(4)

# THE UNIVERSITY OF ZAMBIA

## UNIVERSITY EXAMINATIONS - 1998/99

## SECOND SEMESTER

## SCHOOL OF MINES

| | | | |
|---|---|---|---|
| 1. | GG 202 | - | Physical geology - paper II: practical |
| 2. | GG 202 | - | Physical geology - paper I: Theory |
| 3. | GG 312 | - | Mineralogy and petrology - Paper II: practical |
| 4. | GG 312 | - | Mineralogy and Petrology - Paper I: Theory |
| 5. | GG 332 | - | Structural geology I Paper II: Practical |
| 6. | GG 412 | - | Metamorphic Petrology - Paper II: Practical |
| 7. | GG 412 | - | Metamorphic Petrology - Paper I: Theory |
| 8. | GG 442 | - | Economic geology of metalliferous ore - Paper I: Theory |
| 9. | GG 472 | - | Applied geochemistry - paper II: practical |
| 10. | GG 472 | - | Applied geochemistry - paper I: Theory |
| 11. | GG 542 | - | Economic geology of non - metallic mineral deposits Paper I: Practical. |
| 12. | GG 542 | - | Economic geology of metallic mineral deposits Paper I: Theory |
| 13. | GG 572 | - | Hydrogeology |
| 14. | MG 319 | - | Computer Techniques |

MINES 98/99

# THE UNIVERSITY OF ZAMBIA

## SCHOOL OF MINES

## SECOND SEMESTER EXAMINATIONS - 1998/99

## GG 202: PHYSICAL GEOLOGY

## PAPER II: PRACTICAL

**TIME:** 3 HOURS
**ANSWER:** ALL QUESTIONS

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Q1. By observing the altitude of bedding at an outcrop, conclusions can be drawn concerning the structure in the area. Interpret the structure from bedding or foliation data observed from an outcrop along a road cut section depicted in Fig. 1.

Q2. The Lusaka Water and Sewerage Company would like to expand on their sources of water supply. Information is available of three (3) springs A, B, and C (Fig. 2) pouring out water to the surface in the kalingalinga dambo. Assuming the channel from which this water originates is planar and with constant/uniform dip:

(i) Determine the strike and dip of the channel.

(ii) Draw on the map the possible outcrop pattern of these springs.

(iii) At what depth would water be encountered in a borehole sunk at D?

(iv) Shade the area underlain by the channel where it would be possible to recommend drilling for additional water sources.

(v) What would be the thickness of intersection of the aquifer at point D if it has a true thickness of 5m?

Q3. The diagram given in the appendix (Fig. 3) represents the Chilileka area south of the Kafue town. After careful study of the area depicted in the diagram, **GIVE** a possible sequence of geological events that may have affected the area.

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**END OF EXAMINATION**

# GG 202 - END OF SEMESTER 2 PRACTICAL EXAMINATION
## [Sketch for Question 1]

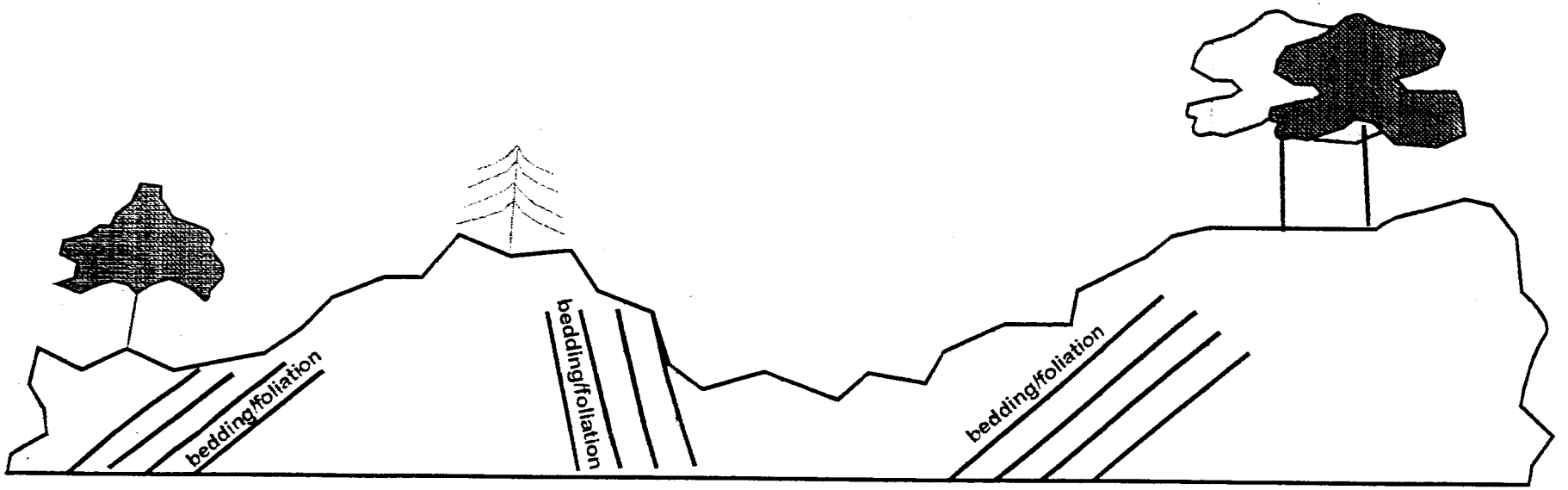
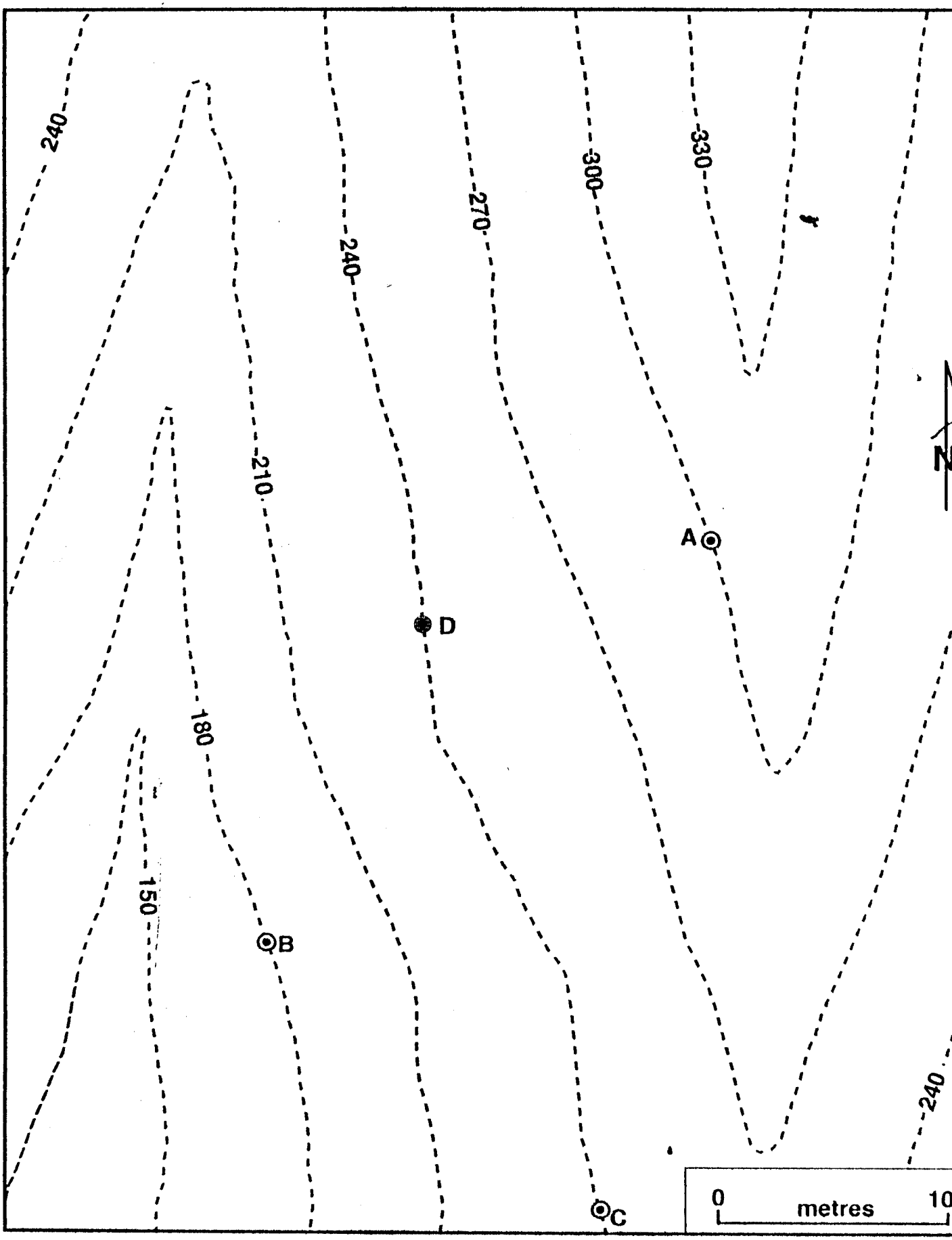



Fig 1: Outcrop along a roadside section

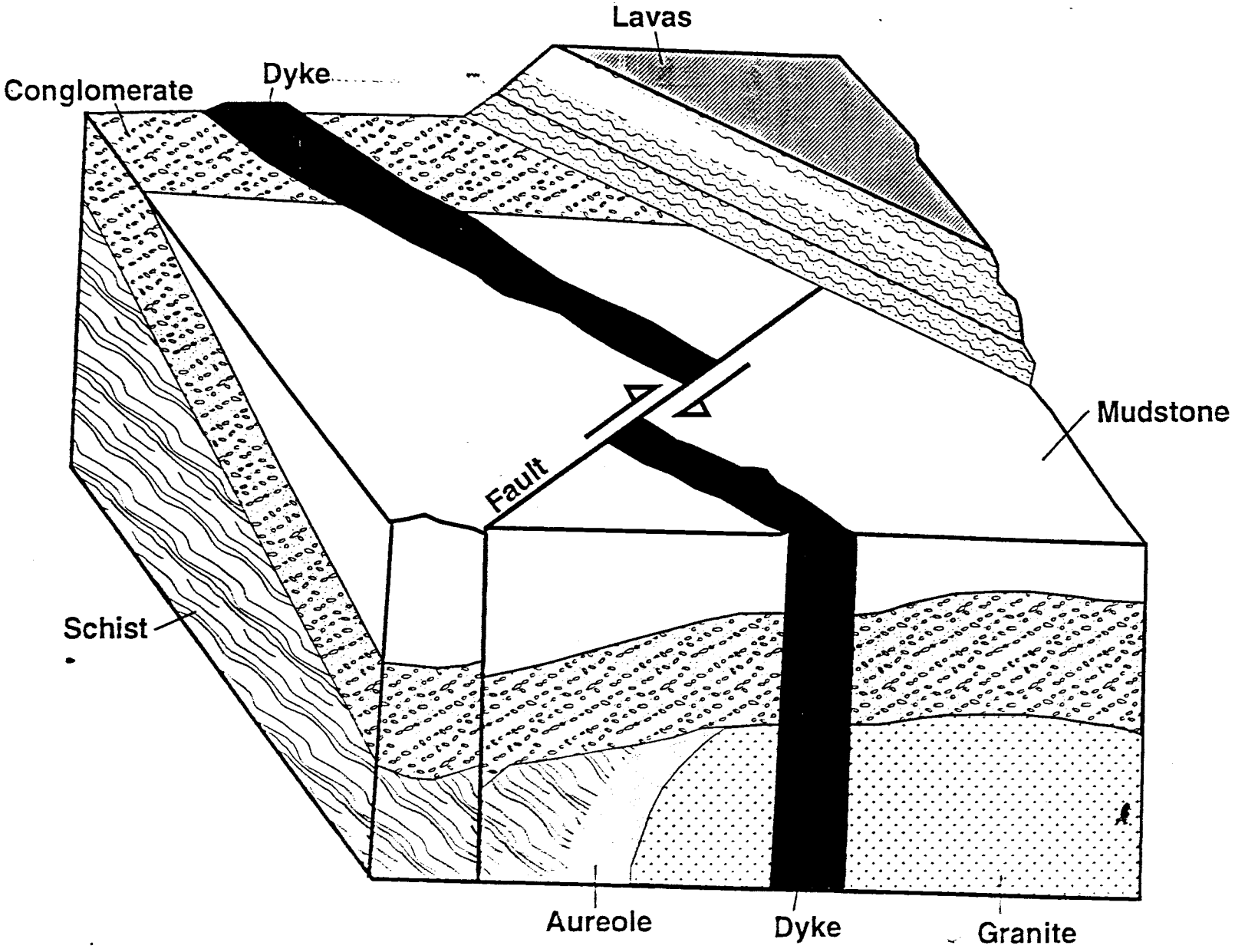
Fig. 2




| Borehole | Granite Sill depth (m) |
|---|---|
| A | 90 |
| B | 30 |
| C | 120 |

GG 202 - END OF SEMESTER 2 PRACTICA
EXAMINATION
[Map for Question 2]

Block Diagram
for Question 3



# THE UNIVERSITY OF ZAMBIA

## SCHOOL OF MINES

## SECOND SEMESTER EXAMINATIONS - 1998/99

## GG 202: PHYSICAL GEOLOGY

## PAPER I: THEORY

**TIME:** 3 HOURS
**ANSWER:** ANY FIVE QUESTIONS

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Q1. (a) Describe;

(i) The movement of water through the hydrologic cycle.

(ii) The difference between porosity and permeability

(iii) Two problems that can arise from excessive use of groundwater.

(b) Explain why bedrock or regolith must be both porous and permeable to be an aquifer.

Q2. (a) Describe how volcanic eruptions can cause climate change.

(b) Name the green house gases and discuss how they affect global temperature.

Q3. (a) What is weathering?

(b) Explain the differences between mechanical and chemical weathering.

(c) Briefly describe;

(i) Five processes that cause mechanical weathering

(ii) Four processes of chemical weathering indicating any reactions that may be involved in each case.

(d) Why is pressure-release fracturing an example of chemical and mechanical weathering?

Q4. (a) State the forms in which carbon is present in the various spheres of the earth.

(b) Draw the carbon cycle and explain the chemical transformations shown in your cycle.

Q5. (a) What is mass wasting?

(b) Describe;

(i) Three main categories of mass wasting

(ii) Any three factors that control mass wasting

(c) Compare and contrast creep, debris flow and mudflow.

(d) Why is solifluction more likely to occur in the Arctic than in temperate or tropical regions?

Q6. (a) Discuss earthquake mechanisms at the three different types of tectonic plate boundaries.

(b) Name and describe the three types of waves generated by earthquakes.

Q7. (a) Describe three factors that control current velocity of a stream.

(b) List and explain three ways in which sediments can be transported by a stream. Which type of transport is independent of stream velocity? Explain.

(c) How is an alluvial fan similar to a delta? How do they differ?

**END OF EXAMINATION**

# THE UNIVERSITY OF ZAMBIA

## SCHOOL OF MINES

## SECOND SEMESTER EXAMINATIONS - 1998/99

## GG 312: MINEROLOGY AND PETROLOGY

## PAPER II: PRACTICAL

**TIME:** 3 HOURS
**ANSWER:** ALL QUESTIONS

---

Q1. Describe the six hand specimens provided, indicating;

(a) Mineralogy

(b) Texture

(c) Name the rock

Q2. Give a full petrographic description of the three thin sections provided paying particular attention to;

(i) optical properties of the constituent minerals

(ii) identification of the major, minor, secondary and accessory minerals

(iii) texture of the rock

(iv) name the rock and give reasons

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[redacted]N

Q3. Describe the following igneous textures:

(a) Vesicular

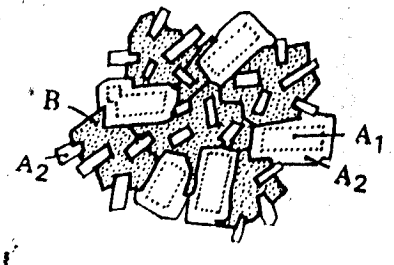
(b) Pegmatitic

(c) Graphic Intergrowth

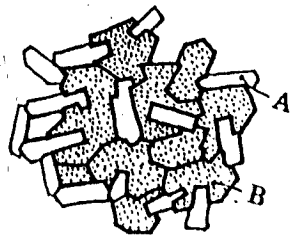
(d) Porphyritic

Q4. What is the order of crystallization in the figures below?

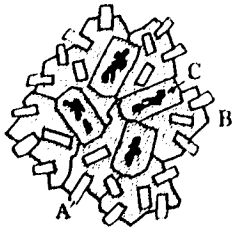
(a)



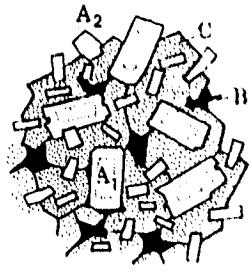

(b)




(c)




(d)



# THE UNIVERSITY OF ZAMBIA

## SCHOOL OF MINES

## SECOND SEMESTER EXAMINATIONS - 1998/99

## GG 312: MINEROLOGY AND PETROLOGY

## PAPER I: THEORY

**TIME:** 3 HOURS
**ANSWER:** FIVE QUESTIONS WITH AT LEAST 2 FROM EACH SECTION

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**SECTION A**

Q1. The following data about a Mg-Fe silicate mineral were found in a handbook. Explain the meaning of the symbols used, determine to which crystal system the mineral belongs (give reasons) and identify it.

$\alpha$ 1.635 - 1.827

$\beta$ 1.651 - 1.869

$\sigma$ 1.670 - 1.879

$\delta\Lambda$ 0.035 - 0.052

$2V_\sigma$ $82^o$ - $134^o$

$\alpha = y$ $\beta = z$ $\sigma = x$

cleavage {010}, {100} imperfect

colour: green - greenish yellow

Q2. (i) How can you precisely discriminate between different members of the feldspar group of minerals.

(ii) What do you understand by the terms perthite and antiperthite.

Q3. How are pyroxenes and amphiboles distinguished from each other in thin section.

Q4. Explain the following terms commonly used in the study of minerals in thin section.

(a) Relief

(b) Interference colour

**SECTION B**

Q1. (a) Viscosity is one of the most important physical properties of magmas. What physical and chemical factors are most important in controlling viscosity?

(b) Which type of lava is the least viscous and which type of volcano is the most violent and explosive?

(c) What is the difference between parphyritic texture and phaneratic texture and what do you understand from each texture?

Q2. Give brief account on the following;

(a) schist

(b) diagenesis

(c) ignemberite

(d) peridotite

(e) conglomerate

Q3. Discuss briefly the main characteristics of contact metamorphism.

Q4. Describe the main types of detrital rocks, paying attention to;

(a) size and composition

(b) depositional environments

**END OF EXAMINATION**

# UNIVERSITY OF ZAMBIA

## SECOND SEMISTER EXAMINATIONS - MAY 2000

## GG331

## STRUCTURAL GEOLOGY I

## PAPER II: PRACTICAL

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**ANSWER:** ALL QUESTIONS
**TIME:** 3 HOURS

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Q1. Figure 1 shows geological maps of uniformly dipping beds, which have been faulted. Indicate on the map:

i) Dip direction of the beds by means of the strike and dip symbols
ii) The up-thrown side and down-thrown side of each fault with U and D, respectively.

Q2. Figure 2 is a geological map of an area.

i) Indicate the axial trace with the appropriate symbol
ii) Determine the attitude of the fold axis of the fold and indicate on the map.
iii) Name the type of fold
iv) Name the fold type if the core of the fold structure consists of older rocks.

Q3. Refer to figure 3

i) Construct strike lines and label them systematically
ii) Draw a geological cross-section along X-Y
iii) List all geological events in chronological order.

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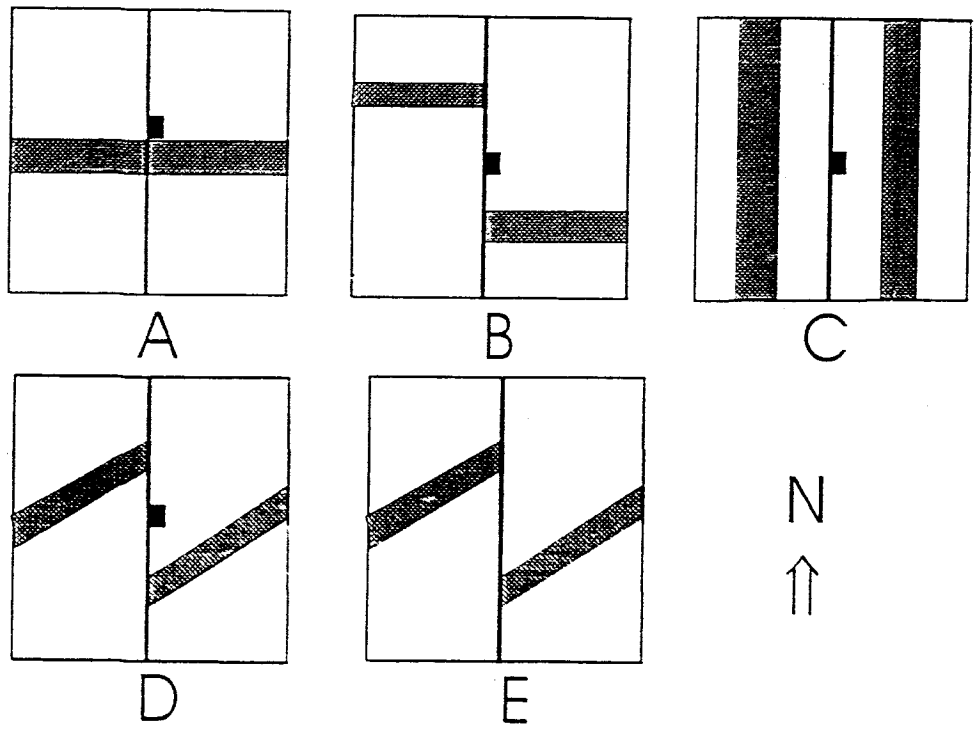
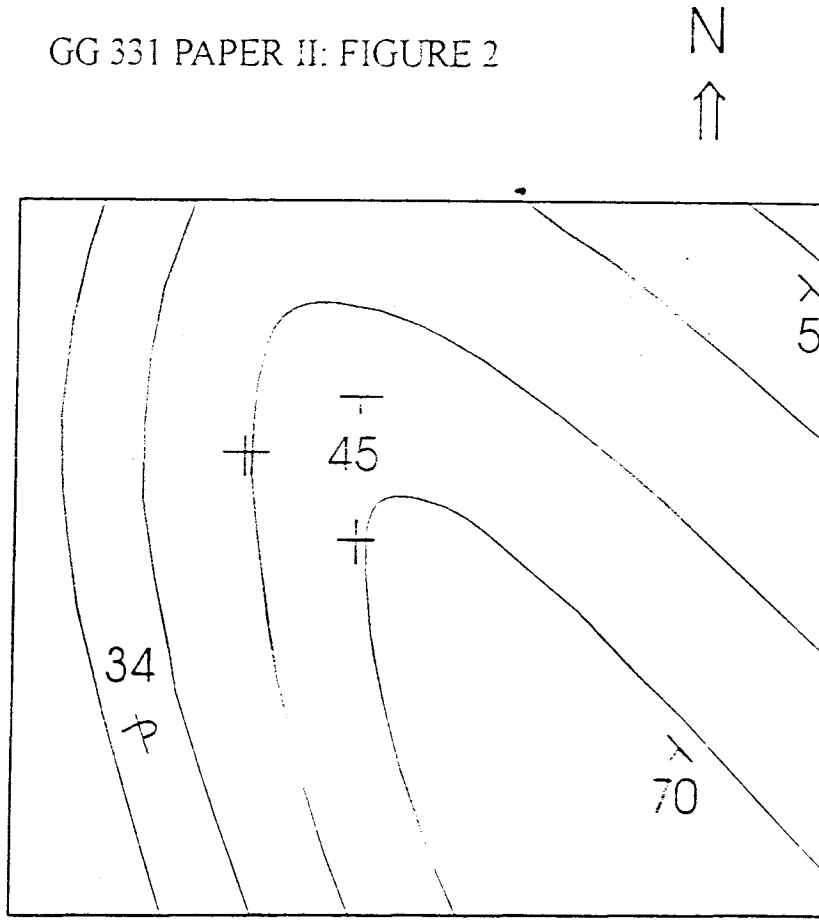
**END OF EXAMINATION**

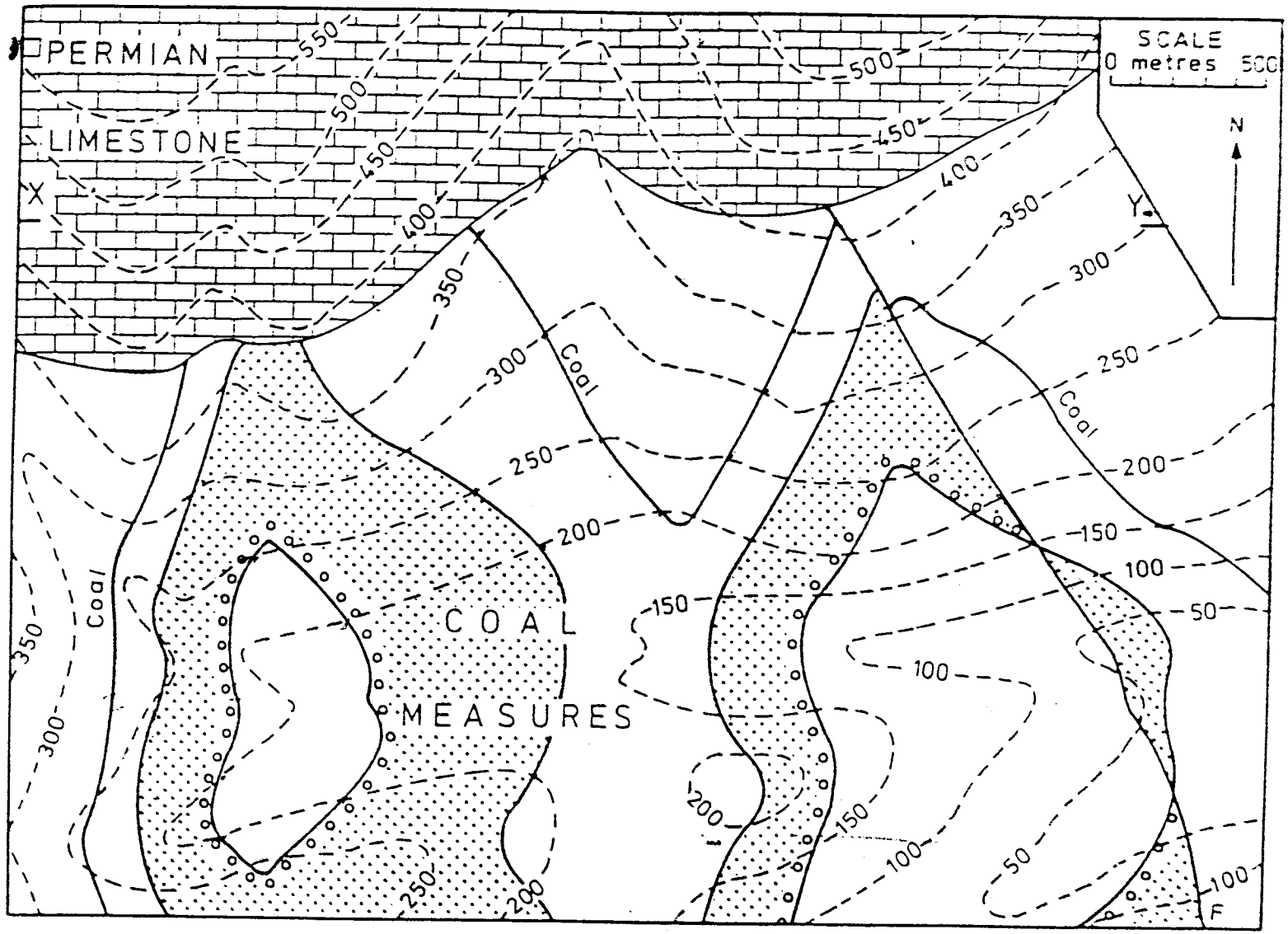
GG 331 PAPER II: FIGURE 1




GG 331 PAPER II: FIGURE 2



GG 331 PAPER II: FIGURE 3.



THE UNIVERSITY OF ZAMBIA

SCHOOL OF MINES

SECOND SEMESTER EXAMINATIONS - 1998/99

GG 412: METAMORPHIC PETROLOGY

PAPER I: THEORY

TIME: 3 HOURS
ILLUSTRATE YOUR ANSWERS WITH SKETCHES WHERE POSSIBLE

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SECTION A: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

Q1. Discuss the concept of metarmorphic facies, organizing your answers as follows:

(a) Give a definition for the term "metamorphic facies".

(b) Explain how facies are recognised.

(c) Explain the basic reason for the existence of facies.

(d) List the main metamorphic facies discussed in this course and show their relative position on P-T diagram. (30 marks)

Q2. Define

(a) metastable state
(b) ocean-floor metamorphism
(c) migmatite
(d) mylonite
(e) syntectonic - crystallization

(15 marks)

Q3. Discuss the tectonic significance of a perferred orientation of platy or elongated minerals in a metamorphic rock.

(15 marks)

Q4. What are the characteristics of paired metamorphic belts? How can their formation be explained in relation to global tectonics?

(15 marks)

**SECTION B:** **ANSWER BOTH QUESTIONS**

Q1. (a) Define the terms **petrogenetic grid** and **isograd.**

(b) Figure 1.1 is a model map of a metamorphic terrane comprising metapelites and quartzites. Mineral assemblages in the different rock types are shown.

(i) Write down the metamorphic reactions that have occurred in the map area.

(ii) Construct an appropriate component diagram showing these metamorphic changes.

Q2. (a) Using examples, describe the main types of metamorphic reactions.

(b) Discuss evidence for the existence of a separate fluid phase during metamorphism.

(15 marks)

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**END OF EXAMINATION**

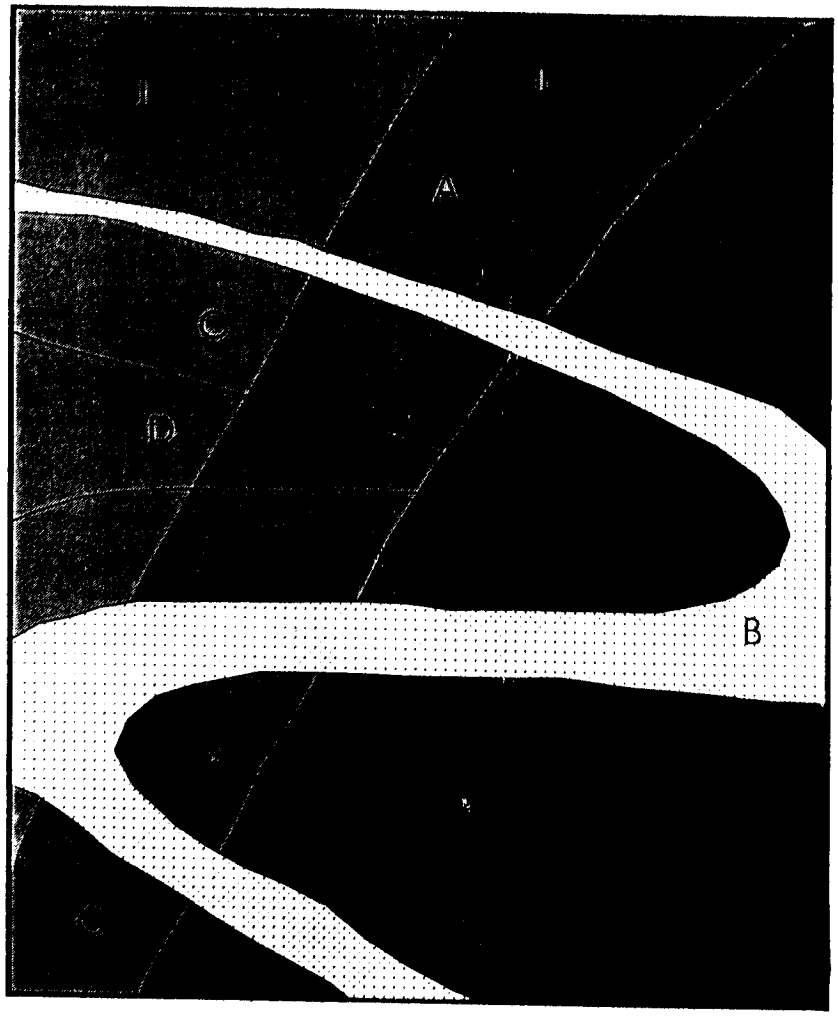


Fig. 1.1

Mineral Assemblages

Zone I
Rocks C & D: Musc + Qtz + Kfsp + And
Rock A: Musc + Cor + And
Rock B: Musc + Qtz + Kfsp

Zone II
Rocks C & D: Musc + Qtz + Kfsp + Ky
Rock A: Musc + Cor + Ky
Rock B: Musc + Qtz + Kfsp

Zone III
Rocks C & D: Musc + Sill + Kfsp
Rock A: Musc + Cor + Sill
Rock B: Qtz + Kfsp + Sill

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SECOND SEMESTER EXAMINATIONS - 1998/99

GG 442: ECONOMIC GEOLOGY OF METALLIFEROUS ORE

PAPER I: THEORY

TIME: 3 HOURS
ANSWER: ANY FIVE QUESTIONS

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Q1. Discuss titanium oxide ores in anothosites with respect to the following:

(a) tectonic setting

(b) types of anorthosites

(c) orebody morphology

(d) ore mineralogy

(e) formation of Ti-Fe minerals

(f) exploration guides

Q2. (a) Compare the mineralogy of kimberlites and lamproites.

(b) Discuss briefly the mineralization associated with basic and ultrabasic rocks.

Q3. Discuss the tectonic setting, rock types and mineralization of carbonatite complexes. Mention any Zambian occurrences.

Q4. (i) Name three types of ore deposits that may form within oceanic crust at constructive plate margins.

(ii) Describe the ways in which the above may be transferred to the continental crust at a destructive plate margin.

Q5. (a) Describe the main characteristics of the six categories of ore-bearing fluids.

(b) For any two of the ore-fluids you have described above, discuss the factors and mechanisms of fluid migration from its source to depositional sites.

Q6. (a) Discuss the factors that lead to the localisation of ore-elements to form an ore deposit.

(b) Briefly describe the characteristics of wall-rock alteration associated with;

(i) porphry base-metal deposits

(ii) skarn deposits.

Q7. (a) Outline four classes of sedimentary ore deposits.

(b) On the classification in (a) above where do you place the Zambian Copperbelt deposits?

(c) You have been requested to present a position paper on the Zambian Copperbelt and you have been asked to include the following in your presentation.

(i) To draw in the three orebody types on Fig. 1 provided and label them.

(ii) To also label the Kafue Anticline

(d) List five main ore minerals on the Zambian Copperbelt including their chemical formula and copper content (wt%)

(e) Outline briefly the general stratigraphy.

(f) What are two widely debated depositional models of the Zambian Copperbelt?

(g) Write short notes on the following:

(i) Detrital (placer) deposits.

(ii) Banded Iron Formations <u>or</u> phosphorite deposits

**END OF EXAMINATION**

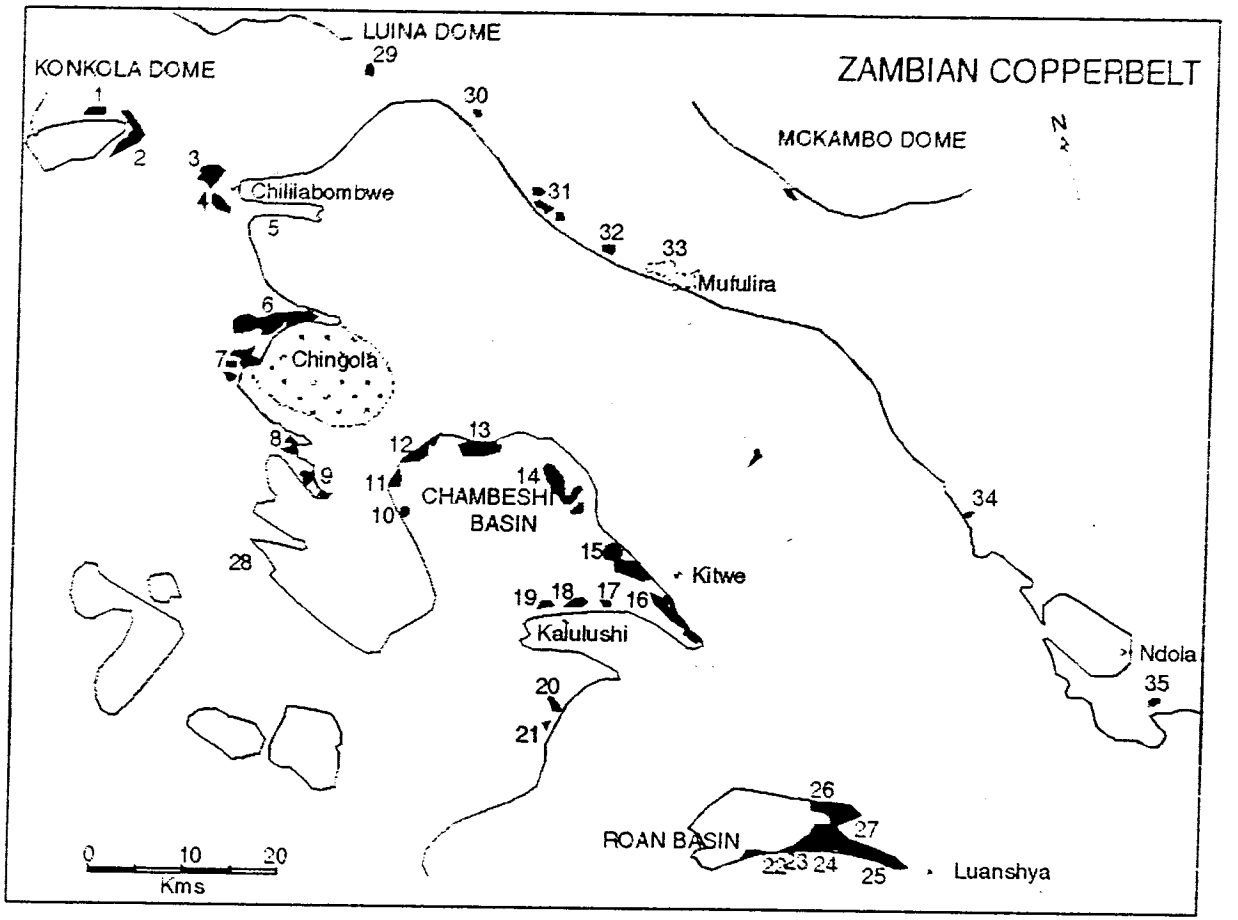


Fig. 1. Copperbelt map showing the orebodies which could be divided into 3 orebodies types

i) Draw in the boundaries of the 3 orebody types and label them

ii) Label the Kafue Anticline

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SECOND SEMESTER EXAMINATIONS - 1998/99

GG 472: APPLIED GEOCHEMISTRY

PAPER II: PRACTICAL

TIME: 3 HOURS
ANSWER: QUESTIONS 1 AND 2 AND ANY OTHER TWO QUESTIONS

Q1. Data obtained in a drainage survey for heavy metals (Cu, Pb, Zn) using a colorimetric method of sample analysis is given in figure 1. Use an appropriate statistical technique to determine the threshold and design a sampling plan for a follow-up survey. (30 marks)

Q2. The data obtained in a soil survey for gold is given in figure 2. Use the cumulative frequency technique to split the data set into anomalous and background populations. Draw a contour map and outline the anomalous area. (40 marks)

Q3. (a) Classify the following elements on the basis of their toxicity Na, Mg, Ca, Be, Zn, Hg, Pb, As, Cd, Ti, Ba, Zr, Rb, Si, W, U.

(b) The average contents of Pb, Zn, and S in the top soil in the vicinity of a smelter are given in table 1. Use the data to answer the following questions.

(i) Determine the background levels for Pb, Zn and S.

(ii) Discuss very briefly the processes which have led to the introduction of the pollutants in the soil.

**Table 1**

| Distance from smelter | Lead (ppm) | Zinc (ppm) | Sulphur (ppm) |
|---|---|---|---|
| 0.5 km | 5220 | 635 | 1088 |
| 1.5 km | 1285 | 210 | 627 |
| 2.0 km | 540 | 113 | 593 |
| 2.5 km | 355 | 79 | 582 |
| 3.5 km | 190 | 72 | 408 |
| 5.0 km | 180 | 70 | 409 |
| 6.5 km | 178 | 72 | 405 |

(iii) Suggest the most appropriate method of treating the soils which have been polluted.

(iv) Are the soils within a radius of 2km from the smelter suitable for growing of vegetables for human consumption?

Q4. The three-year average export of dissolved constituents in stream water from undisturbed and deforested catchment areas are given in table 2. Use this data to discuss in general how large scale cutting of trees can disturb the natural circulation patterns for elements in a forest and affect the quality of water.

(15 marks)

**Table 2**

| Element | Tonnes/km$^3$/yr undisturbed area | Deforested area |
|---|---|---|
| $Ca^{2+}$ | 1.1 | 7.7 |
| $K^+$ | 0.2 | 2.3 |
| $Al^{3+}$ | 0.3 | 1.8 |
| $Mg^{2+}$ | 0.3 | 1.6 |
| $Na^+$ | 0.7 | 1.8 |
| $NH_4^+$ | 0.4 | 0.09 |
| $NO_3^-$ | 0.6 | 65.2 |
| $SO_4^{2-}$ | 5.1 | 4.5 |
| $HCO_3^-$ | 0.2 | 0.1 |
| $Cl^-$ | 0.5 | 0.9 |
| $SiO_2$ (aq) | 3.7 | 6.7 |

Q5. The composition of drainage water discharged from mining areas is given in Table 3. Discuss the quality of this water and suggest methods for treatment of this water.

(15 marks)

**Table 3**

| Parameter | Source of discharge | | |
|---|---|---|---|
| | Underground Coal Mine | Coal stockpile seepage | Deepest underground coal mine |
| pH | 8.0 | 3.1 | 7.5 |
| Alkalinity | 290 | 0 | 190 |
| Ca (mg/l) | 90 | < 0.1 | 2,560 |
| Mg (mg/l) | 93 | < 0.1 | 720 |
| Fe (mg/l) | 1.0 | 160 | 0.6 |
| Mn (mg/l) | 0.4 | 9 | 0.9 |
| Cl (mg/l) | 90 | 80 | 30,800 |
| Sulphate (mg/l) | 700 | 1,220 | 350 |

**END OF EXAMINATION**

GG472 Paper II

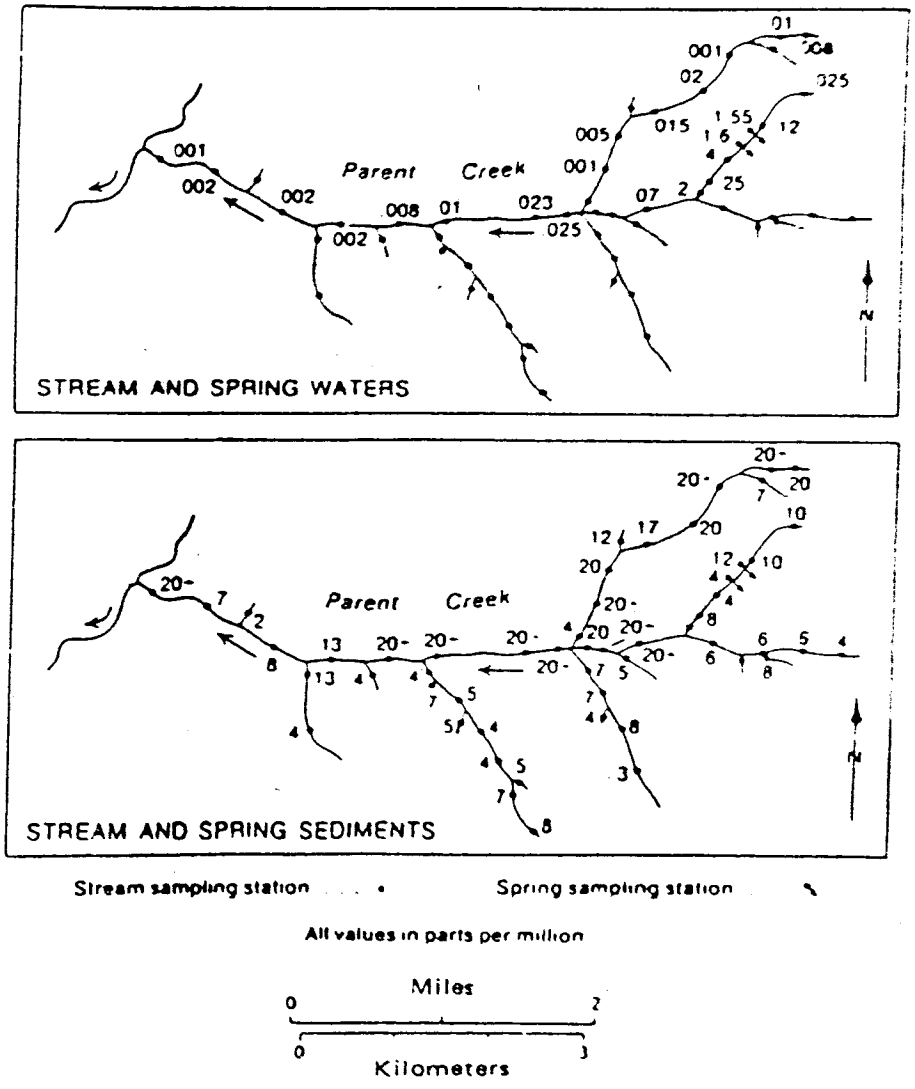


Figure 1: The heavy metal content in waters from streams and springs (upper) and from stream and spring sediments (lower).

GG472 paper II

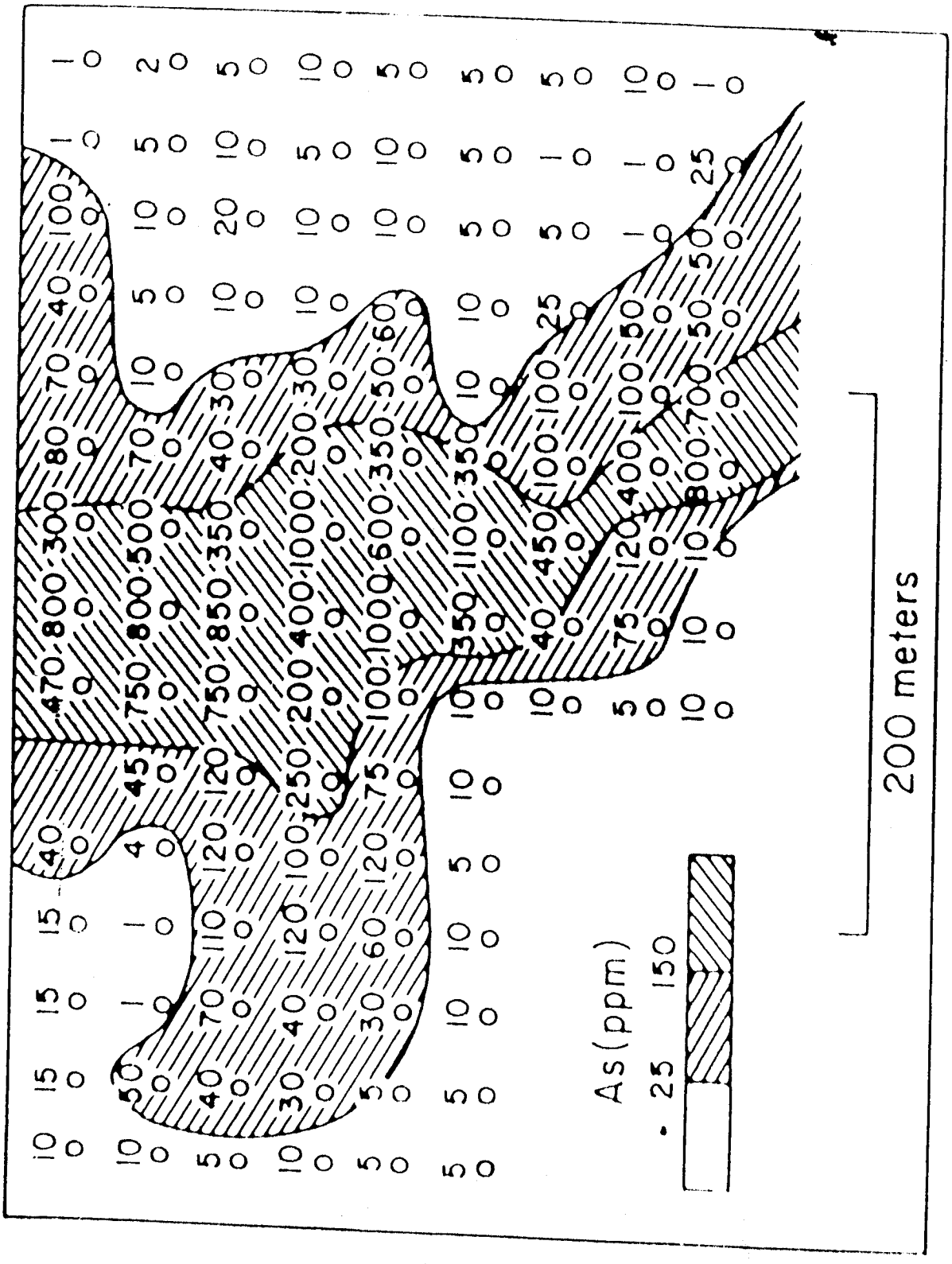


Fig. 2

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SCHOOL OF MINES

SECOND SEMESTER EXAMINATIONS - 1998/99

GG 472: APPLIED GEOCHEMISTRY

PAPER I: THEORY

**TIME: 3 HOURS**
**ANSWER: QUESTIONS 1 AND ANY OTHER THREE QUESTIONS**
**ALL QUESTIONS CARRY EQUAL MARKS**
**(USE CHEMICAL EQUATIONS, DIAGRAMS AND THE SUPPLIED GEOCHEMICAL DATA WHERE EVER IT IS NECESSARY).**

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Q1. (a) Use the thermodynamic data below to construct an Eh - pH diagram for the system Sn-Ta-O-H at 25°C and 1 bar pressure. Assume activities of dissolved species of Sn and Ta to be $10^{-8}$M.

| Species | | $\Delta G^{o}f$(k.Cal/gfw) |
|---|---|---|
| $SnO_2$ (c) | - | 124.19 |
| $SnO_3^{2-}$ (aq) | - | 137.42 |
| $Sn^{4+}$ (aq) | + | 0.06 |
| SnO (c) | - | 61.40 |
| $HSnO_2^-$ (aq) | - | 48.00 |
| $Ta_2O_5$ (c) | - | 456.79 |
| $TaO_2^+$ (aq) | - | 201.39 |
| $H_2O$ (aq) | - | 56.69 |

(b) Use the Eh-pH diagram for the system Sn-Ta-O-H to discuss the role which chemical processes and physicochemical conditions have played in the formation of placer deposits of tin and tantalum from Nkemia type pegmatites whose minerals include the following: K-feldspar, muscovite, Quartz, tantalite, cassiterite, tourmaline.

Q2. (a) Use the data in table 1 and 2 to calculate the ionic strength of sea water and to establish if inorganic precipitation of calcite and dolomite is possible in the upper part of the sea.

**Table 1: The Contents of majorions in sea water**

| Majorions | Concentration (m/kg) | Activity coefficient |
|---|---|---|
| $Na^+$ | 0.475 | 0.76 |
| $Mg^{2+}$ | 0.054 | 0.36 |
| $Ca^{2+}$ | 0.010 | 0.28 |
| $K^+$ | 0.010 | 0.64 |
| $Cl^-$ | 0.56 | 0.64 |
| $SO_4^{2-}$ | 0.028 | 0.12 |
| $HCO_3^-$ | 0.024 | 0.68 |
| $CO_3^{2-}$ | 0.0003 | 0.20 |

(b) Explain why the bicarbonate ion is more dominant than $Co_3^{2-}$ and $H_2CO_3$.

(c) What are the major processes which control the pH of sea water.

(d) Assuming that the sea water is in a state of chemical equilibrium calculate the pH.

Q3. The soil profile of a podzol developed in the tropical region is given in figure 1. Use figure 1 to answer the following questions.

(a) Discuss briefly the processes which have led to the development of the variations in the physical and chemical properties of the different horizons of the soil profile.

(b) Discuss briefly the most appropriate horizon(s) for sampling in environmental and exploration surveys for Cu, Zn, Pb, Cd, Ni and Sn.

Q4. Discuss the role of surficial geochemical processes in the formation of the following types of deposits.

(a) Supergene enrichment deposits of copper from a disseminated Cu-Zn-FeS mineralisation in a carbonate-rich quartz vein.

(b) Iron deposits in lacustrine environments.

(c) Role front sandstone-hosted deposits of uranium.

Q5. (a) Define the following terms:

(i) pathfinder element

(ii) geochemical province

(iii) coefficient of aqueous migration

(iv) secondary dispersion pattern

(v) gossan

(b) Discuss briefly the role of surficial processes in the formation of secondary dispersion patterns of Cu, Co, Ni, S, Cr and Fe from a magmatic deposit whose mineralogical composition is as follows: plagioclase; pyroxene; amphibole; apatite; chromite; magnetite; zircon; chalcopyrite; quartz; cobalt pentlandite $(Co, Fe, Ni)_9S_8$.

**END OF EXAMINATION**

GG 472 Page 1

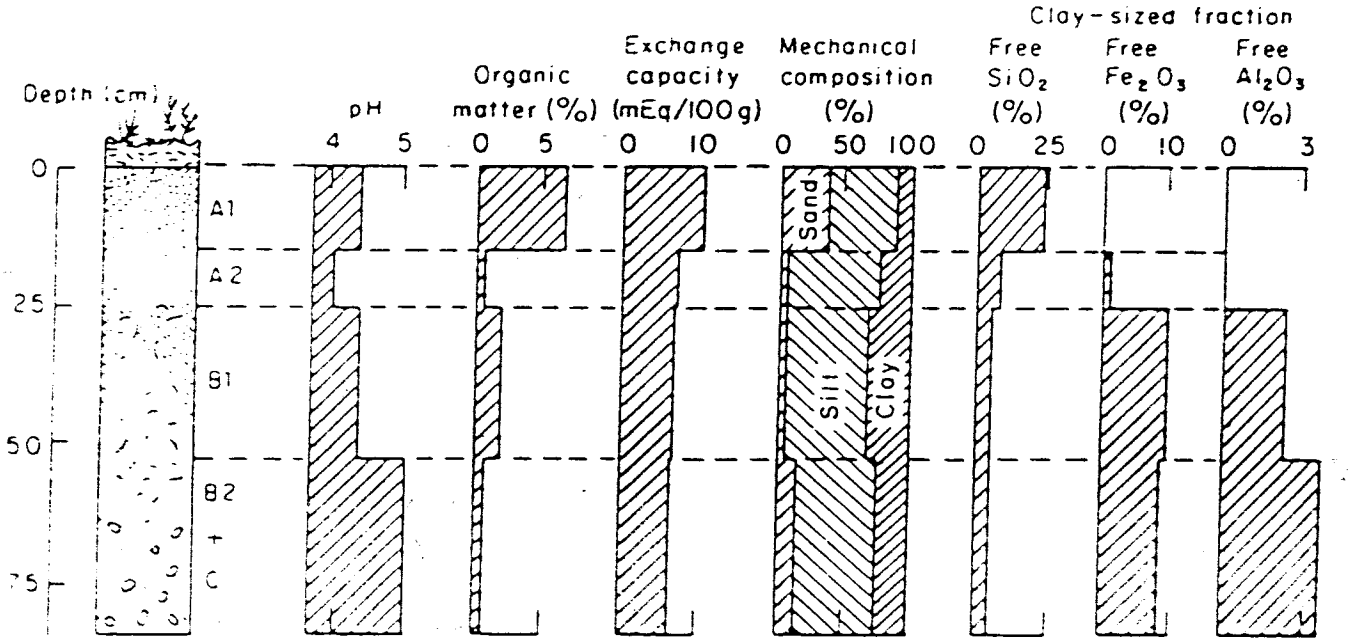


Fig. 1 Some variations in the physical and chemical properties of the different horizons comprising a soil profile.

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Table 2. Enthalpy and Free Energy of Formation of Species Commonly Found In Water

Temperature of 298.15 K (25°C)

| Species and formula | Formula weight | $\Delta H°_f$ kcal/mol | $\Delta G°_f$ kcal/mol | Source* |
|---|---|---|---|---|
| $Ba^{2+}$ (aq) | 137.34 | −128.50 | −134.02 | 1 |
| $BaSO_4$ (barite) | 233.402 | −352.1 | −325.6 | 1 |
| $Ca^{2+}$ (aq) | 40.08 | −129.74 | −132.30 | 1 |
| $Ca(OH)_2$ | 74.095 | −235.58 | −214.76 | 1 |
| $CaF_2$ (fluorite) | 78.077 | −291.5 | −279.0 | 1 |
| $CaSO_4$ (anhydrite) | 136.142 | −342.76 | −315.93 | 1 |
| $CaSO_4 \cdot 0.5H_2O$ | 145.149 | −376.85 | −343.41 | 1 |
| $CaSO_4 \cdot 2H_2O$ (gypsum) | 172.172 | −483.42 | −429.60 | 1 |
| $CaCO_3$ (calcite) | 100.089 | −288.46 | −269.80 | 1 |
| $CaCO_3$ (aragonite) | 100.089 | −288.51 | −269.55 | 1 |
| $CaAl_2Si_2O_8$ (anorthite) | 278.210 | −1009.2 | −955.5 | 1 |
| $CaMg(CO_3)_2$ (dolomite) | 184.411 | −556.0 | −517.1 | 1 |
| $Ca_2Mg_5Si_8O_{22}(OH)_2$ (tremolite) | 812.410 | −2954.0 | −2780.0 | 1 |
| $CO_2$ (aq) | 44.0100 | −98.90 | −92.26 | 1 |
| $CH_4$ (aq) | 16.0430 | −21.28 | −8.22 | 1 |
| $HCO_3^-$ (aq) | 61.0174 | −165.39 | −140.26 | 1 |
| $CO_3^{2-}$ (aq) | 60.0094 | −161.84 | −126.17 | 1 |
| $H_2CO_3$ (undissociated) | 62.0253 | −167.22 | −148.94 | 1 |
| $Cl^-$ (aq) | 35.453 | −39.952 | −31.372 | 1 |
| $F^-$ (aq) | 18.9984 | −79.50 | −66.64 | 1 |
| $H^+$ (aq) | 1.0080 | 0 | 0 | 1 |
| $OH^-$ (aq) | 17.0074 | −54.970 | −37.594 | 1 |
| $H_2O$ (liq) | 18.0153 | −68.315 | −56.687 | 1 |
| $Fe^{2+}$ (aq) | 55.847 | −21.3 | 18.85 | 1 |
| $Fe^{3+}$ (aq) | 55.847 | −11.6 | −1.1 | 1 |
| $Fe_2O_3$ (hematite) | 159.6922 | −197.0 | −177.4 | 1 |
| FeOOH (goethite) | 88.8538 | −133.6 | −117.21 | 1,2 |
| $Fe(OH)_3$ (precipitated) | 89.8617 | −190.7 | −166.5 | 1 |
| $FeS_2$ (pyrite) | 119.975 | −42.6 | −39.9 | 1 |
| $Mg^{2+}$ (aq) | 24.312 | −111.58 | −108.7 | 1 |
| $MgSO_4 \cdot 7H_2O$ (epsomite) | 246.4810 | −809.92 | −686.4 | 1 |
| $MgCO_3$ (magnesite) | 84.3214 | −261.9 | −241.9 | 1 |
| $Mg(OH)_2$ | 58.3267 | −220.97 | −199.23 | 1 |
| $Mg_2SiO_4$ (forsterite) | 140.7076 | −519.6 | −491.2 | 1 |
| $Mn^{2+}$ (aq) | 54.9380 | −52.76 | −54.5 | 1 |
| $MnO_2$ (pyrolusite) | 86.9368 | −124.29 | −111.18 | 1 |
| $NO_3^-$ (aq) | 62.0049 | −49.56 | −26.61 | 1 |
| $NH_4^+$ (aq) | 18.0386 | −31.67 | −18.97 | 1 |
| $K^+$ (aq) | 39.102 | −60.32 | −67.70 | 1 |
| $KAl_2Si_3O_{10}(OH)_2$ (muscovite) | 398.3133 | −1430.3 | −1340.5 | 1 |
| $SiO_2$ (quartz) | 60.0848 | −217.72 | −204.75 | 1 |
| $Na^+$ (aq) | 22.9898 | −57.39 | −62.593 | 1 |
| $NaAlSiO_4$ (nepheline) | 142.0549 | −500.2 | −472.8 | 1 |
| $Sr^{2+}$ (aq) | 87.62 | −130.45 | −133.71 | 1 |
| $SrSO_4$ (celestite) | 183.682 | −347.3 | −320.5 | 1 |
| $SrCO_3$ (strontianite) | 147.629 | −291.6 | −272.5 | 1 |
| $SO_4^{2-}$ (aq) | 96.0616 | −217.32 | −177.97 | 1 |
| $H_2SO_4$ (aq) | 98.0775 | −217.32 | −177.97 | 1 |
| $H_2S$ | 34.08 | −9.5 | −6.66 | 1 |

* (1) Wieast, 1989. (2) Hem, 1992

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MINES

SECOND SEMESTER EXAMINATIONS - 1998/99

GG 542: ECONOMIC GEOLOGY OF NON-METALLIC MINERAL DEPOSITS

PAPER II: PRACTICAL

TIME: 2 HOURS
ANSWER: ALL QUESTIONS

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Q1. A 20m thick clay deposit, occupies a land area of 400,000m$^2$. The clay has a density of 1600kg/m$^3$. A brick factory set on the deposit, has an annual production of 16 million bricks, each weighing 4kg.

(i) What are the reserves of clay present in cubic metres.

(ii) How many cubic metres of clay will be used each year.

(iii) At the given rate of production, what would be the life expectancy of the brick factory on this site.

Q2. Describe in detail stages in a laboratory assessment scheme for aggregate materials.

Q3. In brick making, methods of manufacture vary according to the nature of raw materials. The basic procedure, however, is the same. Outline the stages and procedure.

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END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MINES

SECOND SEMESTER EXAMINATIONS - 1998/99

# GG 542: ECONOMIC GEOLOGY OF METALLIC MINERAL DEPOSITS

## PAPER I: THEORY

**TIME:** 3 HOURS
**ANSWER:** ANY FIVE QUESTIONS

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Q1. (i) Describe the major physical properties of abrasives.

(ii) Name and state the geological occurrence of materials commonly used in the manufacture of abrasives.

Q2. In an industrial minerals operation, six stages of operation are recognised. Briefly describe these stages outlining the expected result from each.

Q3. Outline the raw materials and processes involved in making cement.

Q4. Discuss the classification of industrial minerals by their end uses giving a few examples of raw materials used in each group.

Q5. Describe the origin, geological occurrence and detailed usage of the two industrial minerals.

(i) Talc

(ii) Asbestos

Q6. Name and state the characteristics of structural layers of a road pavement.

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END OF EXAMINATION

# THE UNIVERSITY OF ZAMBIA

## SCHOOL OF MINES

## SECOND SEMESTER EXAMINATIONS - 1998/99

## GG 572: HYDROGEOLOGY

**TIME:** 3 HOURS
**ANSWER:** ANY FIVE QUESTIONS

**QUESTIONS CARRY EQUAL MARKS**

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Q1. In the Equation $\nabla^2 h = \frac{S}{T} \frac{\partial h}{\partial t}$

(a) What type of equation is this? (1 mark)

(b) Derive the equation in terms of cylindrical coordinates. (5 marks)

(c) How is S related to Ss. (2 marks)

(d) Explain all the quantities contained in the parameter S including their significance in well hydraulics. (10 marks)

(e) How is the parameter T related to permeability? (2 marks)

Q2. Given below are data for a well penetrating a confined aquifer and which is pumped at a uniform rate of 2500 cubic metres per day. Drawdowns during the pumping period are measured in an observation well 60 metres away.

(a) Determine the Transmissivity (T) and the Storage Coefficient (S) for the aquifer. (15 marks)

(b) Estimate the expected drawdown after Nine (9) hours of continuous pumping. (5 marks)

**PUMPING TEST DATA (Observation well)**

| Time (min) | Drawdown (m) |
|---|---|
| 0 | 0 |
| 1.0 | 0.20 |
| 1.5 | 0.27 |
| 2.0 | 0.30 |
| 2.5 | 0.34 |
| 3.0 | 0.37 |
| 4.0 | 0.41 |
| 5.0 | 0.45 |
| 6.0 | 0.48 |
| 8.0 | 0.53 |
| 10.0 | 0.57 |
| 12.0 | 0.60 |
| 14.0 | 0.63 |
| 18.0 | 0.67 |
| 24.0 | 0.72 |
| 30.0 | 0.76 |
| 40.0 | 0.81 |
| 50.0 | 0.85 |
| 60.0 | 0.90 |
| 80.0 | 0.93 |
| 100.0 | 0.96 |
| 120.0 | 1.00 |

Q3. The Kariba Dam and its Reservoir is one of Zambia's biggest assets.

Describe the following characteristics of the Dam and its Reservoir; suggesting where possible areas of improvement:

(a) Geology (3 marks)

(b) The geometry of the Dam and the Reservoir. (3 marks)

(c) Management of water in the Reservoir especially as it relates to impacts on the environment. (10 marks)

(d) Seismicity (4 marks)

Q4. (a) Draw a Flow Chart for the preparation of a hydraulic numerical model for groundwater. (10 marks)

(b) Describe the EXPLICIT form of modelling, in one dimension, using the finite difference method. (10 marks)

Q5. (a) List, in form of a table, Drinking Water Standards, as approved by the World Health Organization. (10 marks)

(b) Explain how Nitrates concentrations in a river are affected by cultivation in the catchment area upstream. (10 marks)

Q6. (a) Describe the problems confronting the Lusaka Water and Sewerage with respect to groundwater quality. (10 marks)

(b) Suggest measures that should be put in place to minimize groundwater pollution in Lusaka. (10 marks)

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**END OF EXAMINATION**

# THE UNIVERSITY OF ZAMBIA

## SCHOOL OF MINES

## SECOND SEMESTER EXAMINATIONS - 1998/99

## MG 319: COMPUTER TECHNIQUES

## THEORY AND PRACTICAL

**TIME:** 4 HOURS
**ANSWER:** ALL QUESTIONS

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Q1. A microprocessor is the main chip in any computer.

(a) True
(b) False

Q2. Indicate any of which are operating systems.

(a) Microsoft
(b) DOS
(c) LINUX

Q3. A computer using 8 bits in signed binary coded hexadecimal system will store the decimal number "-324" as:

(a) -324
(b) -144
(c) 1144
(d) 1000100100010
(e) 1111000100100010

Q4. The decimal sum of A + B in a hexadecimal system is:

(a) 23
(b) 21
(c) 11

Q5. A computer using the hexadecimal system is more accurate than a computer using a binary coded hexadecimal system.

(a) True
(b) False
(c) They are the same

Q6. A computer storing information in binary coded decimal system, is less memory hungry than a computer storing information in binary system.

(a) True
(b) False
(c) They are the same

Q7. A hexadecimal system is used because of

(a) It speeds up calculations
(b) It uses less memory than other systems
(c) It uses memory in a more optimal way than other systems

Q8. The two complement number system is favoured over the one complement number system because

(a) It allows faster calculations
(b) It has become a generally accepted computer standard
(c) It handles negative numbers better

Q9. The number "0" is better stored using a one-complement number system.

(a) True
(b) False

Q10. In a floating point number representation, the scale factor is stored.

(a) At the beginning of the number
(b) At the end of the number
(c) Separately

Q11. Which components are to be found in IC's

(a) Electrostatically induced Plastics
(b) Silicon and Aluminium
(c) Tin doting
(d) Carbon conductor
(e) Boron doting

Q12. Without special software help, DOS can only use

(a) Conventional memory
(b) The first 640 Kb and High memory
(c) The first Megabyte

(d) Harddisk memory

Q13. The memory between the first 640Kb and 1Mb in the RAM is called

(a) Extended memory
(b) Expanded memory
(c) High memory area (HMA)
(d) Non-volatile memory

Q14. A device driver is

(a) The cabling that drives a device inside a computer
(b) A chip on the motherboard that allows communication between the CPU and the device
(c) Software that instructs the OS how to work with a device
(d) A program that uses a device

Q15. A warm boot is only allowed as emergency to avoid virus infection.

(a) True
(b) Yes, but it does not always avoid infection
(c) No, we can use it anytime
(d) No, we should avoid using it altogether

Q16. Opening files from a harddisk, rather than from diskettes is advantageous because

(a) It avoids virus infections
(b) It allows faster access
(c) It avoids diskette damage
(d) It does not give any advantage

Q17. Proper file management, using a sensible directory structure, is necessary because

(a) It saves disk space
(b) It provides more data security
(c) It makes it easier to find back files
(d) It avoids accidental deletion

Q18. ASCII stands for

(a) Accepted Standard for Character and Information Interchange
(b) Accepted System for Character and Information Interchange
(c) American System for Character and Information Interchange
(d) American Standard for Character and Information Interchange

Q19. A virus can directly infect a computer through

(a) Receiving data over telephone lines
(b) Making a modem connection
(c) Reading a CD ROM
(d) Copying a virus infected diskette
(e) Opening a file attached to an email
(f) Opening an email

Q20. IC circuitry is based on

(a) Binary coding
(b) Boolean logic
(c) Hexadecimal data combination and transfer

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**END OF EXAMINATION**