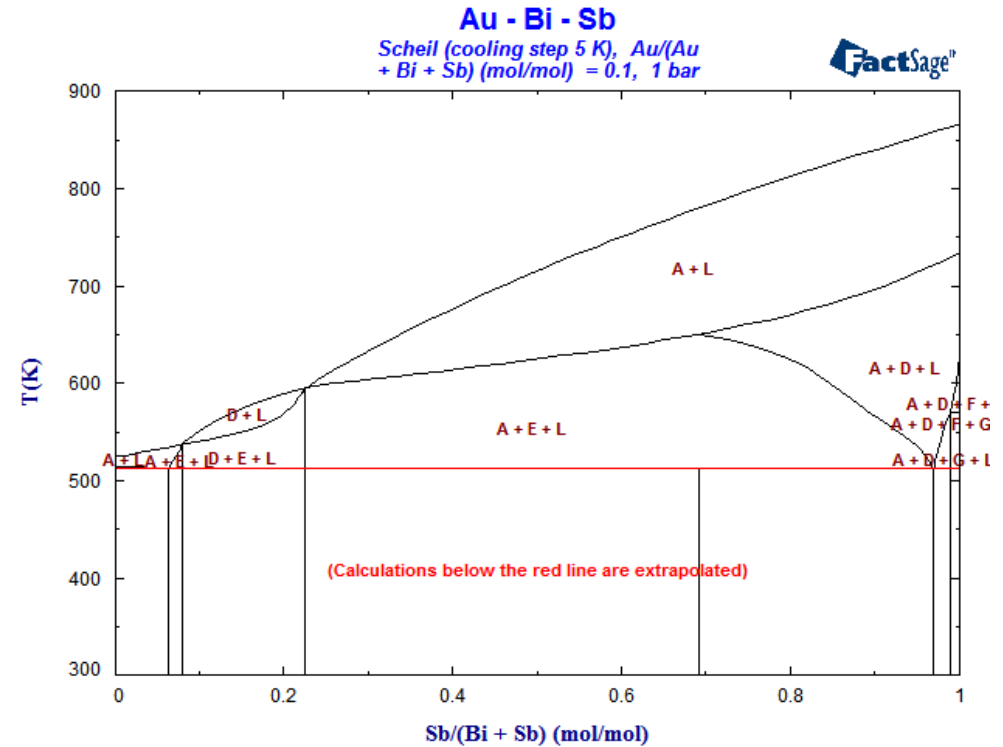
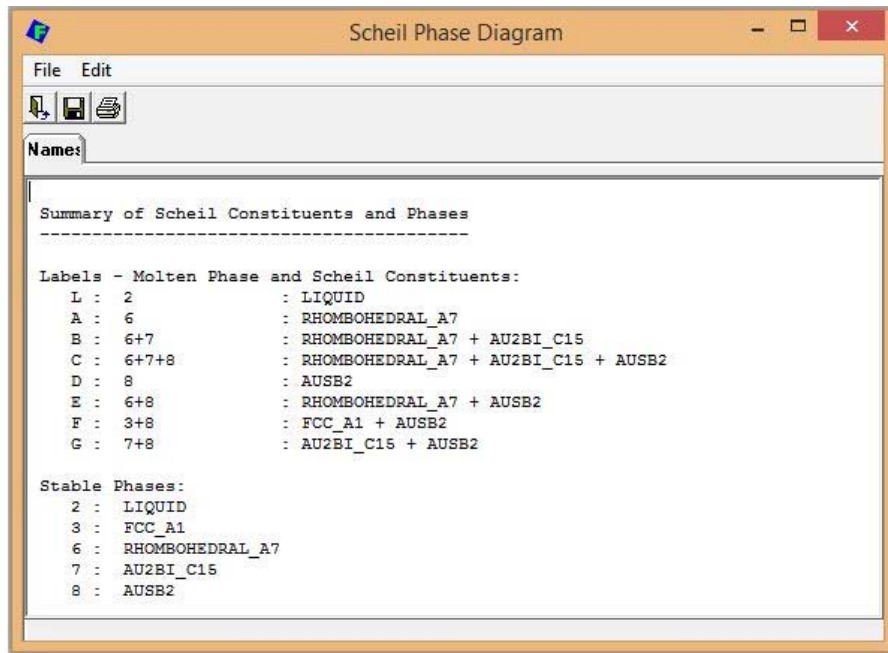


FactSage Developments: Scheil phase formation diagrams

G. Eriksson, M. To Baben, K. Hack
GTT-Technologies
GTT User Meeting, 1.7.2016



Phase formation during cooling in a ternary system:

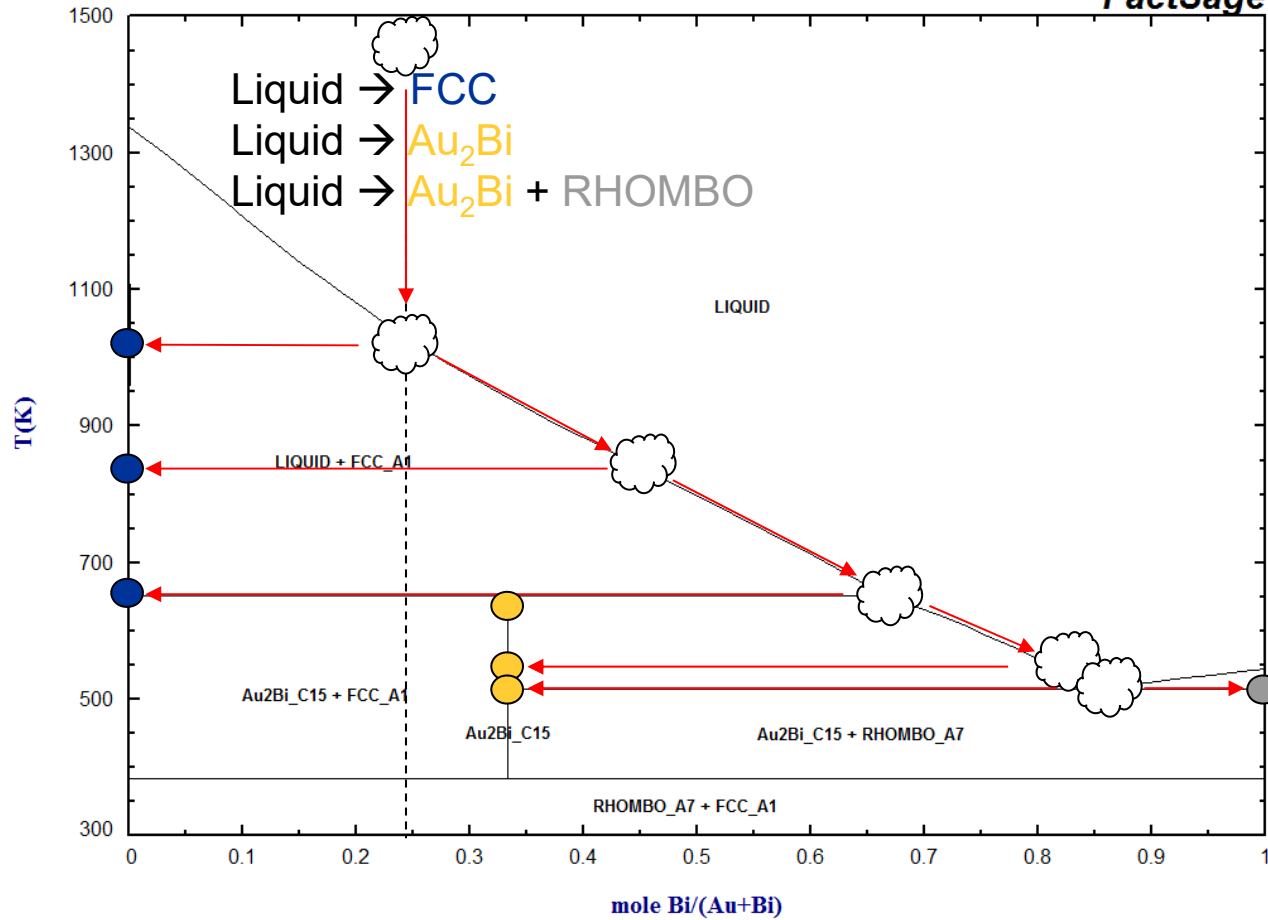


2 component Scheil cooling

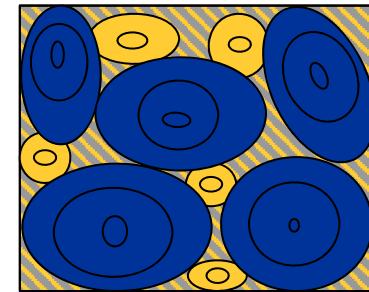
Au - Bi

Data from SGTE solders database (revised 2008)

FactSage



microstructure:

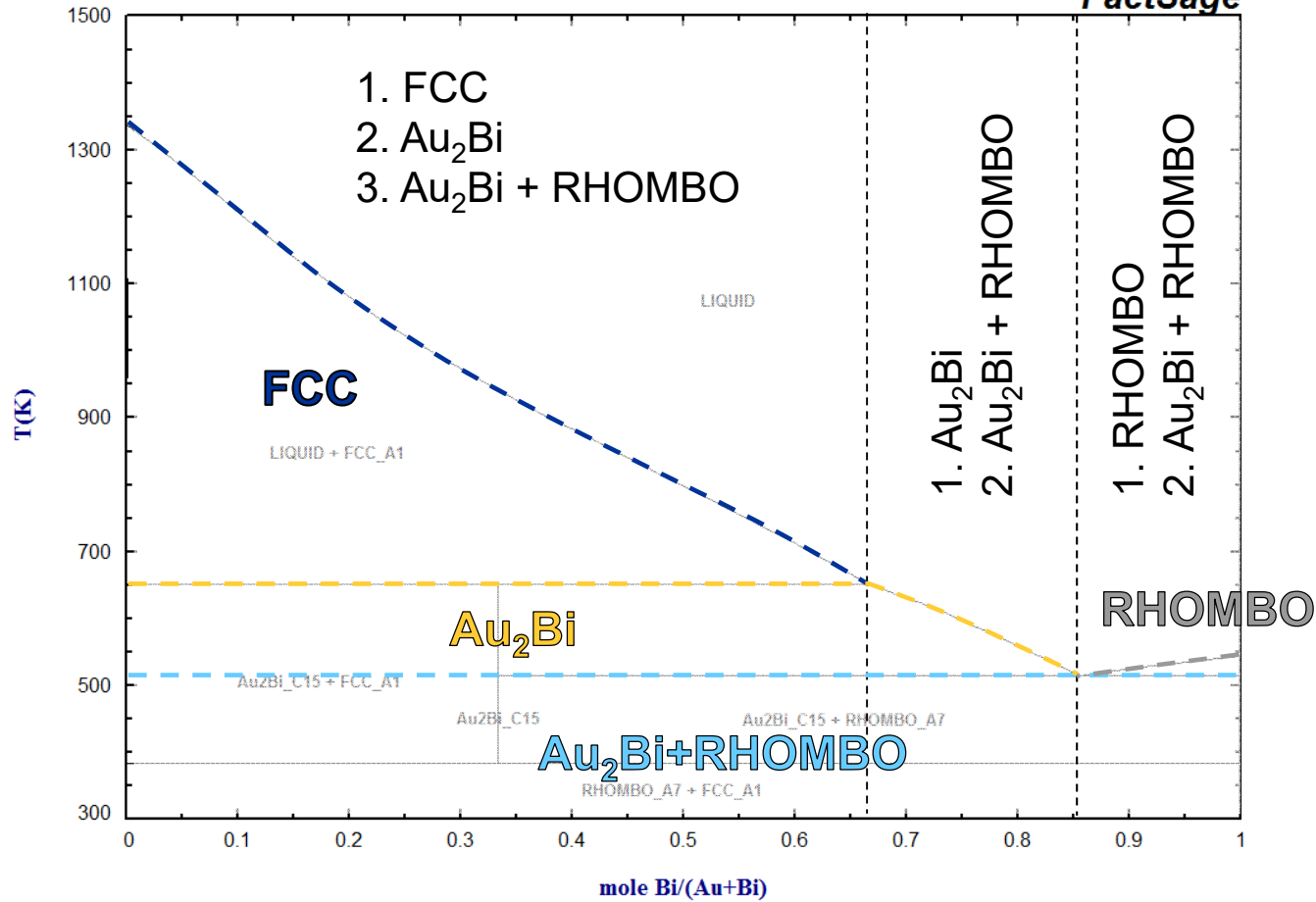


2 component Scheil cooling

Au - Bi

Data from SGTE solders database (revised 2008)

FactSage

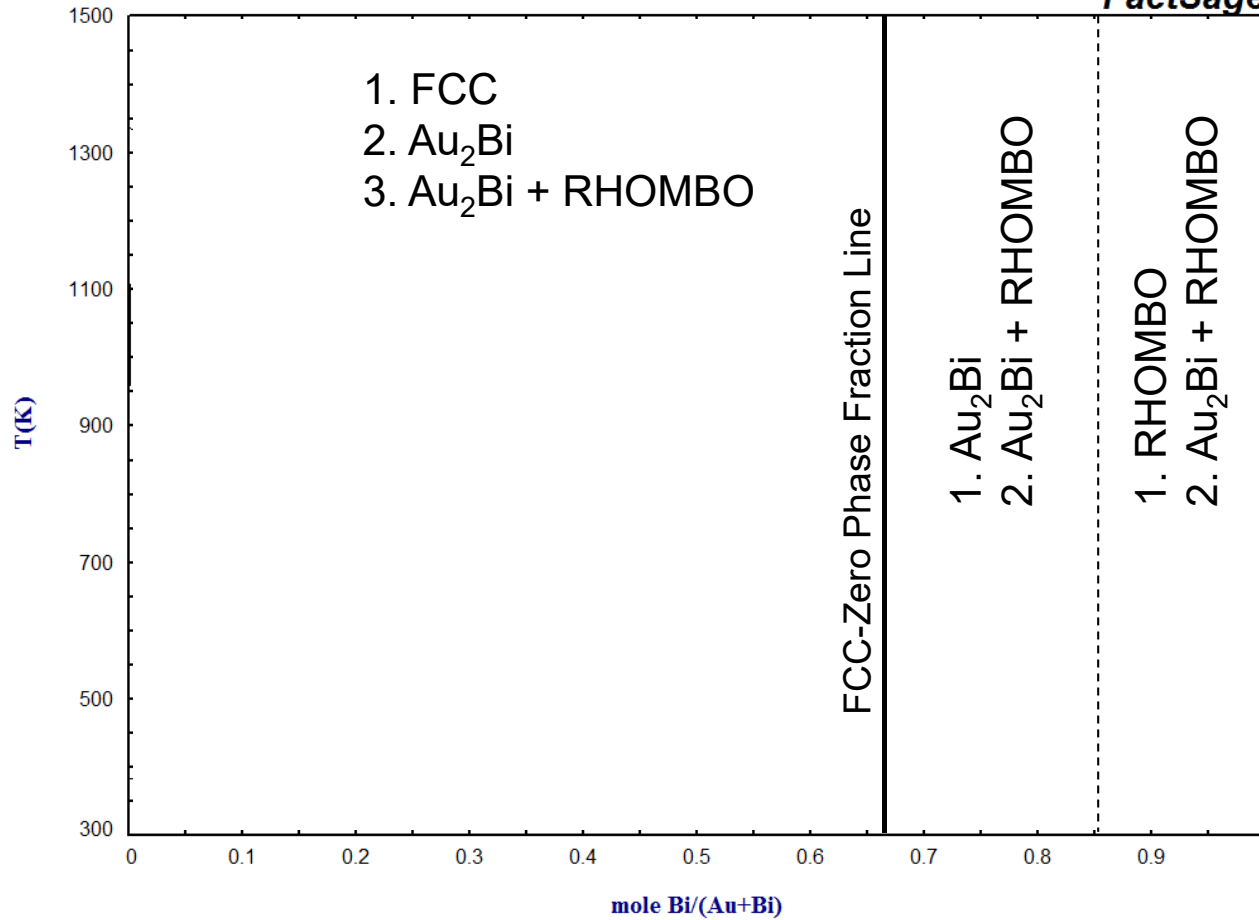


2 component Scheil cooling

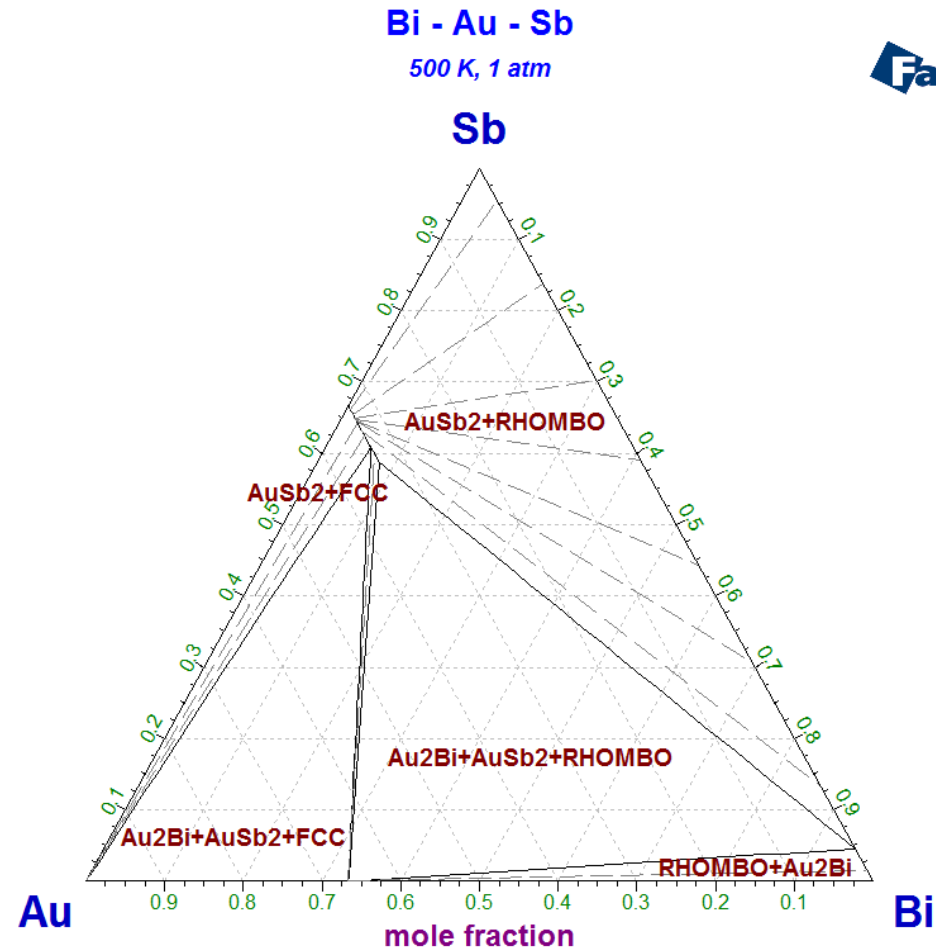
Au - Bi

Data from SGTE solders database (revised 2008)

FactSage



3 components: What are the stable solid phases?



3 components: What is the first precipitating phase? → liquidus!

Sb - Au - Bi
 Projection (LIQUID), 1 atm

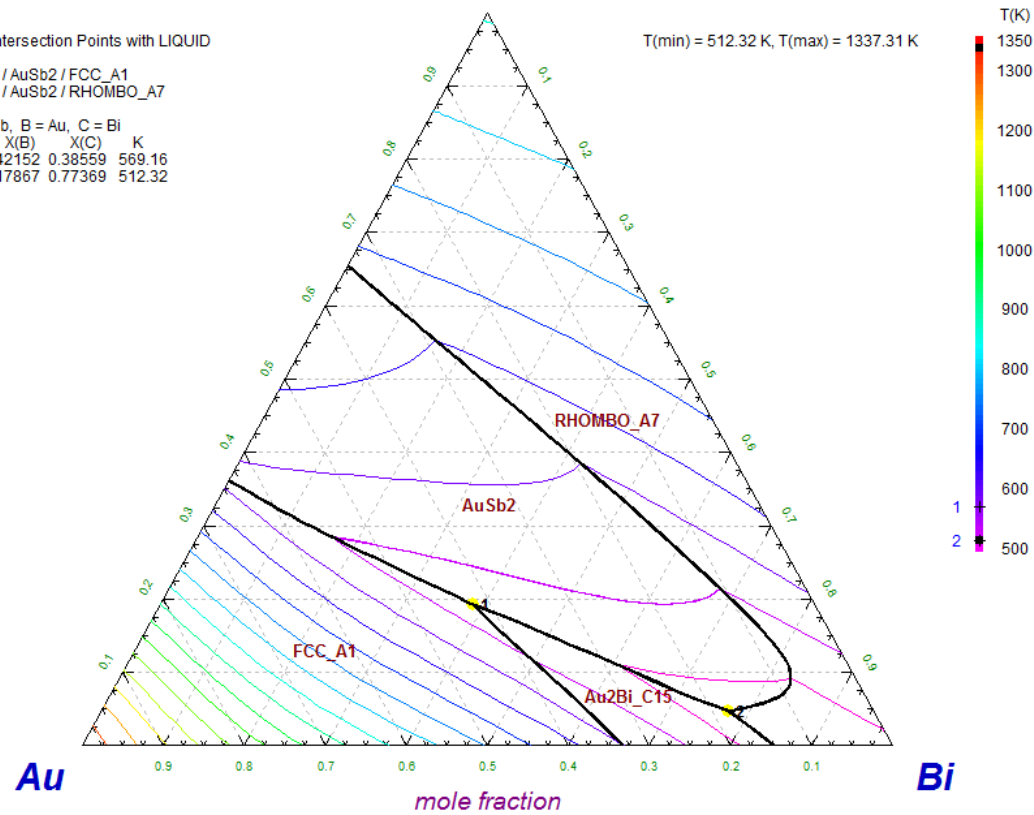


Four-Phase Intersection Points with LIQUID

- 1: Au₂Bi₂C₁₅ / AuSb₂ / FCC_{A1}
- 2: Au₂Bi₂C₁₅ / AuSb₂ / RHOMBO_{A7}

	A = Sb	B = Au	C = Bi	K
	X(A)	X(B)	X(C)	K
1:	0.19290	0.42152	0.38559	569.16
2:	0.04764	0.17867	0.77369	512.32

T(min) = 512.32 K, T(max) = 1337.31 K



3 components: Scheil cooling

Sb70-Au26-Bi4

SUMMARY OF REACTIONS

770.86 to 723.46 K:

LIQ → RHOMBO

723.46 to 538.48 K:

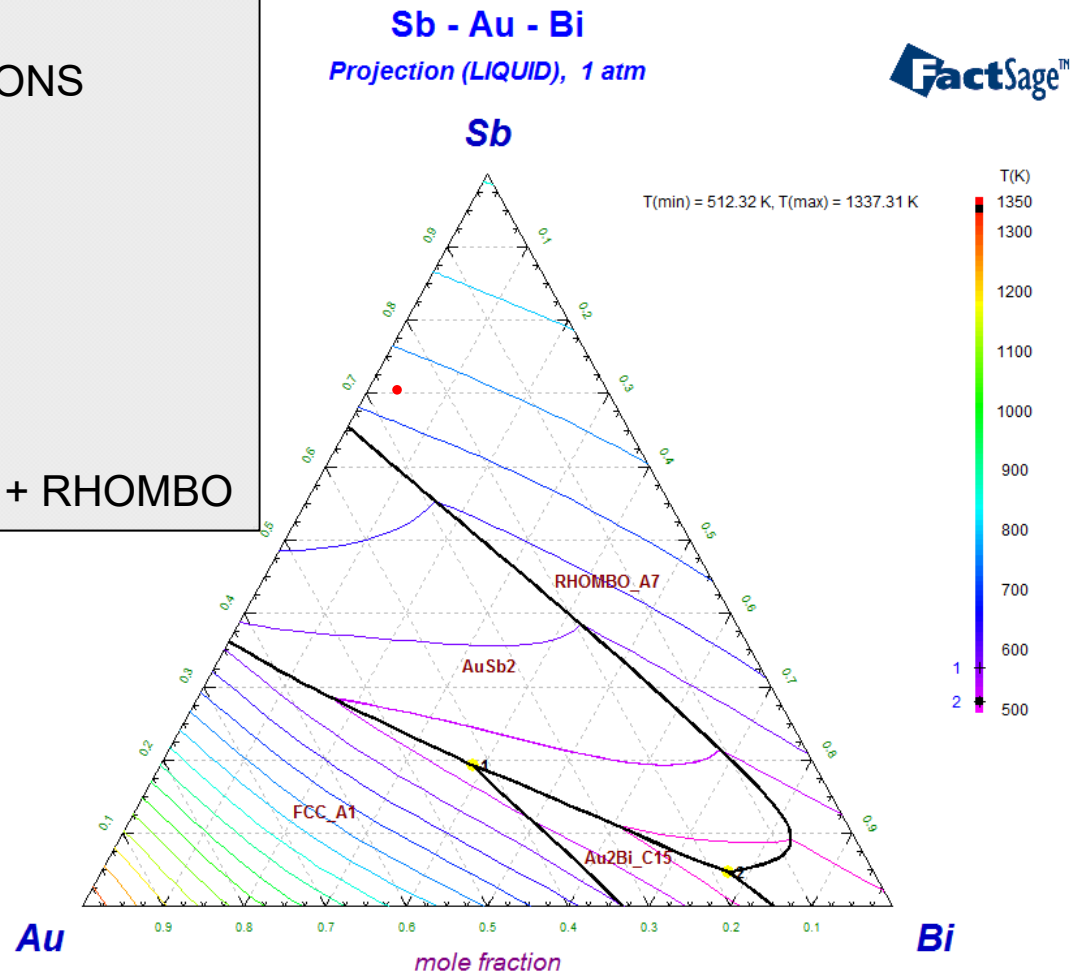
LIQ → AuSb₂

538.48 to 512.32 K:

LIQ → Au₂Bi + AuSb₂

512.32 K (isothermal):

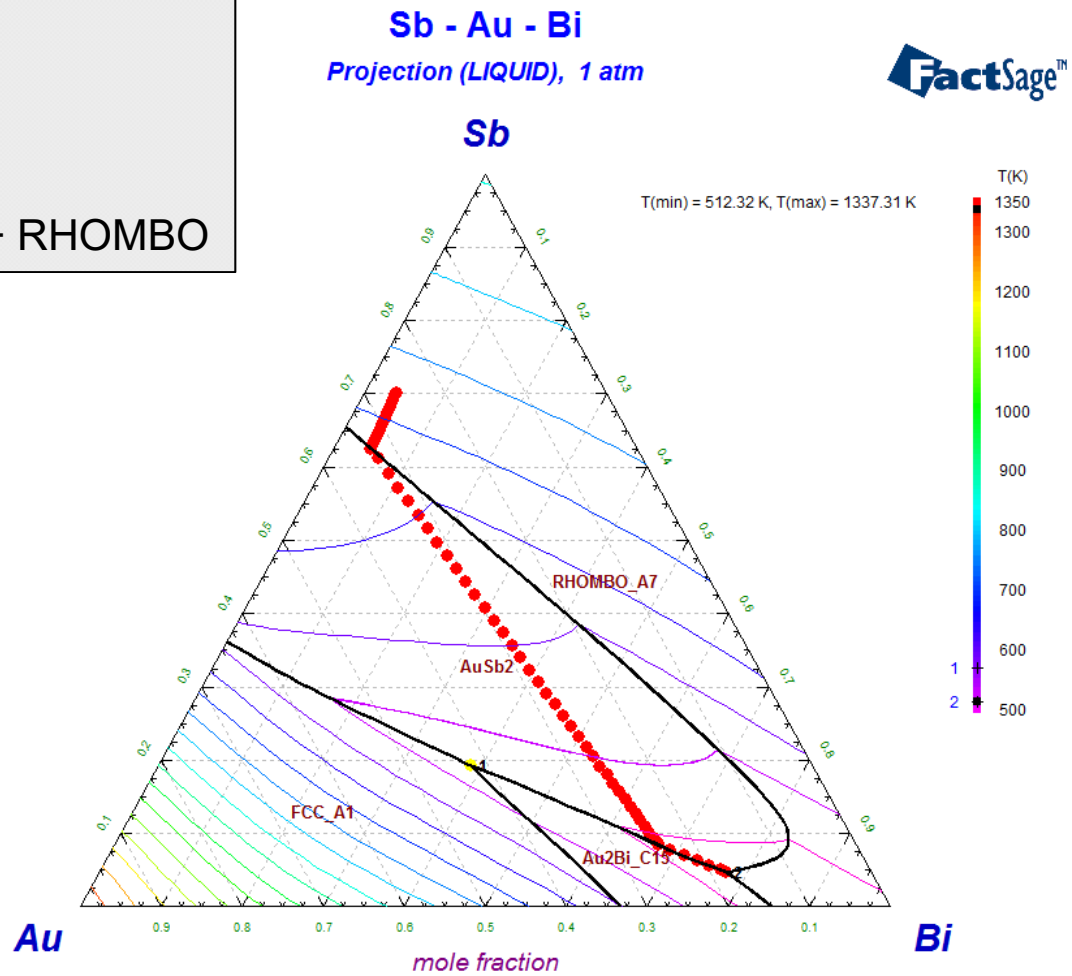
LIQ → Au₂Bi + AuSb₂ + RHOMBO



3 components: Scheil cooling

Sb70-Au26-Bi4

- LIQ → RHOMBO
- LIQ → AuSb₂
- LIQ → Au₂Bi + AuSb₂
- LIQ → Au₂Bi + AuSb₂ + RHOMBO



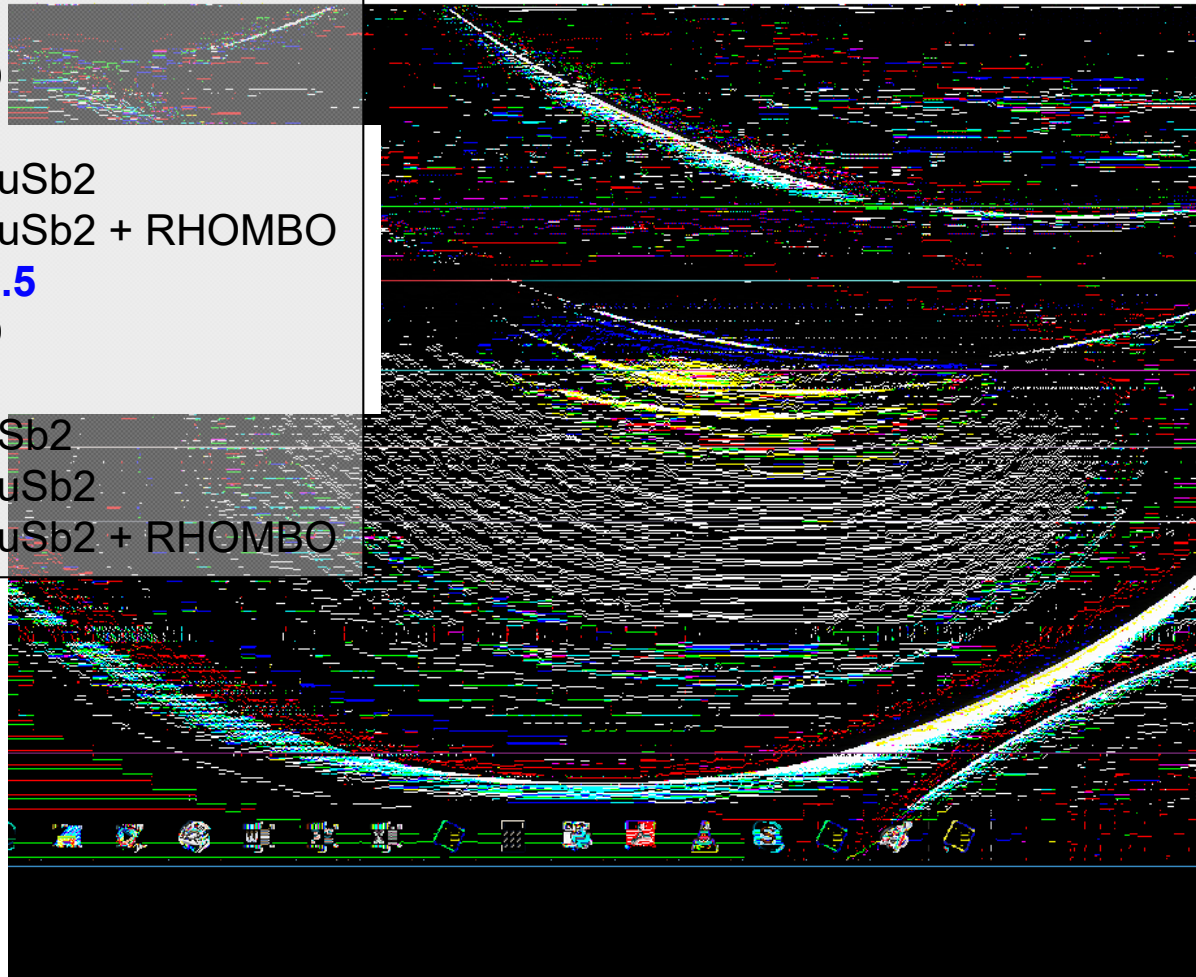
3 components: Scheil cooling

Sb70-Au26-Bi4

- LIQ → RHOMBO
- LIQ → AuSb₂
- LIQ → Au₂Bi + AuSb₂
- LIQ → Au₂Bi + AuSb₂ + RHOMBO

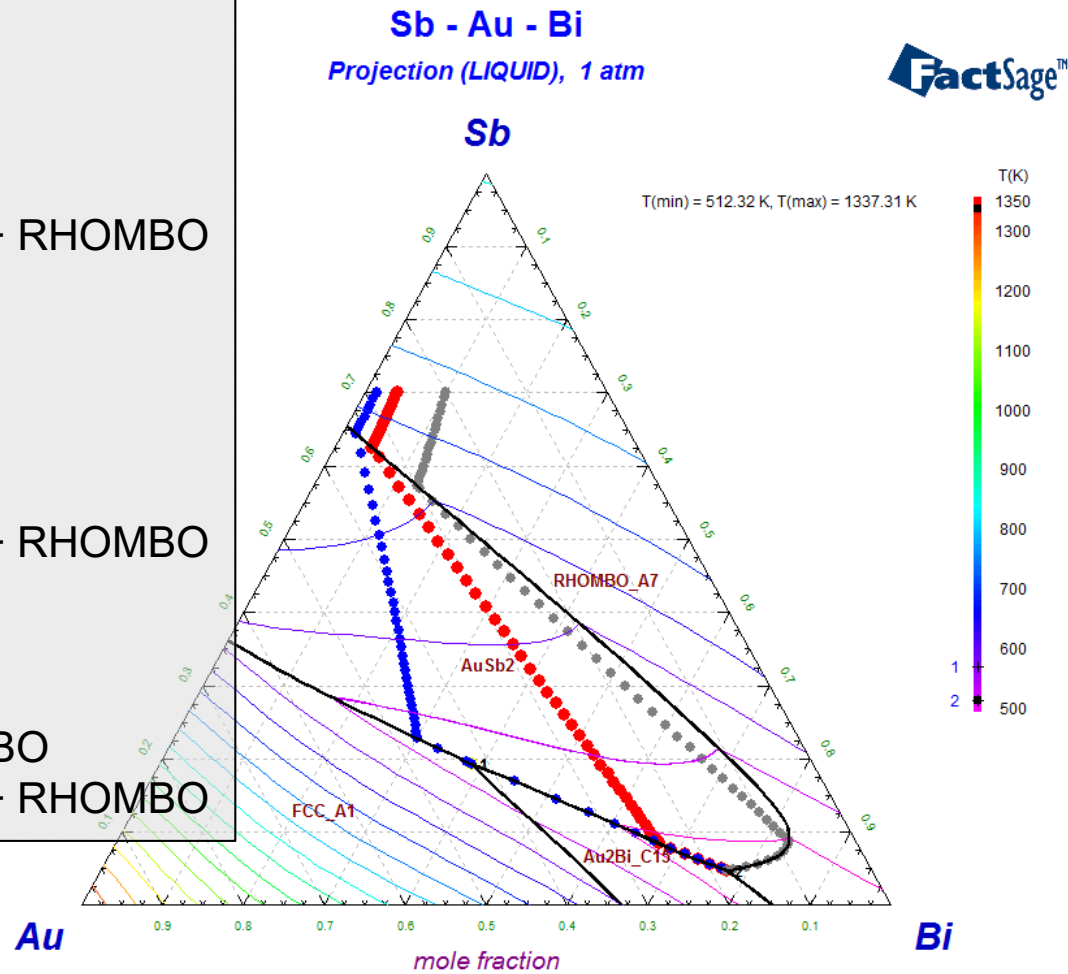
Sb70-Au28.5-Bi1.5

- LIQ → RHOMBO
- LIQ → AuSb₂
- LIQ → FCC + AuSb₂
- LIQ → Au₂Bi + AuSb₂
- LIQ → Au₂Bi + AuSb₂ + RHOMBO

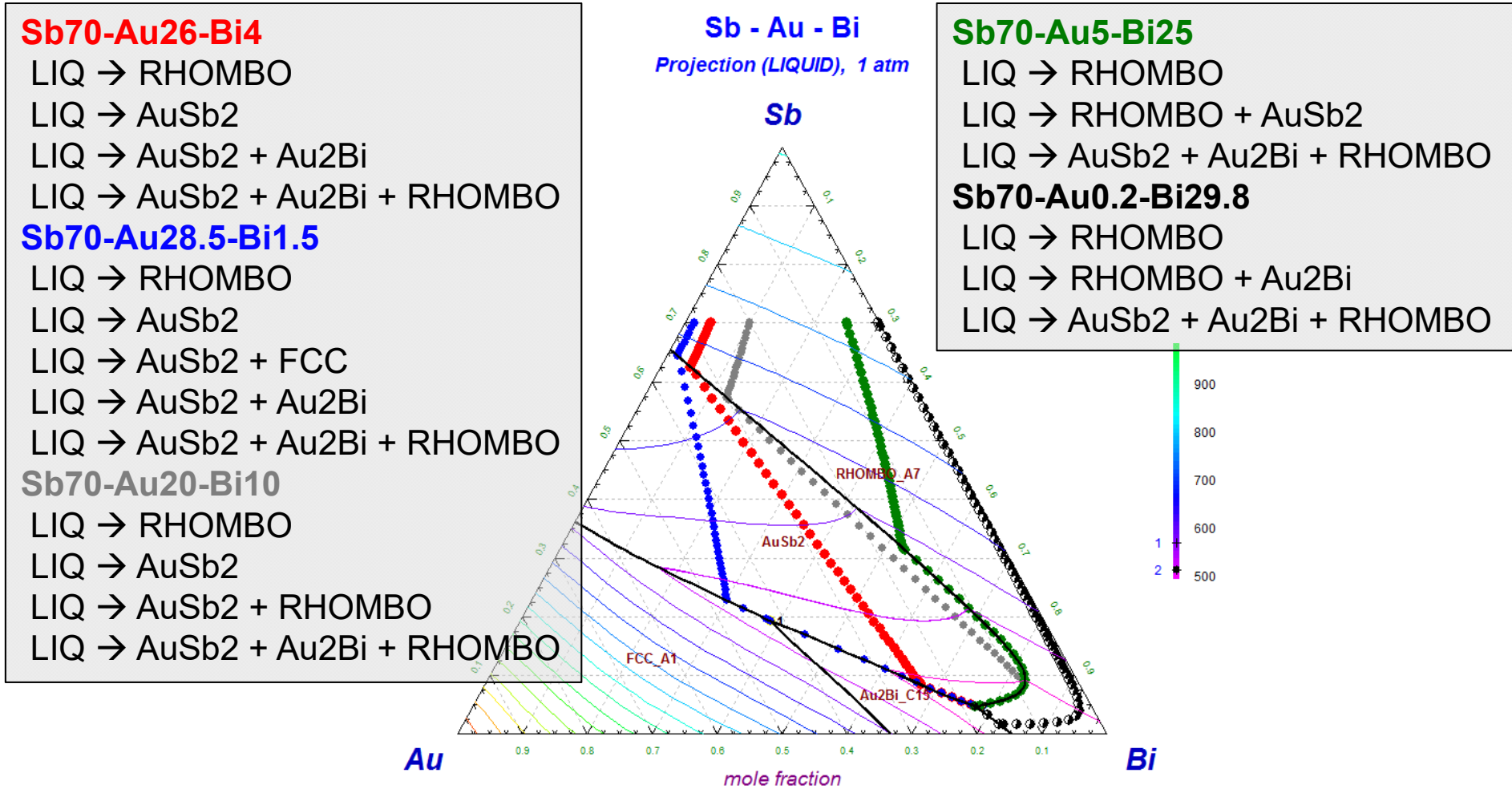


3 components: Scheil cooling

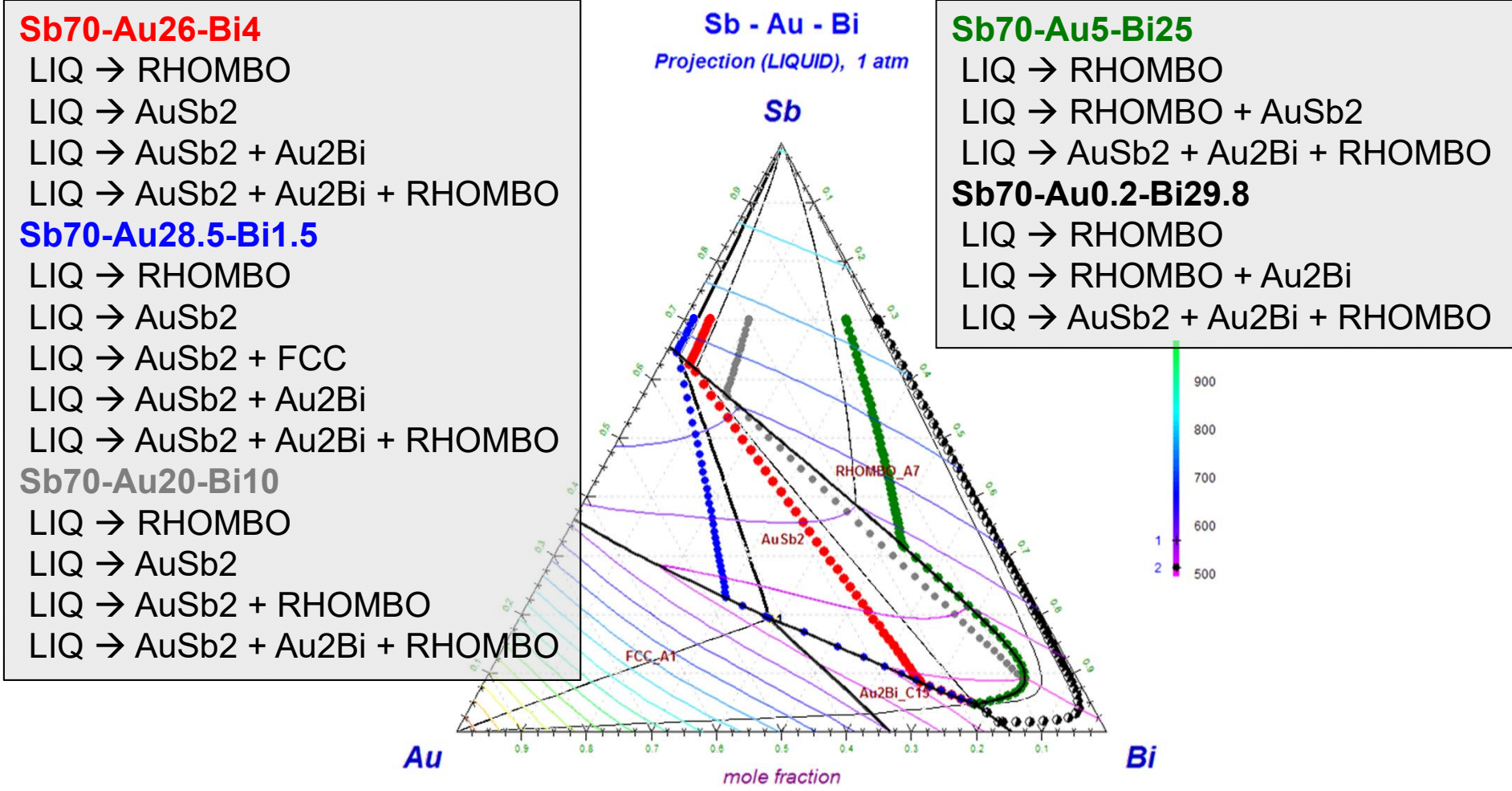
- Sb70-Au26-Bi4**
- LIQ → RHOMBO
- LIQ → AuSb2
- LIQ → AuSb2 + Au2Bi
- LIQ → AuSb2 + Au2Bi + RHOMBO
- Sb70-Au28.5-Bi1.5**
- LIQ → RHOMBO
- LIQ → AuSb2
- LIQ → AuSb2 + FCC
- LIQ → AuSb2 + Au2Bi
- LIQ → AuSb2 + Au2Bi + RHOMBO
- Sb70-Au20-Bi10**
- LIQ → RHOMBO
- LIQ → AuSb2
- LIQ → AuSb2 + RHOMBO
- LIQ → AuSb2 + Au2Bi + RHOMBO



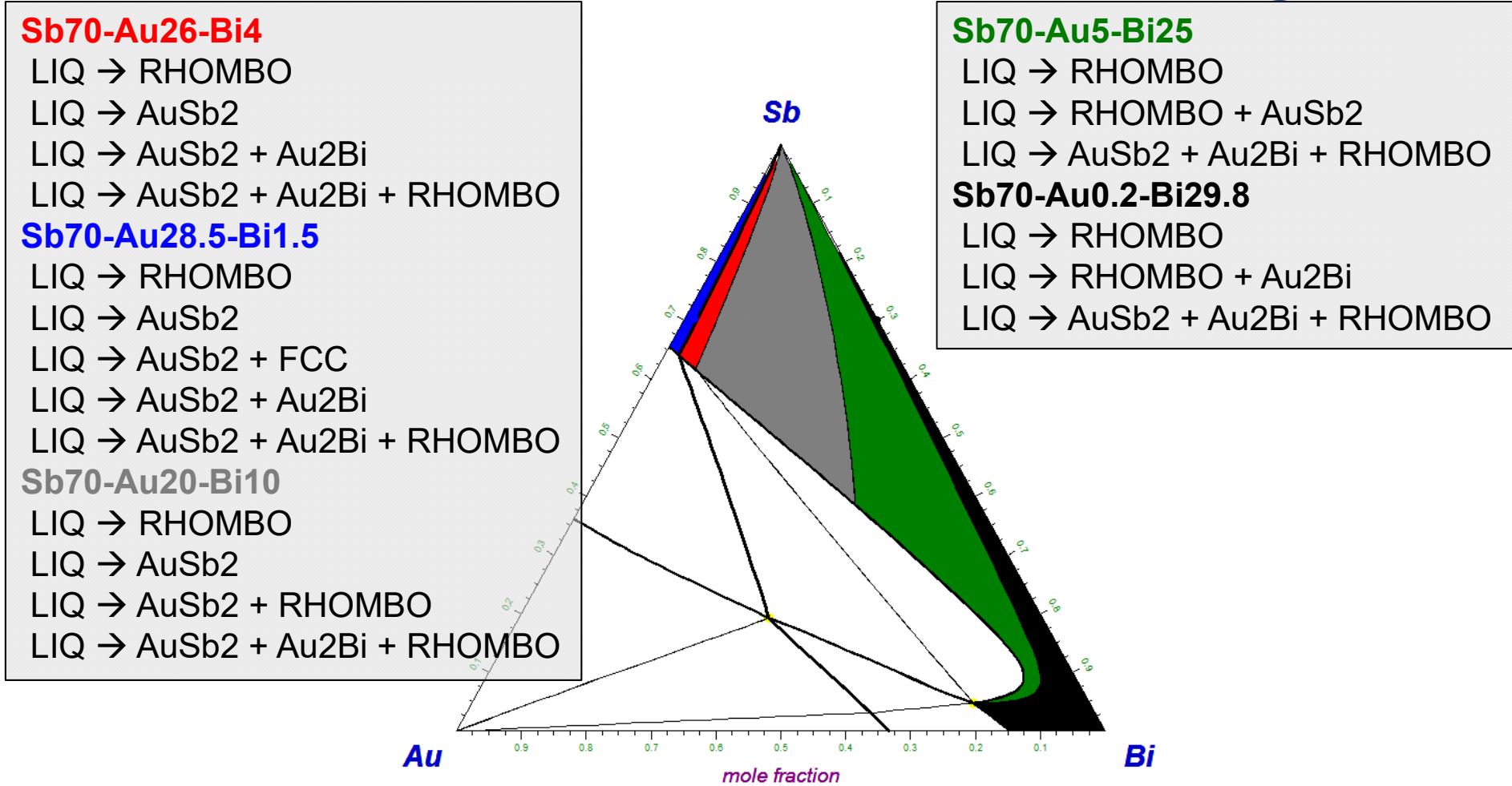
3 components: Scheil cooling



FactSage Developments: 3-component Scheil mapping



FactSage Developments: 3-component Scheil mapping



FactSage Developments: 3-component Scheil mapping

Sb70-Au26-Bi4

- LIQ → RHOMBO
- LIQ → AuSb2
- LIQ → AuSb2 + Au2Bi
- LIQ → AuSb2 + Au2Bi + RHOMBO

Sb70-Au28.5-Bi1.5

- LIQ → RHOMBO
- LIQ → AuSb2
- LIQ → AuSb2 + FCC
- LIQ → AuSb2 + Au2Bi
- LIQ → AuSb2 + Au2Bi

Sb70-Au20-Bi10

- LIQ → RHOMBO
- LIQ → AuSb2
- LIQ → AuSb2 + RHOMBO
- LIQ → AuSb2 + Au2Bi + RHOMBO

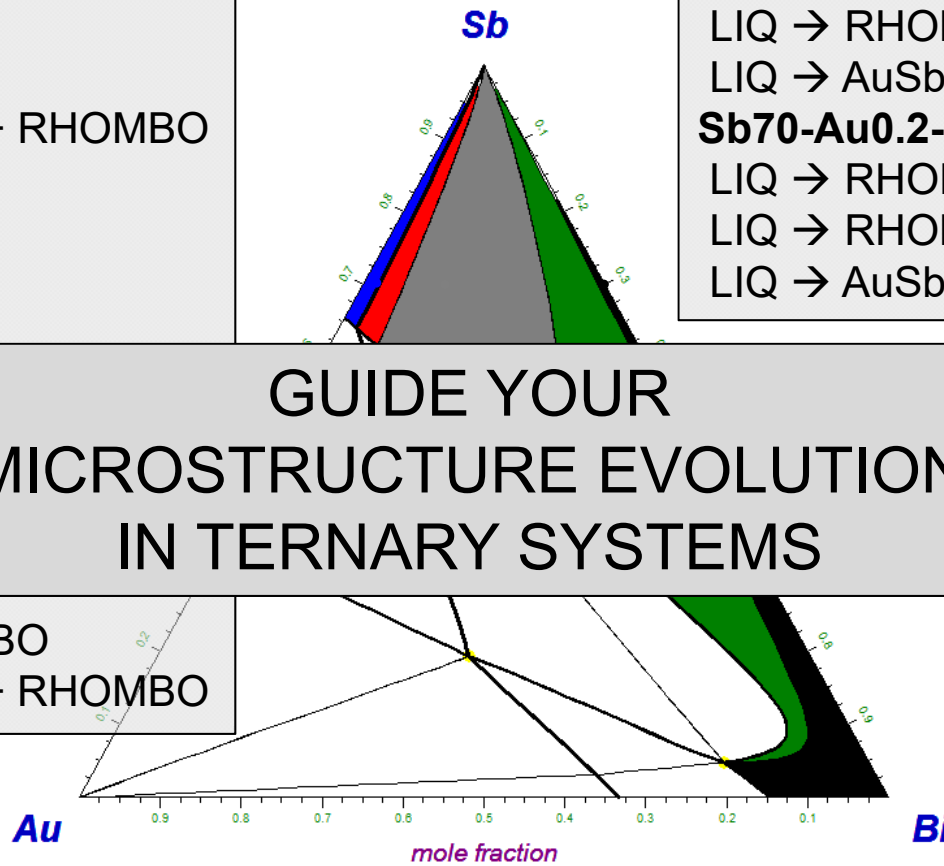
Sb70-Au5-Bi25

- LIQ → RHOMBO
- LIQ → RHOMBO + AuSb2
- LIQ → AuSb2 + Au2Bi + RHOMBO

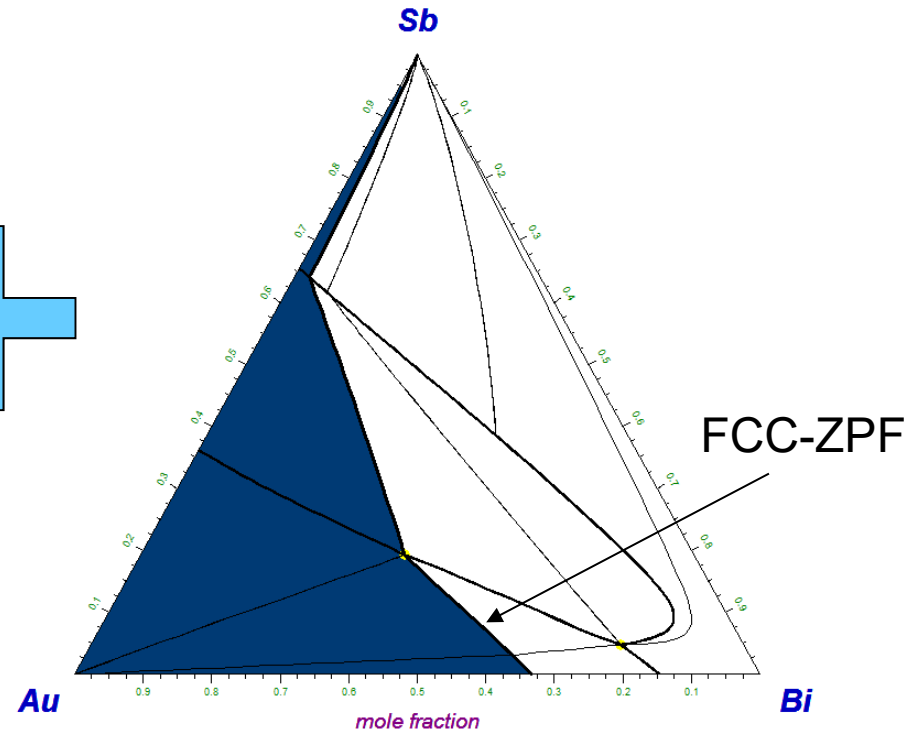
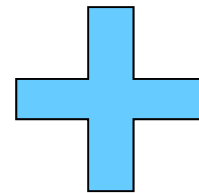
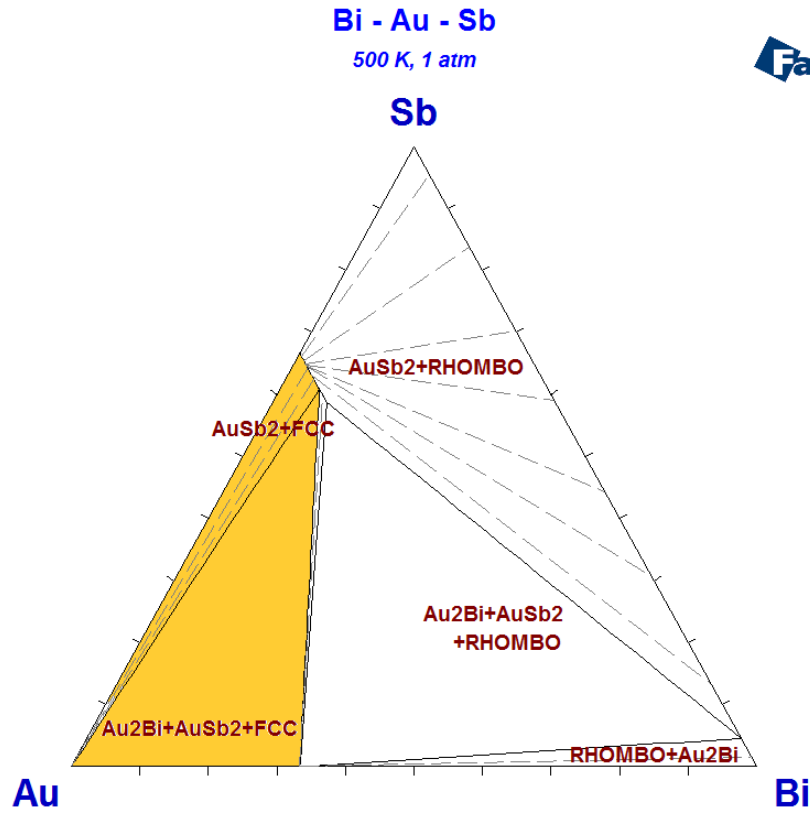
Sb70-Au0.2-Bi29.8

- LIQ → RHOMBO
- LIQ → RHOMBO + Au2Bi
- LIQ → AuSb2 + Au2Bi + RHOMBO

GUIDE YOUR
MICROSTRUCTURE EVOLUTION
IN TERNARY SYSTEMS



FactSage Developments: Tailor-made microstructures



FCC stable at 500 K

FCC during Scheil cooling



FactSage Developments: Tailor-made microstructures

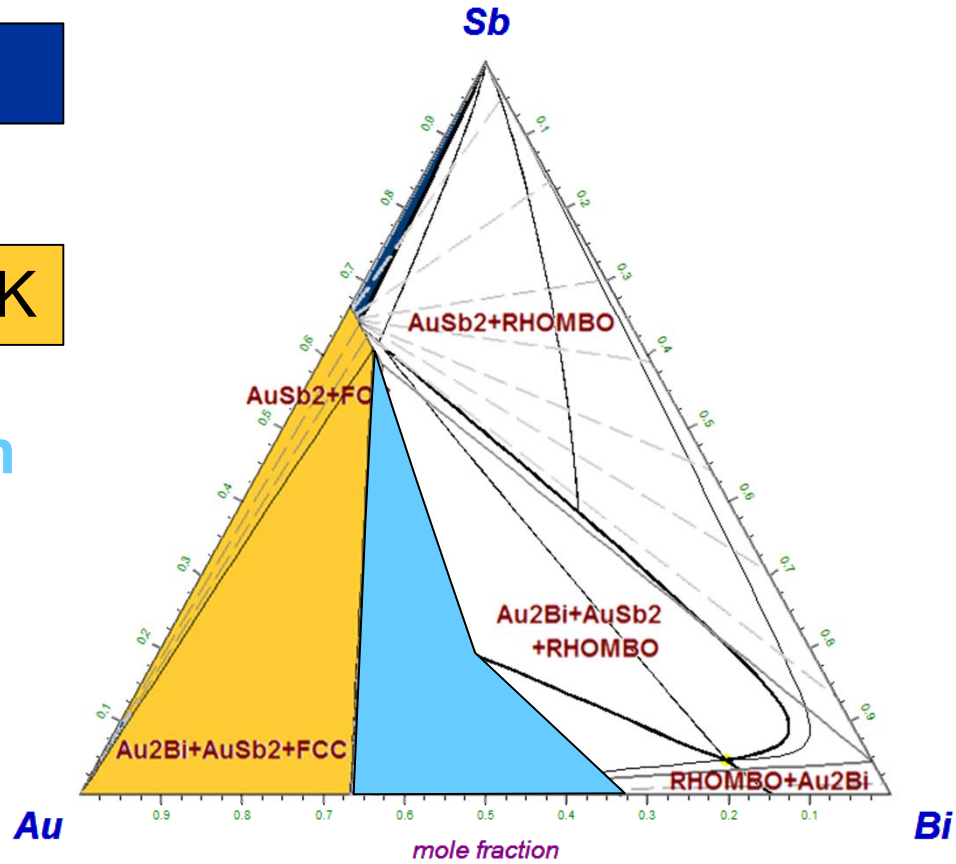


Casting

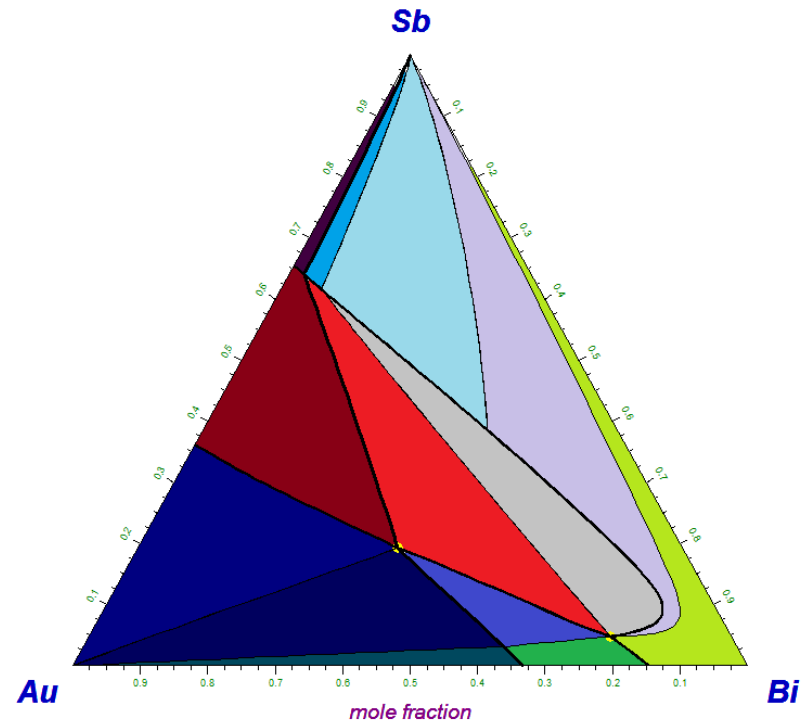


Annealing 500 K

→ Dissolution
of FCC

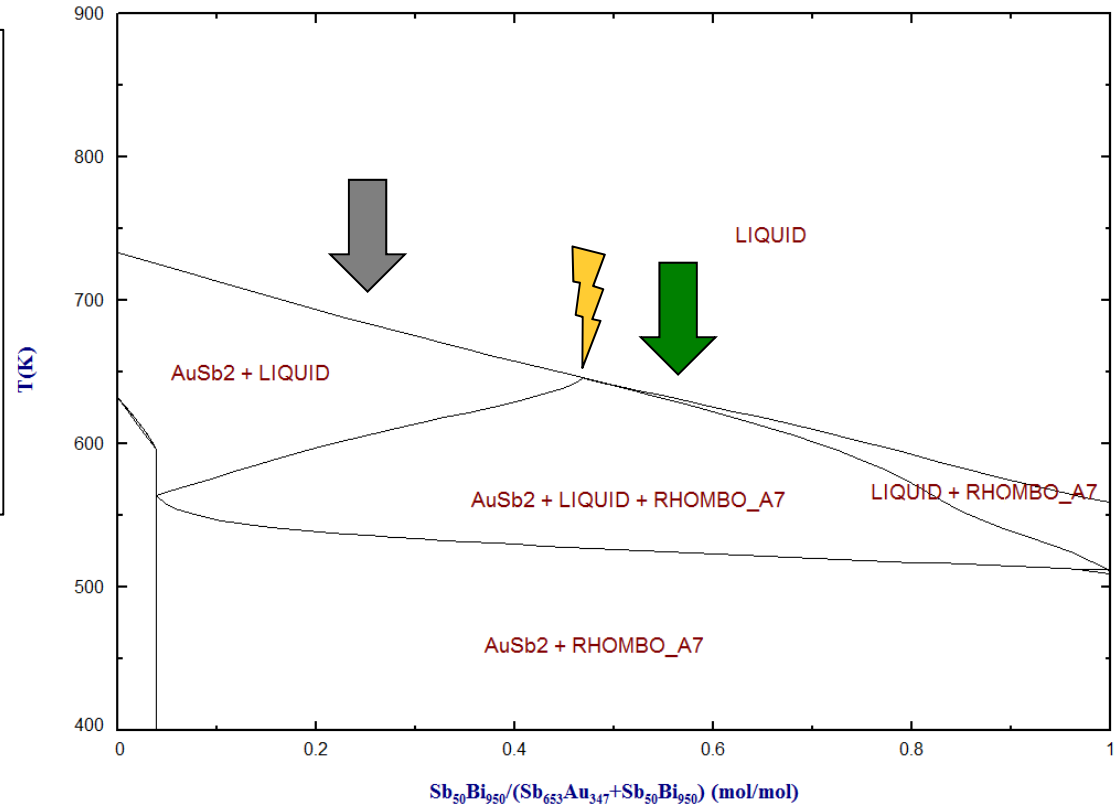
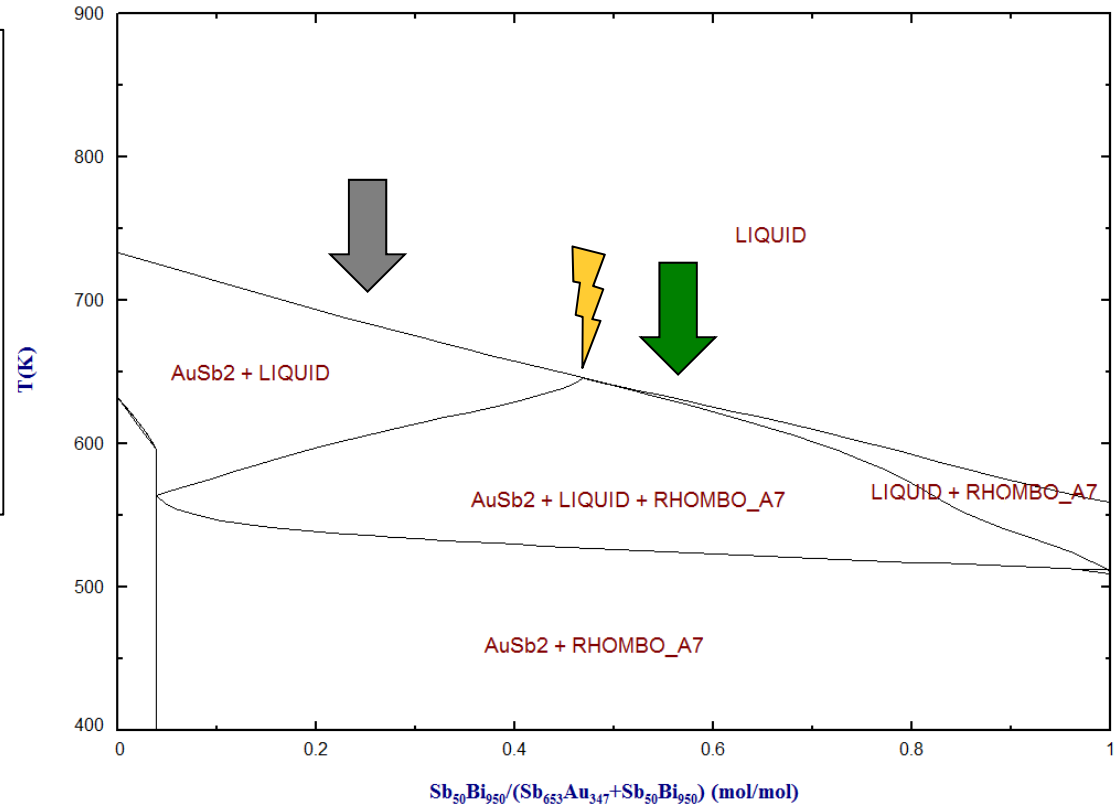


THANK YOU FOR YOUR ATTENTION!





Sb70-Au20-Bi10
 LIQ → RHOMBO
LIQ → AuSb2
 LIQ → AuSb2 + RHOMBO
 LIQ → AuSb2 + Au2Bi + RHOMBO
Sb70-Au5-Bi25
 LIQ → RHOMBO
 LIQ → AuSb2 + RHOMBO
 LIQ → AuSb2 + Au2Bi + RHOMBO



Au

mole fraction

Bi

