2009 fall

Advanced Physical Metallurgy

"Phase Equilibria in Materials"

11. 24. 2009

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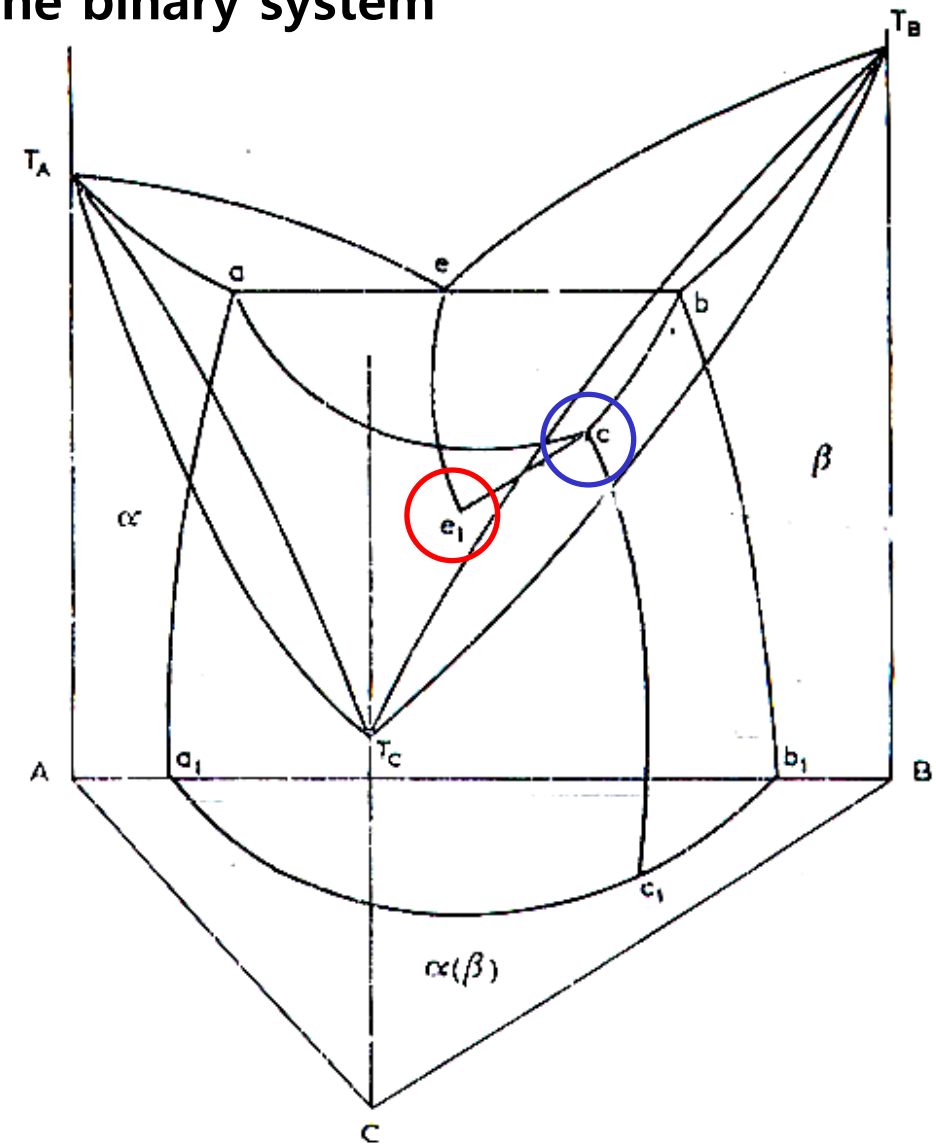
Contents for previous class

9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

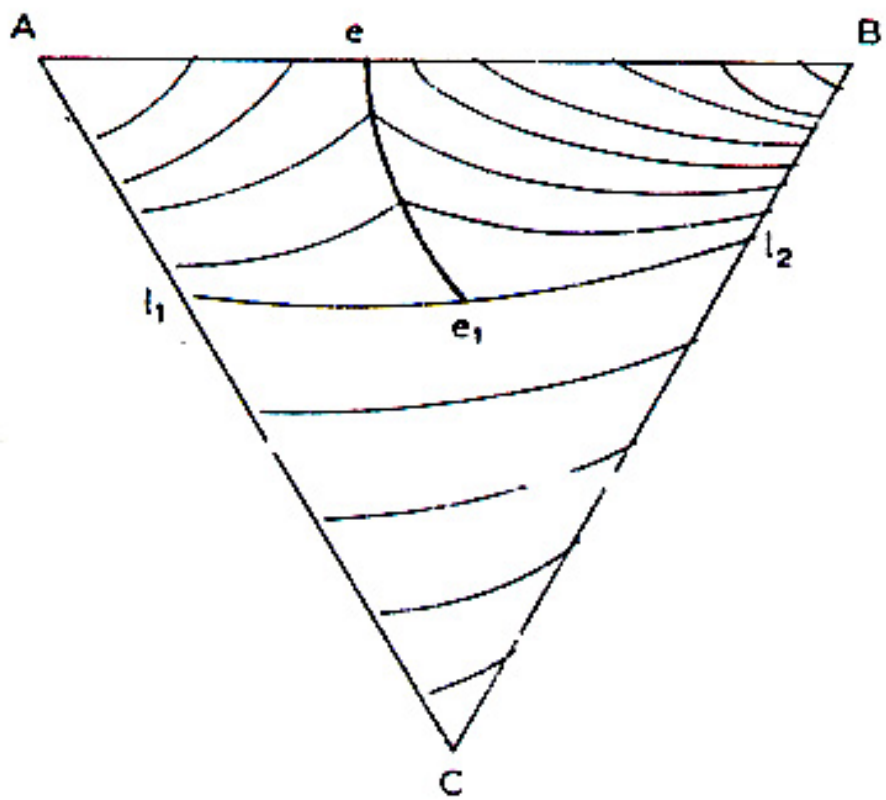
9.3.1. A eutectic solubility gap in one binary system

- One binary eutectic : AB
  Complete solid solution : BC, AC

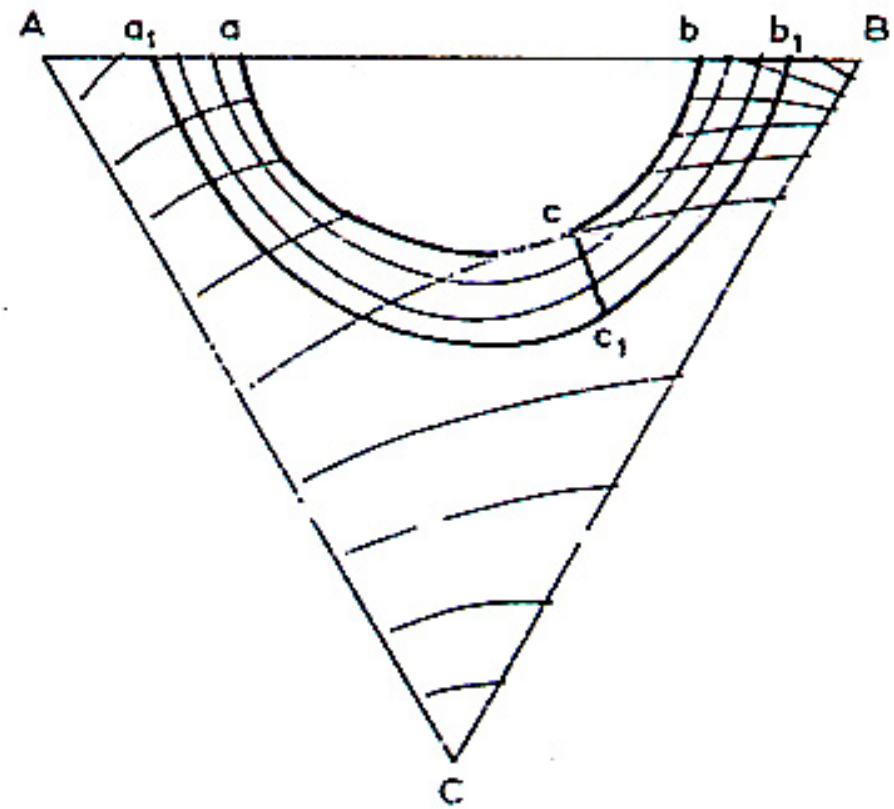


The liquidus surface

The solidus surface and the solubility surface

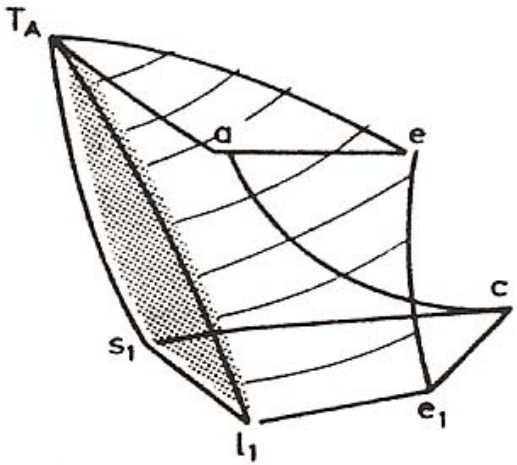


(a)

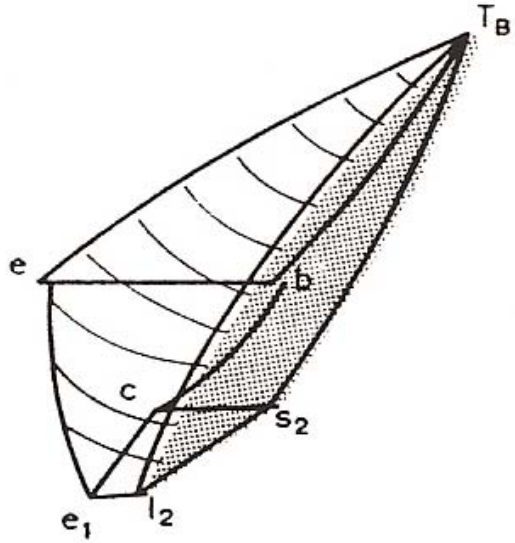


(b)

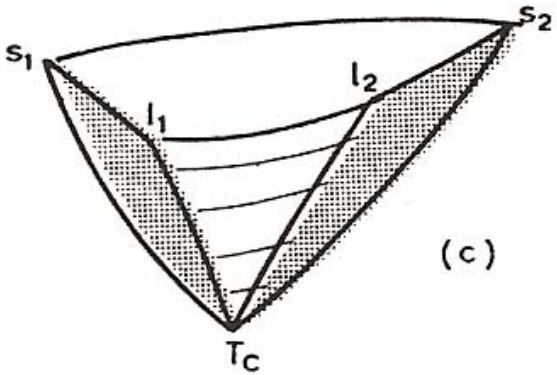
The two-phase regions



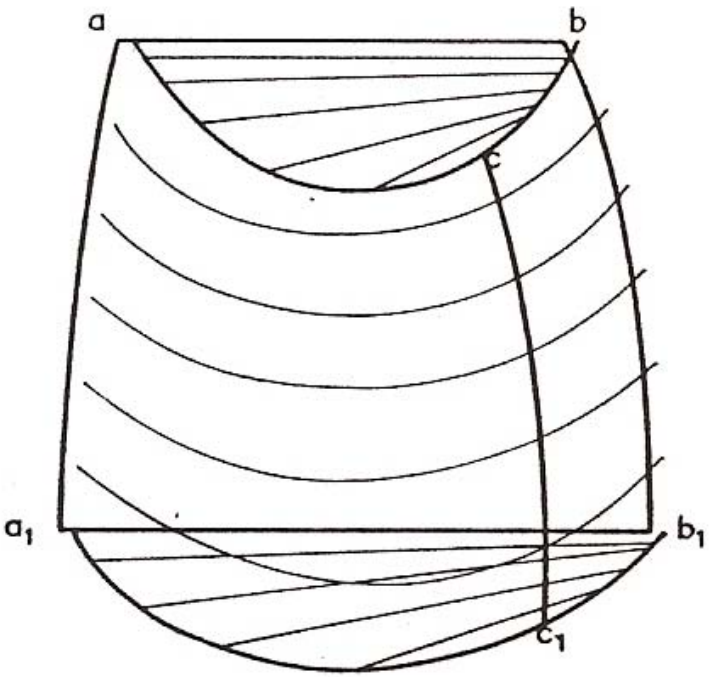
L+α phase region



L+β phase region

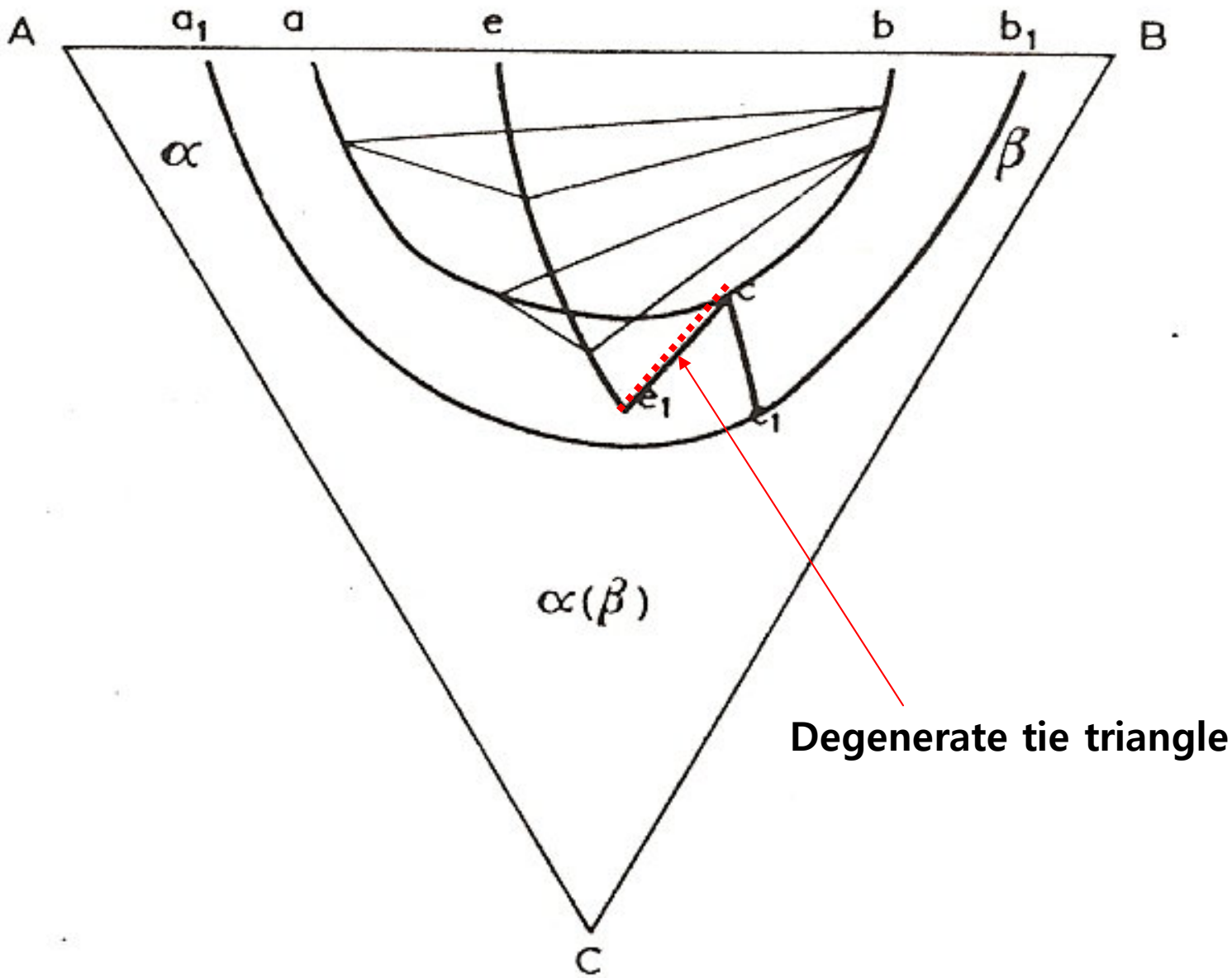


L+α(β) phase region



α+β phase region

- **Projection**


A
a_1
a
e
b
b_1
B
α
β
c
e_1
c_1
$\alpha(\beta)$
C
Degenerate tie triangle

The three-phase regions

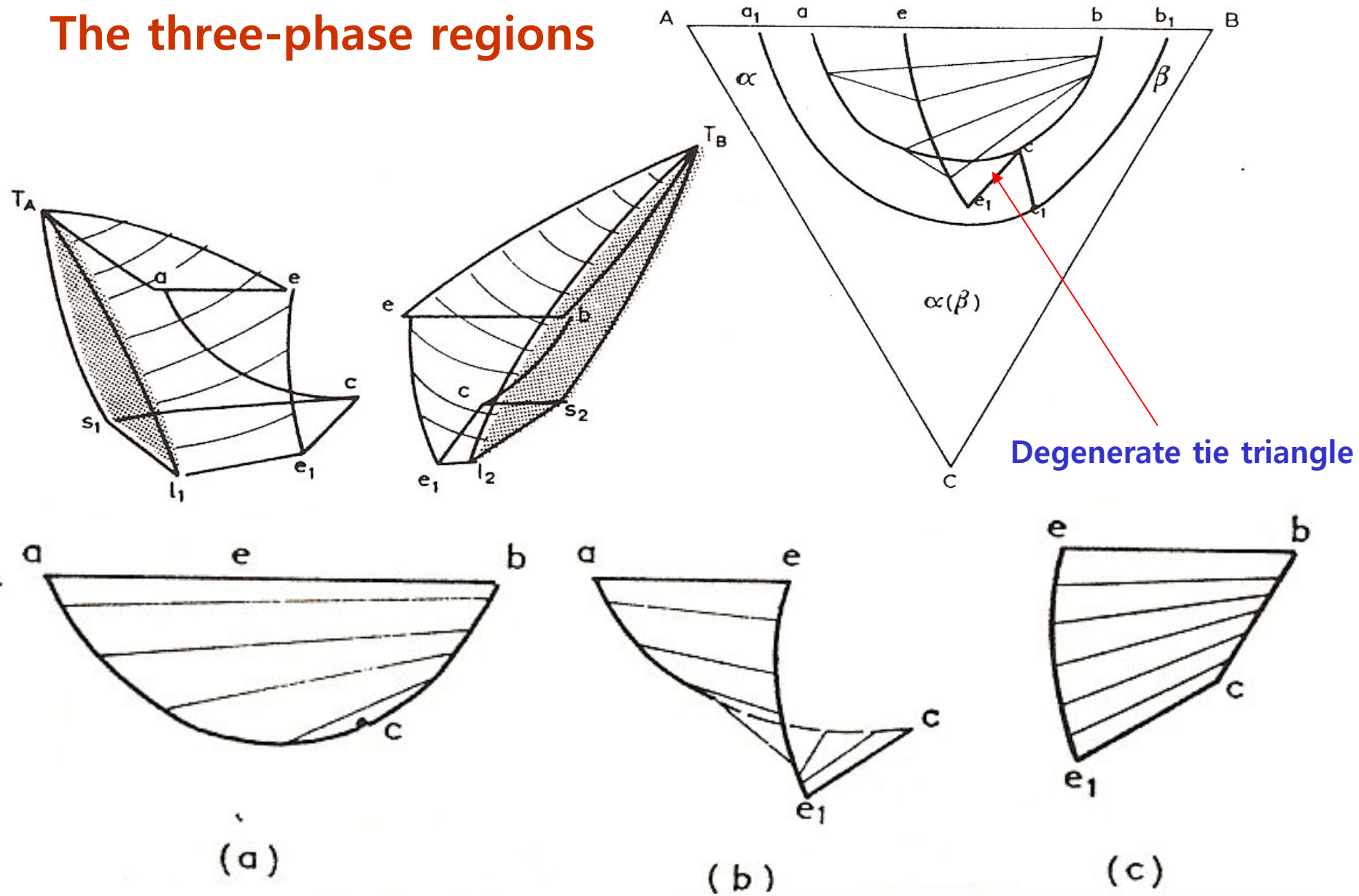
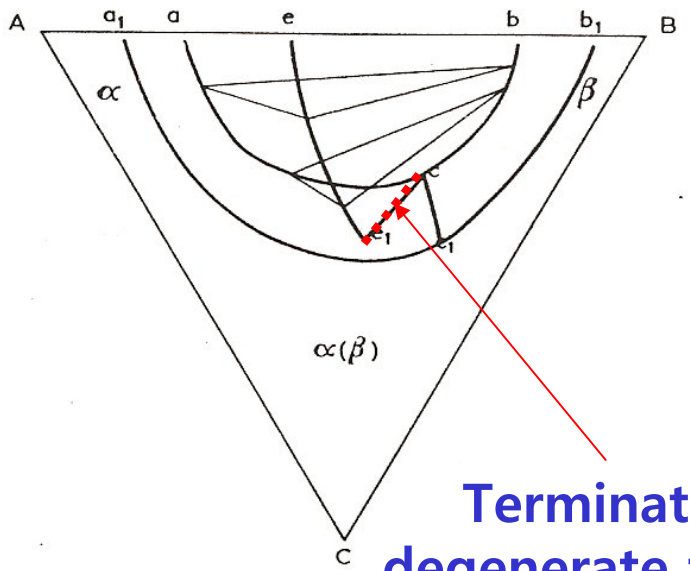
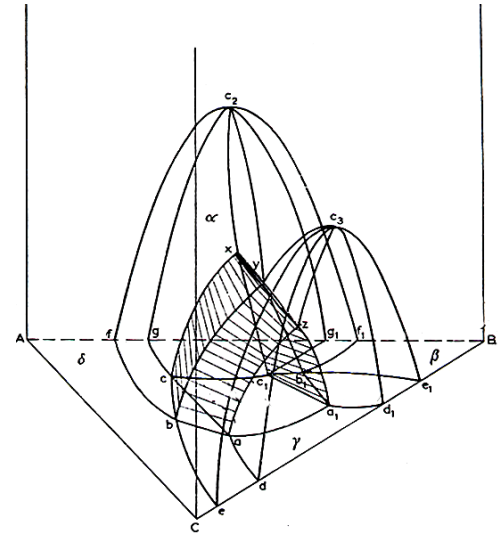


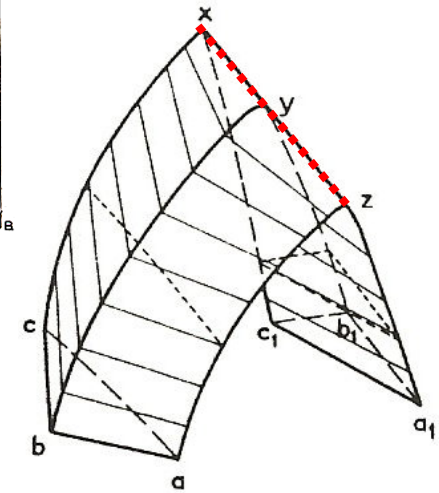
Fig. 147. The ruled surfaces bounding the three-phase ($l+\alpha+\beta$) region in Fig. 142. (a) The $\alpha\beta$ ruled surface; (b) the $l\alpha$ ruled surface; (c) the $l\beta$ ruled surface.

The ways in which three phase regions terminate in ternary systems:

(a)



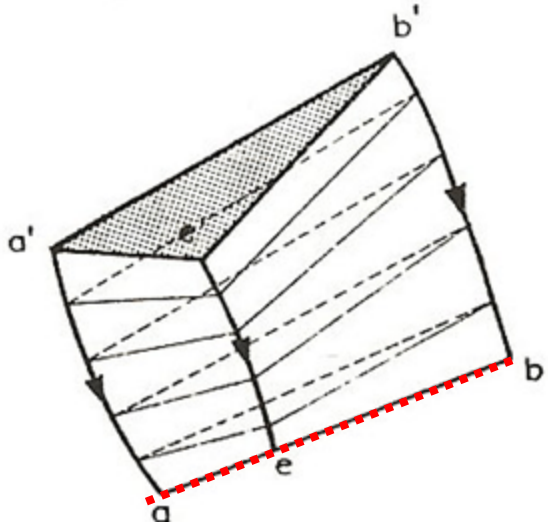


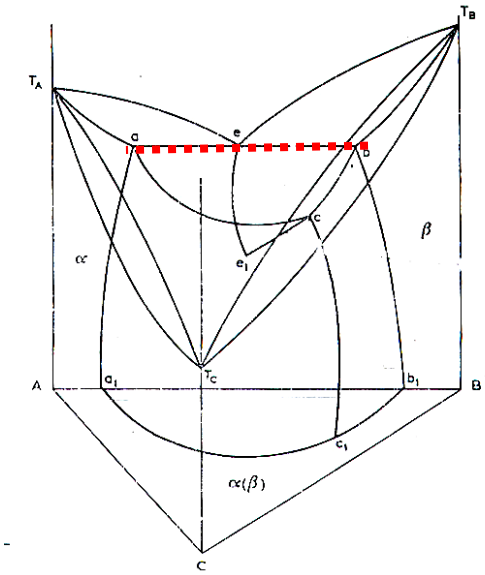


Termination at a degenerate tie triangle

→ **ternary system, 3 phases are in a straight line as three points.**

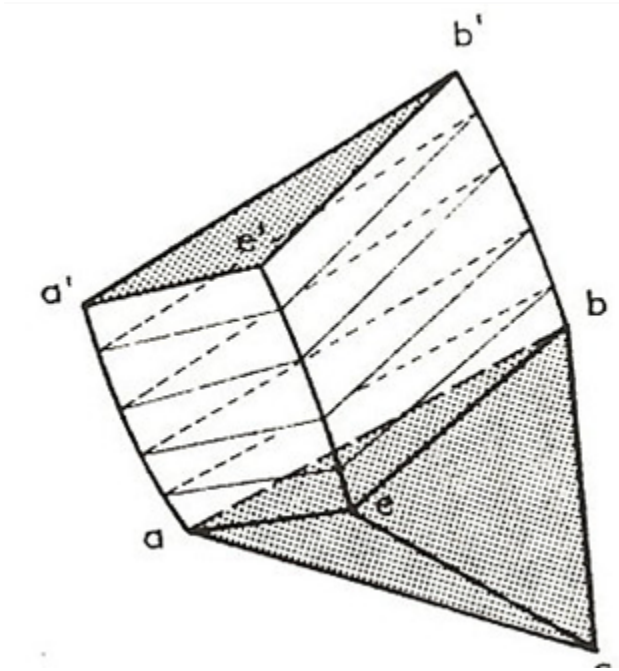
(b) Termination at a reaction isotherm



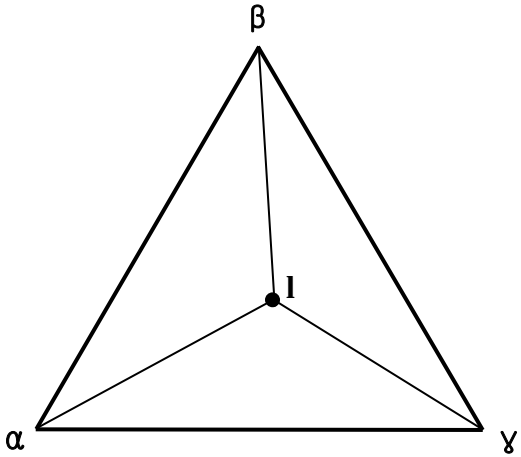


The ways in which three phase regions terminate in ternary systems:

(c) Termination at a four-phase plane

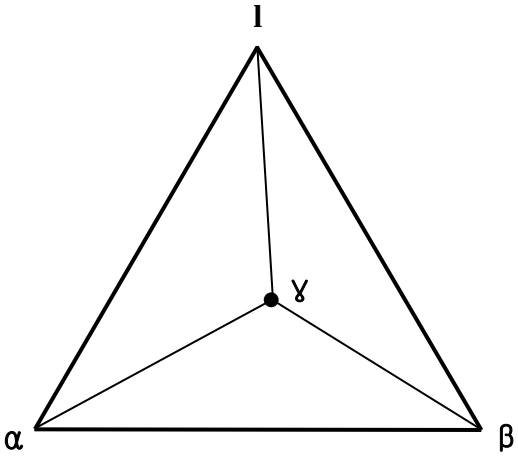


Ternary eutectic

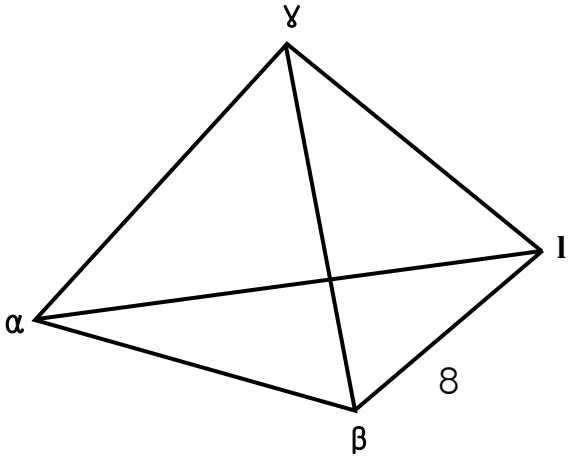


Ternary peritectic

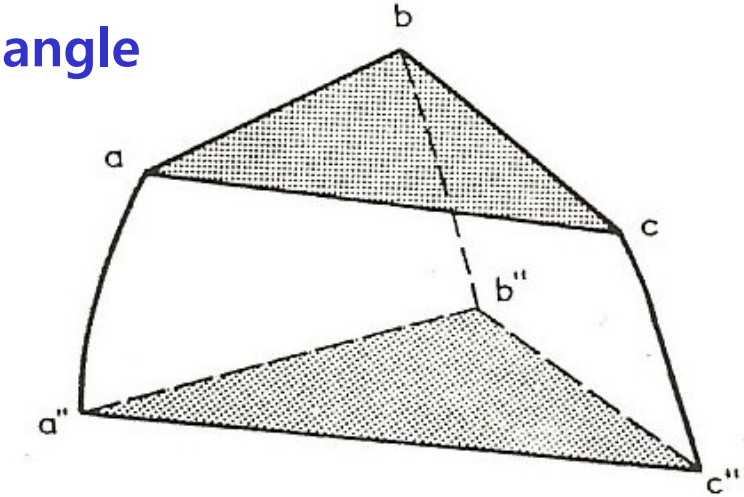
$L + \alpha + \beta \rightarrow \gamma$



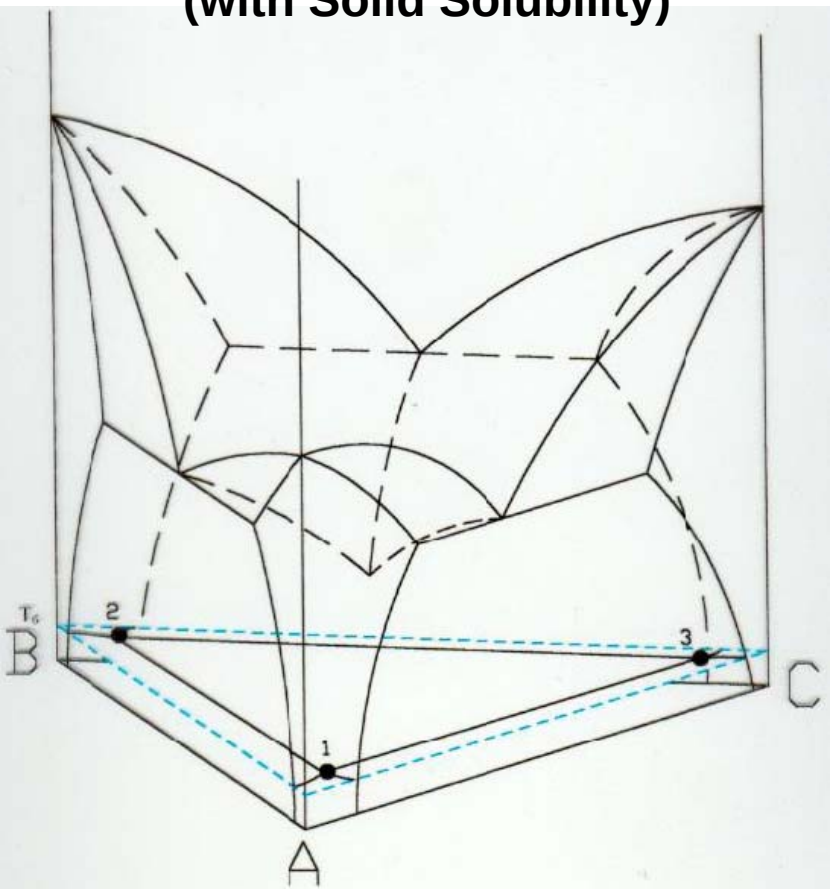
$L + \alpha \rightarrow \beta + \gamma$



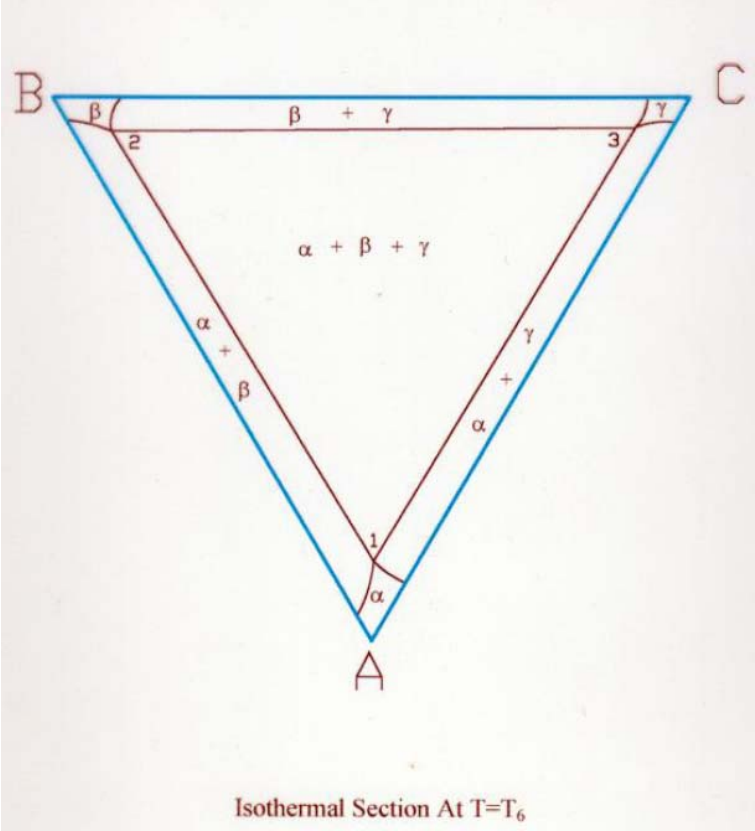
(d) Termination on the concentration triangle



Ternary Eutectic System
(with Solid Solubility)



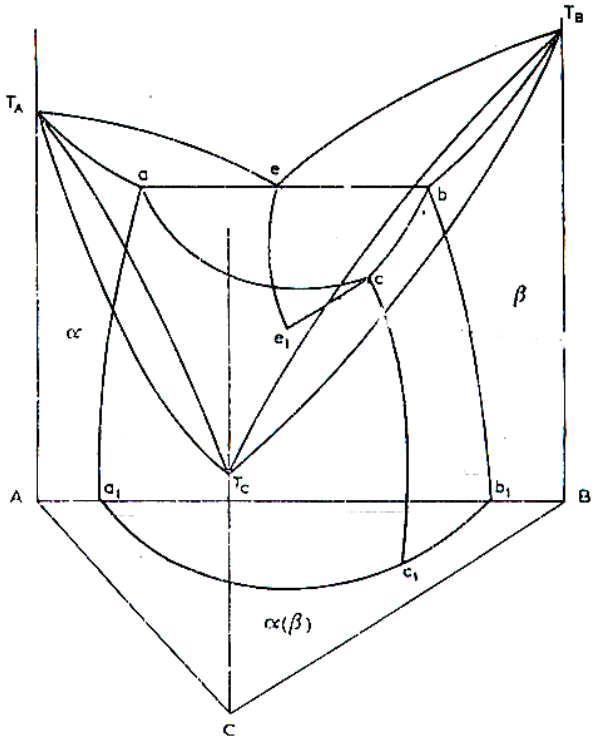
Temperature Slice at $T_6 < T_E$

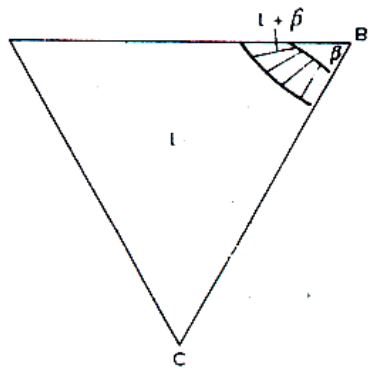


Isothermal Section At $T=T_6$

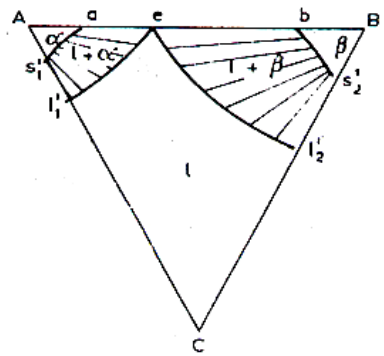
9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

- **Isothermal section**

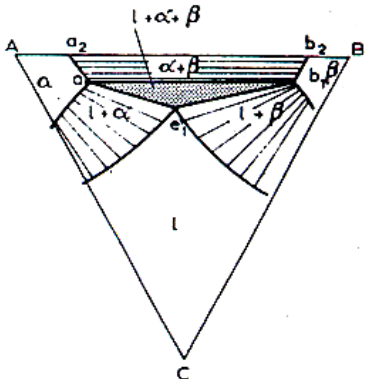




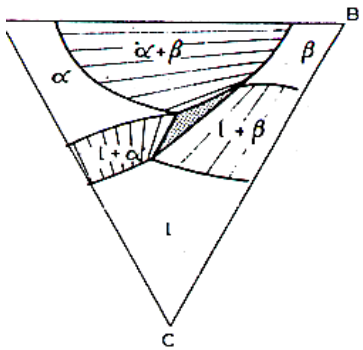
$T_B > T_1 > T_A$



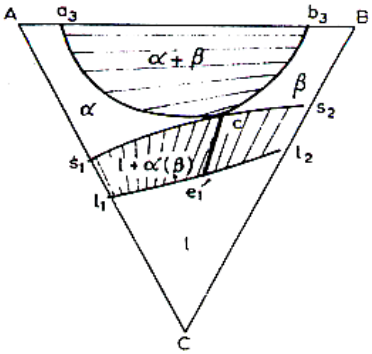
$T_2 = e$



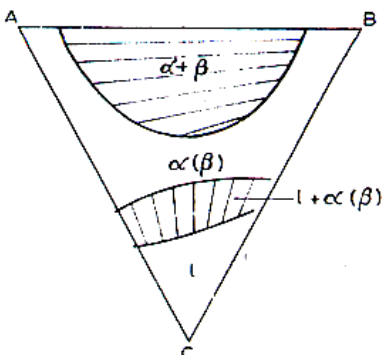
$e > T_3 > e_1$



$T_3 > T_4 > e_1$

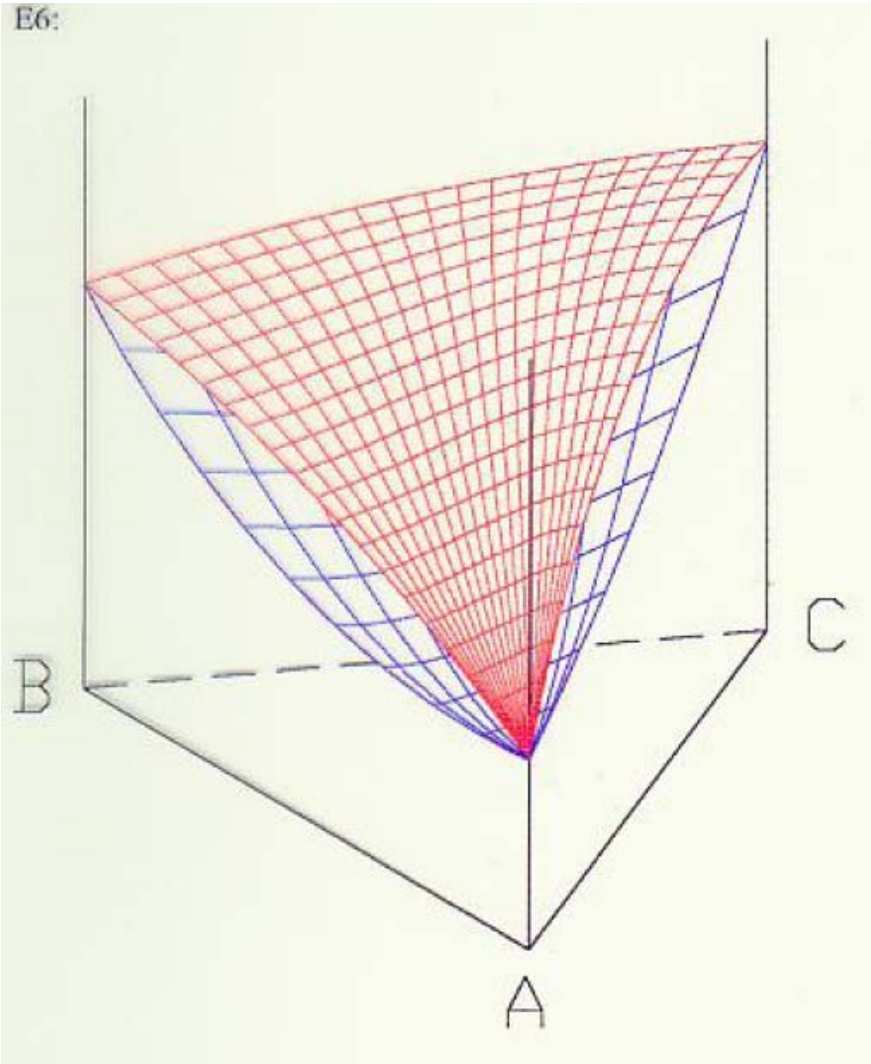


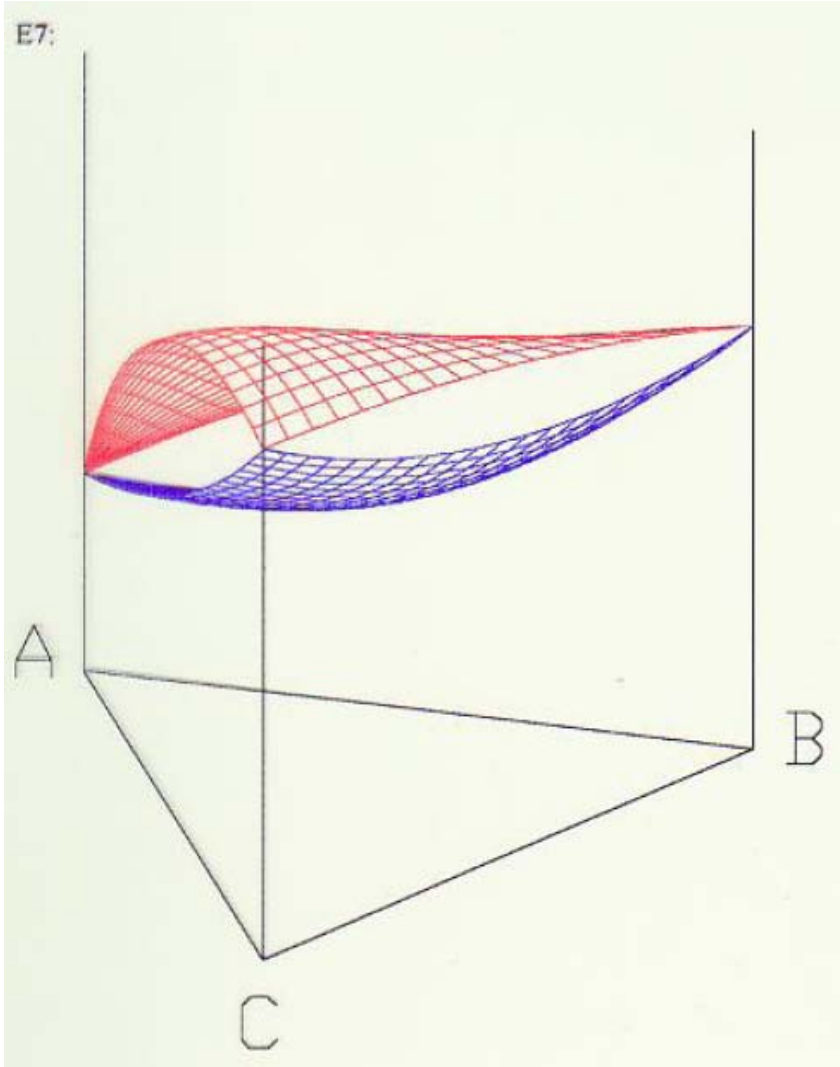
$T_5 = e$



$e_1 > T_6 > T_c$

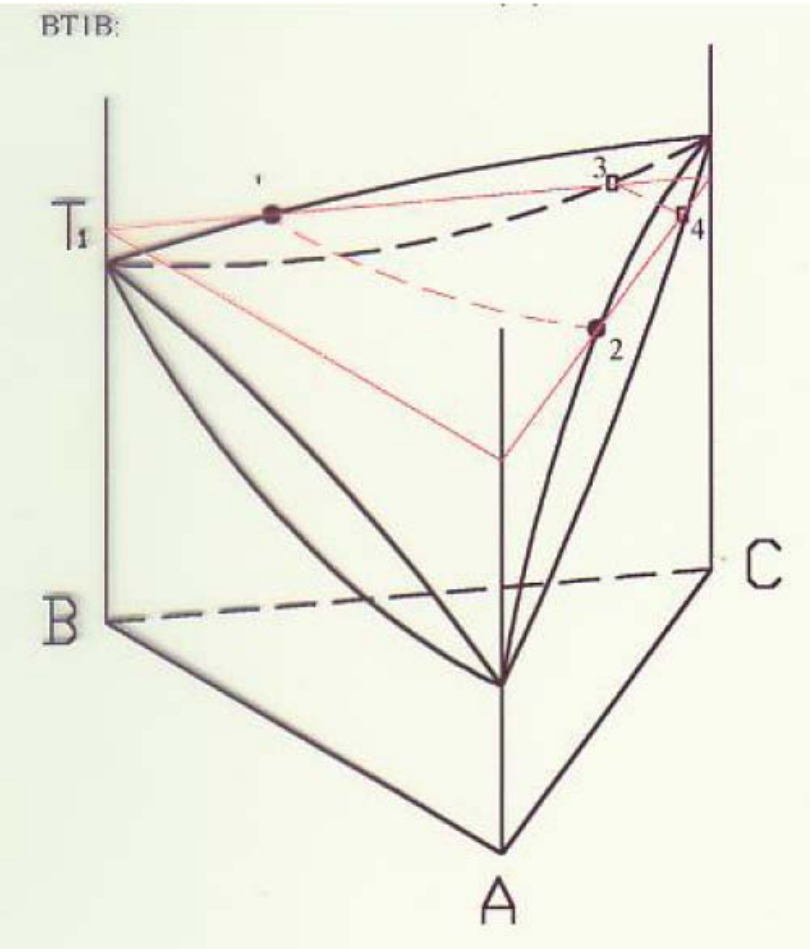
Ternary Isomorphous System

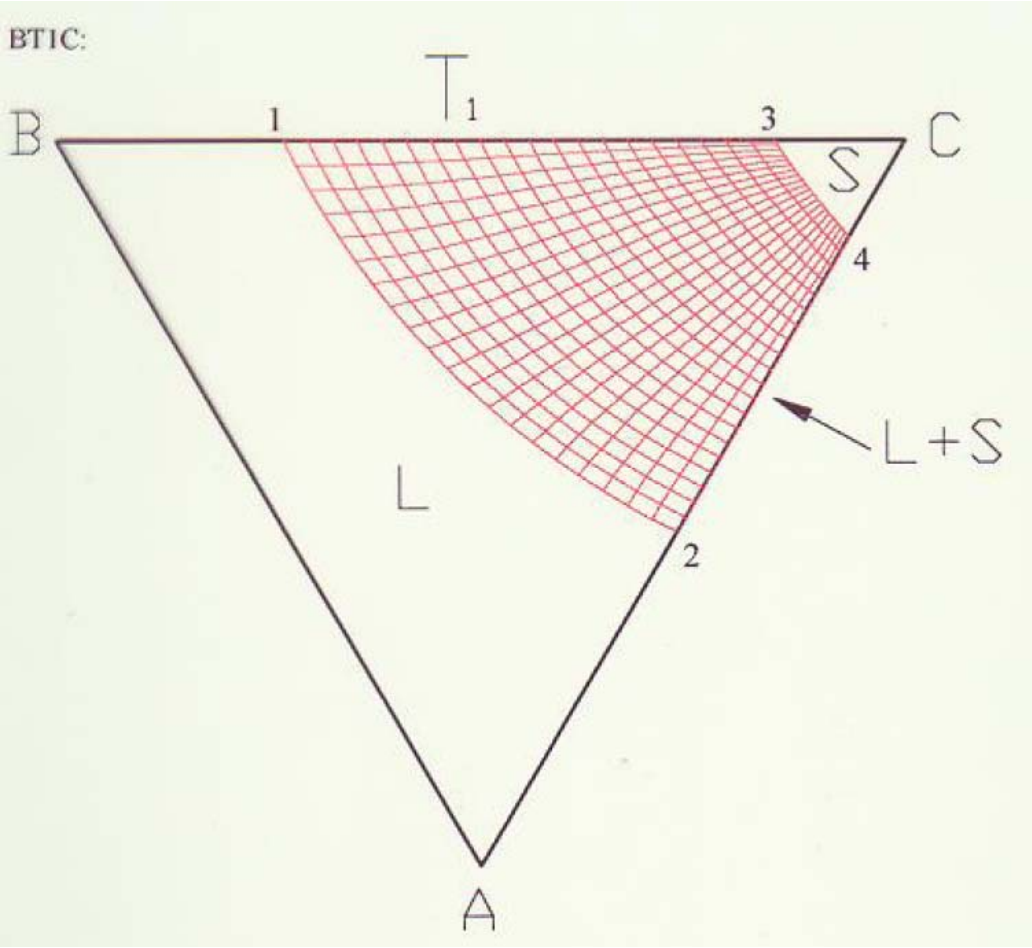




Ternary Isomorphous System

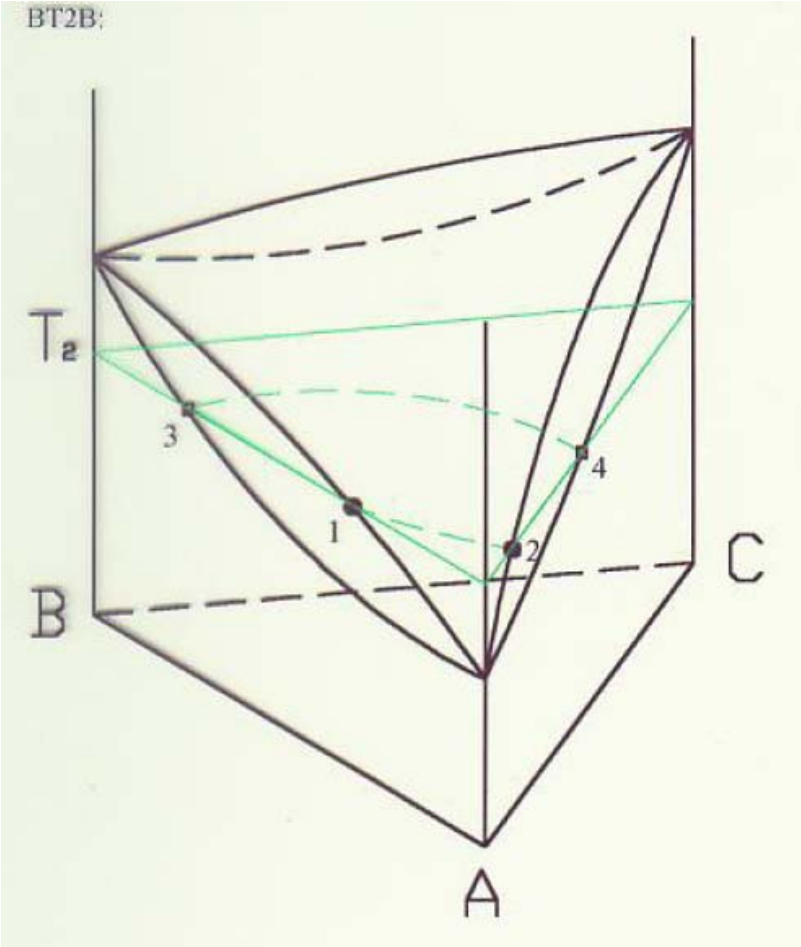
Isothermal section → F = C - P

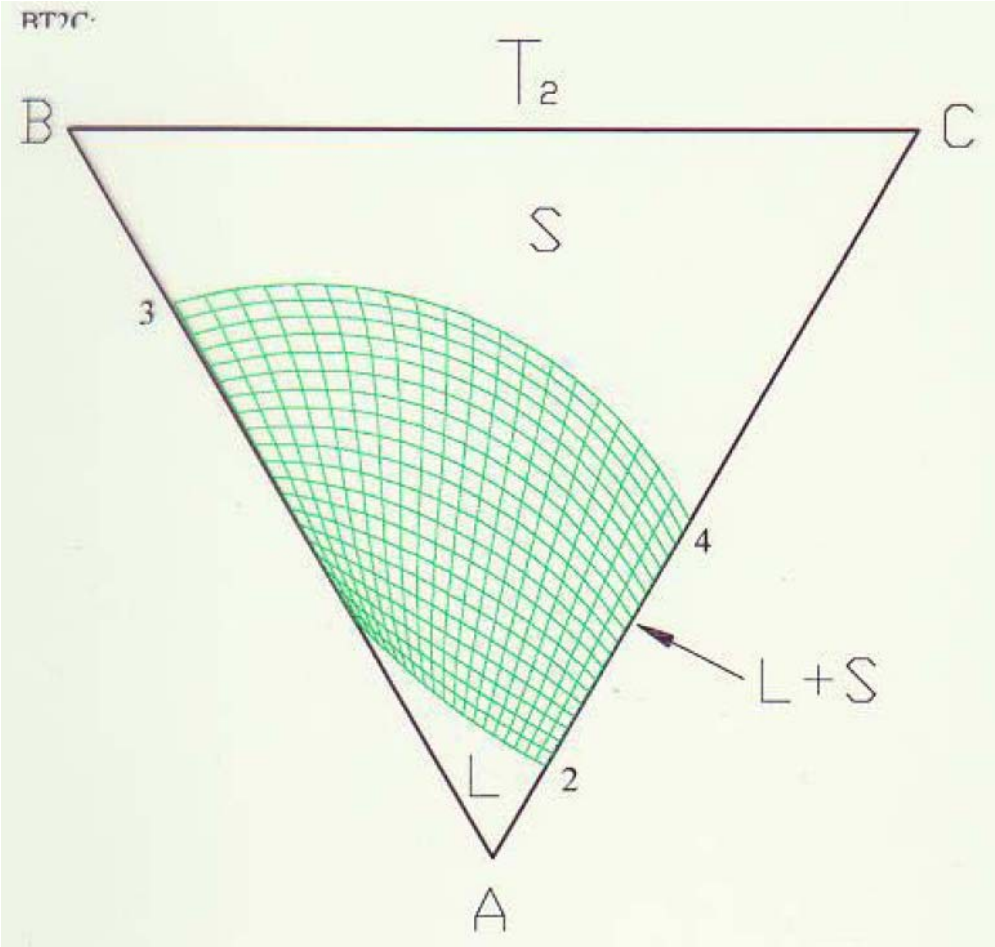




Ternary Isomorphous System

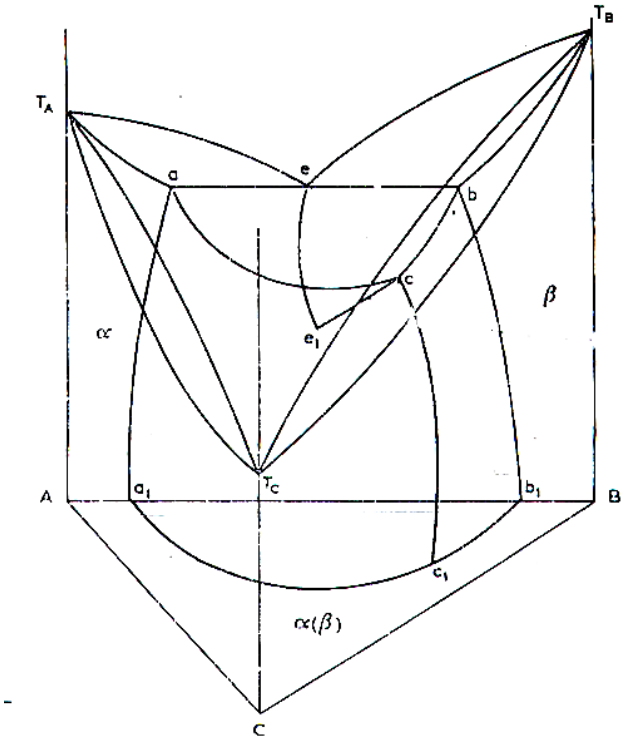
Isothermal section

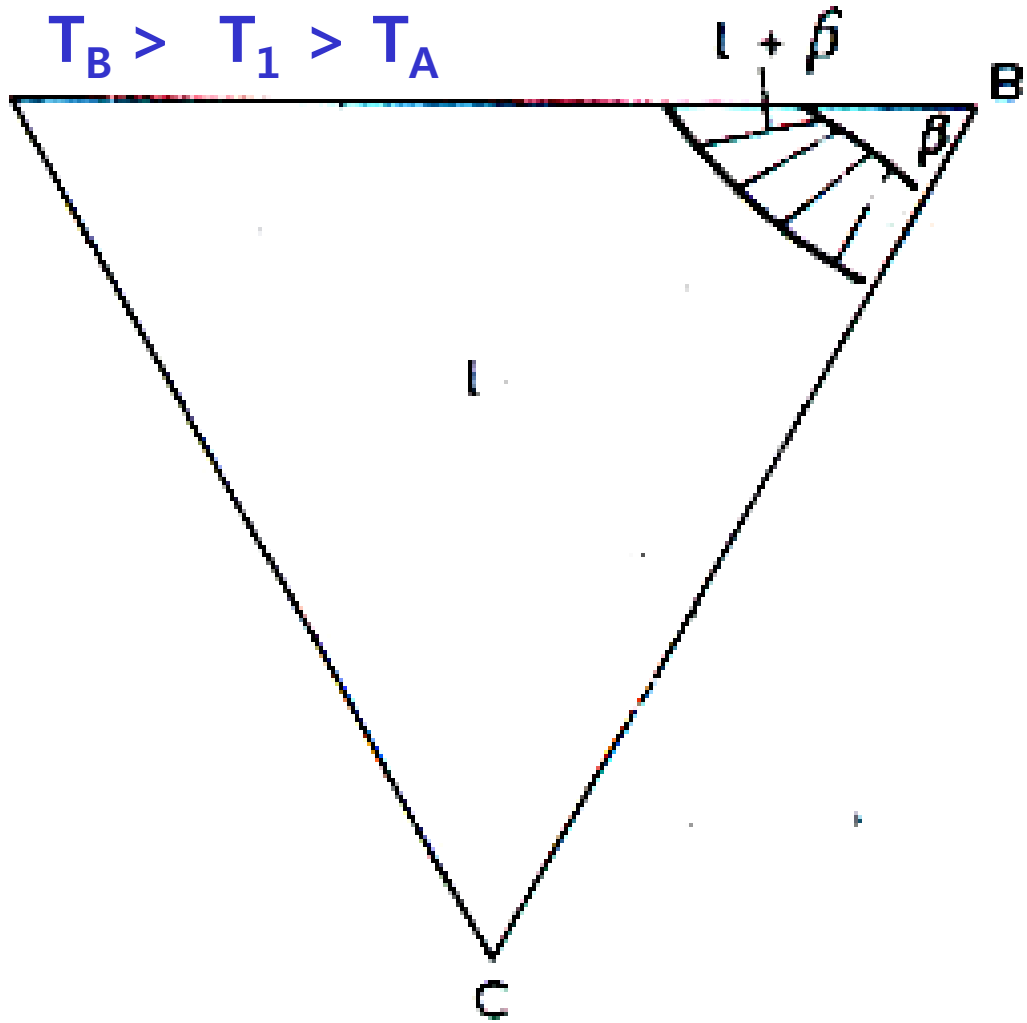




9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

- **Isothermal section**





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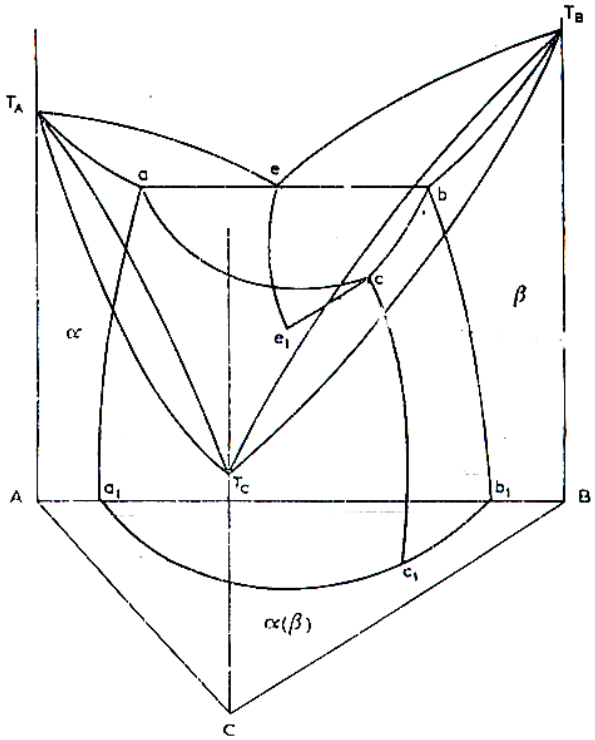

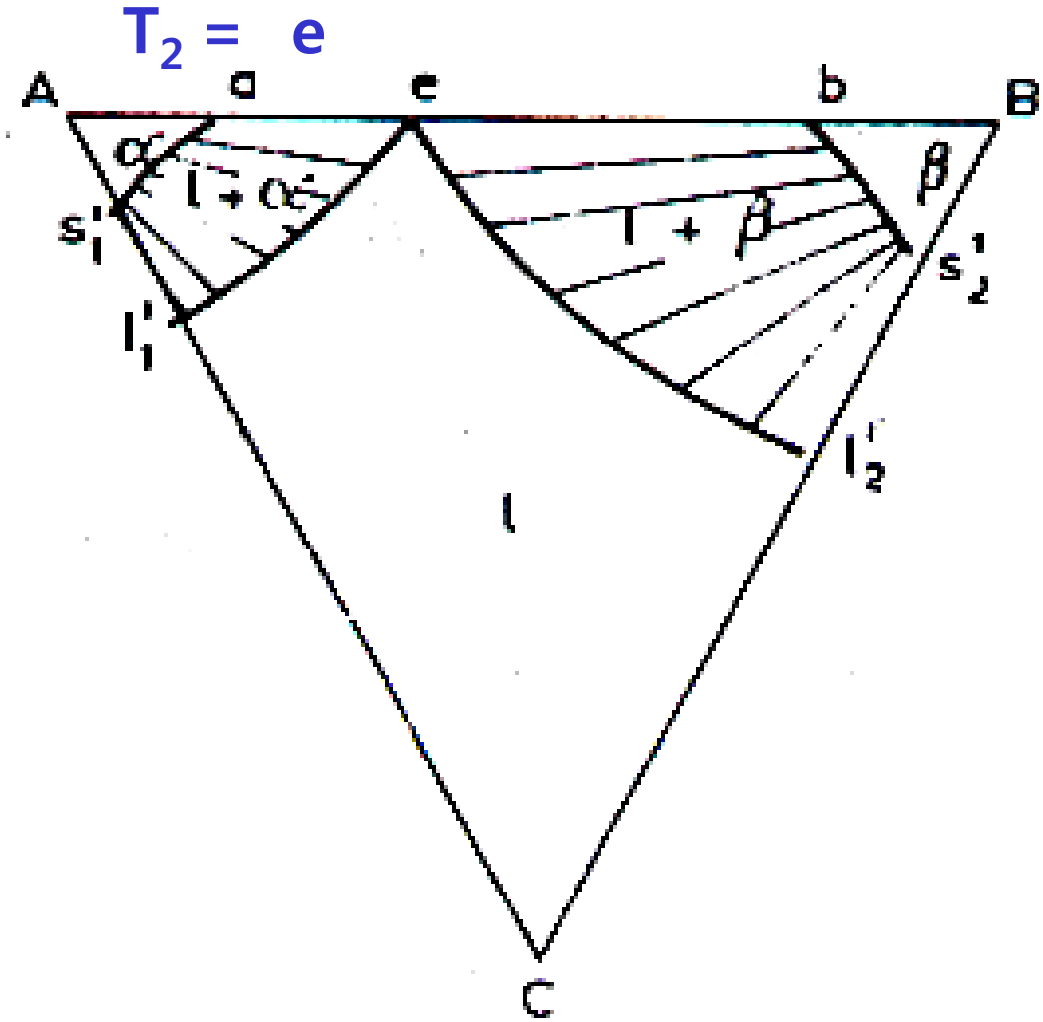

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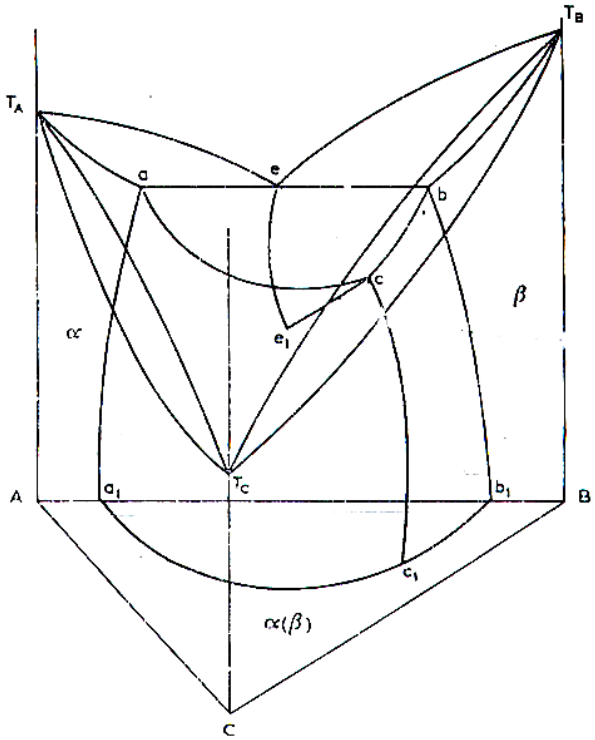
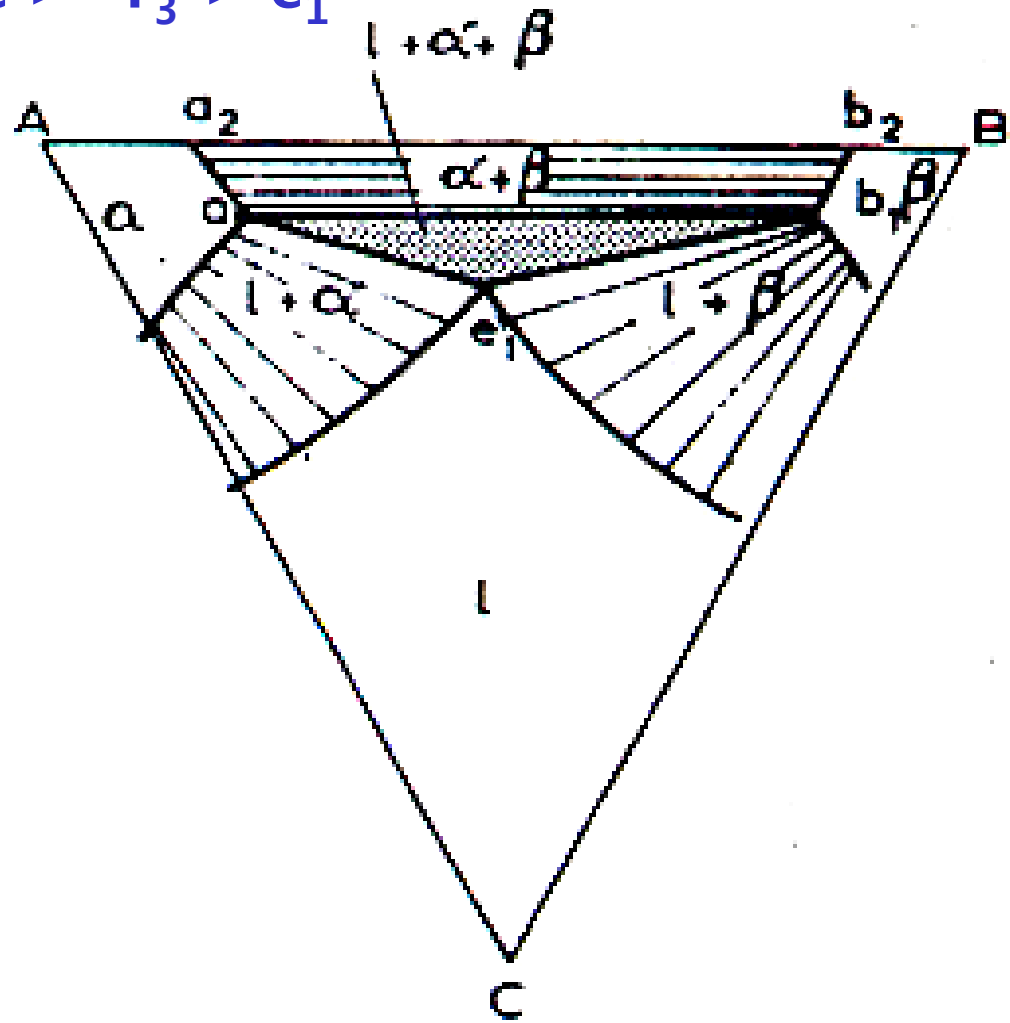
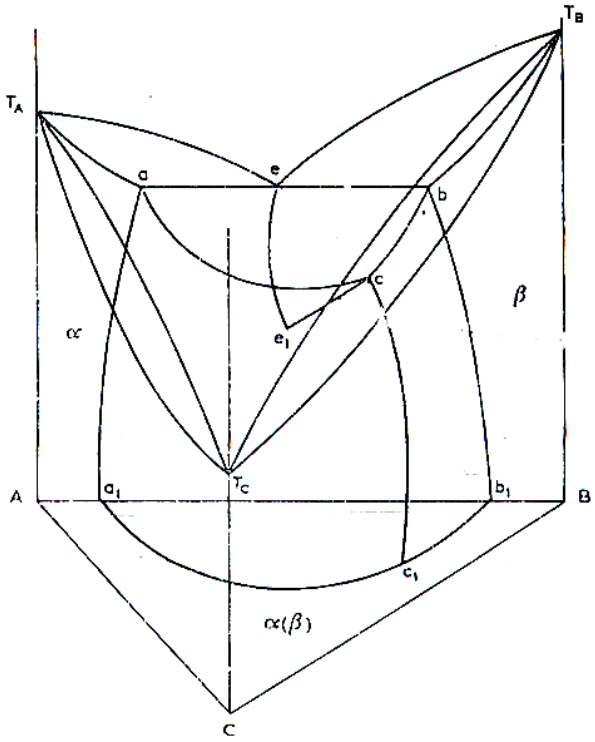


$e > T_3 > e_1$

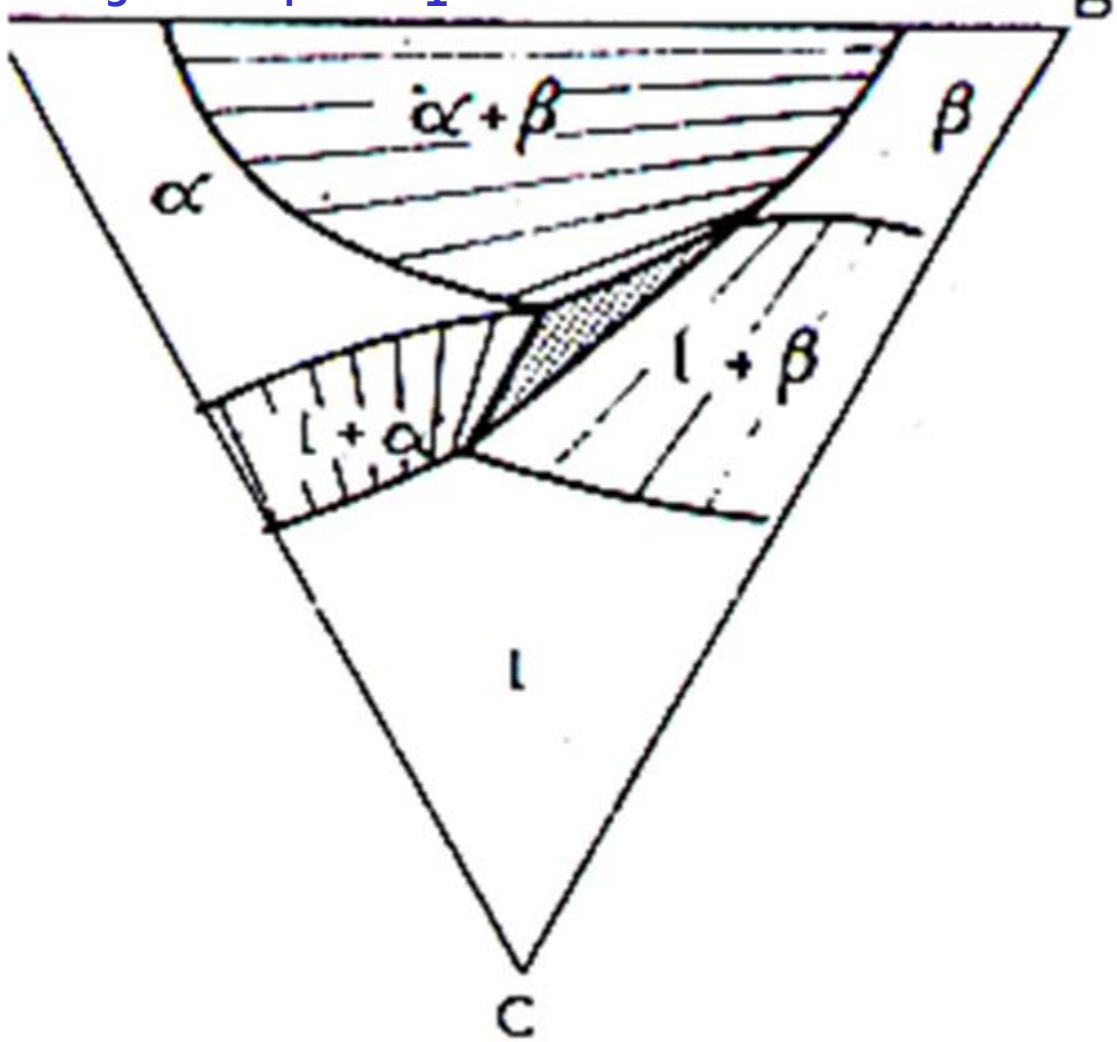


9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

- **Isothermal section**



$T_3 > T_4 > e_1$



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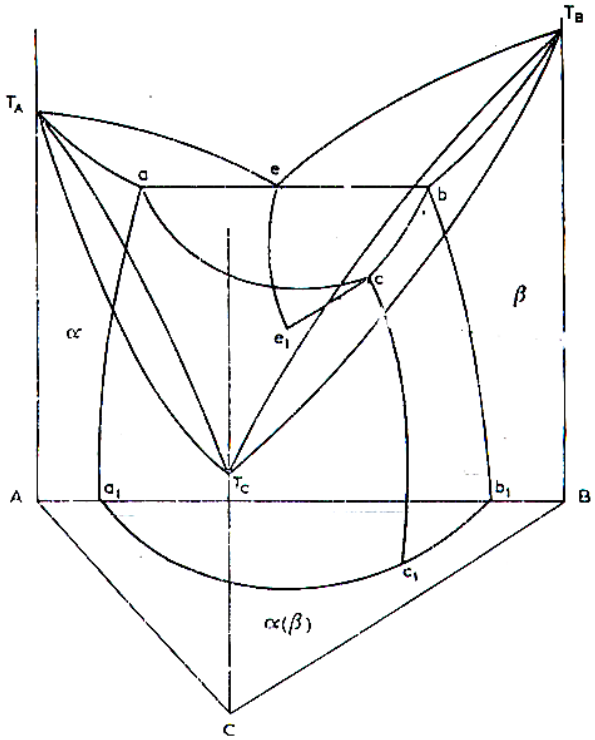
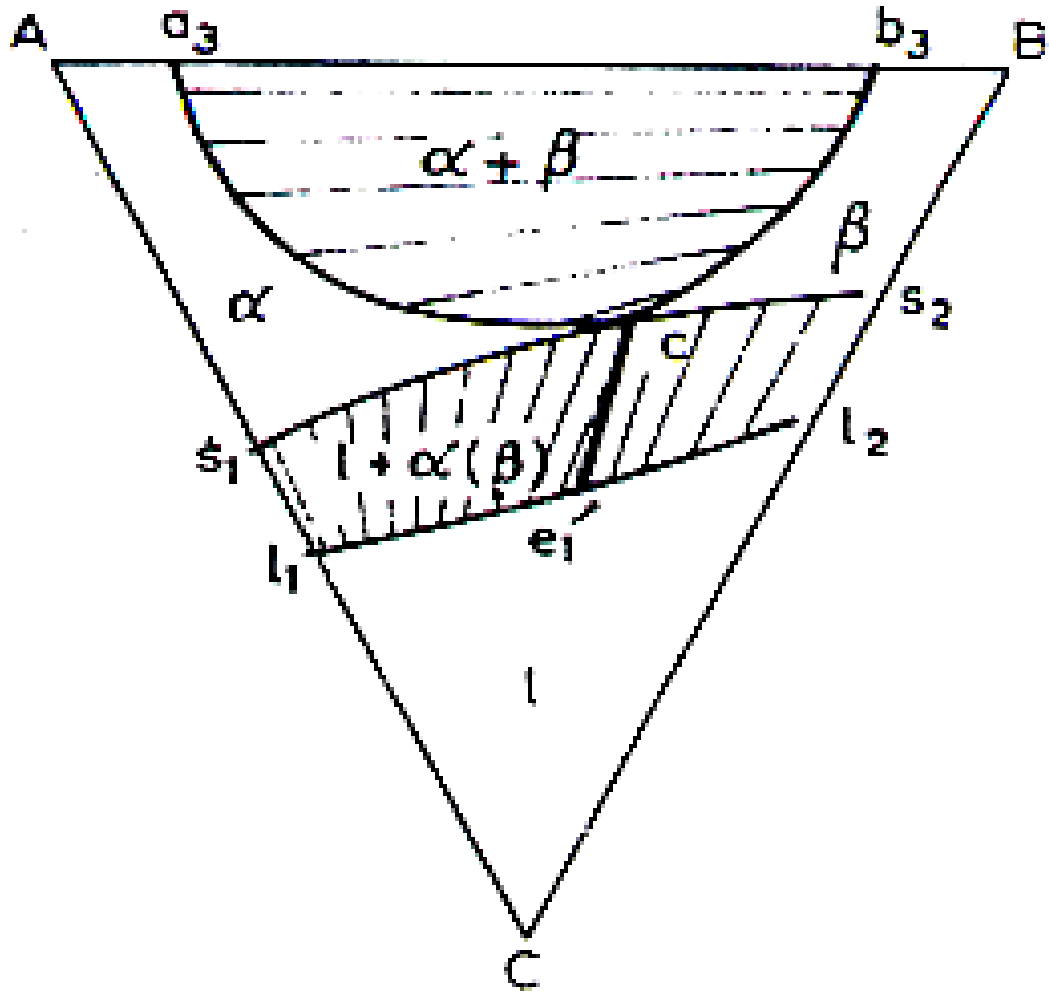
- **Isothermal section**

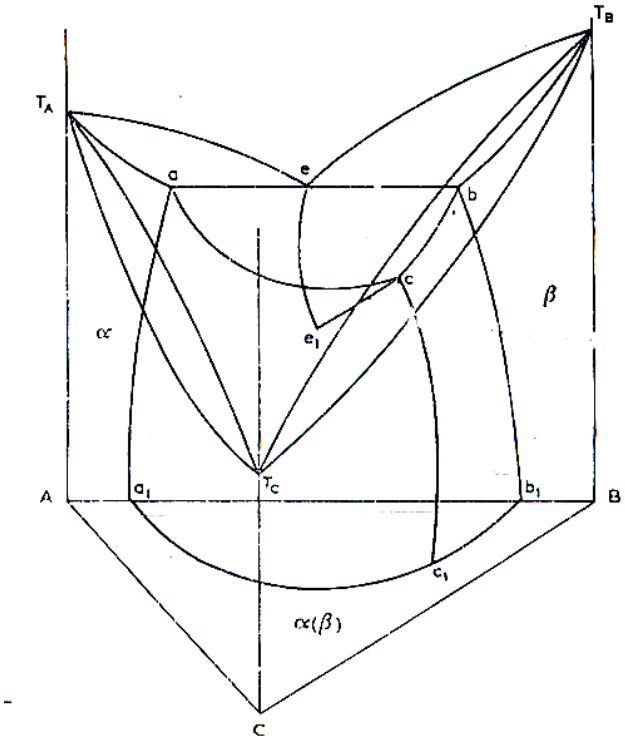


$T_5 = e$

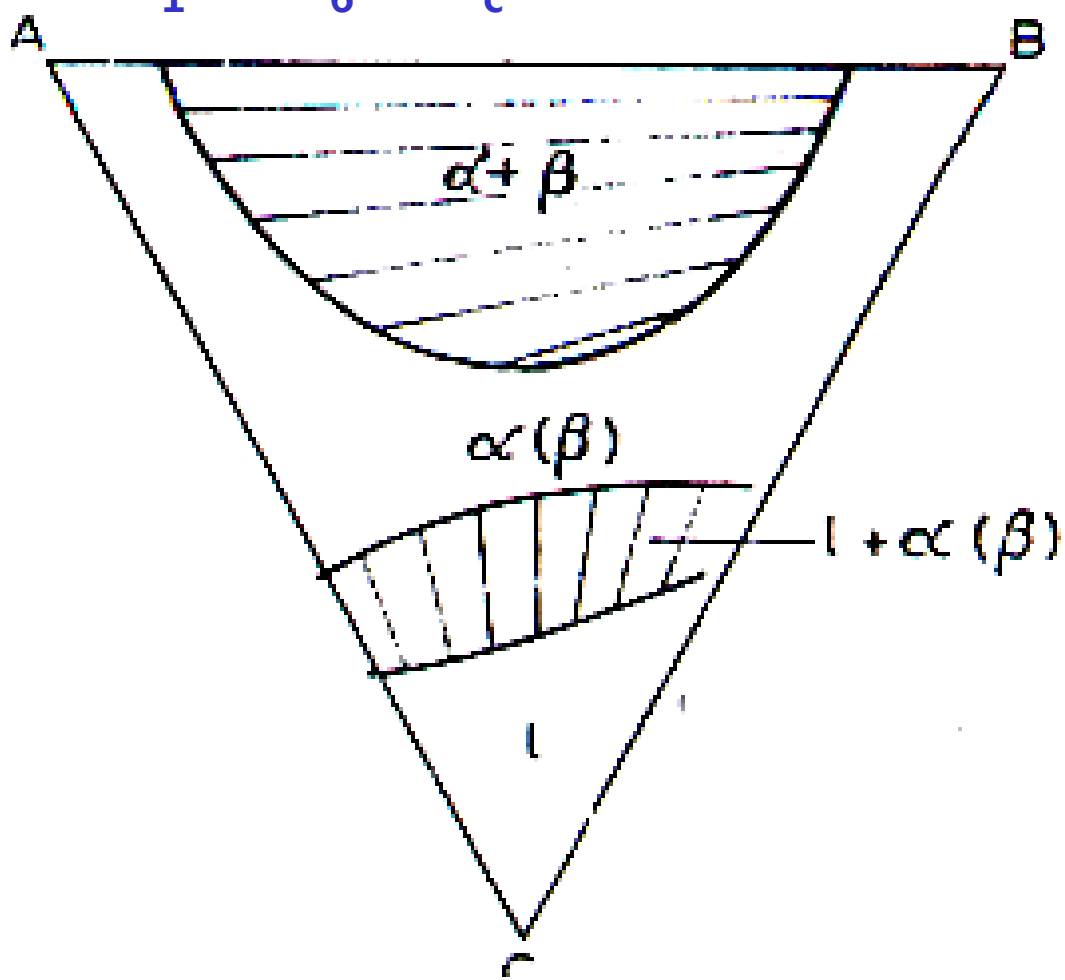


9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

- **Isothermal section**

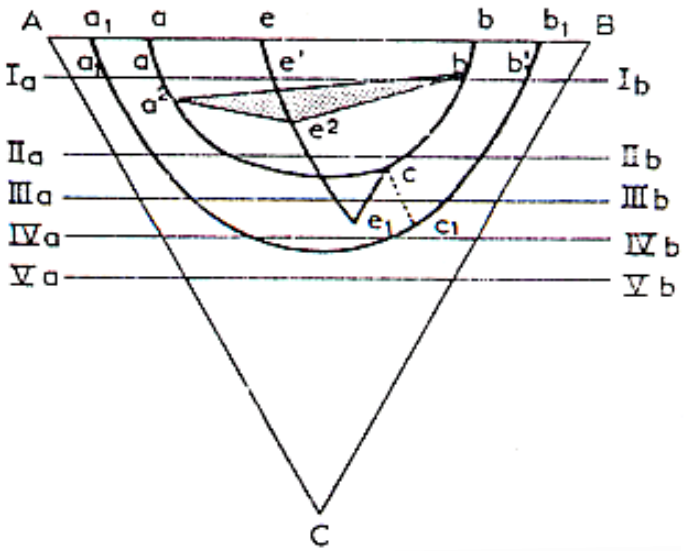


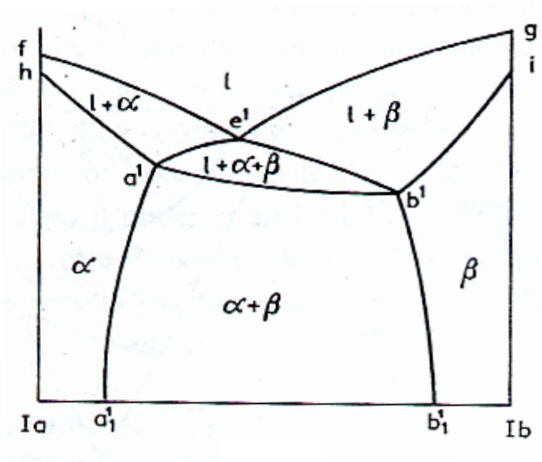
$e_1 > T_6 > T_c$

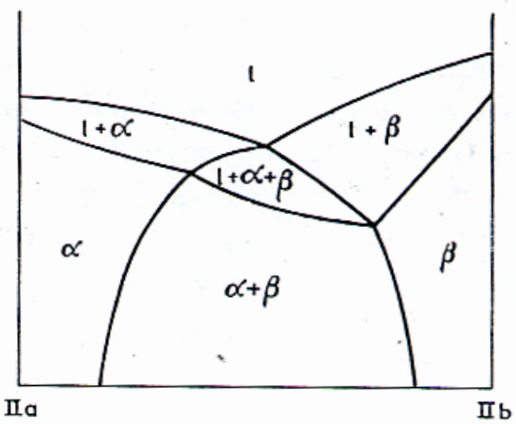


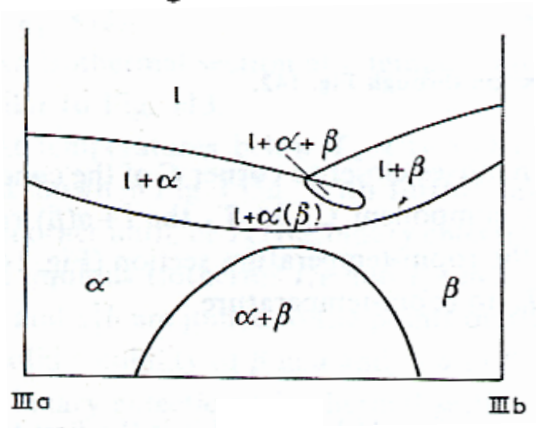
9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

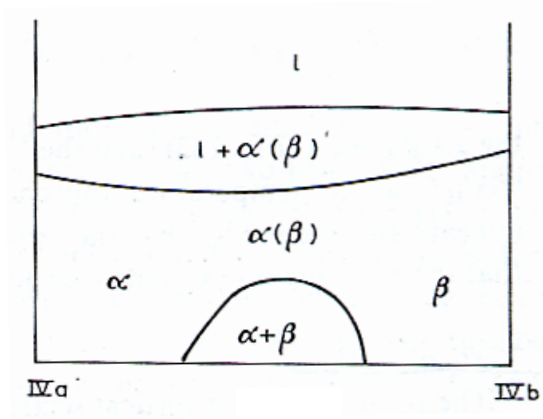
- **Vertical section**

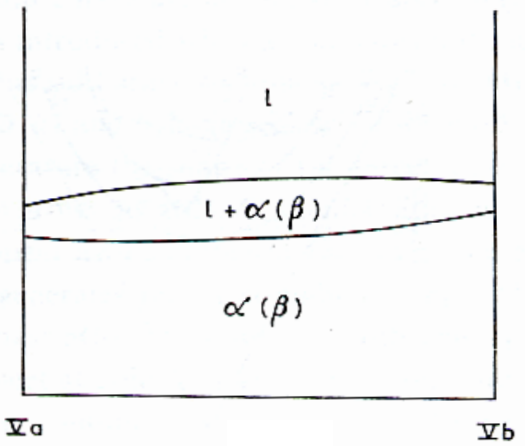






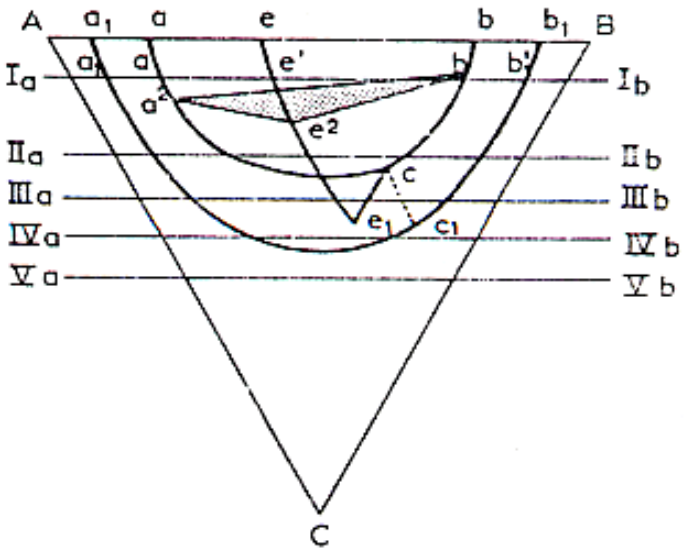


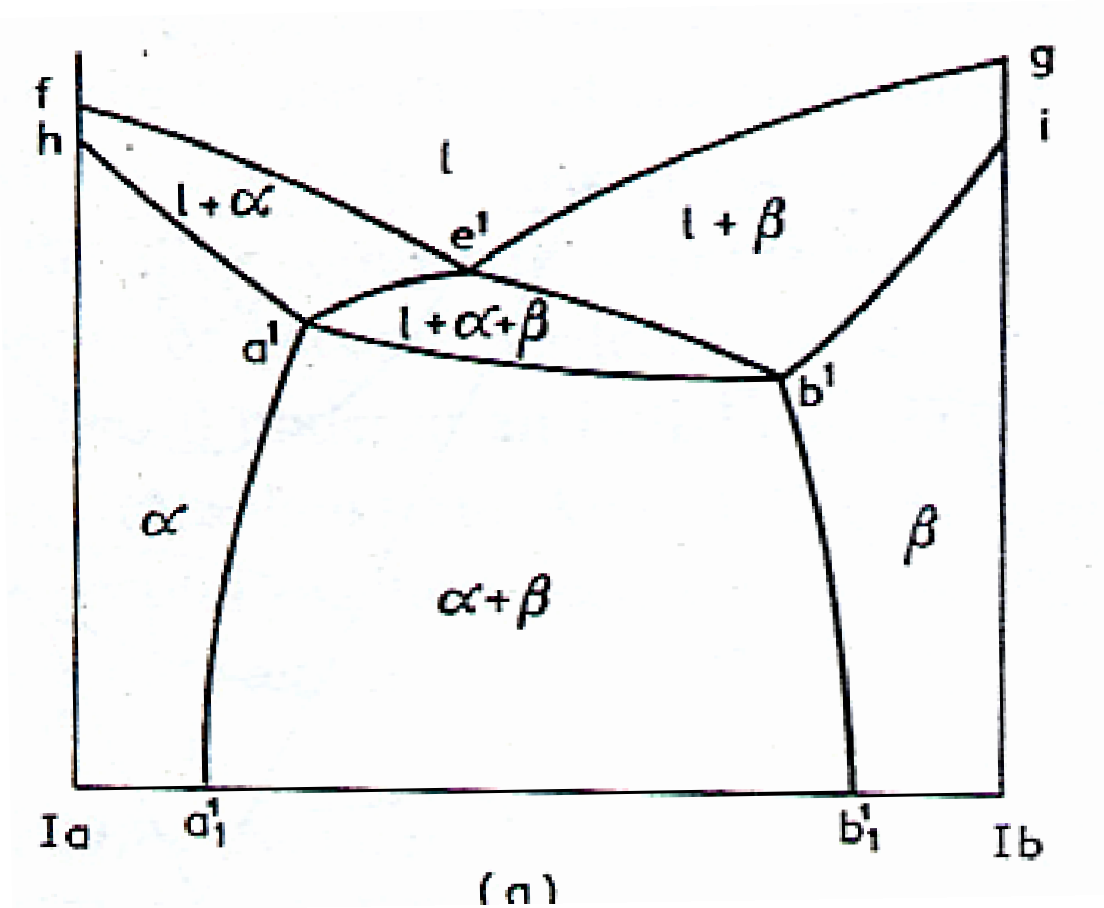




9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

- **Vertical section**

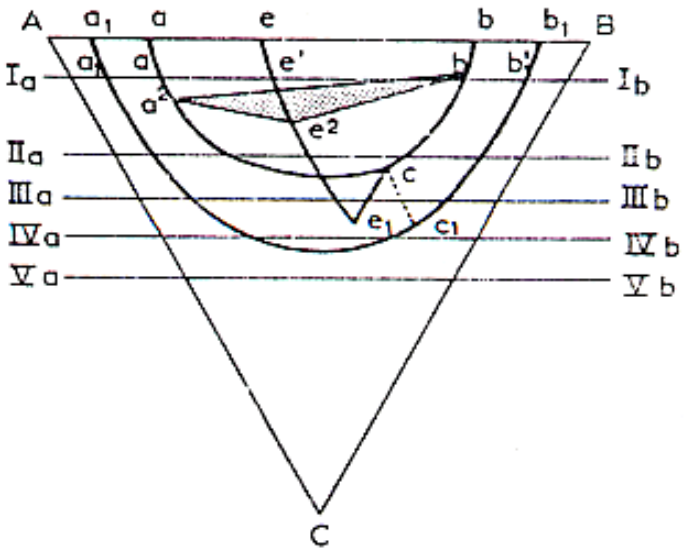


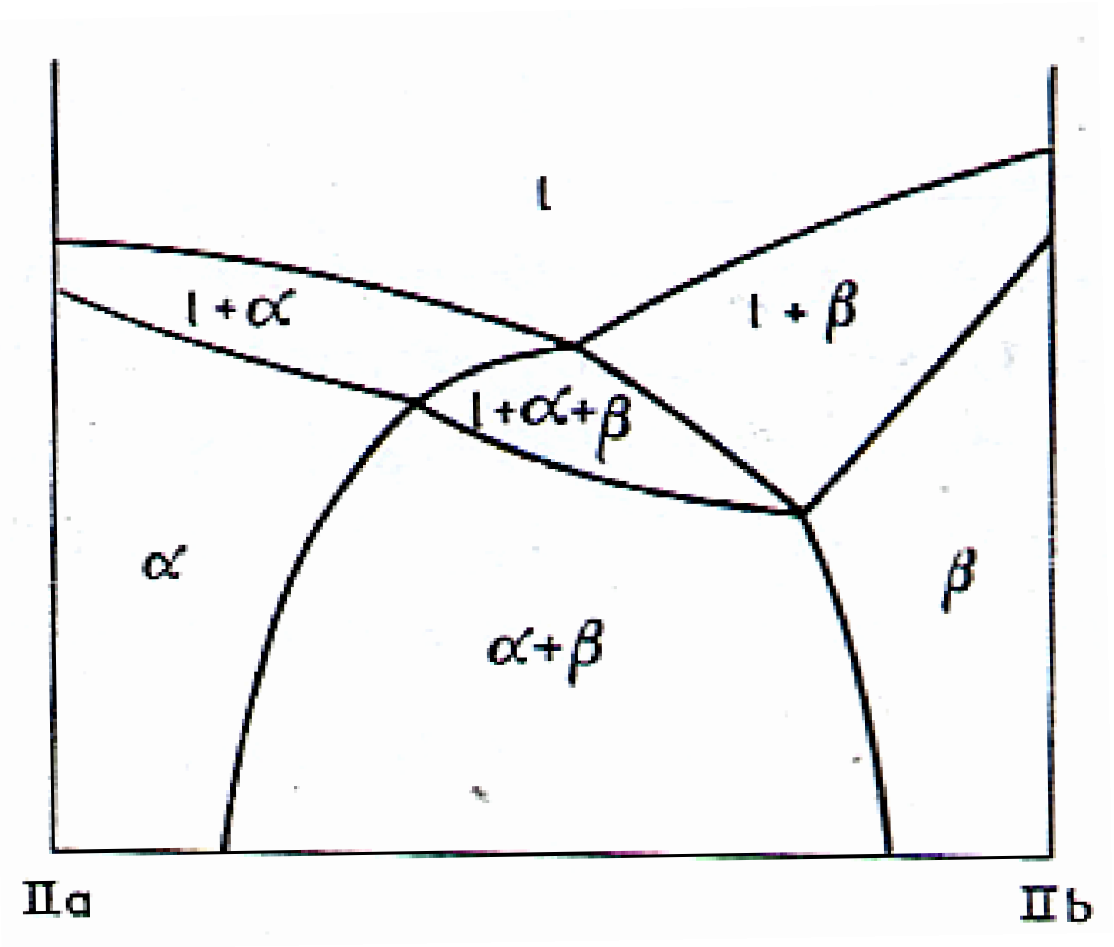


(a)

9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

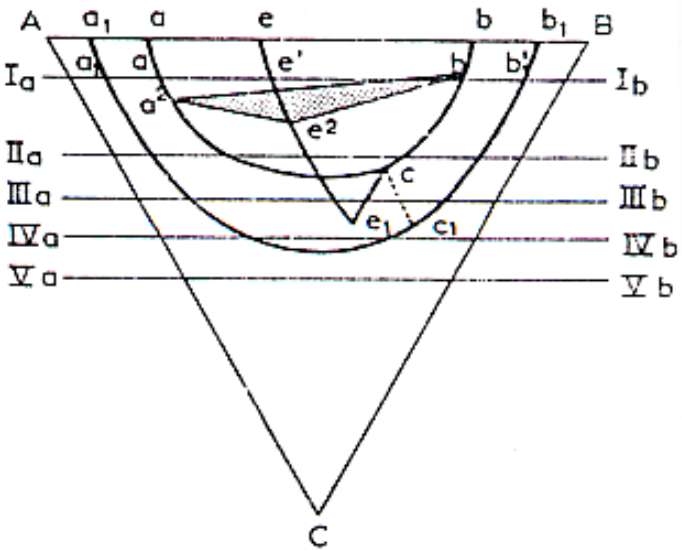
- **Vertical section**

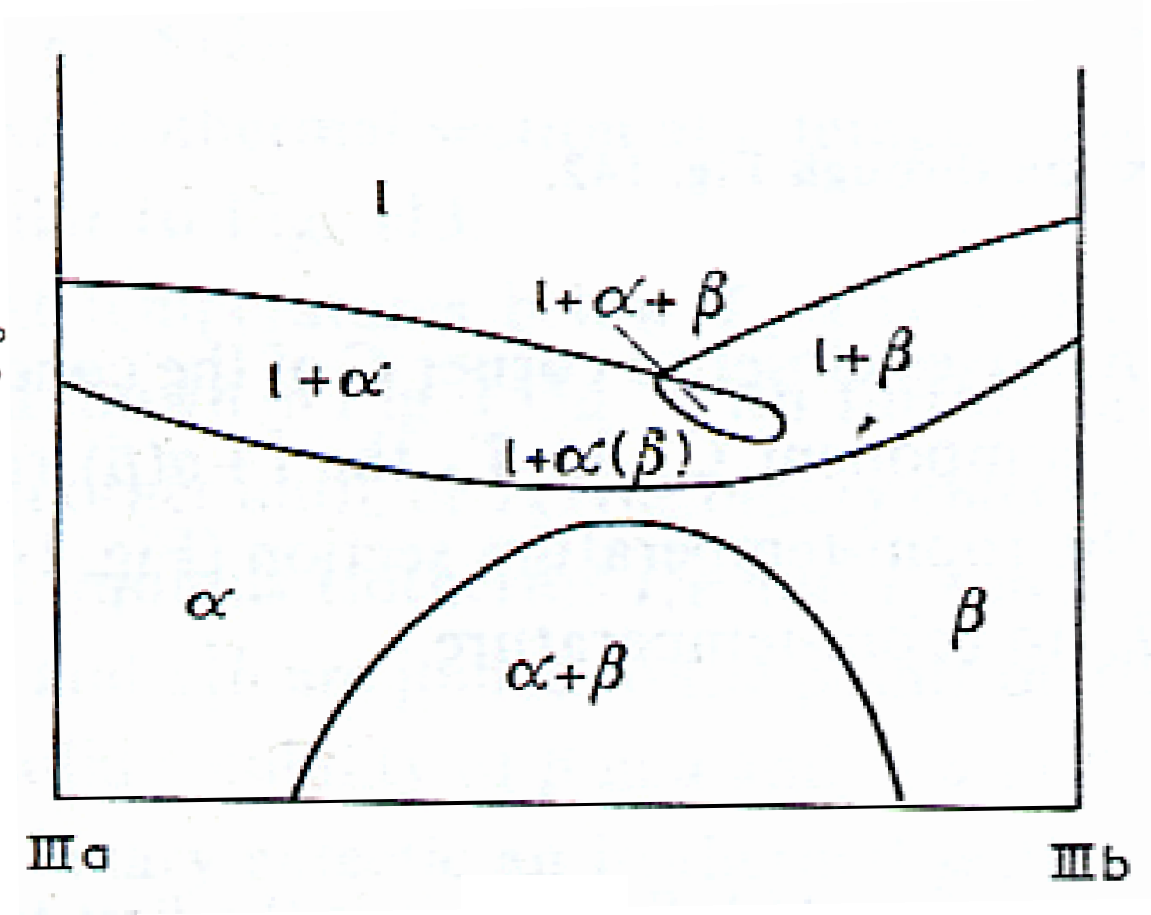




9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

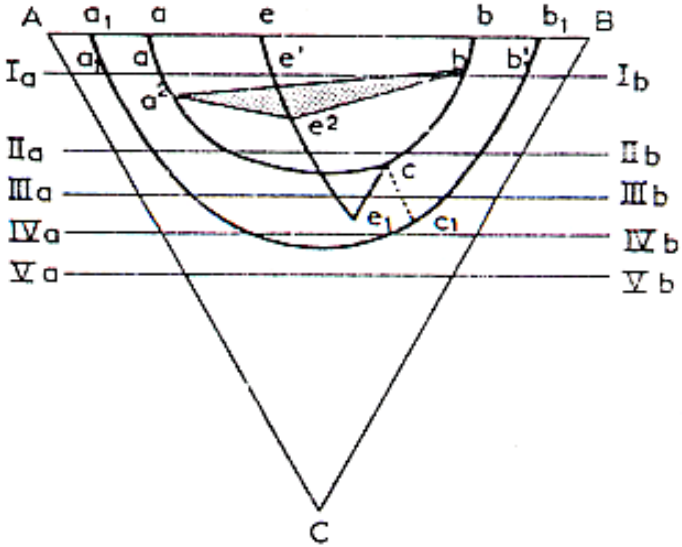
- **Vertical section**

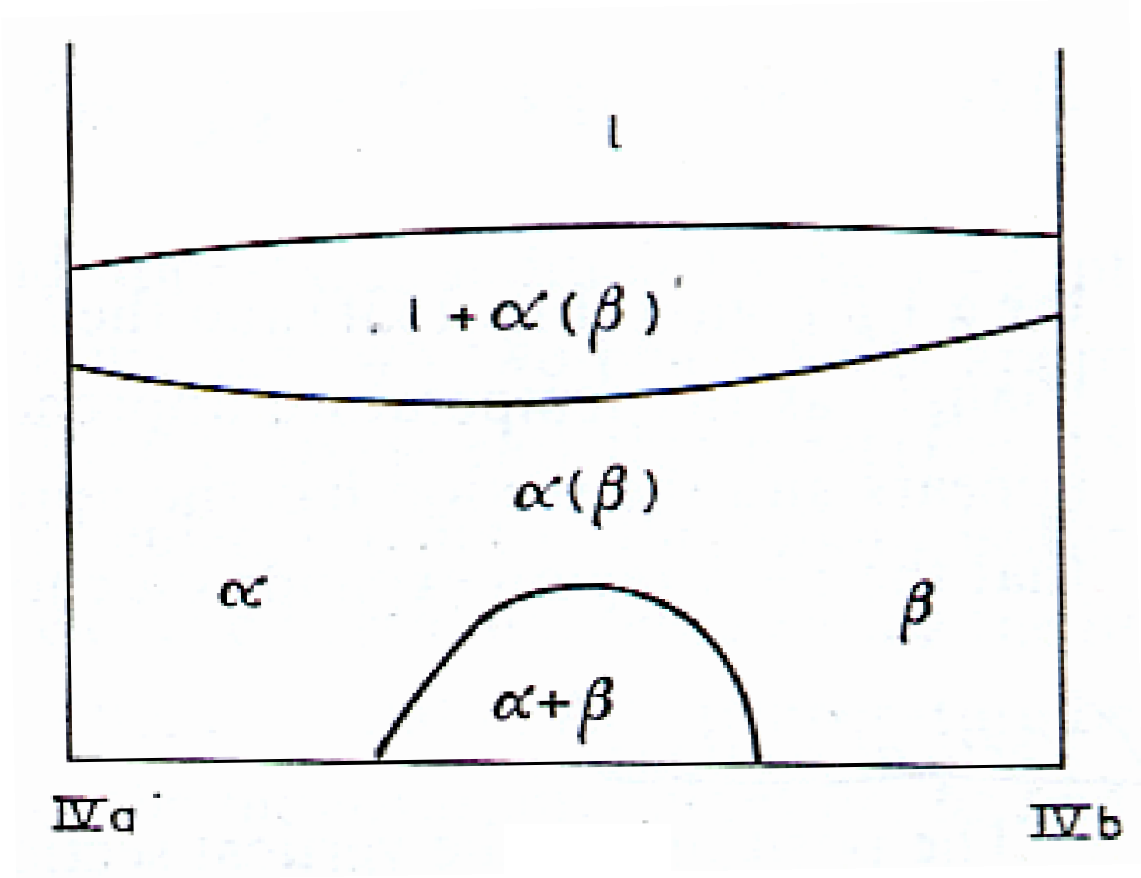


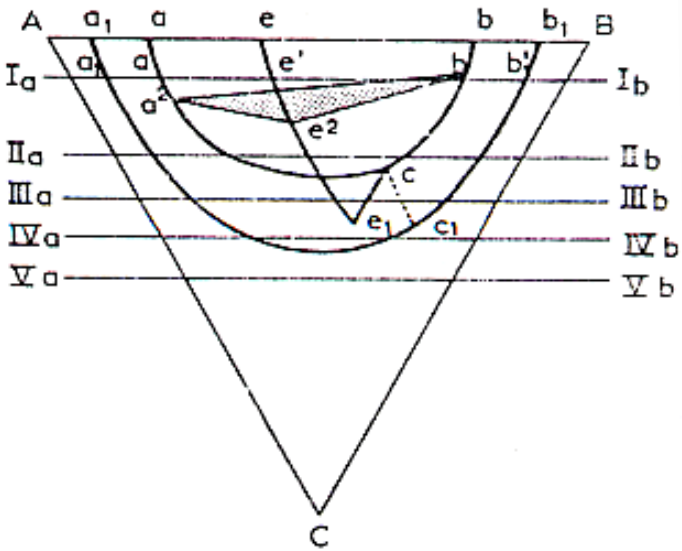
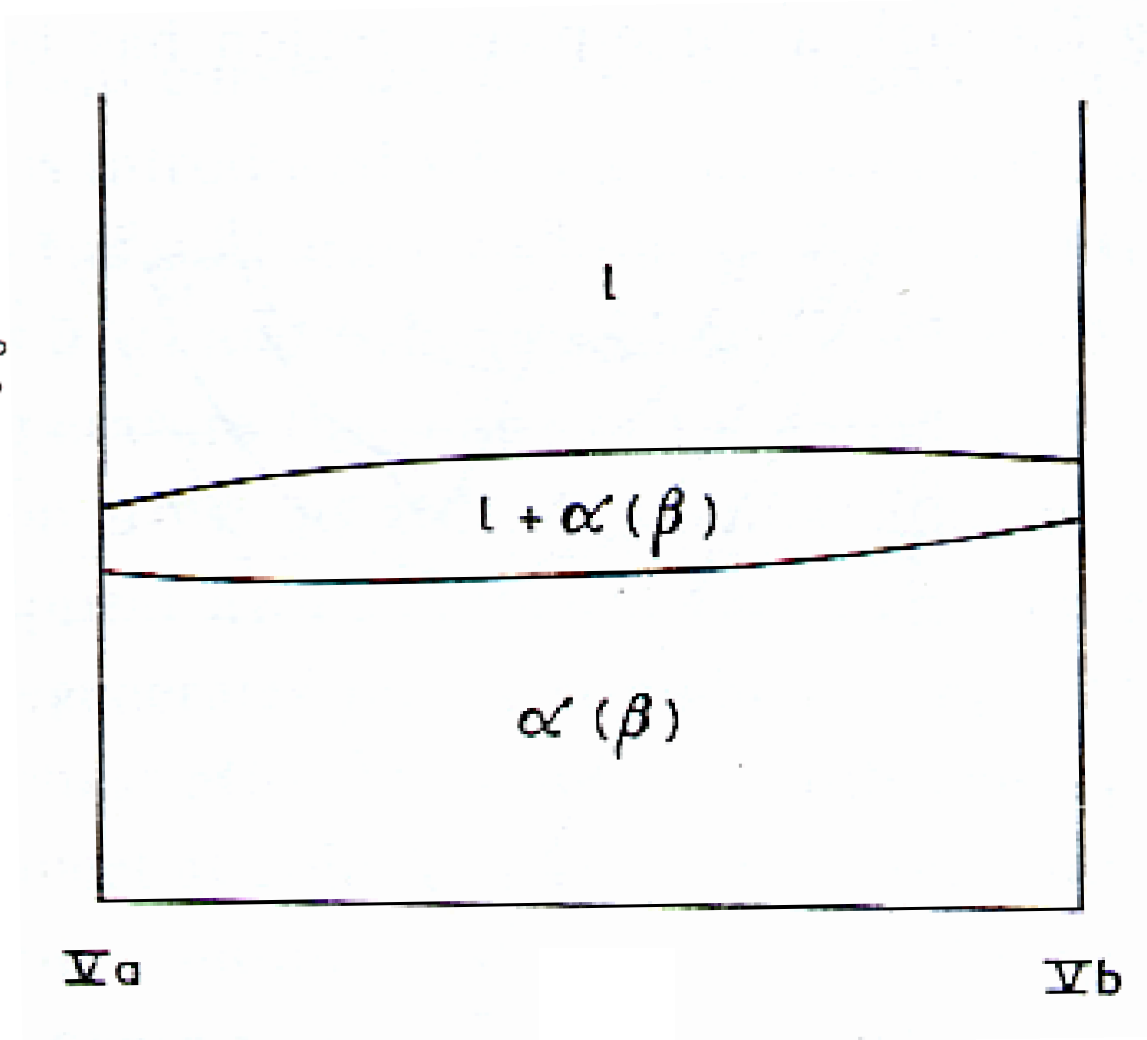


9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

- **Vertical section**





9.3. THREE-PHASE EQUILIBRIUM INVOLVING EUTECTIC REACTIONS

- **Vertical section**