

**M. SC. APPLIED GEOLOGY EXAMINATION, 2023**

( 1st Year, 2nd Semester )

**IGNEOUS PETROLOGY**

**PAPER – CORE/TH/06**

Time : Two hours

Full Marks : 40

(Use a separate Answer script for each Part.)

**Part – I (20 Marks)**

*(Use appropriate phase diagrams and sketches  
whenever necessary)*

1. a) Under what conditions could the mantle rocks equivalent to a plagioclase lherzolite in chemistry generate strongly silica-undersaturated nepheline normative magma and quartz tholeiite magma? Discuss it with suitable phase diagram.
- b) “Below a critical activity of water, hydrous mineral can never be stable at magmatic temperature” – Explain why?
- c) Why does the granitic magma produced from dehydration melting of hydrous minerals in continental orogenic setting commonly not erupt above the surface? 4.5+3+2.5=10
2. Answer any *two* questions: 2×5=10
  - a) How does M-type granite differ from I-type granite in its genesis? Demonstrate their suitable tectonic settings.

[ Turn over

[ 2 ]

- b) Explain the excessive growth of crystals in pegmatite. Why are they commonly granitic in composition? Why is aplite characteristically associated with pegmatite?
- c) What is inverted pigeonite? How does it develop? State the suitable conditions and composition of igneous rock in which it commonly develops.
- d) Discuss the evolutionary paths of alkaline, transitional and sub-alkaline magmas in Nepheline-Kalsilitite-Silica-H<sub>2</sub>O phase diagram. How can phonolites, trachytes and rhyolites be evolved through magmatic evolution?

**Part – II (20 Marks)**

**Q.1 is compulsory and answer any one from the rest.**

*All questions carry equal marks.*

- 1. a) Discuss why many of the arc-set up magmatic rocks show
  - i) Higher ratio of <sup>207</sup>Pb/ <sup>204</sup>Pb
  - ii) Elevated values of <sup>10</sup>Be, and
  - iii) A sharp negative anomaly of Nb in chondrite normalized plot.
- b) Are all Mid-oceanic ridge basalts (MORB) the product of partial melting of depleted mantle? Answer with reasons.

[ 3 ]

- c) How do you petrographically differentiate a tholeiitic basalt from a calc-alkaline basalt in an island-arc setting? 5+3+2
- 2. a) Discuss the role of ‘degree of partial melting’, ‘depth of segregation of magma from the source’ and ‘variation in fluid composition’ in generation of tholeiitic and alkaline basaltic magma.
- b) Is it possible to generate olivine-tholeiite and alkali-olivine basalt from a common fertile mantle source rock through magmatic differentiation at lower pressure conditions? Answer with reasons.
- c) ‘Ocean island basalt formed at greater depth compared to MORB’ – accept or reject the statement with reasons. 5+2.5+2.5

**Or**

- 3. a) Do you expect primitive basaltic magma in the East Pacific Rise? Answer with reasons.
- b) “Calc-alkaline series of magma are extremely explosive in nature” – why?
- c) Comments on:
  - i) Formation of dendritic and hollow crystals in some magmatic rocks
  - ii) Geochemical signature of altered basalt in arc magma. 3+3+4