



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

UNIVERSITY EXAMINATIONS 2021-2022
FOR THE DEGREE IN MASTER OF SCIENCE IN GEOTHERMAL ENERGY TECHNOLOGY

GET 3004 – GEOPHYSICAL EXPLORATION

DATE:

TIME: 3 HOURS

INSTRUCTIONS

- 1) TIME ALLOCATED – 3 hours
- 2) There are FIVE QUESTIONS in this paper
- 3) Attempt only THREE questions
- 4) Question 1 is compulsory and is worth 30 marks. The other two are 15 marks each
- 5) This Paper will count for 60% of the total score of GET 3004 The other 40% will be earned from CATS and assignments

Question 1 [30 marks] – This question is Compulsory

- (a) Geothermal anomalies are linked to geophysical anomalies because changes in temperature and geothermal gradient can change subsurface physical properties that influence measurements at the surface. Name and explain the significance of any 5 parameters that can be measured during exploration for geothermal energy resources using geophysics. [5 marks].
- (b) Refraction can be described by Snell's Law. Explain why the ray in Figure 1.1 changes direction. ([5 marks].

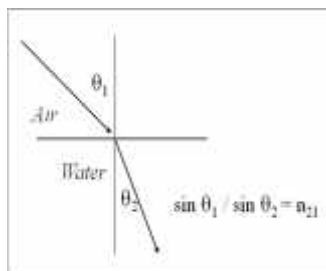


Figure 1.1

- (c) Explain the effect water has on electrical conductivity of rocks [5 marks]
- (d) Explain why shear wave energy propagation discontinues at depths of 3000km as seen in Figure 1.2. [5 marks]

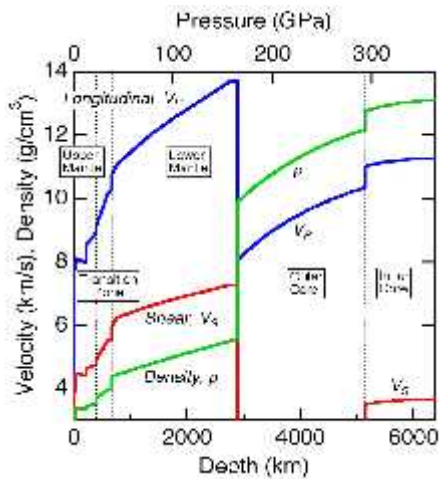


Figure 1.2

- (e) Explain how or why the gravity method ALONE is not reliable as an exploration technique for the determination of a heat source? Recommend a complimentary geophysical method for heat source location. [5 marks]
- (f) Figure 1.3 shows temperature profiles from a shut-in well measured at different times. Offer an explanation for the change in the profile shapes of 1967 and that of 1980. What is the possible cause for the abrupt kick at about 900m depth? [5 marks]

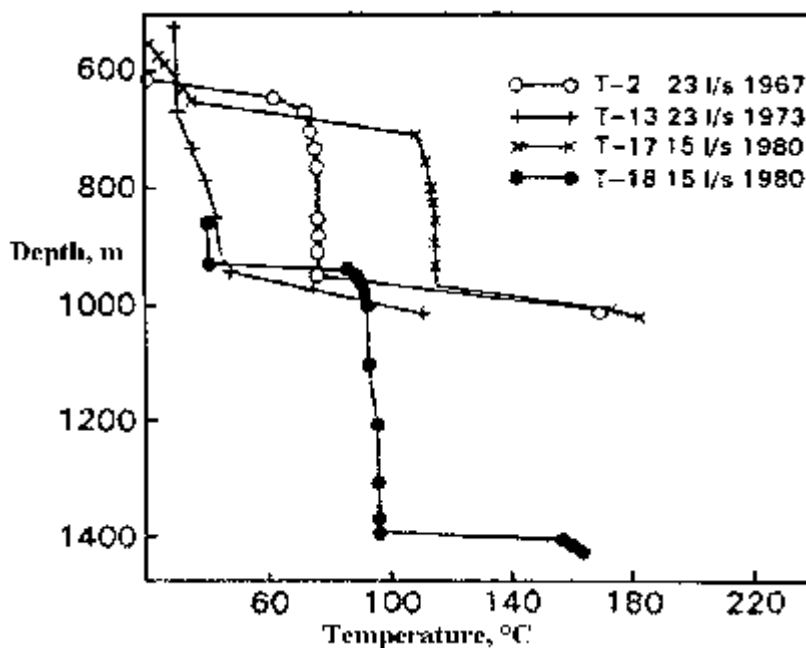


Figure 1.3

Question 2 [15 marks] – This question is Optional

- (a) Distinguish between Shear Waves and Compressional waves. [5 marks]
- (b) A solution to the wave equation can be written as $u(x,t) = A\cos[k(x-ct)]$. Define the terms x , t , A , k and c . [5 marks]

(c) Draw the kind of gravity anomaly (sign and shape) that would be produced across Kenya's Rift Valley, as one travels from Nairobi to Kisumu in western Kenya. [5 marks].

Question 3 [15 marks] – This question is Optional

(a) Figure 3.1 is a conceptualized rift geothermal model. Discuss the conditions under which geothermal fluids are “created” and “mined”. Make use of terms such as recharge, permeability, heat source, geothermal wells and reservoirs. [5 marks]

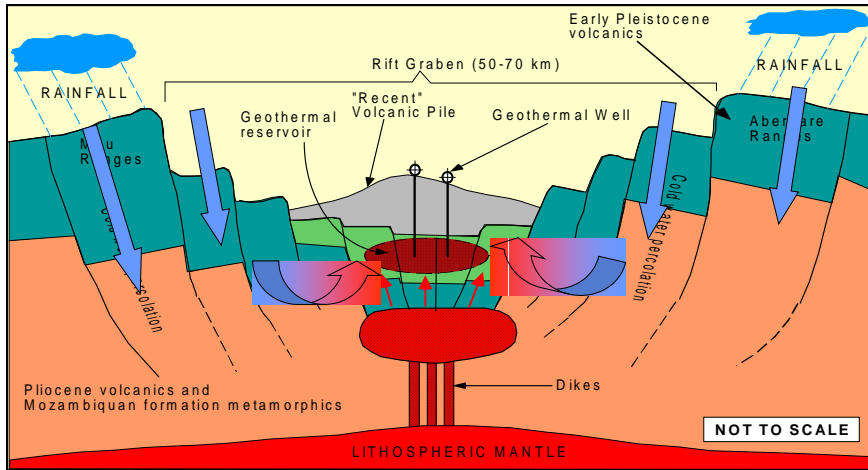


Figure 3.1

(b) Explain what and how geophysical methods are used to infer heat sources, reservoirs and permeable zones. [5 marks]

(c) Electric and electromagnetic methods provide the electrical resistivity (ρ) or its reciprocal electrical conductivity (σ) of the subsurface. Offer and discuss what parameters in the subsurface influence the bulk resistivity of rocks. [5 marks]

Question 4 [15 marks] – This question is Optional

(a) Explain why geologists would be interested in both gravity and magnetic anomalies. [5 marks]

(b) Give reasons why earth's gravitational field is not uniform within the rift valley. [5 marks]

(c) Figure 4.1 shows gravity and magnetic profiles taken across the same line. Discuss the similarities and differences from the two types of measurements on a possible anomaly. [5 marks]

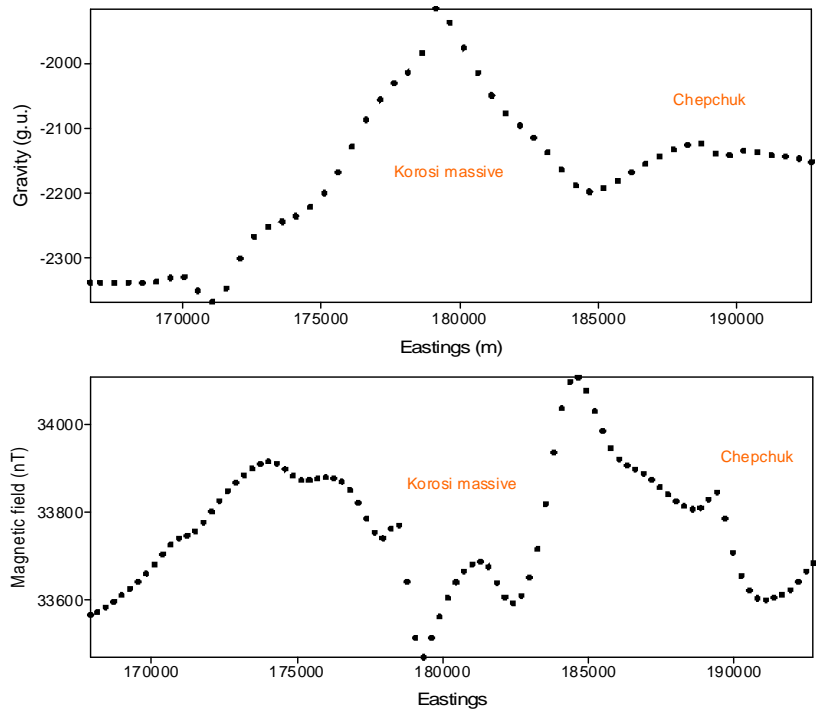


Figure 4.1

Question 5 [15 marks] – This question is Optional

A successful surface exploration effort is likely to be achieved if a multi-skills process is applied in investigating the ground properties to infer presence of a geothermal resource. After the field exercise and data analysis, a report is written to the management. What are the pieces of information that should be included in the report so that the management can make the decision on whether to drill wells or not? [15 marks]