EOSC 310 Quiz 2b

1. Continental and island arc volcanism are quite similar, but have a few important differences. Which of the following points are true (more than one may be correct, points deducted for wrong answers).

- [x] 1. Island arc and continental arc volcanoes are both related to subduction.
- [ ] 2. Continental arc volcanoes are subduction related, island arc volcanoes are caused by plumes (or hotspots).
- [x] 3. Many islands in the Caribbean are island arc volcanoes (look at a map of plate boundaries to decide)
- [ ] 4. Hawaii is an island arc volcano.
- [x] 5. One main difference is that island arc volcanoes tend to be more mafic in composition than continental arc volcanoes. Island arcs are more mafic>>intermediate while continental volcanoes would be more intermediate>>felsic.

1,3,5 are my answers - correct (2/2)

-continental arc would be a chain of volcanoes somewhat parallel to the nearby plate boundary (oceanic-continental convergence)
-island arc occurs out in the ocean, between the subduction of ocean-ocean convergence zone
-both are still forming typical stratovolcanoes
-Hawaii is an intraplate volcano (and its associate islands)

2. The most complete and meaningful way of characterising the size of an earthquake is the *moment magnitude*. It requires more time to calculate than the simpler methods (e.g. Local (or Richter) magntiudes) as several parameters must be determined.
Which of the following are necessary to calculate the moment magnitude?
[There are several correct answers]

- [x] a. the area of the rupture zone along the fault
- [x] b. the distance the fault plane slipped along the rupture
- [ ] c. maximum ground motion measured at the surface
- [x] d. the physical properties of the fault zone rocks (e.g. rigidity, compressibility)
- [ ] e. the gradient of damage moving away from the epicentre
- [ ] f. the focal mechanism of the earthquake

ABD are my answers (found in notes) - correct (1.5/1.5)

3. A chain of volcanoes that exhibits a clear progression in eruption age from recent at one end to older and older along the chain is most likely a/an:

- ( ) a. island arc
- ( ) b. continental arc
- (•) c. hot spot track
- ( ) d. sequence of impacts
- ( ) e. supervolcano

- f. mid-ocean spreading ridge

A is my answer - incorrect (answer is obviously C - correct)

4. On November 17th 2009, there was a M6.6 quake near the southern Haida Gwaii (Queen Charlotte) Islands.
For more information, see:
Queen Charlotte Islands Region
There are maps and other information (like depth) on those pages, including historical seismicity maps. I recommend also referring to the pdf notes for this one to double check the nature of the plate boundaries.
From the location of the earthquake and its depth (see the map, you could plug the coordinates into Google Earth if you like), it was most likely related to:

- (•) a. Transform motion (strike-slip faulting)
- ( ) b. Subduction thrusting in the overriding plate.
- ( ) c. Subduction-related faulting within the downgoing plate
- ( ) d. Subduction thrusting on the plate interface
- ( ) e. Ridgecrest spreading (normal faulting)

A is my answer - correct

-The depth was about 11.6 km, so quite close to the surface
-at this location is near the boundary of the North American and Pacific plate (is on N. American plate)
-not directly subduction, and is shallow, so must be on surface
-there would be no ridgecrest spreading

5. Which of the following points are TRUE?
[There may be more than one correct answer, penalty for wrong answers]
When oceanic lithosphere is subducted into the asthenosphere and lower mantle, _____.

- [ ] a. the entire lithospheric plate eventually melts and is reincorporated back into the convecting mantle
- [x] b. the seawater-saturated oceanic crust melts a little and releases water into the mantle above, which can in turn melt, generating a volcanic arc on the surface above.
- [x] c. the subducting lithosphere gradually heats up to the temperature of the surrounding mantle and is reincorporated back into the lower mantle.
- [x] d. earthquakes can occur within the subducting lithospheric plate down to the base of the transition zone (~660-670 km depth)
- [ ] e. Earthquakes commonly occur on the interface between the upper surface of the downgoing plate and the asthenosphere and lower mantle. These earthquakes define the Wadati-Benioff zone.

CDE are my answers - incorrect - 0.67/2 points - new answers BCD - correct
-I guess earthquakes don't really happen in the asthenosphere and mantle since it's too ductile

E - because this is where the plates are directly interacting, and while earthquakes can also occur closer to the surface or deeper into the mantle, they also occur here quite frequently as well

6. My friend Laurent is skiing below the beautiful granitic peak called Mt. Thiassi (about 30 km north of Pemberton). Several of the following statements are true, which ones?

- [ ] a. Granite is an igneous rock and because it is at the surface it is an extrusive rock.
- [x] b. The mountain is likely part of an old batholith or pluton that is now exposed at the surface.
- [x] c. Erosion from the top of the thickened crust results in the crust buoyantly rising in response (due to isostacy). This exposes rocks at the surface that were originally deeper in the crust.
- [x] d. All the good powder skiing is in the Rockies, not the Coast Range (very important you get this one correct...).

BCD are my answers - correct 2/2

A - yes granite is an igneous rock, but it did NOT cool at the surface (must have cooled slow at a great depth, needed the time for large crystals to form; it is an intrusive rock)
B - yes because of very obvious differences in composition
C -
D - climate

7. On June 24th 2011, there was a M7.2 quake beneath the Aleutian Islands.
For more information, see:
Fox Islands, Aleutian Islands, Alaska
There are maps and other information (like depth) on those pages, including historical seismicity maps.

From the location of the earthquake and its depth (see the map, you could plug the coordinates into Google Earth if you like), it was most likely related to:

- a. Subduction thrusting on the plate interface
- b. Subduction-related faulting within the downgoing plate
- c. Ridgecrest spreading (normal faulting)
- d. Transform motion (strike-slip faulting)
- e. Subduction thrusting in the overriding plate.

E is my answer (second choice is A) - E is correct

-depth was 62.9 km, so definitely not that deep
-this boundary is between North American plate and Pacific plate (at this location, these plates are converging, so there would be subduction occurring)

8. Which of the following statements about isostasy are true?
[Note: More than one answer may be possible]

- [x] 1. Isostasy represents how an object will reach a state of buoyancy balance that depends on its density and that of the fluid (liquid or ductile solid) that it 'floats' in.
- [ ] 2. An object that is less dense than the material it is floating in will float completely on top of the fluid (no part will be submerged because it is less dense).
- [x] 3. Normal continental crust, even when it is cold, is less dense than the ultramafic mantle rock. Therefore, it 'floats' in isostatic balance on/in the mantle and cannot subduct.
- [ ] 4. The lithosphere is rigid and therefore supports all loads without bending into the more ductile asthenosphere.
- [x] 5. How the lithosphere bends under a load reveals information about its stiffness and about how ductile the asthenosphere is below.

1,3,5 are my answers - correct

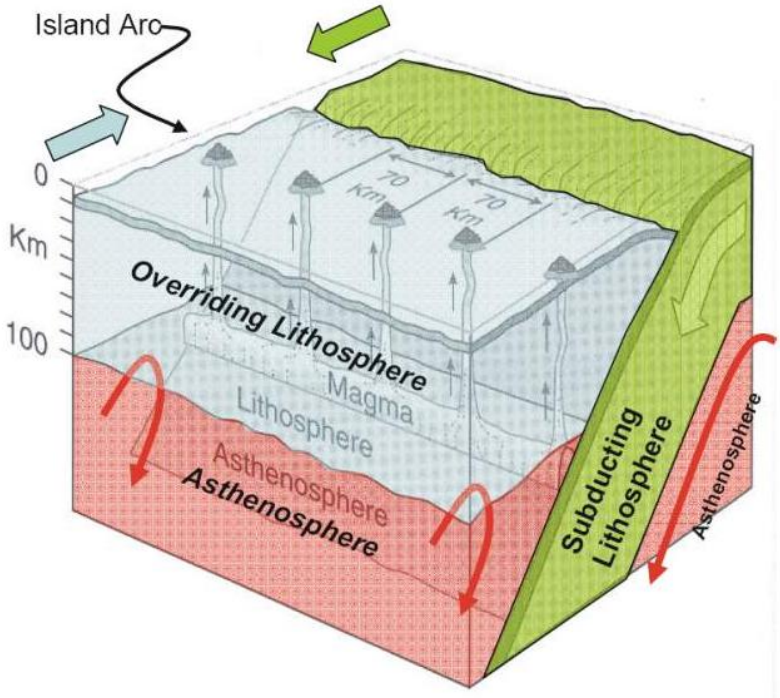
9. The Cascades volcanoes present many hazards. Mount Rainier is the largest of the Cascades volcanoes and it is located just east of Seattle/Tacoma. There is a very large population living to the west of the mountain.
Like all the Cascades volcanoes, it is potentially explosive (and has explosively erupted in the past). So that hazard is always there. However, lahars present a very different hazard - and one that also has a very long, well-documented geological record.
Which of the following statements are true?
(Mark all correct answers, marks deducted for wrong answers).

- [x] a. As long as Mt. Rainier remains dormant (not erupting), then the people in the region don't need to be worried about lahars.
- [x] b. Lahars are potentially dangerous for the entire area around the mountain within about 40 km.
- [x] c. Lahars are mudflows that have quite a low percentage of water (so very high density).
- [x] d. Mt. Rainier has the ingredients required for lahars to form: glaciers (providing water), major rainfall/snow zone, highly unstable edifice.
- [ ] e. One of the big problems with a lahar is that they flow too quickly to warn people in its path.

CDE are my answers - incorrect 1/2 points - ABCD new answers → incorrect, 0/2

B - can be dangerous even further (slides example was for a city 50 km away)
C - much higher proportion of solid material

10. The image below is a cartoon of a young island arc. I say 'young' in that there are just individual volcanoes built on top of the overriding oceanic plate - it hasn't developed into larger islands with thickened crust yet (like say the Philippines or some of the Indonesian islands like Java and Sumatra - well developed, older island arcs). So perhaps only 5-10 million years along in development.
Which of the points below are correct for island arc volcanoes?
[More than one answer may be correct. Marks deducted for wrong answers.]



- [x] a. lavas are intermediate to mafic in composition
- [ ] b. lavas mostly felsic
- [ ] c. lavas very high in silica (SiO2) content: around 75%
- [x] d. lavas mid-low Silica (SiO2) content: around 60%
- [ ] e. lavas very low silica content: < 50%
- [x] f. Moderately viscous magma and gas in the magma, possibility for water to get into the magma, potential to be quite explosive.
- [ ] g. Very fluid magma, little gas, not explosive
- [ ] h. Volcano age (the age of the youngest lava erupted) gets progressively older from left to right down the chain.
- [ ] i. Very gently sloped, shield volcanoes
- [x] j. Composite volcanoes - steeper and built from layers of lava and ash on the exposed parts of the volcanoes (above water).

- [ ] k. Melt feeding the volcanoes was sourced from material in the lower mantle (hot spot plume)
- [x] l. Melt feeding the volcanoes formed by melting in the mantle just above the subducting plate.

AEGJL are my answers -incorrect, only 0.5/2.5 points (ADFJL new answers → all correct)

C - no. high silica content would indicate more felsic material
-higher viscosity associated with more silica, since oceanic plate would have lower silica, it would be more viscous than continental arc volcanoes
-simple age patterns are associated with hotspot volcanoes, and is not the same thing

11. Mount Baker (just southeast of Vancouver) and Mount Garibaldi (just south of Whistler and close to Squamish) are examples of: *(more than one choice is possible)*

- [ ] a. a cinder cone
- [x] b. a stratovolcano (composite volcano)
- [ ] c. a shield volcano
- [ ] d. plume (or hotspot) volcanism
- [x] e. continental arc
- [ ] f. island arc

BE are my answers - correct
-not sure what a cinder cone is

12. On Feb. 6 2013, there was a M5.0 earthquake in the Northern Atlantic Ocean basin.
For more information, see:
Northern Mid-Atlantic Ridge
There are maps and other information (like depth) on those pages, including historical seismicity maps. From the location of the earthquake and its depth (see the map, you could plug the coordinates into Google Earth if you like), it was most likely related to:

- ( ) a. Transform motion (strike-slip faulting)
- ( ) b. Subduction-related faulting within the downgoing plate
- ( ) c. Subduction thrusting in the overriding plate.
- ( ) d. Subduction thrusting on the plate interface
- (•) e. Ridgecrest spreading (normal faulting)

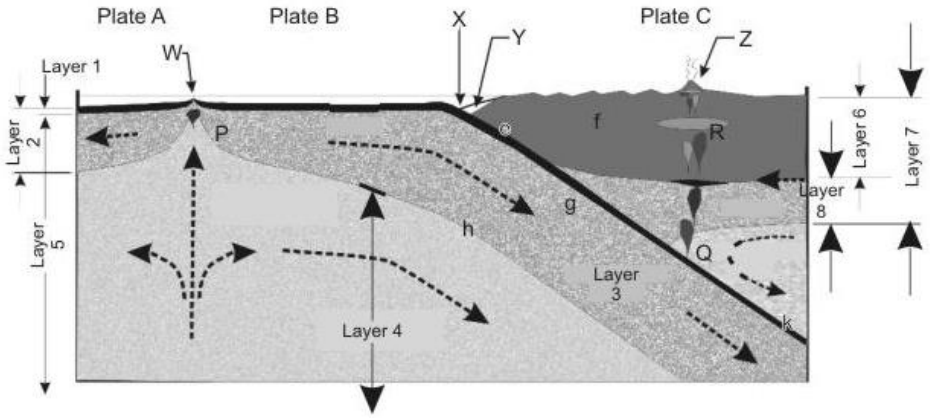
E is my answer - correct
They splitting

13. We'll be talking a lot about 'Cascadia' (the Pacific Northwest including southwest BC) through the earthquakes/volcanoes sections. Here is a sketch of a cross-section of the Cascadia area that we are part of here in Vancouver (I'd expect you to be able to roughly sketch and label the basic types of plate boundaries like this).

Note that this could be a cross-section through just about any oceanic-continental subduction zone. Cascadia is a little unusual (but not too unusual) in that there is a ridgecrest within a few hundred kilometres of the trench.

The sketch isn't exactly to scale but is reasonable. The bottom of the sketch is at roughly 150-250km. The different shades/textures represent major differences in either composition or rheology of the rock.

Rather than label it by hand, your job is to match the labels on the drawing with a list I've provided. It's fine to use labels more than once if you need to.



B. Plate A

C. Plate B

A. Plate C

Answer
A. North American Plate
B. Pacific Plate
C. Juan de Fuca Plate

Plate A is the pacific plate
Plate B is the Juan De Fuca plate
Place C is the North American plate

Correct

14. Hot spot volcanism is caused by mantle plumes - relatively narrow columns of buoyant, hot ultramafic mantle rock, rising up to the crust. When the pressure decreases enough, there is partial melting and basaltic magma rises up through the crust. There are hot spot volcanoes on oceanic and continental crust. Which of the following statements are true? (more than one may be correct)

- [x] 1. Hot spot volcanoes built on continental crust tend to be much more explosive than those on oceanic crust.
- [ ] 2. The type of volcano (stratovolcano) produced by a mantle plume is the same on both oceanic and continental crust
- [ ] 3. Mantle plumes or hotspots can generate felsic volcanism at both oceanic or continental volcanoes.
- [x] 4. Mantle plumes or hotspots can generate mafic volcanism at both oceanic or continental volcanoes.

2,4 are my answers - incorrect (0/1 points) - 1, 4 are my new answers → correct

-hotspot volcanoes are actually less explosive than subduction volcanoes

15. Partial melting is a very important process for modifying the continental crust.
Think about what happens in a subduction zone environment, what causes the melting and how that process works in relation to the subducting lithosphere.
A range of magmas erupt from continental volcanoes (like Mt.Baker, Mt. Garibaldi, Mt. St.Helens), from quite mafic to quite felsic. It is the felsic lavas that are the most explosive.
When felsic lavas erupt where did the vast majority of that felsic lava form?

- a. It represents melted oceanic crust (melted during subduction).
- b. It represents the melted mantle rock above the subducting oceanic plate, which was triggered to melt by water released by the subducting oceanic crust.
- c. It is a melt or partial melt of the continental crust (overriding plate).
- d. It is a partial melt of the subducting continental crust.

C is my answer (is B or C) - C is correct

-most of the continental crust is felsic, so that's where it would have come from
-definitely not D, since it does not subduct

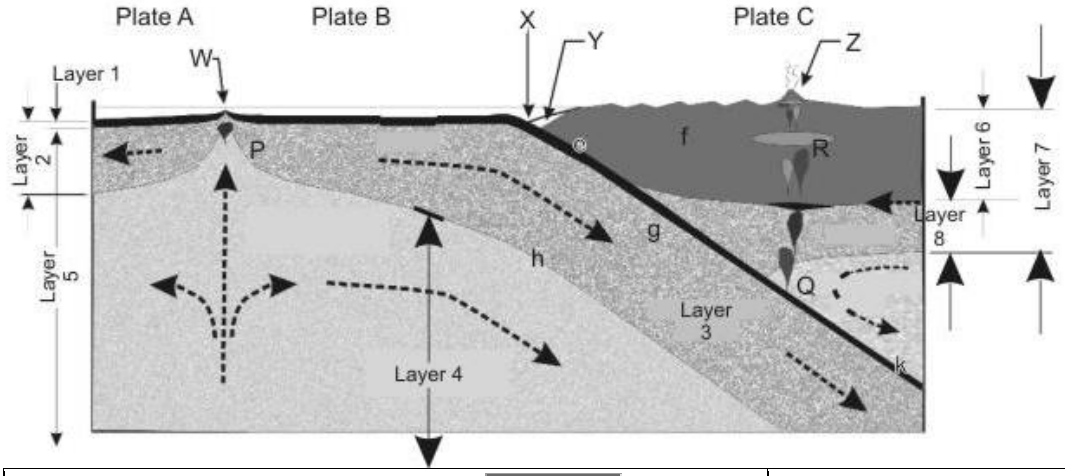
16. Which of the following statements about magma are FALSE?
[Note: several answers may be possible]

- [x] a. The viscosity of a magma increases as the silica content decreases.
  Note: high viscosity = thick, low viscosity = fluid
- [ ] b. High temperature magmas are more fluid (less viscous) than low temperature magmas.
- [x] c. The more gas a magma contains, the less violent the eruption
- [x] d. Mafic magmas are very explosive
- [ ] e. A magma can contain solids (unmelted minerals) and gas.

False answers: ACD are my answers - correct

A - no, higher viscosity with more silica
D - no, felsic magmas are more explosive

17. This is a cross-sectional sketch of the Cascadia area. Compare this with the many different similar figures in the pdf notes to make sure you are oriented as to what the layers are. The dashed arrows indicate the motion of the plates and of the asthenosphere.
The sketch isn't exactly to scale but is reasonable.
Match them up:

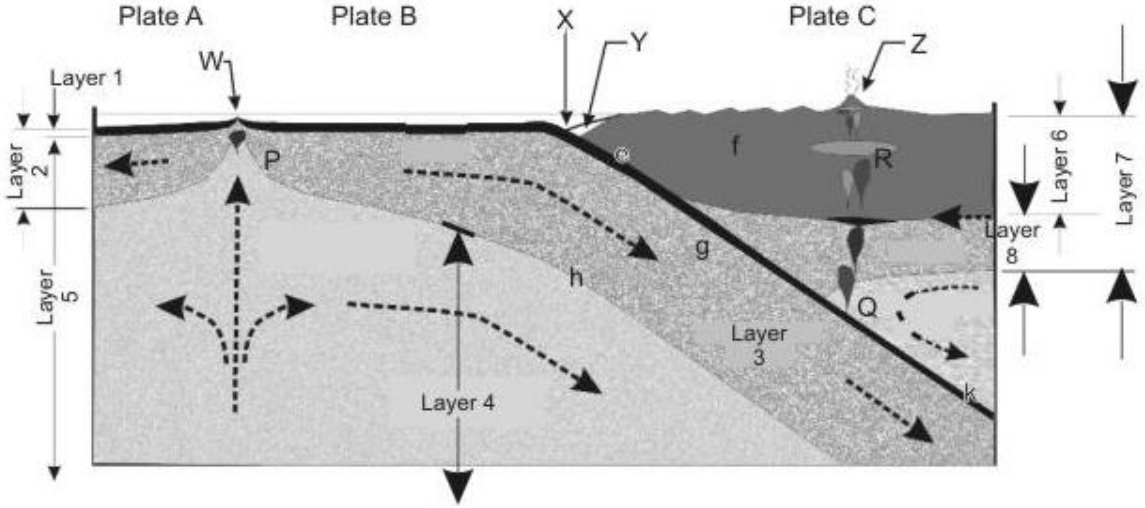


A.	Name of location X	Answer A. trench B. 30-35 km C. accretionary wedge D. thrust E. ~7 km F. normal
C.	Name of feature shown by Y	
E.	Thickness of Layer 1 (black layer)	
B.	Thickness of Layer 6	
D.	Fault type most likely to occur at e (see below Y, on the interface between the black/grey) and at f.	
F.	Fault type most likely to occur near W	

Location X is trench
Location Y is accretionary wedge
Layer 1 thickness is 7 km
Layer 6 thickness is 30-35 km
Fault type at e and f is thrust
Fault type at W is normal

Correct

18. Same sketch as in the previous question, a cross-section through the ridge offshore and our subduction zone here in Cascadia. Choose the best answer to the following layers.
[Note: be careful - There isn't anything tricky, but you have to look carefully to see some of the arrows that define where the layer in question extends to/from. It's easy to go too quickly and make a mistake...]



E. Name of Layer 1 (thin black layer)

F. Name of Layer 2

D. Name of Layer 4

Answer
A. continental crust
B. continental lithosphere
C. lithospheric mantle
D. asthenosphere
E. oceanic crust
F. oceanic lithosphere
G. mantle

G. Name of Layer 5

A. Name of Layer 6

B. Name of Layer 7

C. Name of Layer 8

Layer 1 is oceanic crust
Layer 2 is oceanic lithosphere
Layer 4 is asthenosphere
Layer 5 is mantle
Layer 6 is continental crust
Layer 7 is continental lithosphere
Layer 8 is just lithospheric mantle

Correct

19. Subducting plates produce a chain of volcanoes called a volcanic arc. Approximately how deep is the upper surface of a subducting plate beneath the volcanoes?

- a. 10 km
- b. 50 km
- c. 100 km
- d. 200 km
- e. 660 km
- f. Anywhere from 0 to ~660 km

F is my answer -incorrect - C is new answer - correct

20. You live 15 km away from the base of a glacier-covered stratovolcano (perhaps Mt. Baker, or Mt. Rainier, or Mt. Fuji in Japan). Your house is in a lovely, scenic river valley (the river formed by drainage

from the runoff and snow/ice melt from the volcano). And, just because of the prevailing wind patterns, your house is generally downwind from the volcano.
Which order of hazards (from extremely hazardous to not very) correctly describes the situation?

C. most hazardous:
A. a likely problem, but not extremely hazardous:
B. hazardous but not that likely:
D. not a problem:

Answer
A. Tephra (ash) fall
B. Pyroclastic flow
C. Lahar
D. Lava flow

Most hazardous - lahar
Likely, but not extremely hazardous - tephra fall
Hazardous but not that likely - pyroclastic flow
Not a problem - lava flow

Correct

21. Which of the following events has a similar physical mechanism to the rupture that causes an 'earthquake'?

- (•) 1. A broken elastic snapping back.
- ( ) 2. A glass breaking when you drop it.
- ( ) 3. Tearing a sheet of paper.

1 is my answer - correct