GLG2B10 Final assessment

SECTION A

Plate Tectonics Part of the module (90 marks)

Question 1
Answer all the questions in relation to the figure below:

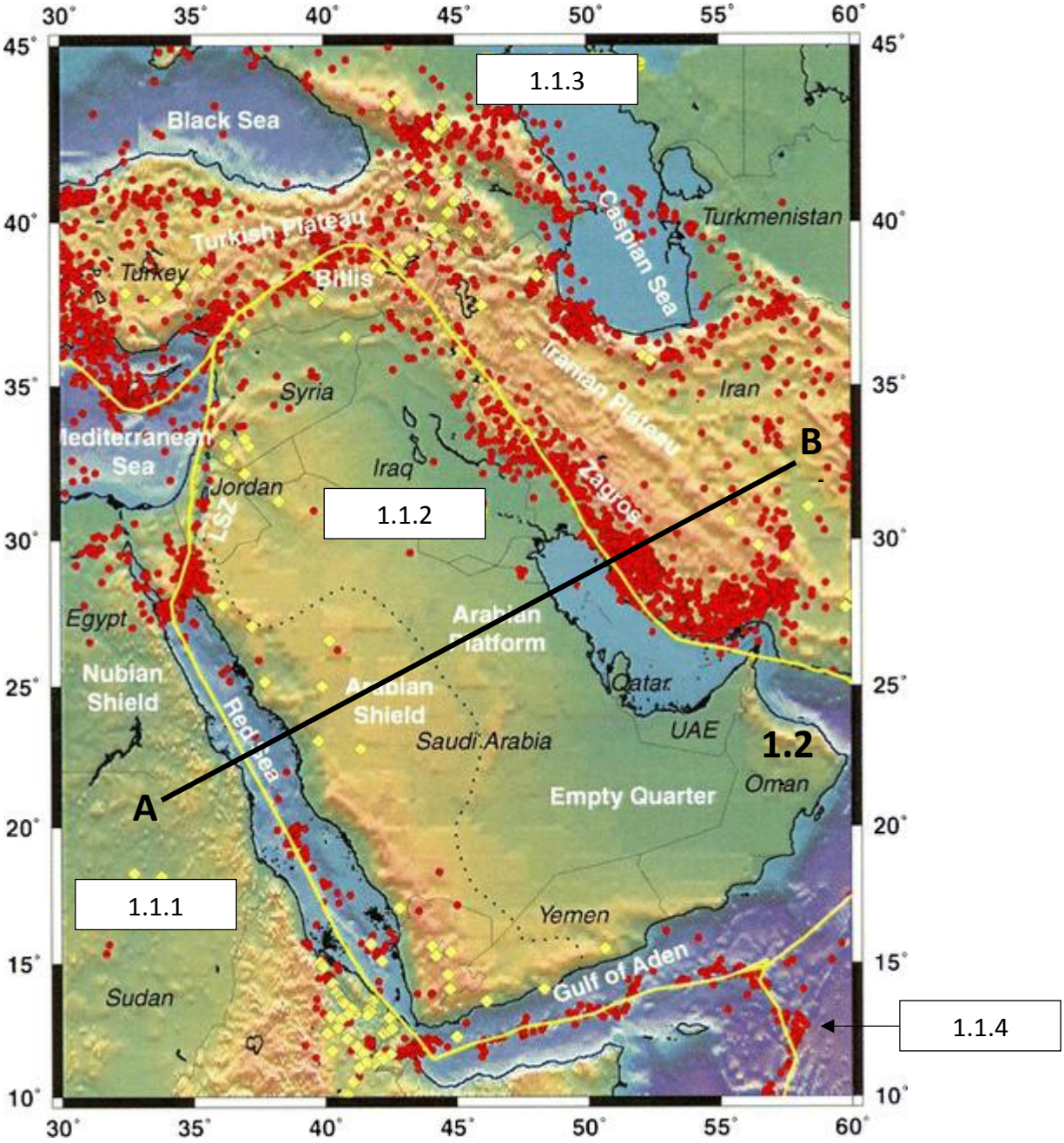

Figure 1.1. Map showing the locality of earthquakes (red dots) and volcanism (yellow diamonds) in the Middle-East.

1.1. Label the plates 1.1.1. to 1.1.4 (8 marks)

8 marks

1.2. The labelled locality (1.2) represents one of the best outcropping ophiolite sequences in the world.

1.2.1. What is an ophiolite? (2 marks)

1.2.2. Draw and label a typical ophiolite sequence indicating the typical lithological layers and their expected thicknesses. (10 marks)

12 marks

1.3. The plate motion of the area can be simplified in velocity space as below:

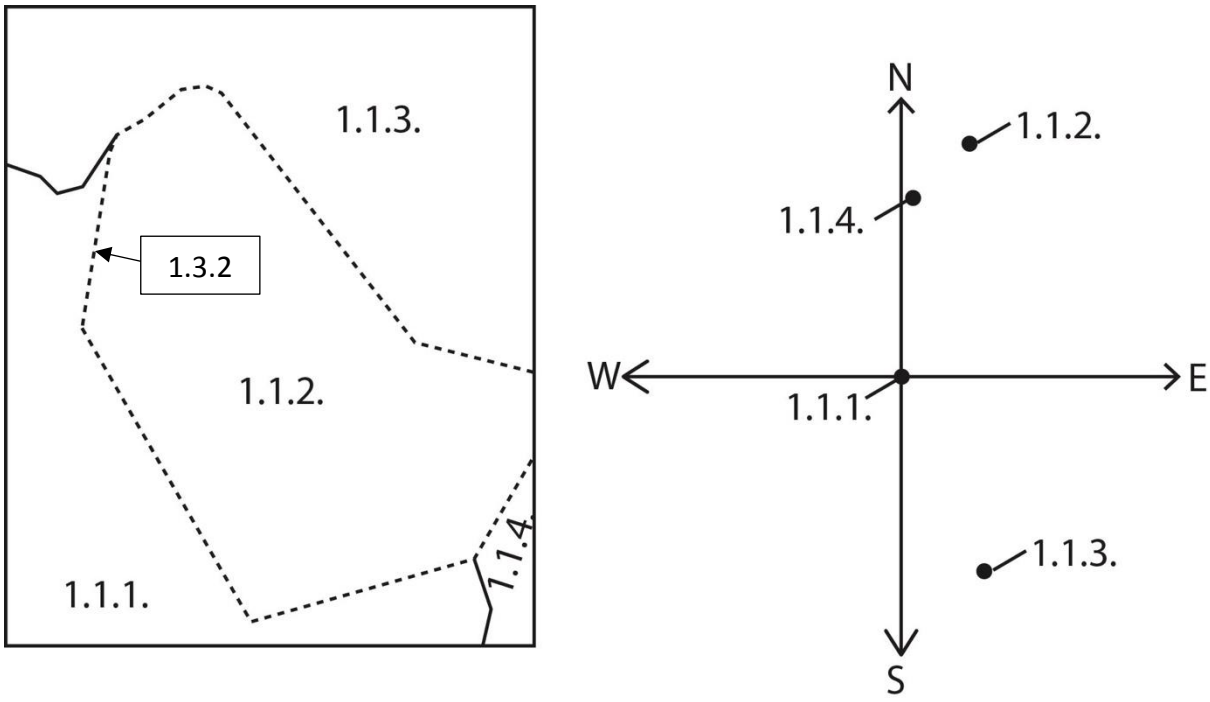

Figure 1.2. The plate motion of the Middle East in velocity space.

1.3.1. Complete the expected nature of the plate boundaries of plate 1.1.2. (stippled line) based on the relative plate velocities. Indicate where the boundary is a ridge, a transform or trench. Where it is a transform, indicate the relative motion as either sinistral or dextral. Where it is a trench, indicate the overriding plate. (8 marks)

1.3.2. Draw the expected focal mechanism solution of an earthquake at point 1.3.2. (2 marks)

10 marks

1.4. Draw and label a realistic sketch cross section A-B with a vertical scale that extends to 800 km depth (2 marks are given for your vertical scale and 3 for the overall sketch). Indicate the position and/or thickness of the following:

1.4.1. Continental crust (4 marks)

1.4.2. Oceanic crust (2 marks)

1.4.3. The Moho (2 marks)

1.4.4. The lithosphere (4 marks)
1.4.5. The LAB (2 marks)
1.4.6. The transition zone (2 marks)
1.4.7. The lower and upper mantle (2 marks)
1.4.8. Plate boundaries (2 marks)

25 marks
[55 marks]

Question 2

Of the list of prominent Earth Scientists below, *briefly explain* the contribution that **ONE of them** made towards plate tectonic theory or our knowledge of the Earth – *draw* a key summarising **sketch/diagram** to illustrate your answer (5 marks):

- Arthur Holmes
- Harry Hess
- Frederick Vine

[5 marks]

Question 3

3.1. What is the GAD hypothesis in paleomagnetism? Illustrate your answer (5 marks).
3.2. Explain with sketches how similarly aged paleomagnetic poles from two cratons can be used to make a paleogeographic reconstruction (i.e., closest-approach method). Show the various paleogeographic possibilities (10 marks).
3.3. Apart from paleomagnetism, what other tools can be used to reconstruct ancient continents? Name and briefly explain three such tools. Use sketches to illustrate. (15 marks)

[30 marks]

SECTION B

1. **Primary and non-primary structures** *(6 marks)*

   - What are the differences between a disconformity and an angular unconformity? Use annotated sketches to illustrate your answer.

2. **Stress and strain** *(12 marks)*

   - A) Body and applied forces are distinct forces that are both important for the deformation of rocks. Explain how these two forces differ and give at least one example of each. (6)
   - B) Draw a stress ellipsoid for sigma 1 > sigma 2 > sigma 3. Draw the equivalent strain ellipsoid for a pure shear strain type. (6)

3. **Rheology** *(18 marks)*

   Are the statements below TRUE or FALSE? If false, give the right answer.

   1. Burial depth is the same as confining pressure.
   2. A triaxial testing apparatus is used to measure the density of a rock sample.
   3. The elastic component of strain usually covers at least 25% of the total strain experienced by a rock.
   4. Salt domes can form in less than 50 years.
   5. Typical tectonic strain rate is 10^{-8} s^{-1}.

4. **Brittle deformation** *(15 marks)*

   - A) How do you recognize conjugate faults in the field? *(8)*
   - B) What is the Coulomb's failure criterion? *(7)*

5. **Ductile deformation** *(18 marks)*

Define the following terms mentioning, where appropriate, the processes responsible for, or the kinematic significance of the feature (use sketches freely!).

   a. Crenulation cleavage (9)
   b. Parallel folding (9)

6. **Fabrics and shear zones** *(21 marks)*

   - A) Give three types of kinematic criteria. Use annotated sketches to illustrate your answer. *(8)*
   - B) Give three different types of lineations. (7)
   - C) What are the characteristics of a mylonite? (6)