

## Unit 4 Exemplar Report Tectonic Activity and Hazards

**Note:** These exemplar reports are based on the work of candidates under examination conditions, during the January 2010 examination series. The reports were originally hand written but have been typed up, with diagrams redrawn. Errors, including QWC errors, have in most cases been kept. The aim of these exemplar reports is to highlight good practice and areas of potential improvement. The marking levels and examiners comments given are indicative and should be used as a basis for discussion in the classroom, rather than indicating a specific grade.

### Pre-release research focus:

#### OPTION 1: Tectonic Activity and Hazards

- **Explore** the types and levels of challenge posed by varying forms of tectonic activity.
- **Research** contrasting locations to draw out the range of tectonic activity and the different impacts produced on communities.

#### Report Title:

Tectonic activity poses varying degrees of challenge for the communities experiencing it. Discuss.

---

Plan:

Volcanoes

- type - magma - Iceland
- benefits - Iceland
- hazard risk equation
- management - prediction → Mt. St. Helens
- perception → Montserrat

Earthquakes

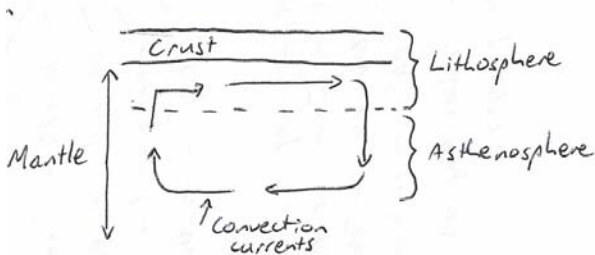
- map
- Ismi vs California
- education - Tokyo
- Haiti - park model

Tsunami

- where they are - Boxing Day
- perception

## Introduction

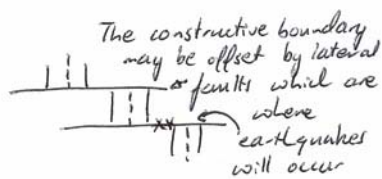
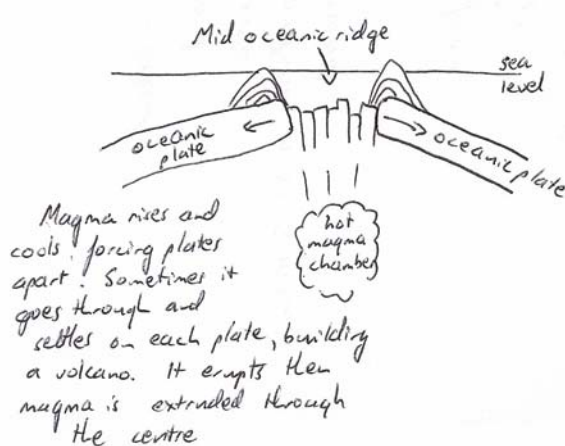
Tectonic activity involves earthquakes, volcanoes, faultlines and tsunamis. They are tectonic because they involve tectonic plates – see diagram.



Convection currents in the asthenosphere move the plates on top. The crust is divided into many plates. Tectonic plates can be either oceanic or continental. When plates move past one another, friction builds and when this is released it can cause an earthquake.

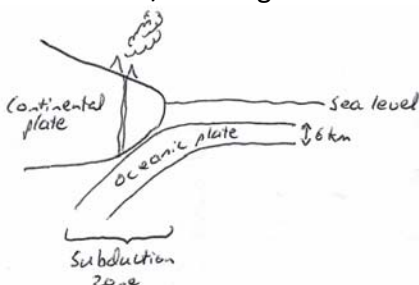
Also due to this friction and the consequential heat, magma can be formed and result in volcanoes. Volcanoes can also happen where plates diverge and magma is extruded through the middle. These situations are at different plate margins – see diagram below. However earthquakes can happen at intra-plate situations, on fault lines. Volcanoes don't occur here because no magma is produced.

Constructive / divergent boundary:



These boundaries produce basaltic magma which is not very viscous, and so eruptions tend to be frequent and not very damaging as it isn't explosive and therefore less of a challenge. 70% of volcanic activity happens here.

Destructive / convergent boundary:



The friction causes earthquakes as the oceanic plate is subducted – they can be up to 600km deep in the Benioff Zone. The friction also melts the continental crust and some sediment, resulting in a build up of viscous lava and a lot of pressure, so when they erupt (infrequently) it is very destructive.

Tectonic activity becomes a challenge or a hazard when it threatens people's lives and property- it becomes a disaster when peoples lives or property are actually lost. According to EM-DAT, the number of earthquakes has gone up fourfold since the last century but the economic losses have gone up fourteen fold. However although EM-DAT is a credible source this may be due to advances in international communications and technology e.g. seismometers. EM-DAT also claim deaths are decreasing – therefore hazards may be becoming more or less of a hazard depending on different perspectives.

In this report I will discuss the reasons behind varying degrees of challenge for a variety of communities and from a variety of hazards, for example economic development, political stability and magnitude.

### Community and Magnitude

If community describes the people involved in the hazard then this is clearly affected by the magnitude, as this will determine the extent to which the hazard is localised or not.

The Boxing Day tsunami in 2004 in the Indian Ocean was triggered by an earthquake of magnitude 9.3 on the Richter scale and was the largest rupture (10 minutes) ever recorded. It was one of the largest the world had seen, and was a global event. According to the UN, 300,000 were left dead, missing or displaced and 5 million were left homeless. People from all around the Indian Ocean died – up to 80% of the population in some Indonesian villages lost their lives. It also hit Africa and killed people there! However holiday makers from Europe, America and Australia were also involved. It also impacted on the global community as it prompted new investigations into faultlines previously thought to be relatively non-hazardous. It also affected our understanding of plate tectonics as scientist did not think such a huge tsunami could be generated from such slow moving tectonic plates. Not only that, but countries from all over the world donated money and aid.

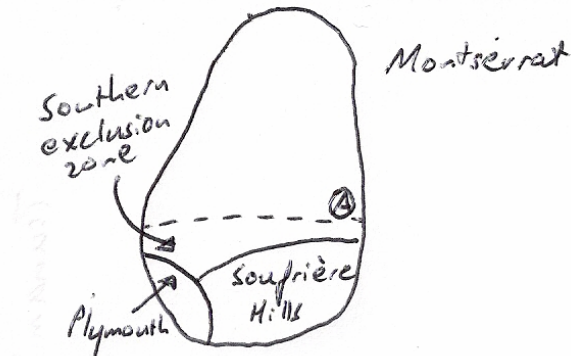
However, this compares with places with tectonic activity of a much lower magnitude. In the UK we quite frequently have earthquakes but at around 2 on the Richter scale few people know about them. Therefore tectonic activity can be a huge challenge for communities in terms of coping with death and destruction as seen with the 2004 tsunami, or none at all – depending on the magnitude and therefore scale of the event.

### Hazard perception and community preparedness

The perception of the community of the threat they face can have a large impact on how challenging tectonic activity is. According to the hazard perception filtering model, the closer to the hazard you are the more realistic your opinion of it. This is certainly true of Hawaii where some houses built of wood are actually able to be moved if they need to be! They have also proposed barriers to protect some communities from resulting lahars. They are able to be prepared because they live with the hazard everyday – Kilauea erupts daily and so the community is realistic in its response and therefore tectonic activity is less of a challenge as they have learned to live with it. However this greatly depends on the frequency of the hazard – as reflected in the daily eruptions they face.

This compares to Montserrat, which is in the Caribbean. It too faces the hazard of volcanic activity, however they hadn't had an eruption for 350 years so simply didn't realise the threat. Their perception was therefore very different as they believed the volcano would 'go back to sleep' as they

lived on a paradise island and god would save them. Clearly, the perception of a community therefore also depends on the frequency of tectonic activity there. This means that when the Soufriere Hills volcano erupted in 1995, the community faced many effects – however only 19 died despite huge pyroclastic flows, as many had been evacuated.



As you can see the entire southern half of the island had to evacuate – many moved to Britain as it is a British Colony. The population went from 12,000 to 4,000 destroying their close knit community. Plymouth, the capital, used to be the bustling heart but was also left deserted. Therefore the community had to deal with displacement, the loss of homes and jobs and communities, because they were not prepared for the disruption. Their hazard perception as unrealistic and so it posed a huge challenge for the community.

### Prediction

Hazard perception will be affected by the ability to predict the hazard event. While this is not strictly possible for earthquakes many think animal behaviour changes or the water table drops due to microseismic fracturing. However, volcanic activity is more easily monitored. For examples Mt St Helens was closely observed by satellites and so people were aware of the changes in it such as bulging of the slopes and the tilt changing. They were therefore able to evacuate and so only 63 people died despite huge pyroclastic flows burning trees for 360km<sup>2</sup>, ash plumes and lahars.

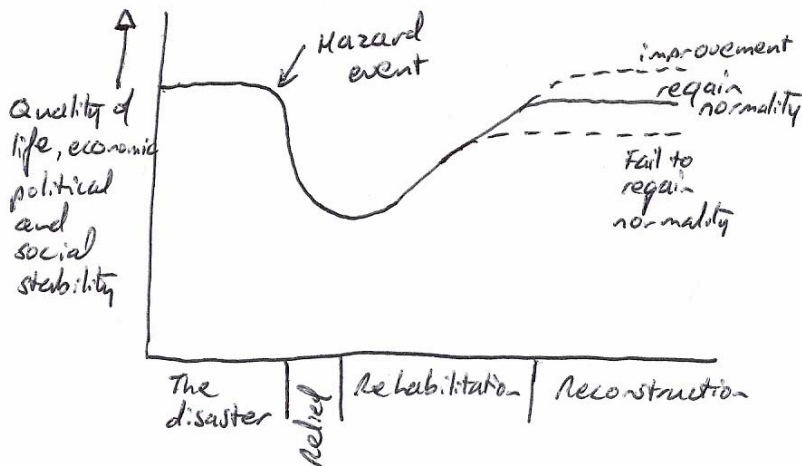
However in California although earthquake risk is well known they cannot be predicted and this can lead to destruction. In the 1989 Loma Prieta earthquake people lost their lives when an elevated freeway collapsed killing people who were travelling in their cars. Even when tectonic activity can be predicted there are still challenges for the community – however not being able to predict them at all clearly is the largest challenge of all. Had there been a tsunami warning system in the Indian Ocean for the Boxing Day tsunami maybe not so many people would have died but this depends on the wealth of the community involved.

### Economic Development of a country

The economic development of places affects the vulnerability of people and the capacity to cope, and so can alter the level of risk and therefore challenges faced. Haiti is a very poor country with a human development index of just 0.5. It has had food riots in 2008 and a corrupt government. It is therefore very vulnerable and so when it was struck by a magnitude 7.8 earthquake in January 2010 there was chaos. No one had been educated in what to do and the level of healthcare was quite poor. They therefore relied very much on foreign aid but this had trouble getting through due to a poor infrastructure. Therefore the lack of food, medicine and education meant that the community had a poor capacity to cope – and clearly could not cope on their own. As the hazard risk equation shows,

this means the risk was greater – therefore the economic development of the country has a huge impact on the degree of challenge.

This can be shown in Chris Park's model:



Haiti spent much time in the relief stage due to them being an LEDC and so it will take longer to get anywhere near normality, therefore they face a greater challenge. This is the same as the Boxing Day tsunami; as a year later 60,000 people in Indonesia still lived in tents because they were an LEDC. However, Japan is relatively used to seismic activity so people know to get under tables and protect themselves during earthquakes. They have effective evacuation plans and responses by local authorities. They are more prepared and can invest more in preparation and education, so can reach the reconstruction stage sooner following an earthquake. Being an MEDC means they face a lower degree of challenge from similar earthquakes.

### Political stability impacts

Money is important in reducing challenges but the community will still face a great challenge if the government is unstable. For example, in Izmit in Turkey in 1999 there was a magnitude 7 earthquake. It killed 17,000 and left 300,000 homeless, mostly due to corruption in industry and policing as building regulations, although they existed, had not been enforced and so poorly constructed buildings fell. This compares to Loma Prieta in 1989 where an earthquake of the same magnitude had a very different impact and killed only 60 as building regulations had been enforced as the government was not corrupt. They therefore faced less of a challenge as fewer people died or were made homeless as the government was able to help the community rather than be a hindrance.

### Management

Management relates to whether the country is an LEDC or MEDC. For example Tokyo has braces on some buildings, rubber foundations and counter-weights, stopping many buildings falling and so reducing the deaths and economic destruction. In the Philippines buildings just topple as they are made of concrete or wood. Economically people are not able to manage their hazard risk and so the community faces a greater challenge.

### Conclusion

There are therefore a range of variables which can cause tectonic activity to be a challenge to people. Obviously the magnitude and type of magma affects it, as pyroclastic flows from more viscous lava can kill hundreds of thousands compared to lava in Iceland which is basaltic and flows at a walking

pace. However, as Izmit and California show the same magnitude can pose very different challenges due to the preparedness, capacity to cope and political stability of the area. The education, healthcare provision is very important and the fundamental reason they differ is due to the differences in economic development throughout the world. This is reflected in the fact that the majority of aid comes from MEDCs – they have money to invest in having facilities at hand and so face a smaller degree of challenge.

However, tectonic activity does not always have to be a negative challenge if it is managed. Iceland uses their tectonically active landscape for tourism and geothermal energy to heat their water! They are lucky though in thin population density, non-viscous lava and a non-corrupt government and high economic development.

### Bibliography

EMDAT

IMF

[www.nationalgeographic.com](http://www.nationalgeographic.com)

[www.usgs.gov](http://www.usgs.gov)

Geography Review journal

DVD – death and destruction on Montserrat

A2 Textbook – Digby et al

**Examiner comments:**

<b>Overall summary</b>	<b>How this could be improved</b>
<p><b>Comments on plan:</b>  <b>NB the plan has no separate marks, but may gain a little credit if introduction is lacking</b>  <i>This plan is arranged by hazard type, with some indication of concepts and models.            Another approach would be to order by section of the report to indicate content and ideas in each section (introduction, analysis etc.)            As can be seen, the candidate did section their report by theme rather than by hazard type, although the introduction does not indicate this.</i></p>	<p><b>If the key words from the title: challenge, community were at least jotted down it might ensure later focus rather than 'all I know about the 3 tectonic hazard categories'</b></p>
<p><b>Comments on introduction, defining and focusing on the question</b>  <i>The report introduces and defines tectonic hazards with reference to several tectonic settings and makes generally accurate use of diagrams to support this.            There is some discussion of the meaning of the question and the direction that the report is heading.</i></p>	<p><b>The focus of the report could be clearer, and outlined from the first paragraphs, rather than starting with background theory.</b>  <b>Some of the explanations of how magma is generated could be clearer, as could the section on trends in earthquakes e.g. clearer reference to the role of better reporting.</b>  <b>The framework could have been developed too</b></p>
<p><b>Comments on researching and methodology</b>  <i>There are some brief comments on the reliability of sources e.g. in reference to EM-DAT although this is an area that could be developed.            There is limited justification of case study and example choice or explanations of why certain sources of information were chosen.            There is a wide range of relevant case studies most of which are contemporary.            Evidence is factually sound for the most part and some concepts and theories are used e.g. reference to plate tectonic theory or Park's model.</i></p>	<p><b>An obvious, brief methodology section or statement to explain how evidence was sampled or selected from a range of reputable sources</b></p>
<p><b>Comments on analysis, application and understanding</b>  <i>Although dealing with extremes (UK –v- 2004 tsunami) the candidate does clearly relate magnitude to degree of challenge.            In the section on 'communities and perception' the candidate compares the situations in Hawaii and Montserrat rather than simply presenting both as separate, descriptive case studies.            In some cases models and concepts are applied to case studies and examples which shows understanding.            In general factual accuracy, and detail, are good; there are some</i></p>	<p><b>The candidate might have made more of the very different tectonic settings of the two examples of Hawaii and Montserrat.</b>  <b>The short 'management' section might have been better placed within the wider section on economic development.</b></p>

<p>errors but these tend to be partial rather than fundamental. There are some good links between sections such as between the 'prediction' section and the section on economic development. Overall, the report relates a number of issues to the degree of challenge including level of development; magnitude, perception and predication – and these are supported by good detail</p>	
<p><b>Comments on conclusion and evaluation</b>  The candidate does include ongoing evaluation, rather than leave all concluding statements to the last section; for instance there are summative statements at the end of the 'community and magnitude' and 'political stability' sections.  Most discussion of case studies is comparative, and the style is evaluative; frequent use of the word 'however' shows that the candidate sees several perspectives on many issues.  The report does address the central issue of 'degree of challenge' in the conclusion and there is reference made to many of the case studies and examples used in the main analysis.  The conclusion recognises that many variables have a role in the degree of challenge, and this shows that the complex nature of the issue is understood.</p>	<p><b>A comment on how the challenges may change over time either in a negative way as vulnerability increases or a positive way because of preparation and adaptation would have shown more complexity. For example the challenges from the Haiti earthquake were exacerbated by a long history of natural disasters in the country</b></p>
<p><b>Comments on quality of written communication and sourcing</b>  This report does have a coherent structure which examines a range of different influences on challenges.  Overall spelling and punctuation are sound and geographical terminology is used frequently, and usually accurately.  The diagrams used work well and are good overall;  The candidate does use the word 'they' frequently (see section on Hawaii) when it would be better to spell out who 'they' refers to i.e. name the player.  A bibliography of appropriate sources is included, although these are not referenced within the main body of the report and do lack detail (dates for instance, and article names)</p>	<p><b>Figure numbers could have been used to help integrate the diagrams into the main text.</b>  <b>Ongoing referencing</b></p>

Summary of marking levels awarded:

<p><b>D</b>  Introducing defining and focusing on the question  (10)</p>	<p><b>R</b>  Researching and methodology  (15)</p>	<p><b>A</b>  Analysis, application and understanding  (20)</p>	<p><b>C</b>  Conclusions and evaluation  (15)</p>	<p><b>Q</b>  Quality of written communication and sourcing  (10)</p>
<p><b>L3</b>  6-8 marks</p>	<p><b>L4</b>  12-15 marks</p>	<p><b>L4</b>  17-20 marks</p>	<p><b>L4</b>  12-15 marks</p>	<p><b>L3</b>  6-8 marks</p>