UNIVERSITY OF FORT HARE

GLG 511
Economic Geology, Geophysics, Mining and Exploration Geology

Main Examination: June 2023

Time: 3 Hours **Marks: 100**

Subject: Geology **One paper**

This paper consists of 5 pages including the cover pages

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INSTRUCTIONS

Answer two questions from Section A, one question from Section B and one question from Section C.

SECTION A: ECONOMIC GEOLOGY

QUESTION 1

[25]

Write an essay on the gold ore-deposits in the Witwatersrand Basin. Discuss the ore-minerals, stratigraphy, distribution areas, geological occurrence, ore origin and ore concentration processes.

QUESTION 2

[25]

(a) Give reasons why some reservoirs are devoid of hydrocarbons whilst others have a commercial accumulation of hydrocarbon. (6)

(b) What is a *prospect* and its significance in the oil and gas exploration? (4)

(c) Define three categories of prospective resources that are defined when assessing the uncertainties of the expected production. (6)

(d) The following information is given for an oil and gas field:

Oil field
Area of zone, A = 200 acres
Thickness, H= 150 ft
Porosity, φ = 15%
Water saturation = 30%
Oil formation volume factor, B_o = 1.65%

Gas field
Area of zone, A = 200 acres
Thickness, H = 150 ft
Porosity, φ = 15%
Water saturation = 30%
Gas formation volume factor, B_g = 0.0035

i. Calculate the volume of oil and gas stock tank conditions and reservoir conditions. (6)

ii. Compare the calculated volumes at stock tank oil and reservoir conditions and give reasons for differences in your answer. (3)

QUESTION 3

[25]

(a) The Proterozoic metallogenesis (2500-550 Ma) represents a period of great accumulation of manganese ores in global sedimentary basins, accounting for almost 70% of known manganese deposits. Briefly discuss the accumulation processes of manganese deposits during this period starting from the Early, Mid to Late Proterozoic. Your answer should capture the aspect of predominated depositional environment, mechanism of ore accumulation and probable sources of ore substances and examples of known deposits under each stage. (15)

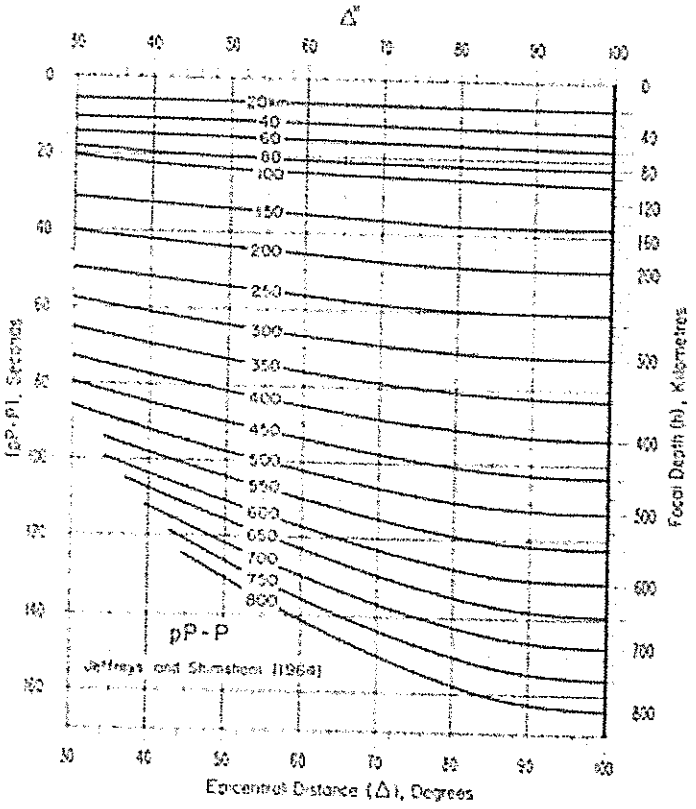
(b) Briefly discuss the geology of the North West Manganese Deposit. Your answer should indicate the ore types, ore mineral assemblages and illustrations showing the nature of ore preservation. (10)

SECTION B: GEOPHYSICS

QUESTION 4

[25]

(a)i. A seismic recording station at an epicentral distance of 65° has a pP-P time difference of 50 seconds. Use the nomogram below to estimate the focal depth of the earthquake. (4)



ii. A seismic recording station receives the first S-wave arrival 39 seconds after the P-wave one and the S-wave has a maximum amplitude of 40 mm. Use the nomogram below to estimate the magnitude of the earthquake and the epicentral distance. (3)

QUESTION 5

[25]

(a) A seismic refraction survey is carried out over an area with four horizontal layers. The top layer velocity is V_1, the second layer velocity is V_2, the third layer velocity is V_3 and the fourth layer velocity is V_4. The velocities are such that $V_2 < V_1 < V_3 < V_4$. The seismic source is placed at beginning of the spread at position A and the end of the spread is at position B. Sketch a ray diagram showing the path for direct waves and headwaves. For each interface, explain whether or not you get headwaves. (7)

(b) The data provided in the table below was obtained from a seismic refraction survey, where x is the distance in metres (m) and t is the time in milliseconds (ms).

Geophone	1	2	3	4	5	6	7	8	9	10	11	12
x(m)	0	50	100	150	200	250	300	350	400	450	500	550
t (ms)	0	32	68	101	134	166	201	228	251	276	299	323

i. Plot a time-distance graph. (6)
ii. Calculate the layer velocities. (6)
iii. Calculate the critical angle θ_c. (3)
iv. Calculate the top layer thickness h given that

$$h = \frac{X_{crossover}}{2}\sqrt{\frac{V_2 - V_1}{V_2 + V_1}},$$

where the symbols have their usual meanings. (3)

SECTION C: MINING AND EXPLORATION GEOLOGY

QUESTION 6

[25]

Write an account on the budget considerations in drilling for exploration and mining. The answer should also include stages of drilling, cost estimation and financial budget in the efficient execution of a core drilling project for mineral exploration.

**********END OF PAPER**********