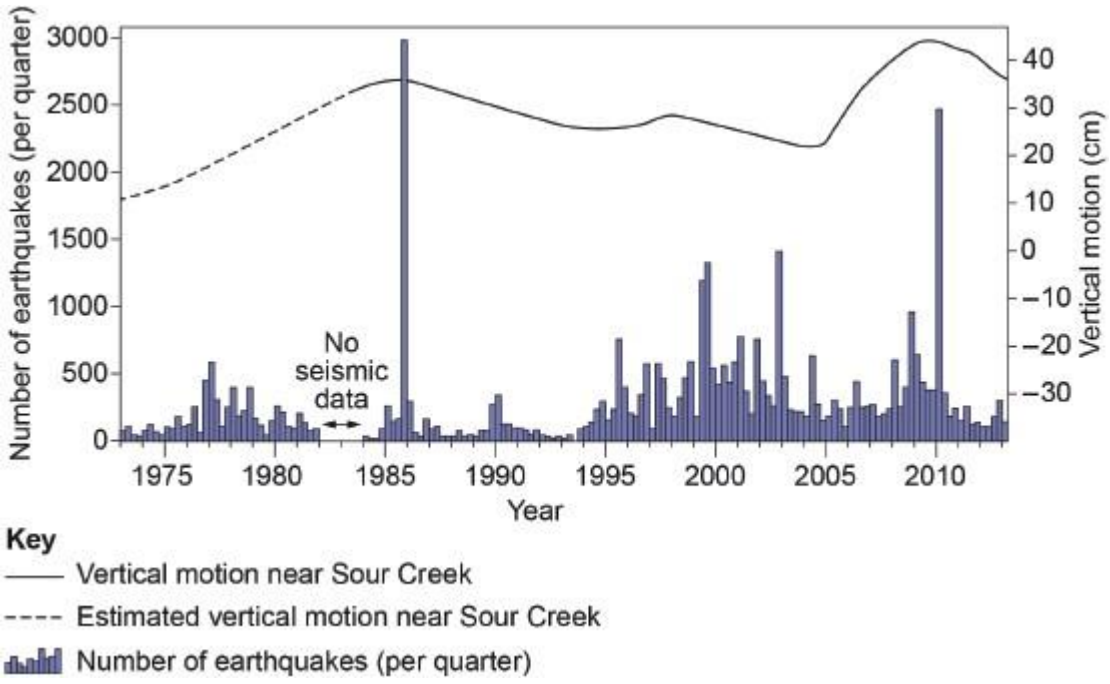
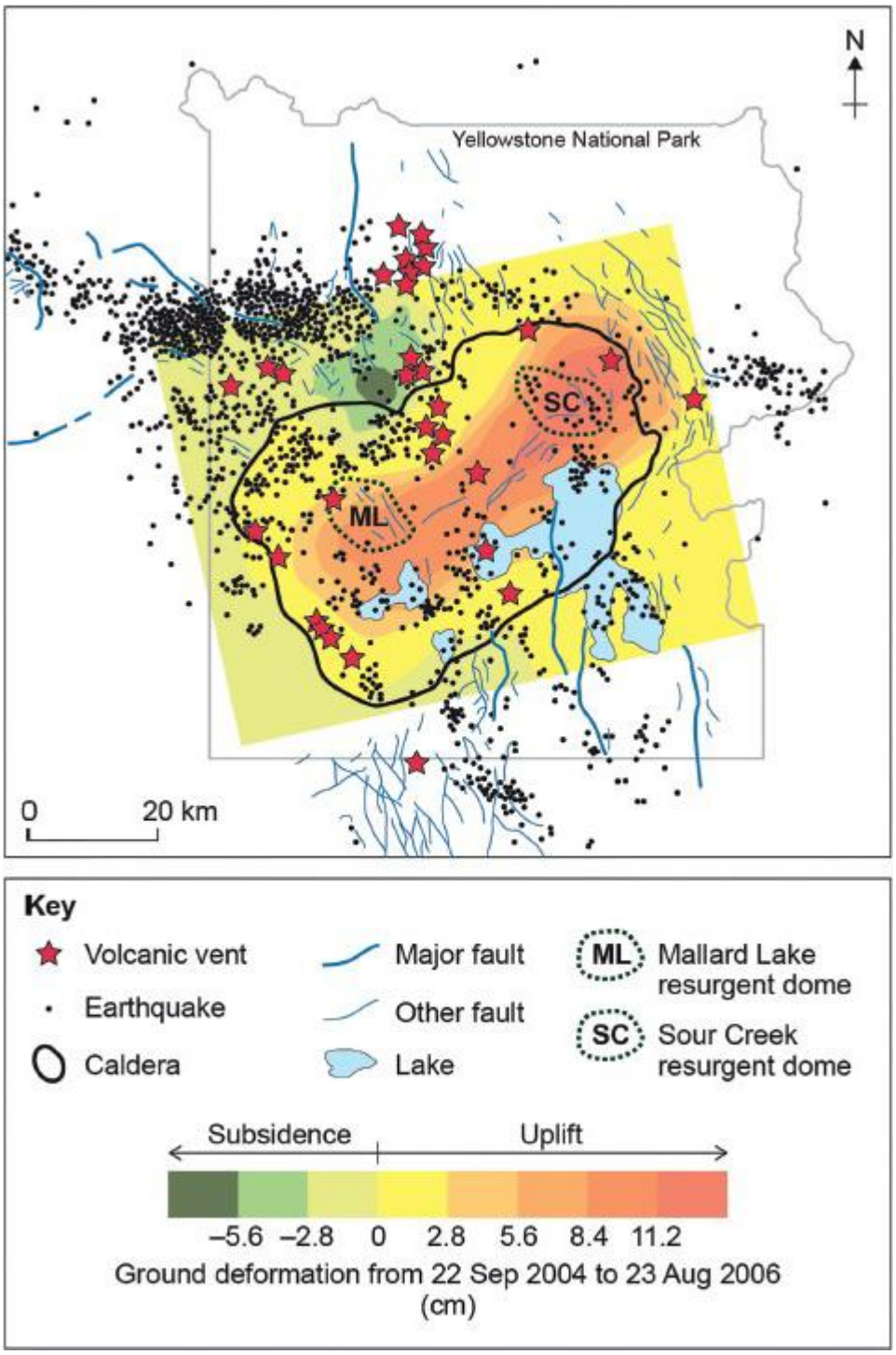


Figure 2



Analyse the data shown in **Figure 1** and **Figure 2**.

[6 marks]

Q19.

'The severity of the impacts of the volcanic hazards experienced in a place is affected more by the nature of plate boundaries than the level of development of the place.'

To what extent do you agree with this view?

[20 marks]

Q20.

To what extent do you agree that the impact of volcanic activity can be mitigated against more effectively than tropical storms?

[9 marks]

Mark schemes

Q1.

AO3 – There should be assessment of the information provided. This should include an awareness of the strengths and limitations of the techniques used to present information in this dataset.

Mark scheme

Level 2 (4–6 marks)
AO3 – Clear analysis of a geographical issue or question. Clear analysis of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence.

Level 1 (1–3 marks)
AO3 – Basic analysis of a geographical issue or question. Basic analysis of the quantitative and qualitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence.

Notes for answers
AO3

- The first graph is useful in that it provides an overview of the countries which experience deadly volcanoes. However, it is not possible to see specifically where these occur or when they occurred. Also, the scale uses a gradation of the colour green but on the map it is only possible to ascertain perhaps 5 colours and practically impossible to identify the number of deaths. Perhaps its only use is that it does given some sense of the relative impact on loss of life by place.
- The second resource (proportional circles) is also significantly limited. Whilst it is possible to see the most deadly volcanoes (eg Ilopanga, Pele, Ruiz), it is not possible to identify where these are located so the first and second resources cannot adequately be compared or related to each other. Similarly, most of the volcanoes have no names so are only useful in terms of identifying the type. Clearly the most deadly are stratovolcanoes.
- The third resource presents two pieces of information and this is more useful. There appears to be a loose correlation between VEI and frequency. VEIs tend to be more explosive where volcanoes are more frequent.
- The final resource is also of limited value and arguably not presented well. The data is discrete and not continuous. For instance, the event around 450 AD appears to have caused around 30 000 deaths. It is hard to understand what is being shown either side of this spike. It implies deaths continued until around 750 AD as a result of this incident because there are no other spikes. This does not seem plausible.
- Overall then, the resource has fairly substantial flaws as a method of presenting this data.
- Expect to see reference to at least two sources for access to Level 2.

Credit any other valid analysis.

AO3 = 6
[Total 6 marks]

Q2.

AO3 − There are two resources to use in conjunction with each other. The skills relate to

satellite image interpretation and cartographical skills. This interpretation will allow for the assessment of scale but will support comment related to the analysis of evidence.

Mark scheme

Level 2 (4−6 marks)
AO3 − Clear analysis and interpretation of the quantitative and qualitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence.

Level 1 (1−3 marks)
AO3 − Basic analysis and interpretation of the quantitative and qualitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence.

Notes for answers

AO3

- **Figure 1** suggests a very large scale eruption with the ash cloud drifting away from the source to the south of the island. The red box indicates the immediate area affected around 175 km^2. The ash cloud then disperses away from Iceland and is blown to the east, north east and south.
- There are two distinctions in the cloud evident by referring to **Figure 2**. This resource distinguishes between the area of ash cloud contamination from 0 to 20 000 ft and the area from 20 000 to 35 000 ft. There is lots of overlap between the two areas affected.
- Some may point to a limitation of the resource in the way it appears to indicate sharp boundary change when the likelihood is of a more gradual change.
- Both areas cover much of Europe (apart from the south) and into the western part of Russia.
- There seems to be a curious anomaly in the area to the north of Scandinavia. A relatively narrow strip of land is not affected at 0 to 20 000 ft. Similarly a large area in central Europe is not affected at 20 000 to 30 000 ft. There is also a curious shape to the area affected at 20 000 to 30 000 ft to the south west of the map which may represent a limitation to the resource.
- The summary should conclude that a very large part of Europe and Russia was affected at 0 to 35 000 ft.

AO3 = 6
[Total 6 marks]

Q3.

AO1 − Knowledge and understanding of a range of impacts of volcanic and seismic hazards.

AO2 − Application of knowledge and understanding to bring specification areas together and to analyse and evaluate, based upon evidence about which types of hazard are more severe and / or widespread. There should be some explicit assessment regarding the extent.

Mark scheme

Level 3 (7−9 marks)
AO1 − Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout.
AO2 − Applies knowledge and understanding appropriately with detail. Connections and

relationships between different aspects of study are fully developed with complete relevance. Analysis and evaluation is detailed and well supported with appropriate evidence. A well balanced and coherent argument is presented.

Level 2 (4−6 marks)
AO1 − Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy.
AO2 − Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Analysis and evaluation evident and supported with clear and appropriate evidence. A clear but partial argument is presented.

Level 1 (1−3 marks)
AO1 − Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy.
AO2 − Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Analysis and evaluation basic and supported with limited appropriate evidence. A basic argument is presented.

Notes for answers

The direction of the response largely depends upon the argument that the student wishes to put forward.

AO1

- When considering volcanic hazards expect to see reference to pyroclastic flows, lava flows, volcanic bombs, ash clouds and seismic activity (at the volcano). Some may bring case study material to the response and consider the impacts of these events and particularly violent events.
- Some may go further and contrast impacts in different places around the world such as Chaiten in Chile (2008) with Mt Etna in Italy (ongoing eruptions).
- For seismic events − hazards will mainly relate to the violent shaking and the associated damage to the built environments, to include wider infrastructural damage.
- Some may consider tsunamis as a hazard created by seismic events.
- Case studies are likely to include Japan 2011 or the Indian Ocean Tsunami in 2004. These may be contrasted with major events such as Haiti in 2010 or Sichuan in 2008.

AO2

- Evaluation − Overall it is extremely difficult to generalise as each is event is unique. However seismic events on land tend to generate extremely severe impacts particularly where the earthquake epicentre strikes a large urban area. Seismic events are also generally associated with more deaths than volcanic events. Management is also a factor in the sense that many countries have mechanisms in place to mitigate against the impact of such hazards, thus reducing the impact and severity. The ash cloud associated with volcanic eruptions can cause very widespread impacts, more widespread than seismic events which tend to cause more localised and severe damage.
- Evaluation − An exception to this is a supervolcano eruption. Whilst there are no recorded incidents of such eruptions, the geological record and structure of places such as Yellowstone, USA tells us that a caldera exists and a supervolcanic eruption could occur. Modelling of a potential eruption suggests the potential for enormous devastation with average global temperature reduction of up 20 °C, due to the

generation of a vast ash cloud. More locally, millions of Americans would be killed and up to two thirds of the USA would become uninhabitable.

- Analysis and evaluation − For the 'widespread' element of the question, it is reasonable to consider events such as the Icelandic volcano (2010) and suggest that the potential impact upon aviation and therefore the regional economy is much more severe than any seismic event. Specific case study knowledge may be applied to support this position.
- Analysis and evaluation − Others may contrast based upon income levels of countries, asserting that impacts tend to be managed more effectively in higher income countries, i.e. it is not seismic or volcanic nature which determines the scale of impact, but it is the location.

AO1 = 4, AO2 = 5

[Total 9 marks]

Q4.

Point marked

Allow 1 mark per valid point with extra mark(s) for developed points (d).
For example:

Point marked

AO1

- Mudflows (or lahars) are associated with the rapid melting of ice and snow following a volcanic eruption (1). These only occur where there is a substantial amount of snow or ice, typically at high altitude (1) (d). Lahars can also be triggered in some locations by tropical storms following an eruption (1) (d). The debris itself is comprised of water, volcanic ash, rocks and pyroclastic slurry (1).
- The lahar will typically flow down a valley side and occupy the river channel valley (1).
- An example was the Nevado Del Ruiz eruption which caused a lahar, killing over 20 000 people in Armero, Columbia (1) (d).

The notes for answers are not exhaustive. Credit any valid points.

AO1 = 4

[Total 4 marks]

Q5.

AO1 – Knowledge and understanding of the impact of seismic events and volcanic eruptions.

AO2 – Application of knowledge and understanding to assess the relative impact of volcanic and seismic events.

Notes for answers

AO1

- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gases/acid rain, tephra. Spatial distribution, magnitude, frequency, regularity and predictability of hazard events. Impacts: primary/secondary, environmental, social, economic, political. Short and long-term responses: risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation. Impacts and human responses as evidenced by a recent volcanic event.
- The nature of seismicity and its relation to plate tectonics: forms of seismic hazard: earthquakes, shockwaves, tsunamis, liquefaction, landslides. Spatial distribution,

randomness, magnitude, frequency, regularity, predictability of hazard events. Impacts: primary/secondary; environmental, social, economic, political. Short and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation. Impacts and human responses as evidenced by a recent seismic event.

AO2

- The direction of the response will largely depend upon the choice of supporting material and case study.
- Evidence suggests that seismic events present a greater threat to life than volcanic events. Recent events such as Haiti (2010), Indian Ocean Tsunami (2004), Tohoku, Japan (2011) and Sichuan, China (2008) all have death tolls in multiple thousands. Whilst this is impact and not management, it does point towards the scale of the management challenge.
- In comparison Mt Merapi Indonesia (2010), Anak Krakatoa, Indonesia (2018) and Nyiragongo, Democratic Republic of Congo (2002) all have death tolls in the hundreds.
- Managing earthquakes is arguably far less predictable than volcanoes as there are less clues to an impending event. It is now clear that events will tend to occur along plate boundaries but not when or at what magnitude. Equally, underwater earthquakes will often trigger tsunamis which can affect huge areas of coastline making then extremely difficult to respond to. Even Japan with its wealth and resources was not adequately prepared for the Tohoku event in 2011. Over 20 000 people died despite a sea wall and a warning system along this area of the coastline.
- Some may argue that it is precisely because of effective management that the number of deaths following volcanic eruptions is so relatively low. Volcanoes produce many early warning signs which are now well known to scientists. This allows for early evacuation and the setting up of exclusion zones.
- Some may consider the Eyjafjallajökull eruption in Iceland as an anomaly in terms of management. Whilst it created no deaths or serious injuries, the ash cloud grounded international air travel for a number of days, causing substantial economic loss. So, whilst the management in this case did not involve dealing with serious casualties, it did prove very difficult to manage and did cause substantial economic losses across Europe in particular.
- Some may consider the concept of the super volcano. The Yellowstone caldera is likely to feature in such responses. Whilst there is no recent evidence of a super eruption, if one did occur, it would be a global event with global consequences. This is likely to counter the idea that seismic hazards are harder to manage.
- Theoretical models are likely to feature in some responses. This is acceptable as long as such material is used to support the argument. The Park Model and the Hazard Management Cycle may feature.

Credit any other valid assessment.

Level 4 (16–20 marks)

- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (AO2).
- Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).
- Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).
- Full and accurate knowledge and understanding of key concepts, processes and

interactions and change throughout (AO1).
- Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).

Level 3 (11–15 marks)
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (AO2).
- Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

Level 2 (6–10 marks)
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).
- Some knowledge and understanding of key concepts, processes and interactions and change (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

Level 1 (1–5 marks)
- Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2).
- Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).
- Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes (AO1).
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

Level 0 (0 marks)
- Nothing worthy of credit.

AO1 = 10, AO2 = 10
[Total 20 marks]

Q6.

AO1 – Knowledge and understanding of the frequency and magnitude of volcanic activity. Knowledge and understanding of how the nature of plate boundaries affects the frequency

and magnitude of volcanic activity.

AO2 – Application of knowledge and understanding to analyse and assess whether the frequency and magnitude of volcanic activity is more or less predictable at different plate boundaries.

Level 3 (7–9 marks)
AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout.
AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well-supported with appropriate evidence.

Level 2 (4–6 marks)
AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant, though there may be some minor inaccuracy.
AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.

Level 1 (1–3 marks)
AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy.
AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

Notes for answers
AO1

- Earth structure and internal energy sources. Plate tectonic theory of crustal evolution: tectonic plates; plate movement; gravitational sliding; ridge push, slab pull; convection currents and sea-floor spreading.
- Destructive, constructive and conservative plate margins. Characteristic processes: vulcanicity.
- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gases/acid rain, tephra. Spatial distribution, randomness, magnitude, frequency, regularity and predictability of hazard events.

AO2

- Responses should assess the frequency of volcanic activity at different types of plate margins.
- Responses should assess the magnitude of volcanic activity at different types of plate margins.
- Assessment may assess the predictability of frequency and magnitude separately, however it is likely that a judgement will be given about the predictability of both at different plate margins.
- It is expected that volcanic activity is assessed at more than one type of plate margin.
- Assessment may be illustrated and supported with evidence from named plate boundaries or specific volcanoes.

Credit any valid assessment as long as the argument is coherent and feasible.

AO1 = 4, AO2 = 5
[Total 9 marks]

Q7.

AO1 − Knowledge and understanding of a range of volcanic hazards. Knowledge of the cause of volcanic hazards. Knowledge and understanding of development issues in hazard prone areas.

AO2 − Application of knowledge and understanding to evaluate the extent to which level of development is a key determinant in the impact of volcanic hazards.

Notes for answers

AO1

- Destructive, constructive and conservative plate margins. Characteristic processes: seismicity.
- Nature, forms and potential impacts of natural hazards (geophysical, atmospheric and hydrological).
- Hazard perception and its economic and cultural determinants.
- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gases / acid rain, tephra. Spatial distribution, magnitude, frequency, regularity and predictability of hazard events.
- The nature of tropical storms and their underlying causes. Forms of storm hazard: high winds, storm surges, coastal flooding, river flooding and landslides. Spatial distribution, magnitude, frequency, regularity, predictability of hazard events.
- Impacts: primary / secondary, environmental, social, economic, political.

AO2

- Some may separate out economic, social and environmental impacts. This is a legitimate approach.
- Scale is also likely to feature in responses. Candidates should recognise that both volcanoes and storms create hazards at a variety of scales.
- Volcanic hazards numerous and varied. Expect to see some consideration of a range of hazards which may well root in case study examples. Locally, the poisonous gases, lava flows, tephra and ash fall create problems for communities in the immediate vicinity of the event. Some will refer to the fact that with the latest monitoring equipment, evacuation procedures are now well developed in many places experiencing volcanic activity. These local impacts, in most cases, should not lead to loss of life but there is likely to be substantial economic damage, to infrastructure, property and farmland (most notably with ash falls). Expect to see reference to volcanoes such as Mount Pinatubo and Mt Etna.
- Hazards associated with ash cloud, lahars and pyroclastic flows are much more unpredictable and difficult to manage. Some may refer to the ash cloud associated with the Icelandic Eyjafjallajokull eruption which caused major economic impacts by downing international air travel due to risks for the jet engines caused by the fine particles. Others may refer to the Nevada Del Ruiz eruption which triggered a deadly lahar killing approximately 25,000 people. Others may refer to the potential impact of super volcanic eruptions and the potential global impact of these.
- In considering storm hazards, responses should note there are similarities which can help to mitigate the impact of storms. Modern meteorology is so advanced that the most damaging storms (tropical revolving storms) can be planned for days in advance. Nevertheless when they do strike, considerable damage is often caused. The main impacts are coastal and relate to flooding caused by storm surges. Cyclone Nargis is known to have killed up to 138,000 people as a result of flooding. Storms also cause heavy rainfall which causes river flooding. This is often much more difficult to manage and is less predictable. Some may consider UK river flood events. The impacts here are likely to relate to economic and environmental damage as opposed to significant loss of life.

- Similarities in volcanic and storms hazards may be drawn in considering tsunamis (which can be triggered by volcanic eruptions).
- Evaluation should come to a view. Any view is permissible provided it is geographically sound and related to preceding content. Comparison and contrast should permeate the response.

Level 4 (16−20 marks)
- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (AO2).
- Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).
- Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).
- Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout (AO1).

Level 3 (11−15 marks)
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (AO2).
- Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1).

Level 2 (6−10 marks)
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretations are partial but do support the response in places.
- Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).
- Some knowledge and understanding of key concepts, processes and interactions and change. There may be a few inaccuracies (AO1).

Level 1 (1−5 marks)
- Very limited and / or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretation is basic.
- Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).
- Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).

- Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies (AO1).

Level 0 (0 marks)
- Nothing worthy of credit.

AO1 = 10, AO2 = 10
[Total 20 marks]

Q8.

A

AO1 = 1
[Total 1 mark]

Q9.

Notes for answers

1 mark per valid point with additional marks for developed points (d).

- Pyroclastic flows are created in the midst of a volcanic explosion (1).
- Plumes of hot gas, ash and dust are forced out of the glacier (up to 1100°C, (1).
- The debris moves at very high speed (up to 450 mph) down the sides of the volcano under the force of gravity (1).
- The scale of the pyroclastic flow can be vast covering 1−10 km^3 (1).
- The intense heat, poisonous gasses and speed combine to create highly hazardous conditions (d)(1).

AO1 = 3
[Total 3 marks]

Q13.

AO1 – Knowledge and understanding of the human response to a recent volcanic event. Knowledge and understanding of the role played by exogenous in the response to the volcanic event.

AO2 – Application of knowledge and understanding to assess the level of importance of exogenous factors in a place in response to a recent volcanic event.

Mark scheme

Level 3 (7–9 marks)
AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout.
AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Analysis is detailed and well-supported with appropriate evidence.

Level 2 (4–6 marks)
AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant, though there may be some minor inaccuracy.
AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Analysis is evident and supported with clear and appropriate evidence.

Level 1 (1–3 marks)
AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy.
AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Analysis is basic and supported with limited appropriate evidence.

Notes for answers

AO1

- Impacts and human responses as evidenced by a recent volcanic event.
- Impacts: primary / secondary, environmental, social, economic, political. Short and long-term responses: risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.
- Nature, forms and potential impacts of natural hazards (geophysical, atmospheric and hydrological). Hazard perception and its economic and cultural determinants. Characteristic human responses – fatalism, prediction, adjustment / adaptation, mitigation, management, risk sharing – and their relationship to hazard incidence, intensity, magnitude, distribution and level of development. The Park model of human response to hazards. The Hazard Management Cycle.
- Case study at a local scale of a specified place in a hazardous setting to illustrate the physical nature of the hazard and analyse how the economic, social and political character of its community reflects the presence and impacts of the hazard and the community's response to the risk.
- Factors contributing to the character of places:
  – Exogenous: relationships with other places.

AO2

Responses are expected to show an understanding of the nature of the response to a volcanic event. There should be clear recognition of the learning from the Changing Places unit in assessing the importance of exogenous factors on the people's response to the volcanic event. Reciting learned case study material does not constitute AO2. It is the integration of the place study ideas and concepts which allow access to AO2.

- There are any number of recent volcanic events to which candidates can refer; therefore, their overall assessment of the importance of exogenous factors will depend on the case study provided.
- When assessing the response to the recent volcanic event candidates may address concepts of fatalism, prediction, adjustment / adaptation, mitigation, management and risk sharing.
- Responses may also assess the response to the volcanic event in the context of The Park model and the Hazard Management Cycle.
- Responses may assess both short- and long-term responses including the level of preparedness, mitigation, prevention and adaptation.

The above are legitimate elements to include in a response, but assessment must focus on the level of importance of the exogenous factors on these responses.

- The nature of the exogenous factors being assessed will depend on the recent volcanic event. However, exogenous factors to be assessed could include:
  – in the relief phase – support in the form of emergency food, medical and other supplies; search and rescue advice, equipment and teams; financial aid
  – in the rehabilitation and reconstruction phases – support in rebuilding and repairing damage in the form of financial aid, equipment and materials, and volunteers; support in the form of expert advice and guidance in terms of rebuilding in ways to mitigate future risks
  – the role of NGOs or other governmental organisations in response to the volcanic event
  – other factors that could be explored could include the strength of international

openness to the affected location; the level and importance of international connections of the place, i.e. if it is a popular tourist destination or important location for international business and trade; the level of personal external links to family and friends overseas, i.e. the availability of financial remittances from overseas.

- Exogenous factors can operate at a range of scales. Some may refer to links with neighbouring settlements, whilst others may refer to international links. All scales are valid.
- The key is that there is clear assessment of the importance of the exogenous factors on the response to the volcanic event.

Credit any other valid assessment.

AO1 = 4
AO2 = 5
[Total 9 marks]

Q14.

AO3 – There are two resources to use in conjunction with each other. The skills relate to map and satellite data analysis.

Mark scheme

Level 2 (4–6 marks)
AO3 – Clear analysis of a geographical issue or question. Clear interpretation of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence.

Level 1 (1–3 marks)
AO3 – Basic analysis of a geographical issue or question. Basic interpretation of the quantitative and qualitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence.

Notes for answers

AO3

- This area has experienced a significant amount of volcanic activity in recent years. The flows appear to be emanating along a rift zone which is aligned from south west to north east and close to the summit of the Kilauea volcano. All of the flows appear to then move in a south easterly direction towards the coast. The only exception is an area to the south east of the Leilani Estates. Here the lava appears to follow a path of steepest descent. The flows also, at least in part, follow flow channels towards the coastline south west of Pohoiki.
- **Figure 2** shows a plume of what appears to be volcanic ash, gas and dust. The direction of travel is south westerly and the plume appears to lose height with distance from site of eruption. From around 3km the plume drops in height by around 2.25km just south of Ocean View Station. This is approximately 70 to 100km from the eruption site. One anomaly appears to be that the plume of gas, ash and dust appears to rise again by around 1km to 1.5km.

Credit any other valid analysis.

AO3 = 6
[Total 6 marks]

Q15.

C

AO1 = 1

[Total 1 mark]

Q16.

AO1 − Knowledge and understanding of a named multi hazardous environment. Aware of the factors which have contributed to generate the hazards.

AO2 − Application of knowledge and understanding to identify and assess the causes of hazards in multi hazardous environments.

Notes for answers

The direction of the response largely depends upon the chosen case study of the multi hazardous environment as well as the hazards contained within that location.

AO1

- Case study of a multi-hazardous environment beyond the UK to illustrate and analyse the nature of the hazards and the social, economic and environmental risks presented, and how human qualities and responses such as resilience, adaptation, mitigation and management contribute to its continuing human occupation.
- Nature, forms and potential impacts of natural hazards (geophysical, atmospheric and hydrological). Hazard perception and its economic and cultural determinants. Characteristic human responses − fatalism, prediction, adjustment / adaptation, mitigation, management, risk sharing − and their relationship to hazard incidence, intensity, magnitude, distribution and level of development. The Park model of human response to hazards. The Hazard Management Cycle.

AO2

- Los Angeles, USA is considered to be a multi hazard environment though other case studies may feature. Expect to reference to places such as Haiti, The Philippines and Japan.
- In Los Angeles, it would be difficult to argue to that all hazards are generated by human activity. As an advanced economy, the city has the economic advantage of being able to manage many of its hazards, though not all are easily manageable or predictable. Lying close to the San Andreas Fault (with a number of other minor faults in the area such as the Northridge / Santa Barbara Fault), the area is prone to significant seismic activity. It is not possible to argue that this root cause is human activity in this regard. However, managing the impact of the hazard is a significant preoccupation and human endeavour in the area. Some may argue that hazard is made more or less dangerous by the extent of management of the hazard. This is a legitimate approach. There are other hazards though, which are certainly the product of human activity.
- Wildfire periodically affects the Los Angeles basin. Whilst the main cause is the flammability of vegetation as a result of drought and the dry vegetation, human factors certainly exacerbate the issue. Human activity is known to start wildfire and building in areas prone to wildfire inevitably adds to the problem. Expect to see reference to recent events in support e.g. June '17 four major brush fires struck LA, affecting over 6000 acres of land. It was sparked by a car crash in the San Jacinto mountains. However, it was also fuelled by high temperatures, low humidity and wind gusts of up to 35 mph. This shows that in this case, it was a combination of human and physical factors which created this hazard.

Whatever the approach, there should be more than one hazard considered and a clear overarching response to the question.

Level 4 (16−20 marks)

- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (AO2).
- Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).
- Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).
- Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout (AO1).

Level 3 (11−15 marks)

- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (AO2).
- Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1).

Level 2 (6−10 marks)

- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretations are partial but do support the response in places.
- Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).
- Some knowledge and understanding of key concepts, processes and interactions and change. There may be a few inaccuracies (AO1).

Level 1 (1−5 marks)

- Very limited and / or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretation is basic.
- Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).
- Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies (AO1).

Level 0 (0 marks)
- Nothing worthy of credit.

AO1 = 10, AO2 = 10
[Total 20 marks]

Q17.

AO1 − Knowledge and understanding of the primary and secondary impacts of volcanoes.

AO2 − Application of knowledge and understanding to assess the extent to which the secondary impacts cause greater long-term damage to populations than the primary impacts.

Mark scheme

Level 3 (7−9 marks)
AO1 − Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout.
AO2 − Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well supported with appropriate evidence.

Level 2 (4−6 marks)
AO1 − Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy.
AO2 − Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.

Level 1 (1−3 marks)
AO1 − Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy.
AO2 − Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

Notes for answers

AO1
- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gases / acid rain, tephra. Spatial distribution, magnitude, frequency, regularity and predictability of hazard events.
- Impacts: primary / secondary, environmental, social, economic, political.
- Impacts as evidenced by a recent volcanic event.

AO2
- The focus of the response is impact. Cause and response may feature but protracted narrative is unlikely to remain focused upon the question.
- There is likely to be a brief distinction made between the two types of hazard. Primary impacts are immediate and arise directly out of the event. Secondary hazards are triggered as a result of the primary hazards and occur in the aftermath.
- The main primary hazards are pyroclastic flows. These are accepted as the deadliest of the primary impacts responsible for thousands of deaths worldwide. They are impossible to avoid if a person is in the vicinity because they travel with

great speed and are highly destructive. The other hazards of lava flows, volcanic gases and tephra generally cause less deaths. Lava flows are much easier to avoid. Tephra is highly dangerous but easier to avoid. Volcanic gases are deadly but only in rare circumstances do they cause death. Some may argue that threats to people includes ash fall on farmland as well as destruction of property by lava flows. This is a legitimate approach.

- Historically it is the secondary impacts which have proven most deadly, even generating global impacts.
- Lahars are triggered in circumstances where there is rapid ice melt following an eruption. These are perhaps the deadliest of all secondary hazards. Some will point to the impact of the Nevada Del Ruiz eruption in this regard. Floods may also be considered in this context.
- Whilst tsunamis are more associated with seismic activity under sea water, they can be triggered by volcanic eruptions also.
- There is also a known and clear link to climate change associated with eruptions. Ash clouds from the Pinatubo were shown to reduce global temperatures by up to 1°C.
- Some may point to the substantial economic costs associated with the generation of ash clouds, particularly if air travel is disrupted.
- Some may also consider the global impact of a super eruption. Such an event is likely to present catastrophic primary effect in the region but also in terms of the global climatic impact.

If threat is measured by amount of destruction, greatest loss of life and longest recovery time, then it is likely that most will argue secondary hazards posed the greatest threat.

AO1 = 4, AO2 = 5

[Total 9 marks]

Q18.

AO3 − There are two resources to use in conjunction with each other. The skills relate to graphical interpretation and analysis of the map data. Analysis relates to identification of pattern and trends as well as anomaly. Where appropriate there should be some manipulation of data.

Mark scheme

Level 2 (4−6 marks)
AO3 − Clear analysis and interpretation of a geographical issue or question. Clear analysis and interpretation of the quantitative evidence provided, which makes appropriate use of data in support. Clear connection(s) between different aspects of the data and evidence.

Level 1 (1−3 marks)
AO3 − Basic analysis and interpretation of a geographical issue or question. Basic analysis and interpretation of the quantitative and qualitative evidence provided, which makes limited use of data and evidence in support. Basic connection(s) between different aspects of the data and evidence.

Notes for answers

AO3

- **Figure 1** suggests that there might be some correlation between the number of earthquakes and the vertical deformation in the caldera. However, this is by no means strong. For instance, the large peak in 1985 appears to correlate with the peak of vertical deformation of around 30 cm. Similarly, around 2006 to 2011, the

flurry of earthquakes in that period appears to correlate with another substantial vertical deformation of up to 40+ cm. Some may calculate the growth rate at between 5 and 7 cm per year. However, between 1997 and 2004 there is a sustained period of regular seismic activity but seismic activity shows a decline in vertical deformation.

- Some may suggest that over the period in question the caldera is growing despite the relative variation within the data. This includes a period where the data has been estimated. This could be calculated at around 27 cm or 0.3 cm per year approximately.
- **Figure 2** supports some aspects of **Figure 1** though the timescales for data collection are different. The data suggests an uplift of over 11.2 cm across the central part of the caldera. **Figure 2** also suggests uplift but not to this degree and it does include the same study area (Sour Creek). **Figure 1** suggests only around 5 cm of uplift during this period.
- There is some evidence of clustering of earthquakes and some may argue that these clusters appear more common around major and minor faults. The main cluster appears to the north-west of the caldera, but this is not an area experiencing uplift according to the data. This may be used to challenge the link between vertical deformation and seismic activity.
- The vents seem to appear in linear bands stretching from almost north to south across the caldera. There is no obvious link to the vents and either seismic activity or vertical deformation except for one cluster in the centre of the caldera.

AO3 = 6

[Total 6 marks]

Q19.

AO1 − Knowledge and understanding of the nature of volcanic hazards. Knowledge and understanding of the effects of the nature of plate boundaries and levels of development on the impacts of volcanic hazards.

AO2 − Application of knowledge and understanding to assess how the nature of plate boundaries and levels of development affect the severity of the impacts of volcanic hazards. Judgements should be made about the importance of the nature of plate boundaries compared to the level of development in determining the severity of the impacts of volcanic hazards experienced.

Notes for answers

AO1

- Nature, forms and potential impacts of natural hazards (geophysical).
- Hazard perception and its economic and cultural determinants.
- Characteristic human responses − fatalism, prediction, adjustment / adaptation, mitigation, management, risk sharing − and their relationship to hazard incidence, intensity, magnitude, distribution and level of development. The Park model of human response to hazards. The Hazard Management Cycle.
- Earth structure and internal energy sources. Plate tectonic theory of crustal evolution: tectonic plates; plate movement; gravitational sliding; ridge push, slab pull; convection currents and sea floor spreading.
- Destructive, constructive and conservative plate margins. Characteristic volcanic processes. Associated landforms − volcanoes.
- Magma plumes and their relationship to plate movement.
- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gasses / acid rain, tephra. Spatial distribution, randomness, magnitude, frequency, regularity and

predictability of hazard events.

- Impacts: primary / secondary, environmental, social, economic, political. Short and long-term responses: risk management designed to reduce the impacts of the hazards through preparedness, mitigation, prevention and adaptation.
- Impacts and human responses as evidenced by a recent volcanic event.

AO2

- Analysis − Responses are expected to give an assessment of the nature and severity of volcanic hazards associated with different plate margins.
- Analysis − Some responses may suggest that plate boundaries have little impact on some volcanic hazards as they are associated with magma plumes and hot spots, and occur at some distance from plate boundaries.
- Analysis − Responses are expected to include a discussion of the extent to which the level of development affects the nature and severity of volcanic hazards experienced. Expect discussion of the role of development in affecting characteristic human responses to volcanic hazards.
- Analysis − The specific nature of the content of the response may depend on the illustrative examples used in support. In some instances the nature of the plate boundary is clearly significant as it either leads to very severe volcanic hazards on the one hand, or hazards that are perceived to be much less severe on the other, and responses may compare hazards as destructive versus constructive plate margin settings.
- Analysis − Responses may address the effect that the level of development has on the impacts of volcanic hazards via a comparison of the severity of the impacts experienced in places considered to be at different levels of development.
- Analysis − Some responses may suggest that places considered to be at higher levels of development may experience more severe impacts due to the extent of potential costs to the economy, infrastructure and possessions, whilst the impacts in places at lower levels of development may experience less severe impacts in this regard.
- Expect responses to use illustrative examples to support points made, and reference to any place experiencing volcanic hazards is valid, and this approach may enhance the quality of the response.
- Analysis − Expect responses to include a discussion of level of economic development and its impact on the ability to cope with the hazard risk. However, equal weighting could be given to other factors such as cultural and social factors that may have just as great an impact, or greater, on hazard perception and therefore the ability to cope with the risk, and so affect the severity of the impacts.
- Overall the response must make clear links between how the nature of plate boundaries and level of development affect the severity of the impacts of volcanic hazards.
- Any overall conclusion is legitimate as long as there is clear rationale based upon preceding content.

Level 4 (16−20 marks)

- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question (AO2).
- Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).
- Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).
- Full and accurate knowledge and understanding of key concepts and processes throughout (AO1).
- Detailed awareness of scale and temporal change which is well-integrated where

appropriate (AO1).

Level 3 (11−15 marks)
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (AO2).
- Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

Level 2 (6−10 marks)
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).
- Some knowledge and understanding of key concepts, processes and interactions and change (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

Level 1 (1−5 marks)
- Very limited and / or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2).
- Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).
- Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes.
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

Level 0 (0 marks)
- Nothing worthy of credit.

AO1 = 10, AO2 = 10

[Total 20 marks]

Q20.

AO1 – Knowledge and understanding of the responses to tropical storm hazards. Knowledge and understanding of the responses to volcanic hazards.

AO2 – Application of knowledge and understanding in evaluating the relative ease with which these events can be managed.

Mark scheme

Level 3 (7–9 marks)
AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout.
AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well supported with appropriate evidence.

Level 2 (4–6 marks)
AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy.
AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.

Level 1 (1–3 marks)
AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy.
AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

Notes for answers

AO1

- The nature of tropical storms and their underlying causes. Forms of storm hazard: high winds, storm surges, coastal flooding, river flooding and landslides. Spatial distribution, magnitude, frequency, regularity, predictability of hazard events.
- Impacts: primary / secondary, environmental, social, economic, political. Short and long-term responses:
- risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.
- Impacts and human responses as evidenced by two recent tropical storms in contrasting areas of the world.
- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gases / acid rain, tephra. Spatial distribution, magnitude, frequency, regularity and predictability of hazard events.
- Impacts: primary / secondary, environmental, social, economic, political. Short and long-term responses:
- risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.
- Impacts and human responses as evidenced by a recent volcanic event.

AO2

- Candidate responses are likely to be heavily influenced by the exemplification and case study material. Clearly the answer to the question depends upon the event.
- Cyclone Nargis for example killed 138 000 in 2008. This caused the worst natural disaster in the recorded history of Myanmar.
- The cyclone made landfall in Myanmar on Friday, 2 May 2008, sending a storm surge 40 kilometres up the densely populated Irrawaddy delta, causing catastrophic destruction. The Labutta Township alone was reported to have 80 000 dead, with about 10 000 more deaths in Bogale. Damage was estimated at over US$10 billion.
- Clearly managing this event, for the government of Myanmar was impossible. The

scale of the devastation and the lack of preparedness and evacuation strategies meant that local people simply did not have a chance. There was an international aid effort following the event and this no doubt helped to minimise the secondary impacts.

- Similarly the Armero tragedy of 1985 led to 23 000 deaths when an eruption triggered a series of lahars. The location and relative poverty meant that local people did not have a chance to escape the 50 kmph lahars.
- Some may argue that tropical storms are more predictable and with latest forecasting and satellite technology, it is possible to avoid the worst impacts by evacuation. However equally, in recent history, tropical storms (and their impacts) have proved to be far more deadly than volcanic eruptions.

Either position is acceptable as long as it is coherently argued.

AO1 = 4
AO2 = 5
[Total 9 marks]

Examiner reports

Q4.

It was surprising to note that many of the students did not know what a mudflow was in the context of volcanic hazards. Some drifted into the characteristics of mudflows and the damage they can cause without actually addressing the factors leading to the formation of them. There was no credit for this.

Q5.

This was another highly accessible question which allowed students full access of the mark range depending on their preparation. The main differentiators related to the depth of support and the quality of the argument. Most agreed with the statement, though some considered the super volcano concept or Pinatubo eruption as evidence of global impact, thus challenging the statement. In this sense, they split predictability and scale and produced quite sophisticated responses.

Q6.

This question differentiated quite well, with almost 2/3 of students getting into Level 2 or higher, and only about 15% getting in to Level 3. The best responses had clear knowledge and understanding of the tectonic processes operating at different plate margins. These often also evidenced a clear grasp of how the nature of volcanic activity differed at these different boundaries. It was envisaged that most students would take a theoretical approach, and then possibly support points with some specific detail or evidence from a named example. Many did do this, but a significant number also made case studies of volcanoes in different tectonic settings the focus. This was creditworthy. Again, the best answers gave very clear assessment, and came to a clear view of the predictability of volcanic activity in different settings. The weakest answers displayed very little knowledge and understanding of either the nature of different plate margins or volcanic activity.

Q7.

Students generally engaged well with this question and it also differentiated well. 58% of students accessed Level 3, producing clear and focused (if not detailed) responses to the question set.

It was impressive to note the number of case studies which were used to support responses. These were generally used well to support and exemplify but also to address the AO2 element. This required comparison between the two types of hazard.

Students were free to argue either with the majority arguing that storm hazards present greater impact than volcanic hazards.

Less impressive responses failed to compare and largely recited learned case studies with limited clarity. This constituted AO1 only and was held to a maximum of Level 2 as a partial answer.

Q13.

This question required students to make a link across the specification units and it remains worthwhile to remind centres that in every series there will be one question which crosses specification units - at both AS and A-level. It is clear that many students were well prepared for this with a large majority achieving Level 2 or higher. In this case, the link was from *Hazards* to *Changing Places*. The concept from *Changing Places* of exogenous factors (links with other places) featured in this hazards question.

Examiners encountered a range and variety of case studies. However, some centres have clearly interpreted the requirement to study a 'recent' event very broadly. Students were not penalised for this. Most students went beyond a simple list of responses to their chosen event and did at least begin to assess the involvement of links to other places. There was no prescription as to how distant the places considered should be, nor was, for example, an international dimension required. Some responses successfully referred to links to places that were relatively close to the event, for example neighbouring settlements providing shelter or support workers, whilst others interpreted 'links with other places' to be more distant international links. Various approaches were acceptable.

Q14.

Opportunities to clearly engage with the resource were missed by many students. A number did access level 2 but few scored full marks. In this type of question, students should look for patterns; in this case, how the latest flow compared with previous flows or how the direction of flow varied. Students should also look for analysis of scale and area of coverage. Relatively few did this and instead focused on describing potential impacts and disruption cause by the eruption. This constituted AO2 and was not credited. **Figure 2** was more effectively engaged with. Many did consider the scale of eruption and direction of ejected material. Many noted the gradual reduction in height of ejected material with distance from the source of the eruption.

Q15.

It was surprising to note that only 42% of responses knew that nuee ardente was option C.

Q16.

Some students self-penalised here by referring to more than one multi hazard environment. This did not allow such responses to get to the required depth in such a relatively short amount of writing time. In considering the question, the best responses understood that human activity is always the underlying the cause. The fact is that an event only becomes a hazard when it affects people in places. It is the human occupation of the place which creates the hazard. However equally others argued that the underlying cause is often physical, for example referencing tectonic processes in the development of seismic hazards. Either approach was credited. Some students ran out of time and lost marks simply through poor time management.

Q17.

The main issue here was in relation to what constitutes a primary and secondary impact of a volcanic eruption. Some failed to distinguish between them. More sophisticated responses suggested that it was not a matter of primary versus secondary but more an issue of where the event strikes. Links were then made to development and how different countries are able to respond according to economic factors. Case studies did feature, most notably the Icelandic Eruption of 2010 and Montserrat in 1997. These were generally incorporated well into the response. It was also important to note that students needed to form a view in relation to the context of the question. Some clearly forgot to do this.

Q18.

The main point here was the two sources showed overlapping information but also both showed information that the other did not. The best approaches tried to analyse what was common between both resources. However there was credit for identifying links within

each data set. For example in **Figure 1**, there was some evidence that uplift did occur following periods of more intense seismic activity. A basic link in **Figure 2** was to see the correlation between the main faults and more intense seismic activity in the northwest of Yellowstone. The best answers looked closely at Sour Creek and tried to compare and contrast the two sets of information.

Q19.

This question differentiated reasonably well with 47% of candidates reaching Level 3 or higher. This suggests that alongside these clear, and at times detailed, responses there were many that did reach this level of clarity. The better answers were rooted in located examples. Many good responses were able to give clear and detailed AO1 knowledge and understanding of the nature of plate boundaries and the impact this has on the frequency, severity and magnitude of the volcanic events experienced. These also explored how the level of development of the place affected the level of impact. Many explored the extent to which the level of development affected the level of vulnerability, ability to cope and any mitigation that may be in place. This was creditworthy. Some made general statements that implied low levels of development inevitably led to more severe impacts. Whilst others made assessment relating to specific locations. Some of the weakest responses had very limited awareness of the nature of volcanic activity in different tectonic settings. It was difficult for these responses to move beyond Level 2 as partial responses. Generally, it was the quality of assessment that moved responses through the levels.

Q20.

Students were free to argue either way, meaning that responses were very varied. Indeed, these question types are generally constructed in order to allow any reasonable geographically based argument. Evidence suggests that storms are harder to mitigate, as it is tropical storms which are responsible for the greatest loss of life year on year across the world. However, it is equally true to suggest that storms are much more frequent events affecting greater concentrations of populations across the world. The key to success was the nature and quality of support and it was generally used well whichever particular argument was being pursued. Where it was used descriptively, without engagement with the evaluative nature of the question, responses struggled to gain higher marks.