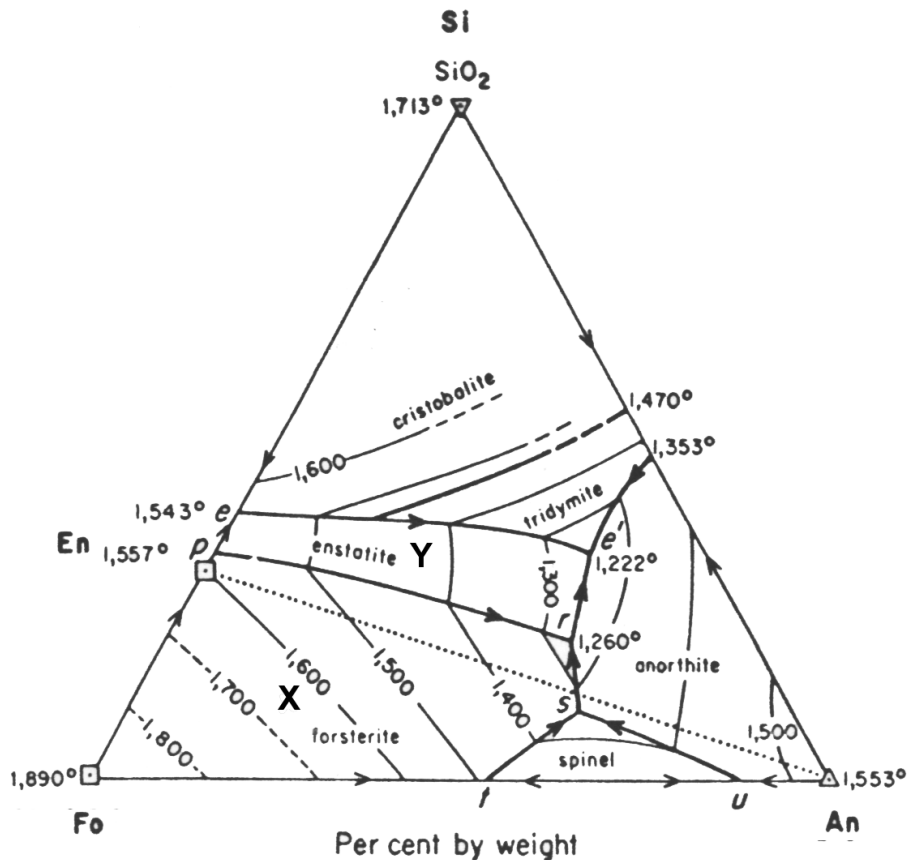


1. Consider the Fo-An-silica diagram. Temperatures are in °C. Hint: Each area is labeled with its primary crystallization phase. **The dotted line indicates the subsolidus compatibility relationships.**



- For each of the four compounds abbreviated as Fo, En, Si and An, give the mineral name and describe the melting behavior (congruent or incongruent). [8 pts]
- Give the ternary eutectic temperature, and its approximate composition expressed as % end-member components. [5 pts]
- Sketch and label a 900°C phase diagram for this system, and label the stable mineral assemblage in all phase fields. [5 pts]
- Use standard nomenclature to name the rock with composition X. [5 pts]
- Provide a narrative of crystallization behavior for a melt of composition Y. [10 pts]
- Use the Gibbs Phase Rule to determine F (degrees of freedom) at the eutectic. [5 pts]
- From the information on the ternary diagram, draw the Fo-silica binary phase diagram. Be sure to include a temperature scale. [10 pts]

2. What are equivalents?

[5 pts]

Phaneritic	Aphanitic
granite	_____
_____	dacite
syenite	_____
gabbro	_____
_____	andesite

3. Draw a neat and well-labeled generalized cross section of the shallowest 600 km of the Earth, showing a **mid-ocean ridge**, an **island arc**, a **back-arc rift**, an **active continental subduction zone**, an **ocean island basalt**, and an **intracontinental rift**. [15 pts]

4. Draw a cross section of the Earth, and include the following items (labeled): [20 pts]

- inner and outer core, mantle, and crust
- approximate depths (in km) to each interface from the surface.
- general mineral composition of each layer

5. Consider a hypothetical set of related volcanic rocks, derived by progressive evolution from a mafic magma. Assuming the parental magma composition below, [12 pts]

- draw predicted Harker diagrams for MgO-SiO₂, CaO-SiO₂, and K₂O-SiO₂. Include scales.
- describe how fractionation of specific minerals could control the trends, and why.

Oxide	(wt. %)
SiO ₂	50.2
TiO ₂	1.1
Al ₂ O ₃	14.9
Fe ₂ O ₃ *	10.4
MgO	7.4
CaO	10.0
Na ₂ O	2.6
K ₂ O	1.0
LOI	1.9
Total	99.5