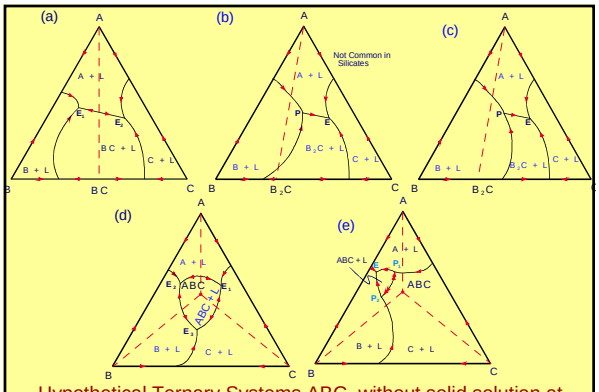
Ternary Systems - General Rules

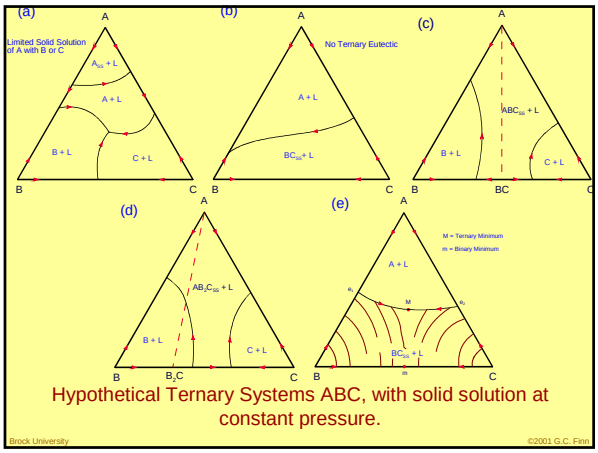
- **Congruently melting compounds** lie within the primary phase field for that compound
- **Incongruently melting compounds** do not fall within the primary phase field for that compound
- Systems **without solid solution** contain 1 or more ternary **eutectics**
- Conjugation or Alkemade Lines within such systems are **thermal barriers**

Ternary Systems - General Rules

- Systems containing an **incongruently melting compound** will contain at least one ternary **peritectic**
- Systems displaying **complete solid solution** will not contain a ternary **eutectic** within the triangular area representing the system
- **Tie lines** on a ternary diagram join two phases at the same temperature which are in equilibrium with each other



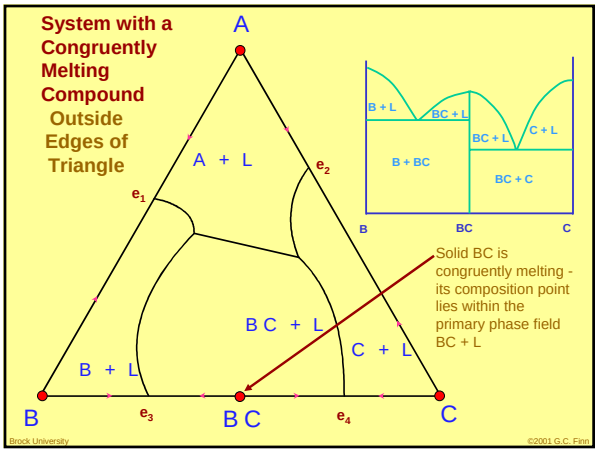
Hypothetical Ternary Systems ABC, without solid solution at constant pressure.

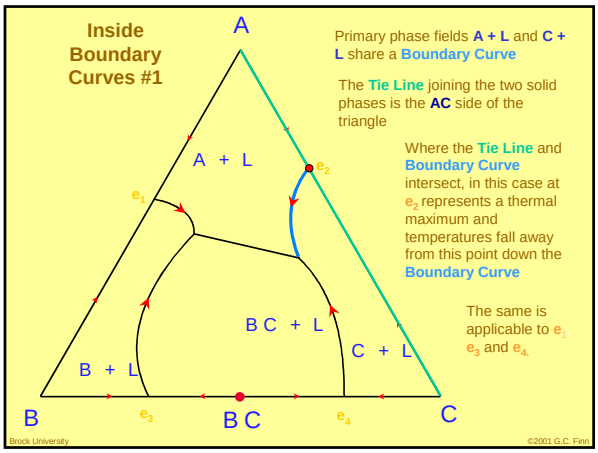


Hypothetical Ternary Systems ABC, with solid solution at constant pressure.

Directions of falling temperature on a Ternary Diagram

- Temperatures fall away from the three apices of the triangle.
- The point of intersection of:
  - a tie line joining two compounds that share a boundary curve,
  - with the boundary curve, or an extension of the curve
- represents a thermal maximum along that section of the boundary curve.




Inside Boundary Curves #1
A
Primary phase fields A + L and C + L share a Boundary Curve
The Tie Line joining the two solid phases is the AC side of the triangle
Where the Tie Line and Boundary Curve intersect, in this case at e2 represents a thermal maximum and temperatures fall away from this point down the Boundary Curve
The same is applicable to e1, e3 and e4.
A + L
e1
e2
B C + L
C + L
B + L
B
e3
B C
e4
C
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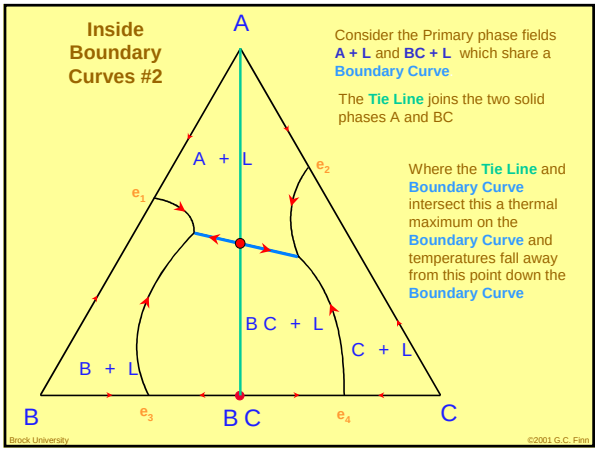
Inside Boundary Curves #2
A
Consider the Primary phase fields A + L and BC + L which share a Boundary Curve
The Tie Line joins the two solid phases A and BC
Where the Tie Line and Boundary Curve intersect this a thermal maximum on the Boundary Curve and temperatures fall away from this point down the Boundary Curve
A + L
e1
e2
B C + L
C + L
B + L
B
e3
B C
e4
C
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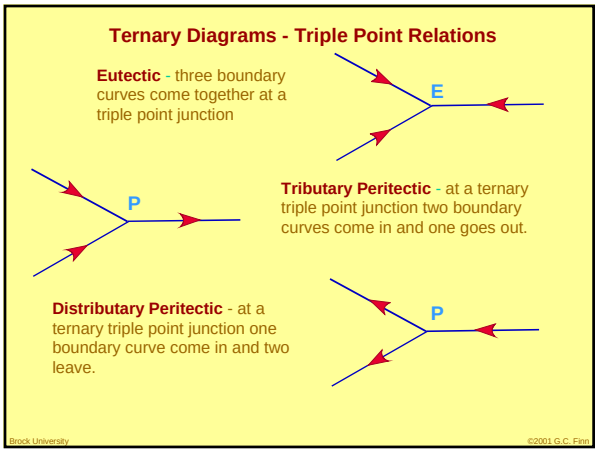
Ternary Diagrams - Triple Point Relations
Eutectic - three boundary curves come together at a triple point junction
E
P
Tributary Peritectic - at a ternary triple point junction two boundary curves come in and one goes out.
Distributary Peritectic - at a ternary triple point junction one boundary curve come in and two leave.
P
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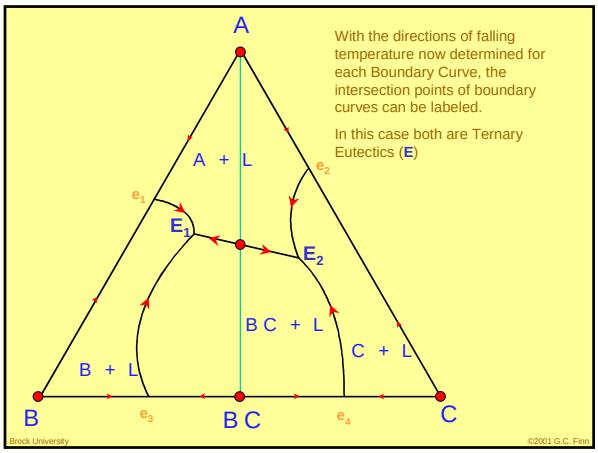
A
With the directions of falling temperature now determined for each Boundary Curve, the intersection points of boundary curves can be labeled.
In this case both are Ternary Eutectics (E)
A + L
e1
e2
E1
E2
B C + L
C + L
B + L
B
e3
B C
e4
C
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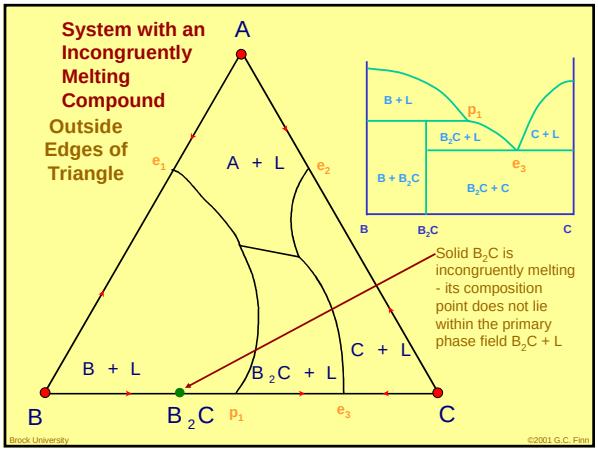
System with an Incongruently Melting Compound
Outside Edges of Triangle
A
A + L
e1
e2
B + L
p1
B2C + L
C + L
e3
B + B2C
B2C + C
B
B2C
C
Solid B2C is incongruently melting - its composition point does not lie within the primary phase field B2C + L
C + L
B + L
B2C + L
B
B2C
p1
e3
C
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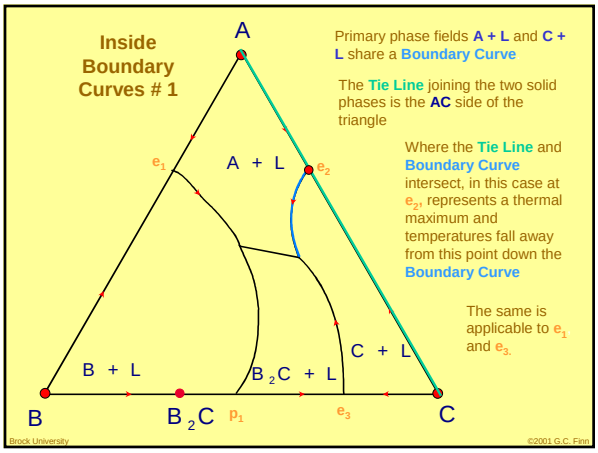
Inside Boundary Curves # 1
A
Primary phase fields A + L and C + L share a Boundary Curve
The Tie Line joining the two solid phases is the AC side of the triangle
Where the Tie Line and Boundary Curve intersect, in this case at e2, represents a thermal maximum and temperatures fall away from this point down the Boundary Curve
The same is applicable to e1 and e3.
A + L
e1
e2
C + L
B + L
B2C + L
B
B2C
p1
e3
C
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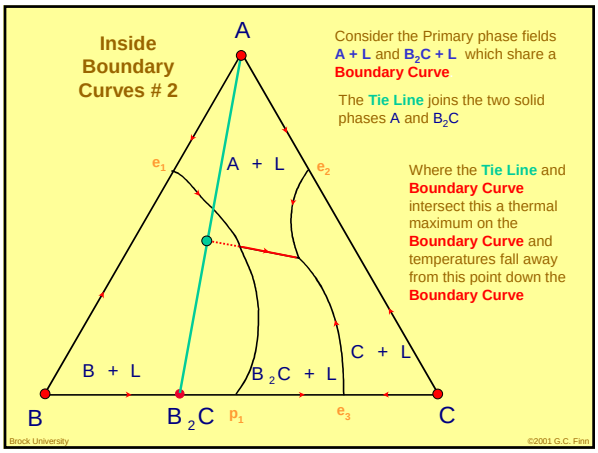
Inside Boundary Curves # 2
A
Consider the Primary phase fields A + L and B2C + L which share a Boundary Curve
The Tie Line joins the two solid phases A and B2C
Where the Tie Line and Boundary Curve intersect this a thermal maximum on the Boundary Curve and temperatures fall away from this point down the Boundary Curve
e1
A + L
e2
B + L
B2C + L
C + L
B
B2C
p1
e3
C
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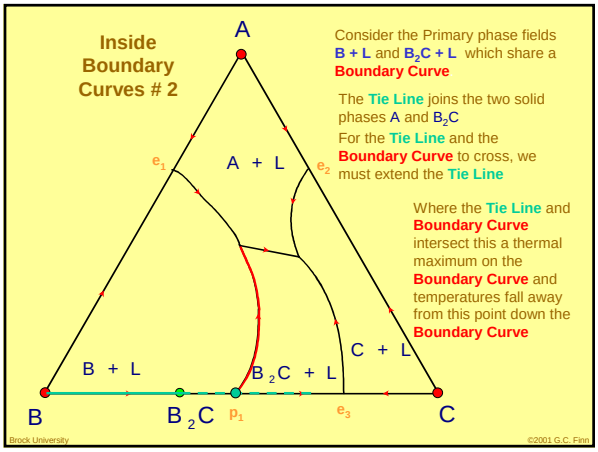
Inside Boundary Curves # 2
A
Consider the Primary phase fields B + L and B2C + L which share a Boundary Curve
The Tie Line joins the two solid phases A and B2C
For the Tie Line and the Boundary Curve to cross, we must extend the Tie Line
Where the Tie Line and Boundary Curve intersect this a thermal maximum on the Boundary Curve and temperatures fall away from this point down the Boundary Curve
e1
A + L
e2
B + L
B2C + L
C + L
B
B2C
p1
e3
C
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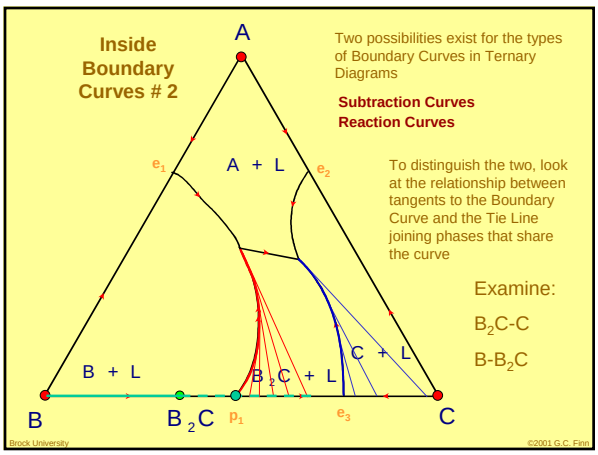
Inside Boundary Curves # 2
A
Two possibilities exist for the types of Boundary Curves in Ternary Diagrams
Subtraction Curves
Reaction Curves
To distinguish the two, look at the relationship between tangents to the Boundary Curve and the Tie Line joining phases that share the curve
Examine:
B2C-C
B-B2C
e1
A + L
e2
B + L
B2C + L
C + L
B
B2C
p1
e3
C
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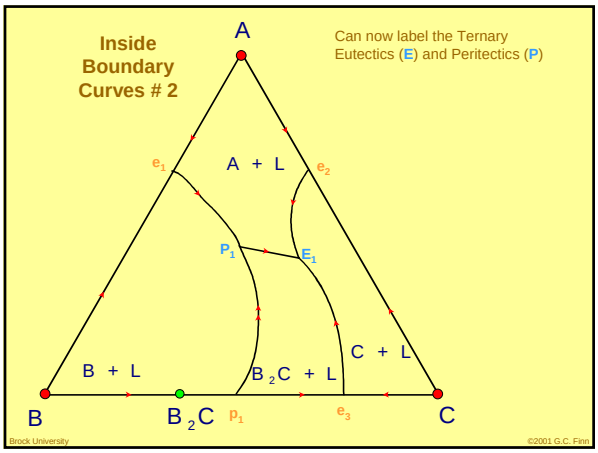
Inside Boundary Curves # 2
Can now label the Ternary Eutectics (E) and Peritectics (P)
A
e1
A + L
e2
P1
E1
B + L
B2C + L
C + L
B
B2C
p1
e3
C
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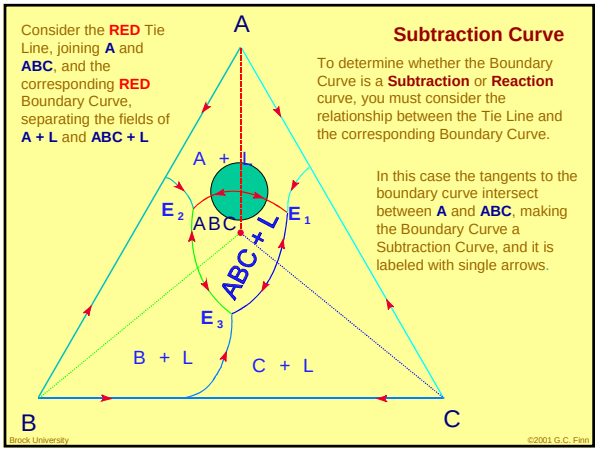
Consider the RED Tie Line, joining A and ABC, and the corresponding RED Boundary Curve, separating the fields of A + L and ABC + L
Subtraction Curve
To determine whether the Boundary Curve is a Subtraction or Reaction curve, you must consider the relationship between the Tie Line and the corresponding Boundary Curve.
In this case the tangents to the boundary curve intersect between A and ABC, making the Boundary Curve a Subtraction Curve, and it is labeled with single arrows.
A
A + L
E2
ABC
E1
ABC + L
E3
B + L
C + L
B
C
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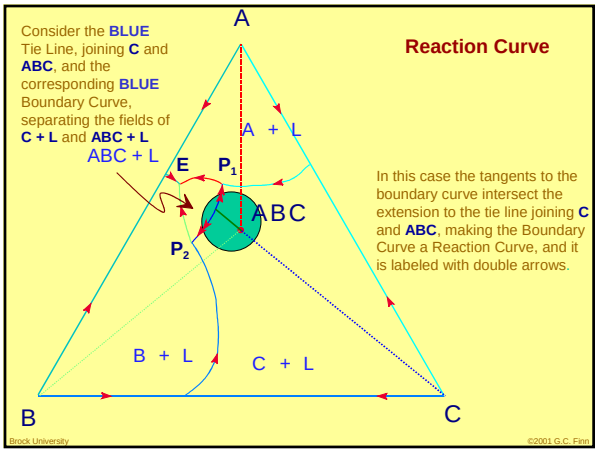
Consider the BLUE Tie Line, joining C and ABC, and the corresponding BLUE Boundary Curve, separating the fields of C + L and ABC + L
Reaction Curve
ABC + L
E
P1
A + L
ABC
P2
In this case the tangents to the boundary curve intersect the extension to the tie line joining C and ABC, making the Boundary Curve a Reaction Curve, and it is labeled with double arrows.
B + L
C + L
A
B
C
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