UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF GEOLOGY

MODULE **APG3B10 – Economic Geology**

CAMPUS **APK**

SSA EXAM **NOVEMBER 2015**

DATE: NOVEMBER 2013 **SESSION**

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DURATION **3 HOURS** **MARKS** **180**

NUMBER OF PAGES: PAGES

INSTRUCTIONS: **Answer all the questions.**

QUESTION 1: INTRODUCTION (9 marks)

1.1 Provide definitions for the following:
1.1.1 Supergene deposits.

(2)

1.1.2 Epigenetic deposits.

(2)

1.1.3 Hypogene deposits.

(2)

1.2 Give an example of each of the following:
1.2.1 Lithophile element.

(1)

1.2.2 Chalcophile element.

(1)

1.2.3 Siderophile element.

(1)
(9)

QUESTION 2: IGNEOUS ORE-FORMING PROCESSES (36 marks)

2.1 Vanadium (V) is extracted from the magnetite layers of the Bushveld Complex in South Africa.
2.1.1 From which two elements is magnetite mostly composed?

(2)

2.1.2 How can magnetite layers contain economic concentrations of vanadium?

(3)

2.2 The following questions are related to the role that basaltic magmas and lavas play in metallogeny.
2.2.1 In what geological settings are basaltic rocks most commonly formed?

(3)

2.2.2 How are basaltic melts formed in the mantle?

(2)

2.2.3 According to Goldschmidt's classification, what element types are generally enriched in basaltic rock-hosted magmatic ore deposits?

(2)

2.3.1 Define batch melting.

(2)

2.3.2 Define fractional melting.

(2)

2.3.3 Compatible element enrichment is more likely to occur with fractional melting than batch melting. Why?

(6)

2.4.1 What is the difference between a felsic and a mafic intrusion that have undergone fractional crystallization with regards to its internal structure, compositional zonation as well as where one expects an enrichment of incompatible elements to occur?

(6)

2.4.2 Explain the reasons for the internal structure and incompatible element enrichment one would expect in a felsic intrusion that underwent fractional crystallization.

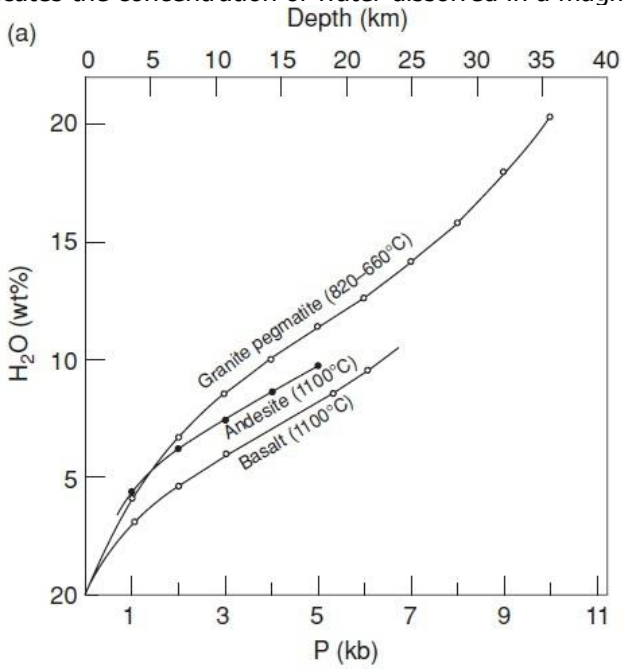
(6)

2.5 In a magic magma undergoing fractional crystallization, what of two possible things need to happen for a monomineralic chromitite seam to start crystallizing from the magma, according to the Irvine model?

(2)
(36)

QUESTION 3: MAGMATIC-HYDROTHERMAL ORE-FORMING PROCESSES (32 marks)

3.1 The following diagram is taken from "An Introduction to Ore-forming Processes" by Robb (2005). The y-axis indicates the concentration of water dissolved in a magma.



3.1.1 What are the two main conclusions that can be made regarding the solubility of water in magma from the above diagram?

(3)

3.1.2 In what form does dissolved water exist in a magma at lower pressures?

(1)

3.2 Explain the Burnham model for the formation of magmatic-hydrothermal ore deposits in granitoid intrusions. Use a sketch to illustrate the answer.

(10)

3.3 Tungsten (W) has a lower fluid-melt partition coefficient than molybdenum (Mo). However, W is incompatible in a crystal-melt system whereas Mo is compatible in a crystal-melt system.
3.3.1 Based on the above information, is it more likely to form a magmatic-hydrothermal ore deposit with more W than Mo in a shallow or deep level granitic intrusion?

(2)

3.3.2 Motivate your answer in 3.3.1.

(5)

3.4.1 Name and explain the two ways in which intrusions can lose its heat through time.

(4)

3.4.2 When considering question 3.4.1, why is the potential to form magmatic-hydrothermal ore deposits higher for larger or multi-episodic intrusions when compared to single, smaller intrusions?

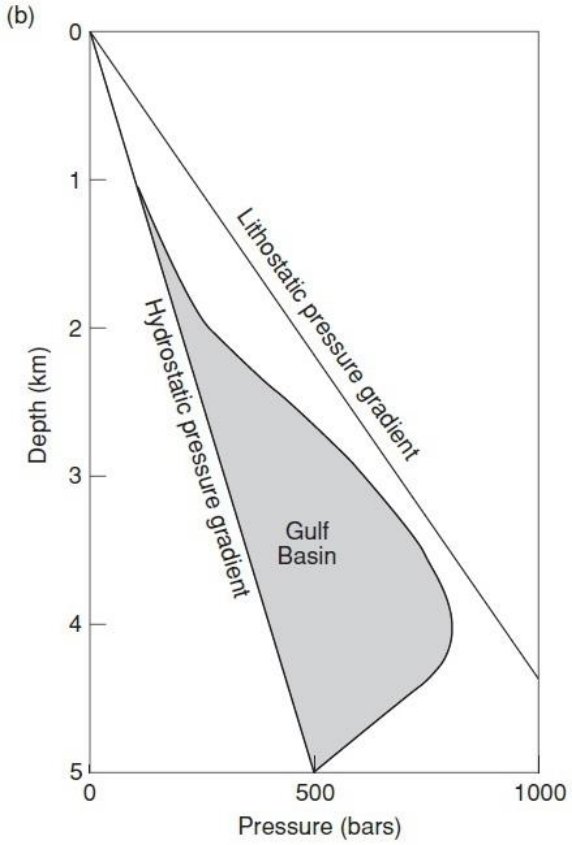
(4)

3.5 What ore deposit is most likely to form when a high level porphyry-style intrusion intrudes carbonate rocks?

(3)
(32)

QUESTION 4: HYDROTHERMAL ORE-FORMING PROCESSES (50 marks)

4.1 The figure below, taken from "An Introduction to Ore-forming Processes" by Robb (2005), illustrates the variation of fluid pressure with depth in the Gulf Coast sediments of the southern USA.



4.1.1 What is the source of the water causing the hydrostatic pressure indicated in the above figure?

(1)

4.1.2 What is illustrated by the shaded region in the figure?

(2)

4.1.3 What causes the feature referred to in question 4.1.2?

(3)

4.1.4 The water referred to in question 4.1.1 typically increases in salinity with depth. What process causes this salinity increase and how does it work?

(7)

4.2.1 What is the permeability of a rock?

(2)

4.2.2 What is the difference between intrinsic and hydraulic permeability?

(4)

4.3 Shortly describe the following alteration types by referring to how it happens, the alteration mineral assemblage associated with it and the temperature range associated with it. Also mention an ore deposit/ore forming environment with which this type of alteration is associated.
4.3.1 Intermediate argillic alteration.

(4)

4.3.2 Advanced argillic alteration.

(6)

4.4 Vulcanogenic massive sulphide (VMS) deposits have well-developed metal zonation patterns. Make a sketch to illustrate the zonation pattern and explain how it develops.

(16)

4.5.1 Why did Mississippi Valley Type (MVT) deposits tend to form in low latitudinal settings?

(4)

4.5.2 What is thought to have caused the fluid flow that formed MVT deposits?

(1)
(50)

QUESTION 5: SURFICIAL AND SUPERGENE ORE-FORMING PROCESSES (18 marks)

5.1.1 Name and shortly explain the two main processes involved in laterite formation.

(4)

5.1.2 How do nickel laterites form?

(7)

5.1.3 How are platinum group elements (PGE) enriched in laterites?

(4)

5.2 Under what conditions and from which precursor minerals do illite clays form?

(3)
(18)

QUESTION 6: SEDIMENTARY ORE-FORMING PROCESSES (35 marks)

6.1.1 What is the main principle behind the formation of placer deposits?

(3)

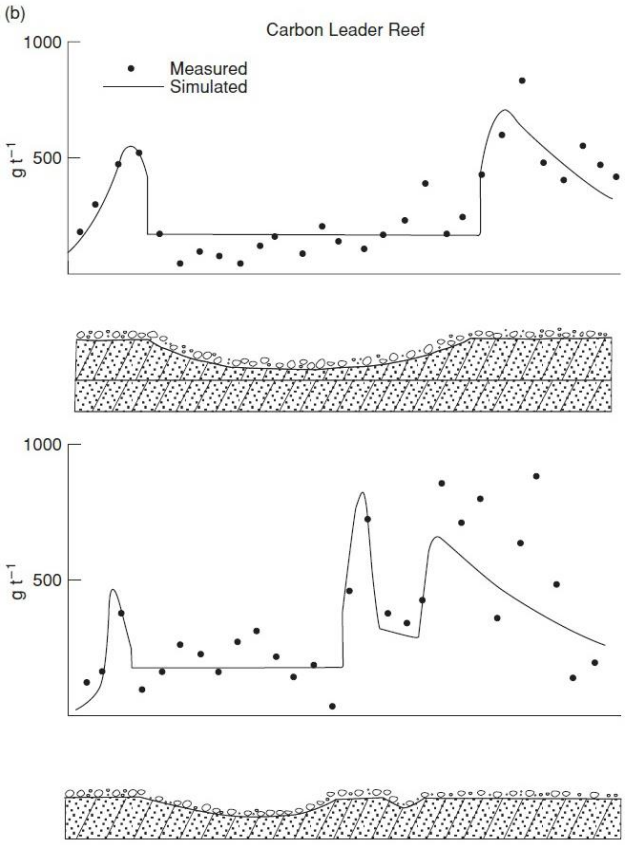
6.1.2 Give five examples of ore minerals that can be concentrated in placer deposits.

(5)

6.1.3 Name and explain the three ways in which particles can be transported in the solid state in water as based upon their grain sizes.

(8)

6.2 The following diagram from "An Introduction to Ore-forming Processes" by Robb (2005) illustrates measured gold grades in paleochannels of the carbon leader reef (dots) as well as simulated gold grades (lines) using a numerical simulator. The two can be seen to correlate well.



6.2.1 Where do the highest gold grades tend to occur?

(2)

6.2.2 Explain why the highest gold grades occur as seen in the figure and as answered in question 6.2.1.

(7)

6.3.1 What is a chemical sedimentary rock?

(2)

6.3.2 Explain the most likely transport and precipitation mechanisms that were involved in the deposition of the iron-rich minerals in Superior-type banded iron formations.

(8)
(35)