



## **FACULTY OF SCIENCE**

### **DEPARTMENT OF GEOLOGY**

**MODULE      APG3B10 – ECONOMIC GEOLOGY**

**CAMPUS      APK**

**SSA EXAM      DECEMBER 2016**

**DATE: DECEMBER 2016**

**SESSION**

**ASSESSOR(S)**

**DR. AJB SMITH**

**INTERNAL MODERATOR**

**EXTERNAL MODERATOR**

**DR. Z JINNAH**

**DURATION      3 HOURS**

**MARKS      180**

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**NUMBER OF PAGES: 4 PAGES**

**INSTRUCTIONS:      Answer all the questions.**

**QUESTION 1: INTRODUCTION (9 marks)**

1.1 Provide definitions for the following:

1.1.1 Metallogenic epoch.

(3)

1.1.2 Mesothermal deposit.

(3)

1.2 What is the main goal of sustainable development in economic geology?

(3)

(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 normally composed?

(2)

2.1.2 How can magnetite layers contain economic concentrations of vanadium?

(3)

2.2.3 How and where do diamonds form?

(6)

2.2.4 What is the difference in formation between P-type and E-type diamonds?

(3)

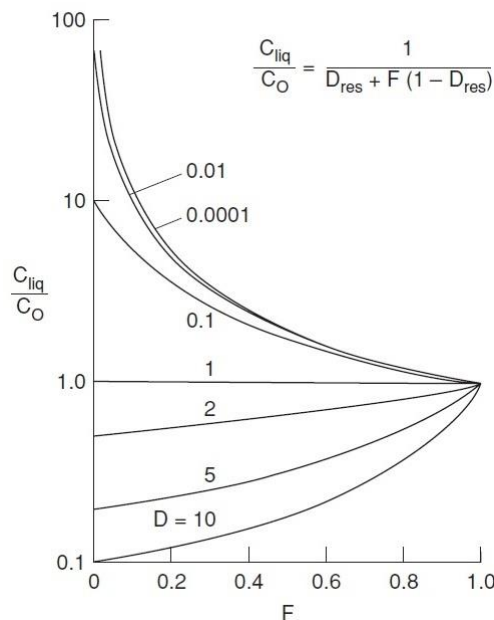
2.3.1 How is fertile mantle formed?

(4)

2.3.2 Why is fertile mantle important in forming magmatic ore deposits?

(3)

2.4 The following diagram (Robb, 2005) illustrates element partitioning as partial melting progresses:



2.4.1 Does the diagram illustrate batch melting or fractional melting? Explain your answer.

(3)

- 2.4.2 What does the symbol "D" in the above diagram refer to? Also define the term. (4)
- 2.4.3 "A small fraction partial melt derived from fractional melting would most likely have a higher potential to form an incompatible element-enriched ore deposit than a partial melt derived from batch melting". Would you agree or disagree with this statement? Explain your answer. (5)
- 2.5 What are the typical commodities concentrated by sulphide saturation in a magma? (3)
- (36)

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

- 3.1 What are the four properties of water that make it important for chemical, biological and geological processes on Earth? Also explain why each property is important. (8)
- 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 Is it more likely than an element that is compatible relative to crystals formed in a melt will be concentrated by a magmatic-hydrothermal process during a low level (i.e. deep) or high level (i.e. shallow) granitic intrusive event? Explain why. (6)
- 3.4 What are the differences between the high- and low-sulfidation mineralization processes that form epithermal gold deposits? (8)
- (32)

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

- 4.1 Excluding magmatic sources, what are the four sources from which hydrothermal ore-forming fluids can be derived? (4)
- 4.2 How are hydrothermal fluids produced and circulated in oceanic crust? (5)
- 4.3 How does seismic pumping of crustal aqueous fluids work? (6)
- 4.4 Give **two** examples each of the following: (2)
- 4.4.1 Hard metals. (2)
- 4.4.2 Borderline metals. (2)
- 4.4.3 Soft metals. (2)
- 4.5 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)
- 4.5.1 Intermediate argillic alteration. (4)
- 4.5.2 Advanced argillic alteration. (6)
- 4.6 What is the difference between biologically induced mineralization and biologically controlled mineralization? (2)

4.7 In some instances, the hydrothermal fluids that form volcanogenic massive sulphide (VMS) deposits can vent into the ocean as hydrothermal plumes. Based on the density of the hydrothermal fluid, explain the three possible VMS deposit types that can be formed in such a scenario.

(9)

4.8 How is the gold deposition interpreted to have occurred in Carlin-type gold deposits?

(8)

(50)

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

5.1.1 What is a laterite?

(5)

5.1.2 What commodities can be concentrated in laterites?

(4)

5.2.1 What is calcrete?

(2)

5.2.2 What are the differences in how U occurs and how it is precipitated in calcrete-hosted deposits and roll-front type deposits?

(7)

(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 What ore minerals 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, remembering to refer to grain sizes.

(8)

6.2 Explain where and how bog iron ores form. Use a sketch to illustrate your answer.

(8)

6.3 What are the typical products mined from evaporitic deposits.

(5)

6.4.1 What are the molecular building blocks involved in petroleum formation?

(4)

6.4.2 Into which major two types are most organic matter on Earth classified?

(2)

(35)