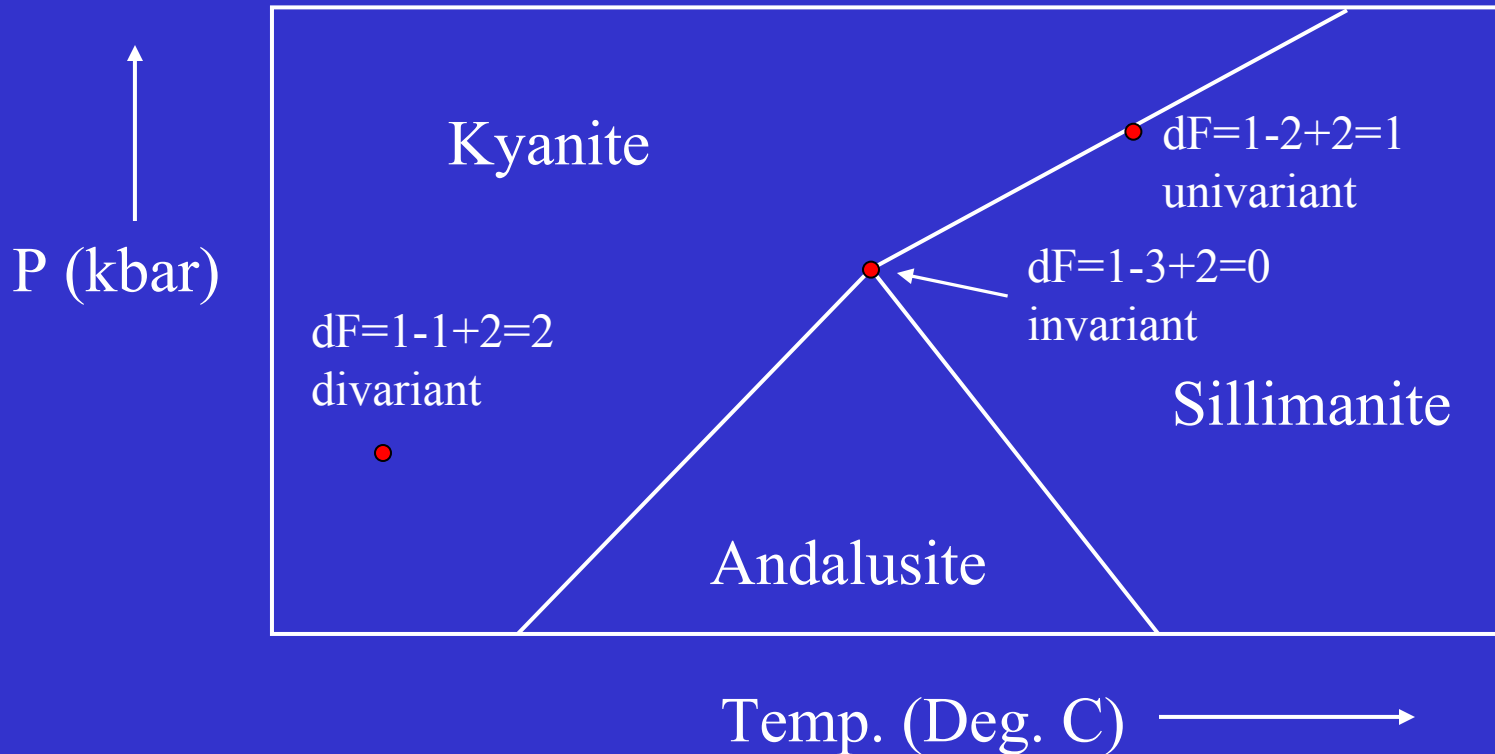


Binary Phase Diagrams

Application to the crystallization of
magmas

Phase Rule

- $dF = C - P + 2$
- $C = \text{no. of chemical components} = 1$ for this example (Al_2SiO_5)
- $P = \text{no. of phases}$
- $dF = \text{degrees of freedom}$

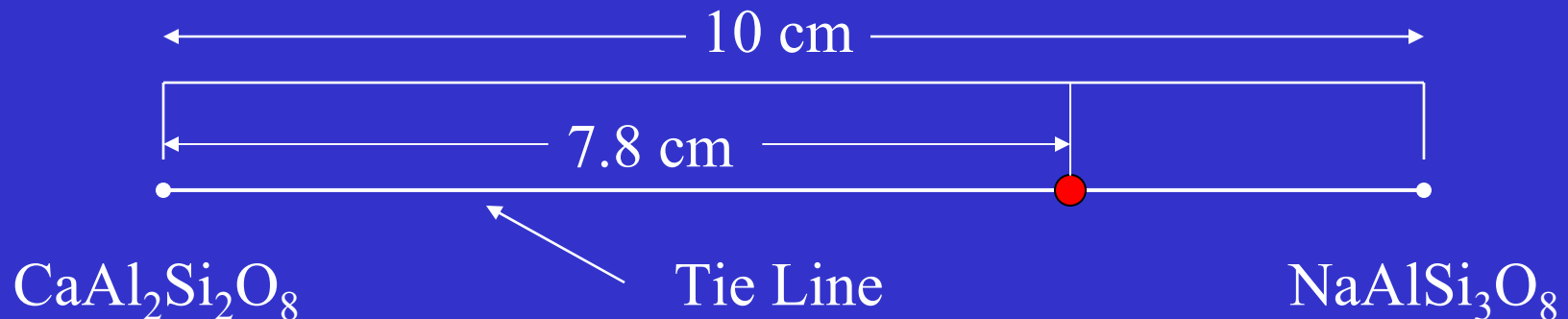


Igneous Phase Rule for Binary Systems

- Phase rule: calculates the variability of a chemical system- the degrees of freedom:
 - $dF = C - P + 1$ (Note: pressure not on graph)
 - dF = degrees of freedom
 - C = number of chemical components
 - P = number of phases

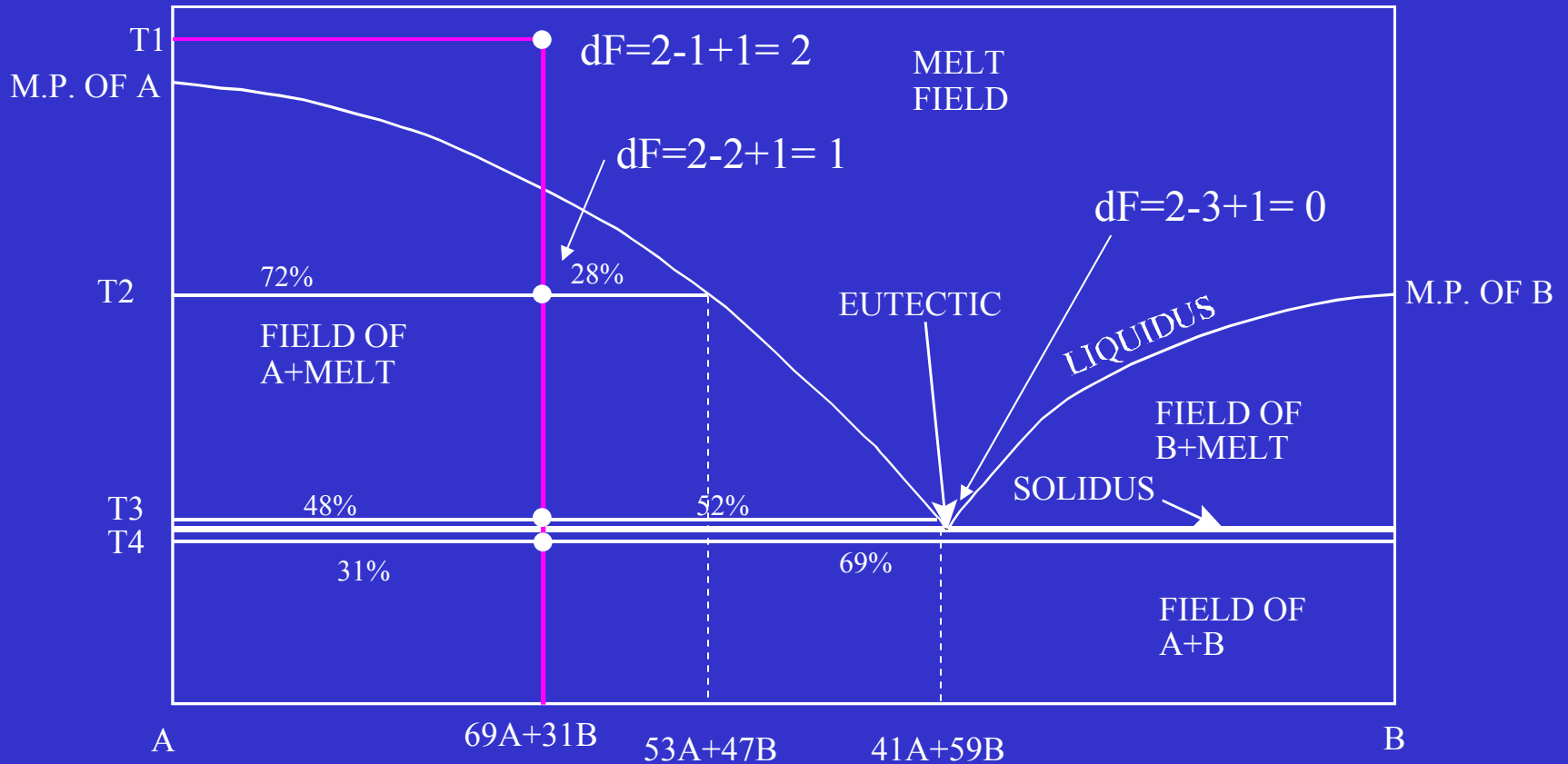
Lever Rule (Tie Line Rule)

- Given a line representing a mixture of 2 components the phase composition is proportional to the proximity to the end member components



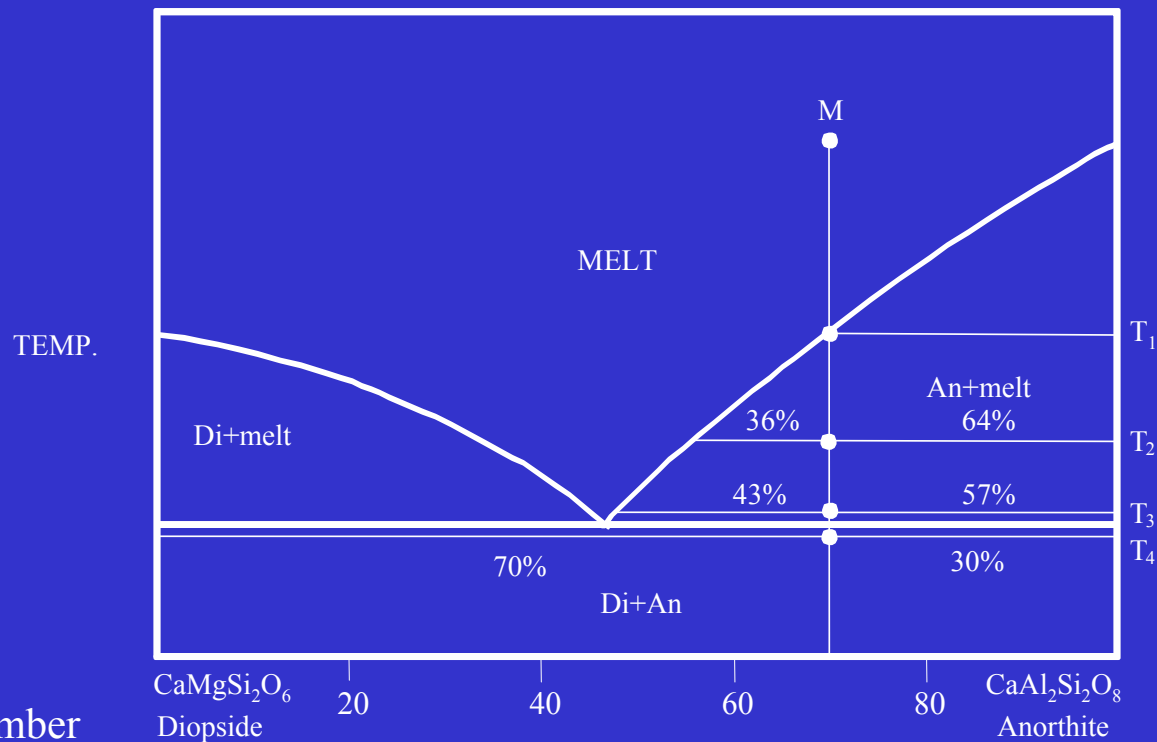
Red dot represents a plagioclase crystal of composition 78% Albite and 22% Anorthite (i.e. Ab_{78} or An_{22})

Binary Eutectic Phase Diagram

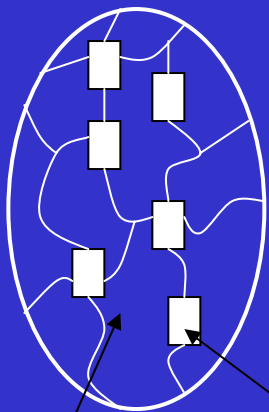


Temp.	Vol. % Melt	Melt comp.	Vol. % Solid	Solid comp.
T1	100	69A+31B	0	NA
T2	72	53A+47B	28	A
T3	48	41A+59B	52	A
T4	0	NA	100	69A+31B

Di+An Binary System



T3 Magma Chamber

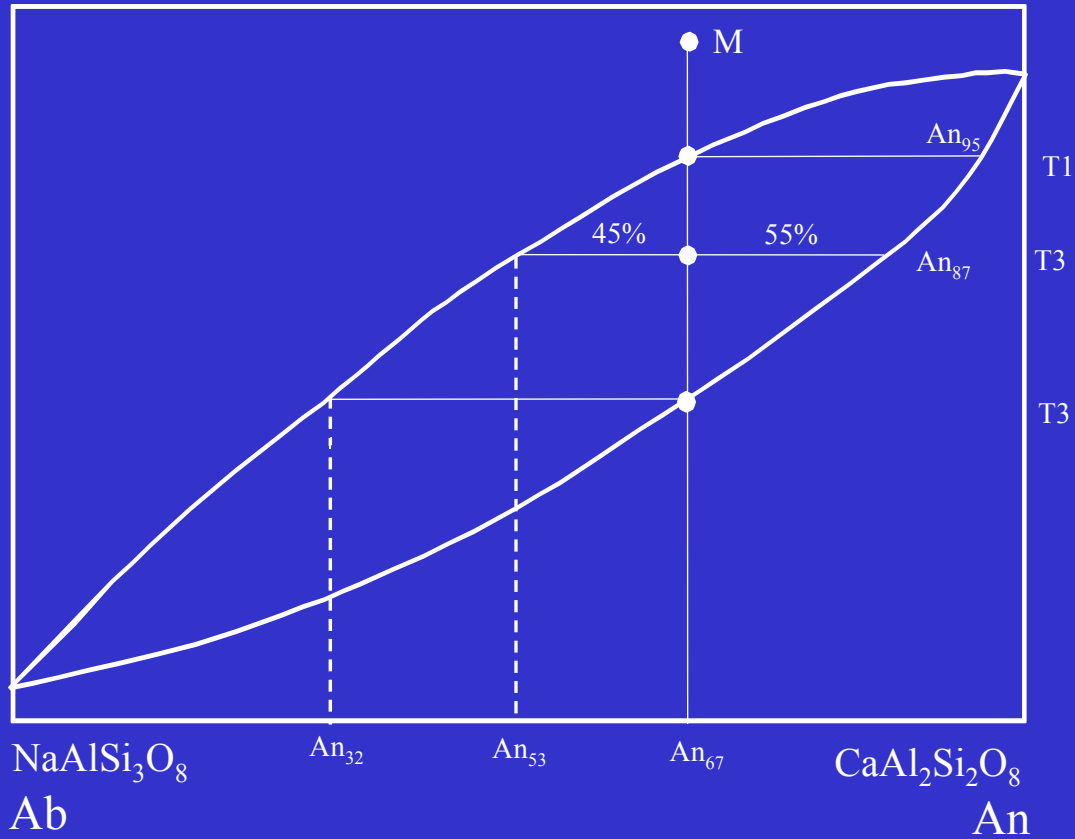


Temp.	Vol. % Melt	Melt Comp.	Vol. % Solid	Solid Comp.
T ₁	99.9	70An+30Di	0.1	An
T ₂	64	53An+47Di	36	An
T ₃	57	47An+53Di	43	An
T ₄	0	NA	100	70An+30Di

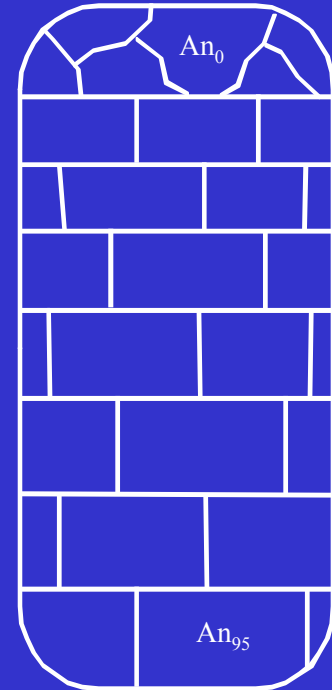
An+Di groundmass

An phenocrysts

Binary Solid Solution Phase Diagram



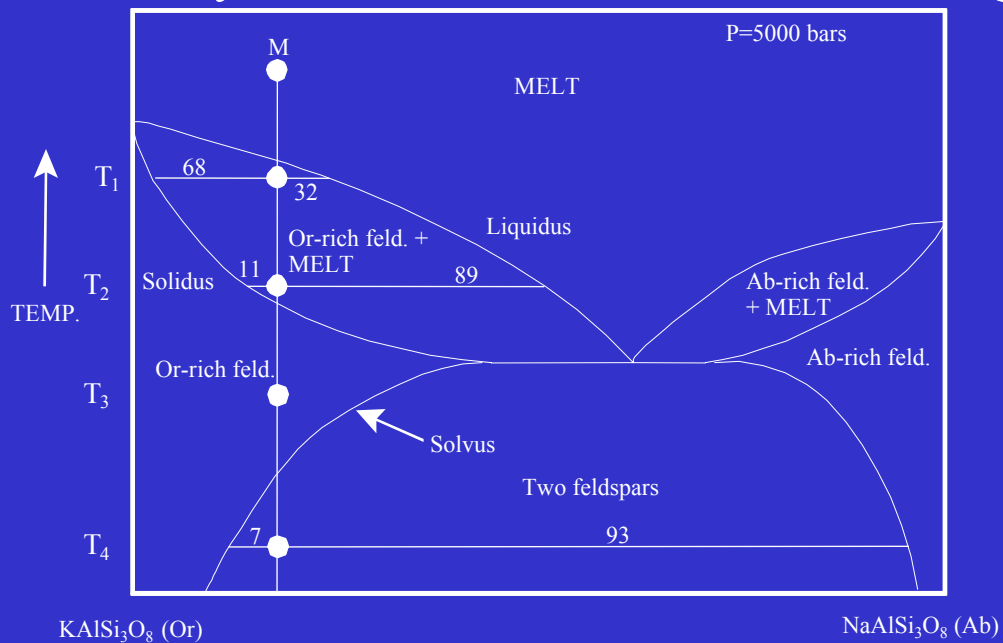
Fractional crystallization of composition M



Equilibrium Crystallization of M

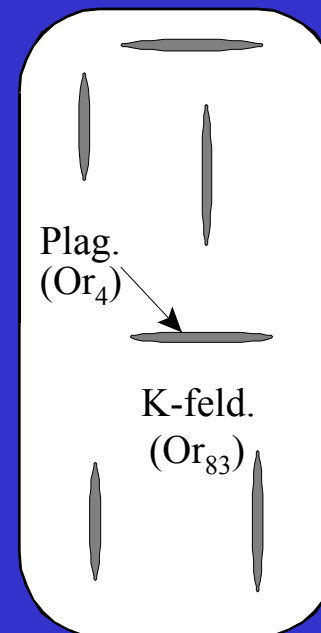
Temp.	%Melt	Comp. Melt	%Solid	Comp. solid
T ₁	100	An67	0	An95
T ₂	55	An53	45	An87
T ₃	0	An32	100	An67

Binary Eutectic+Subsolidus Phase Diagram



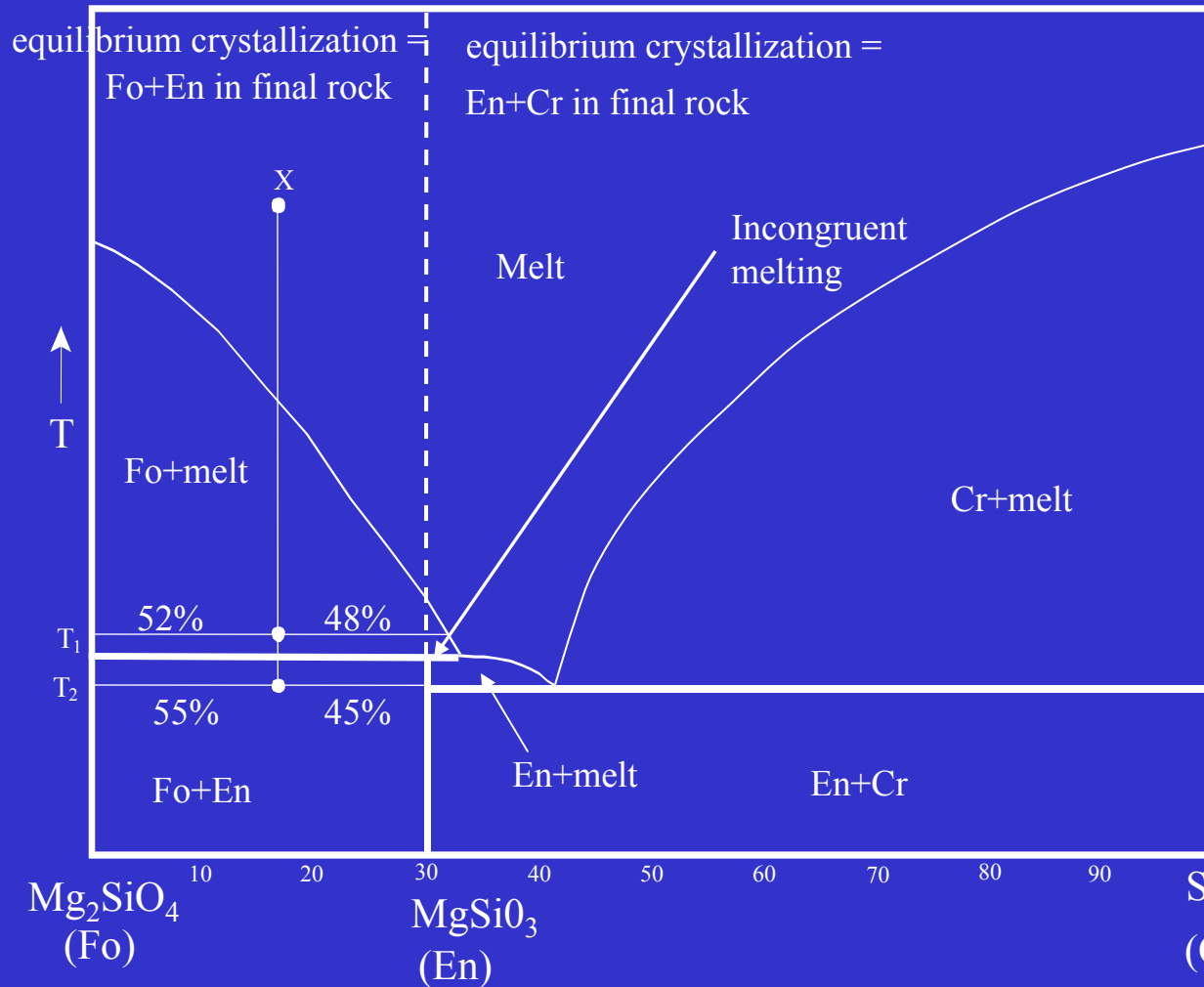
Equilibrium crystallization of composition M

Single feldspar phenocryst at T₄ (Perthite)



Temp.	% solid	solid comp.	% melt	melt comp.
T ₁	32	Or ₉₇	68	Or ₇₆
T ₂	89	Or ₈₆	11	Or ₄₈
T ₃	100	Or ₈₂	NA	NA
T ₄	100	93%Or ₈₃ +7%Or ₄	NA	NA

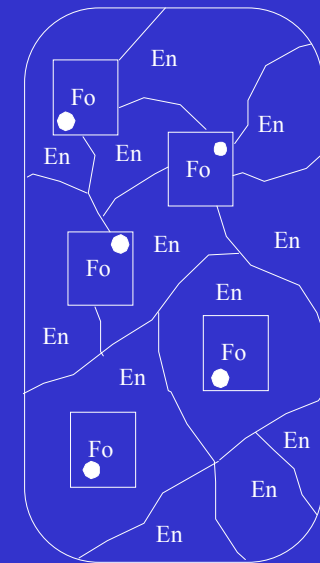
Binary Peritectic Phase Diagram



Equilibrium crystallization of composition X

T₁: %Solid = 48 (pure Fo)
 %Melt = 52
 (32%SiO₂+68%Mg₂SiO₄)

T₂: %Solid = 100
 (45%Fo+55%En)



Groundmass composition = 100% En (55% of chamber)

Phenocryst composition = 100% Fo (45% of chamber)

● Replacement of Fo by En

