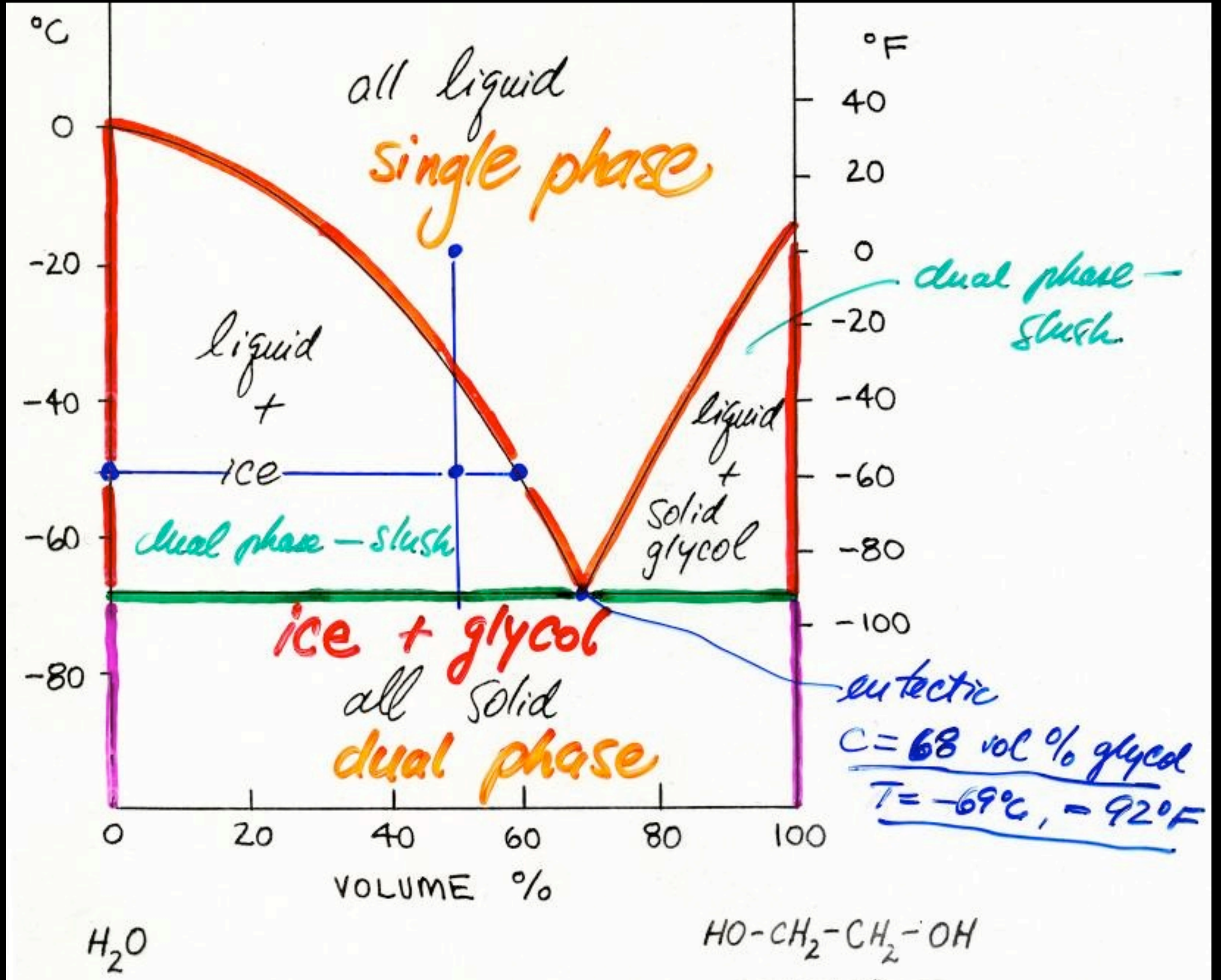
Welcome to 3.091

Lecture 35

December 9, 2009

Binary Phase Diagrams: Limited Solubility

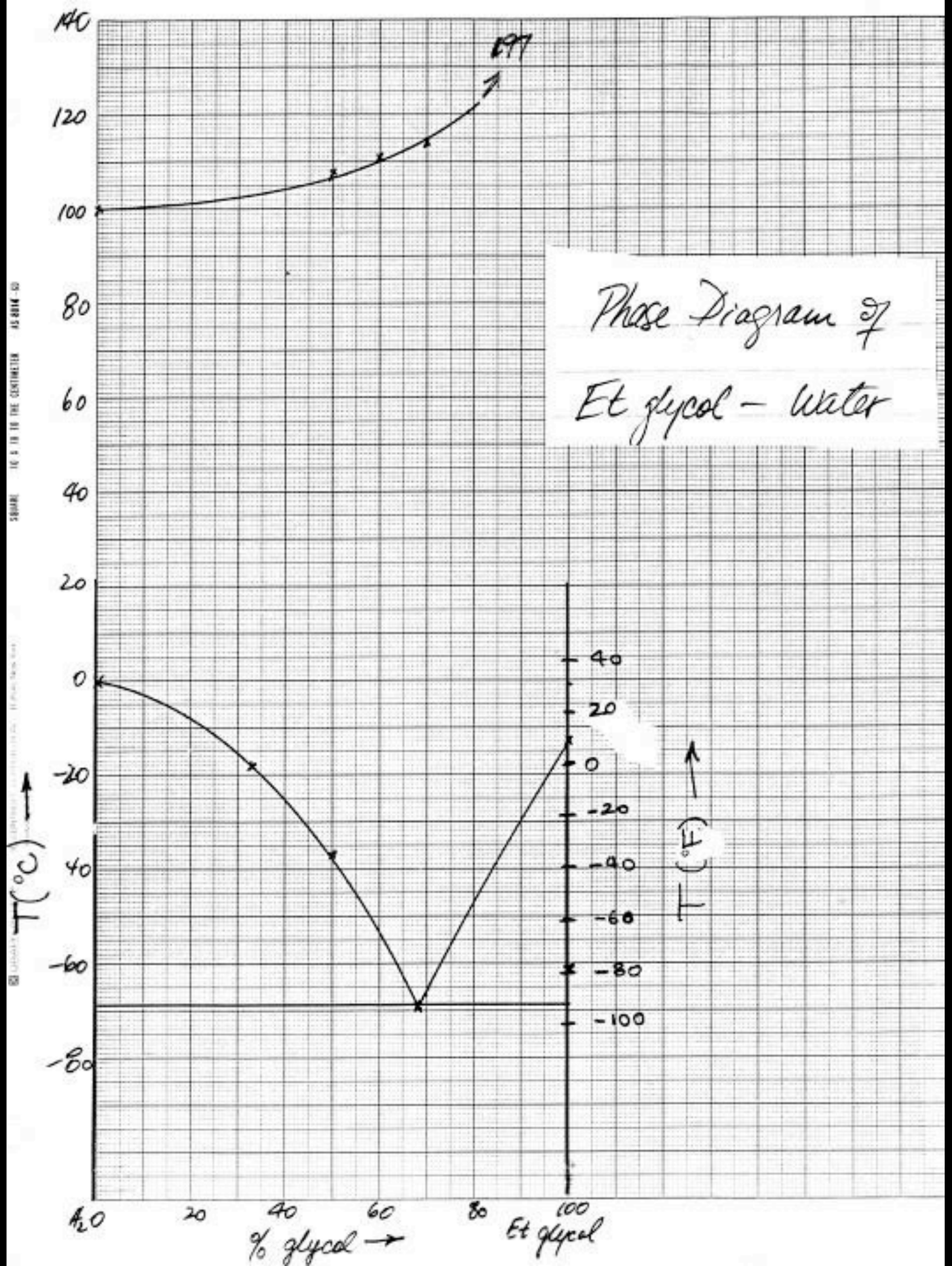


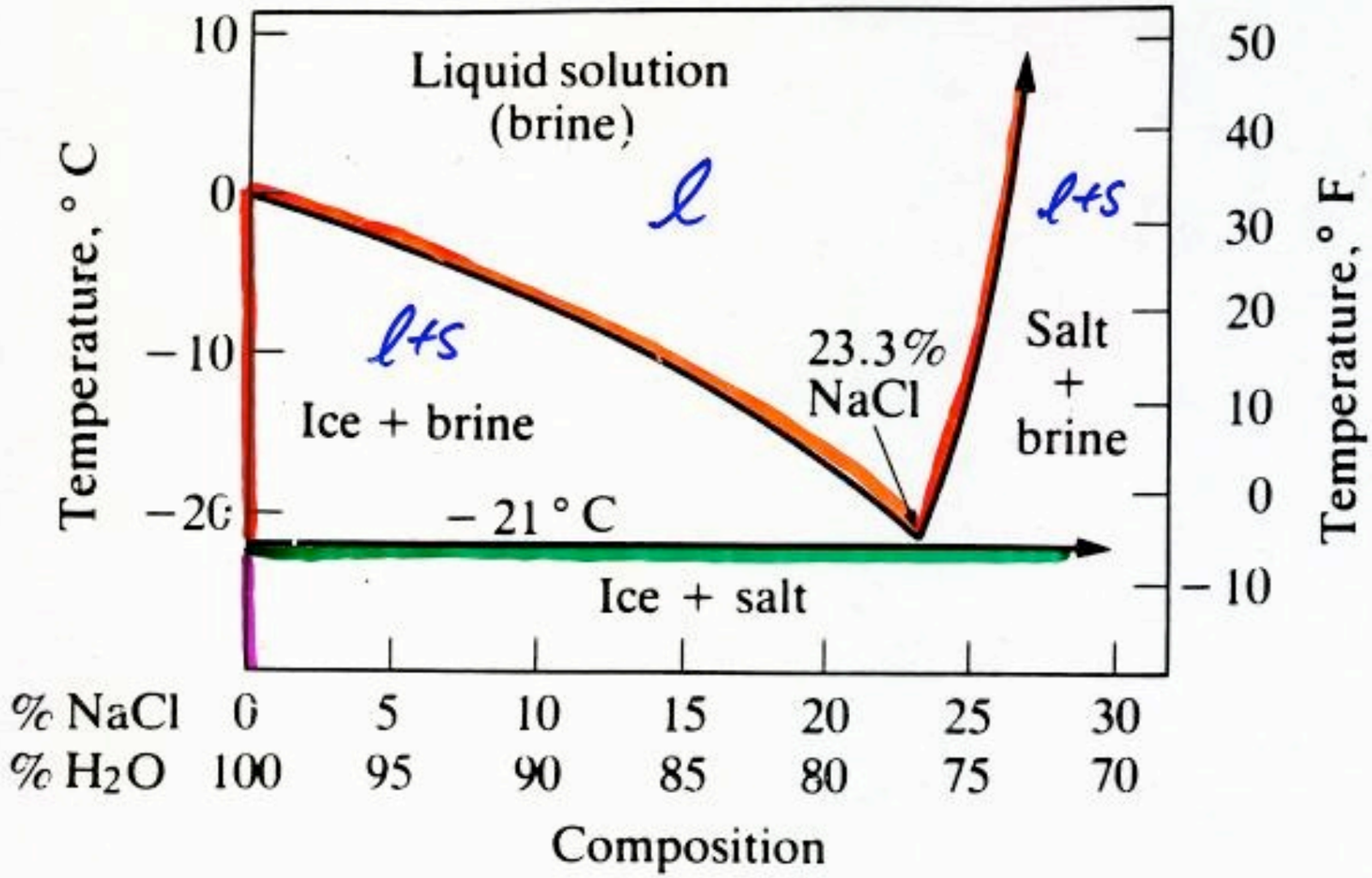
PHASE DIAGRAM OF ETHYLENE GLYCOL - WATER

Auto Applications

Typical Physical Properties of Coolant Compounds

Property	Water	Methyl Alcohol	Ethylene Glycol
Specific gravity 20/20°C	1.00	0.7924	1.1155
Specific heat, 25°C cal/(g) (°C)	0.99765	0.600 (20°C)	0.574
Freezing point, °C pure	0	-97.7	-13.3
Freezing point, 50% water solution (°C pure)	. . . . .	-44.5	-36.6
Boiling point, °C	100	64.5	197.3
Vapor pressure, 20°C mm Hg	17.535	96.1	0.12
Flash point, open-cup °C	. . . . .	15.6	115.6
Viscosity, 20°C, cP	1.01	0.59	20.9


140
120
100
80
60
40
20
0
-20
-40
-60
-80
T(°C)
197
Phase Diagram of
Et glycol – water
40
20
0
-20
-40
-60
-80
-100
T(°C)
H2O
20
40
60
80
100
% glycol →
Et glycol

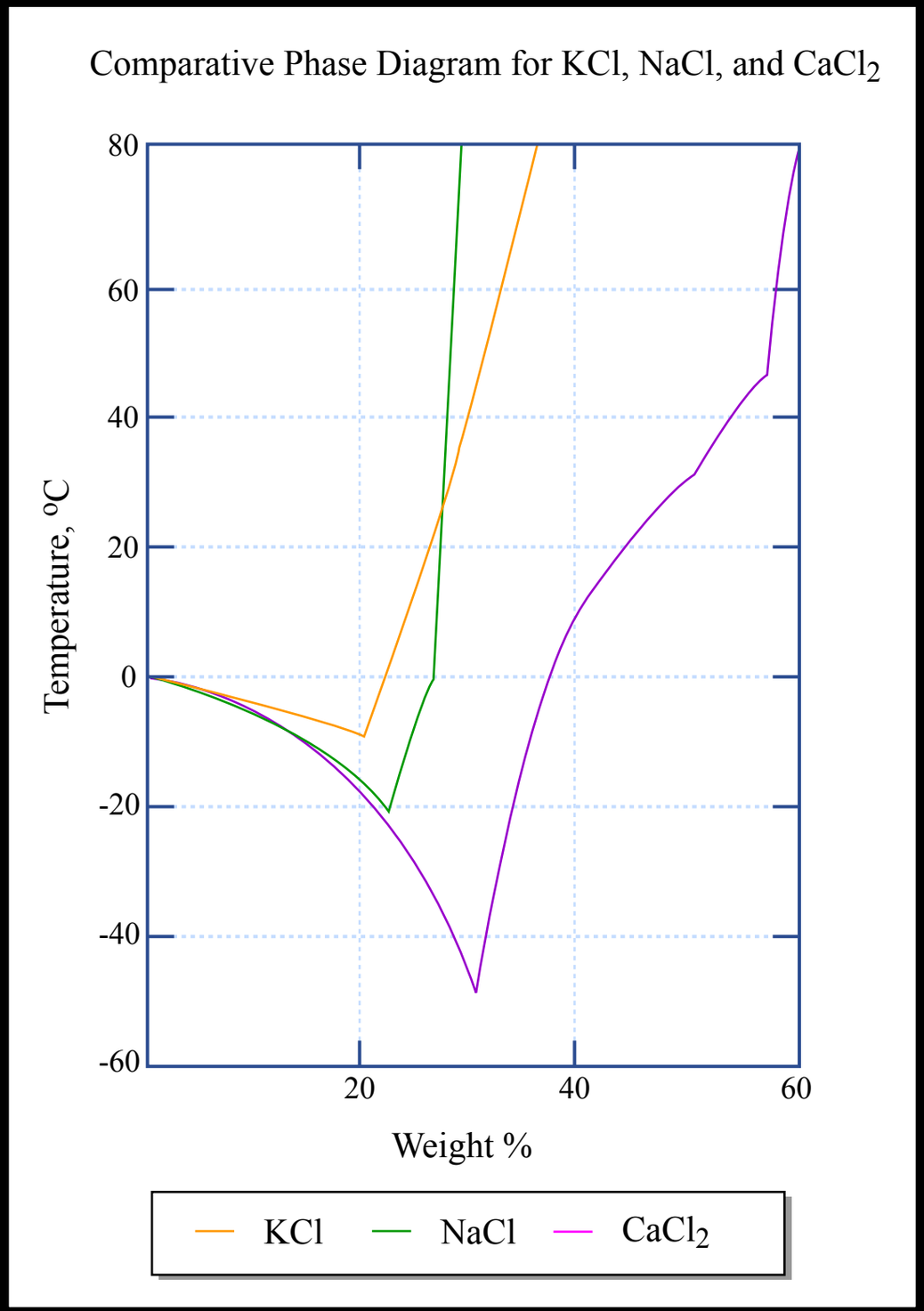


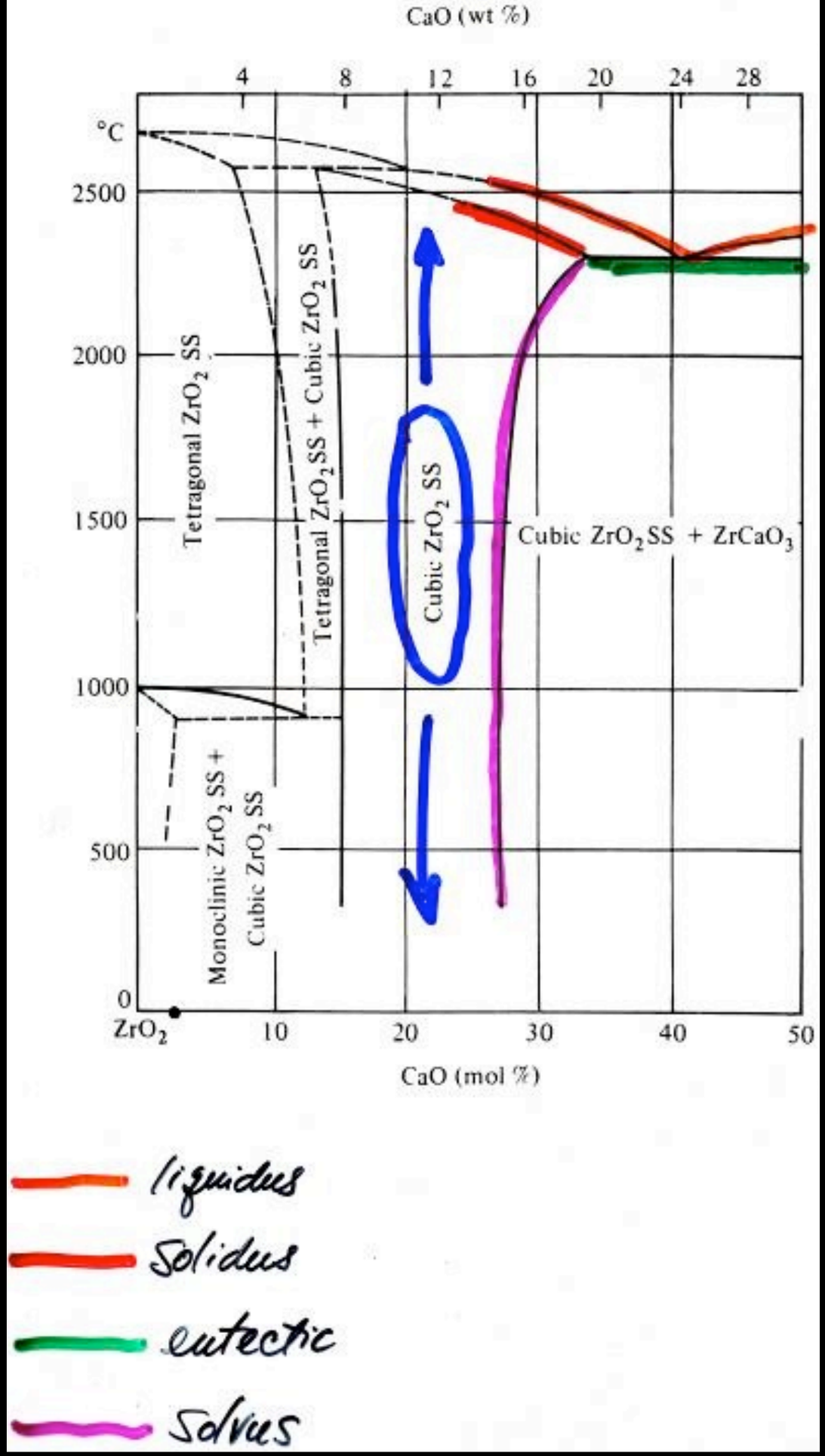
liquidus $l \rightleftarrows l+s$

solidus $s = l+s$

solvus $s = s_1 + s_2$

eutectic $l \rightarrow s_1 + s_2$



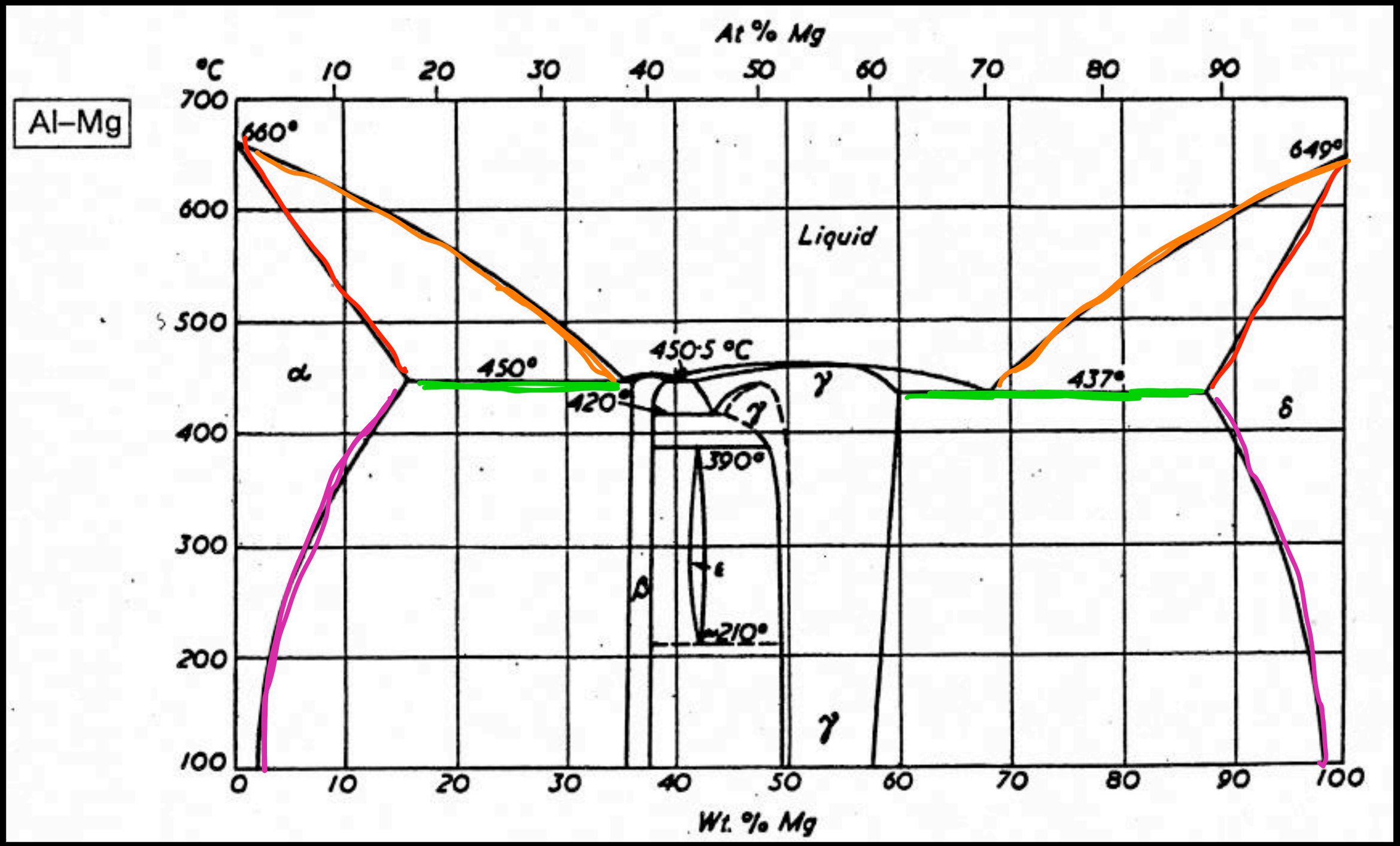


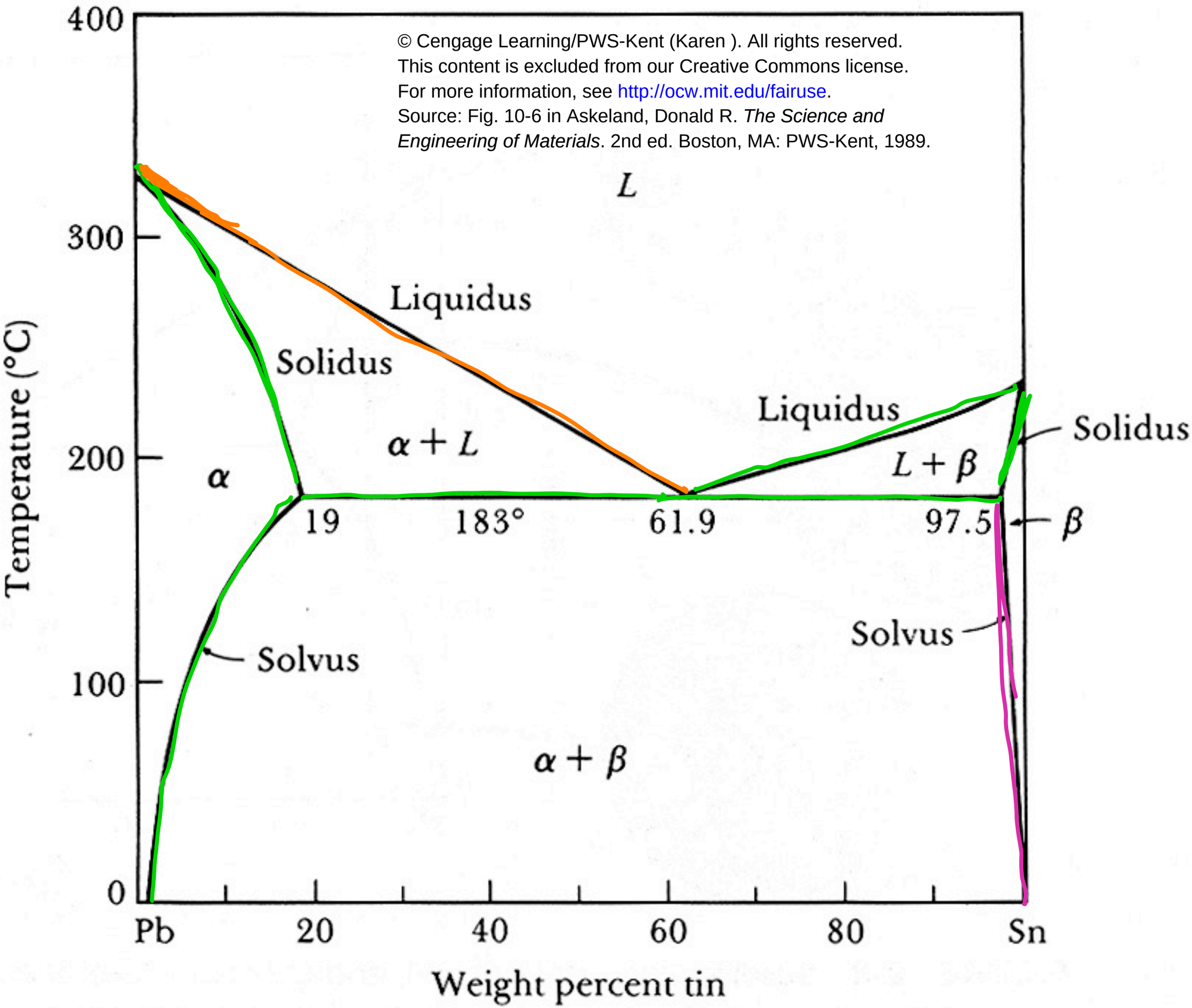
liquidus

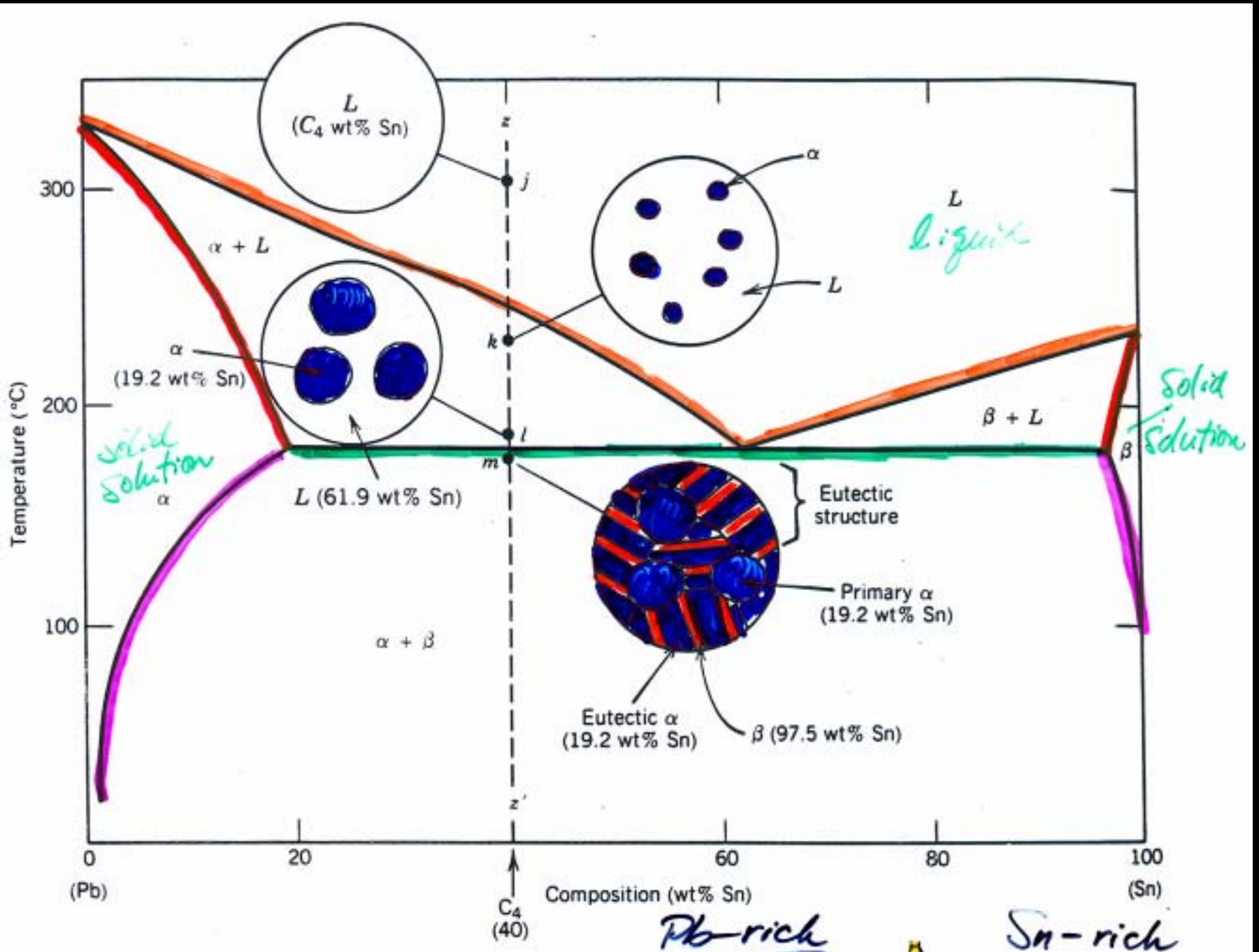
solidus

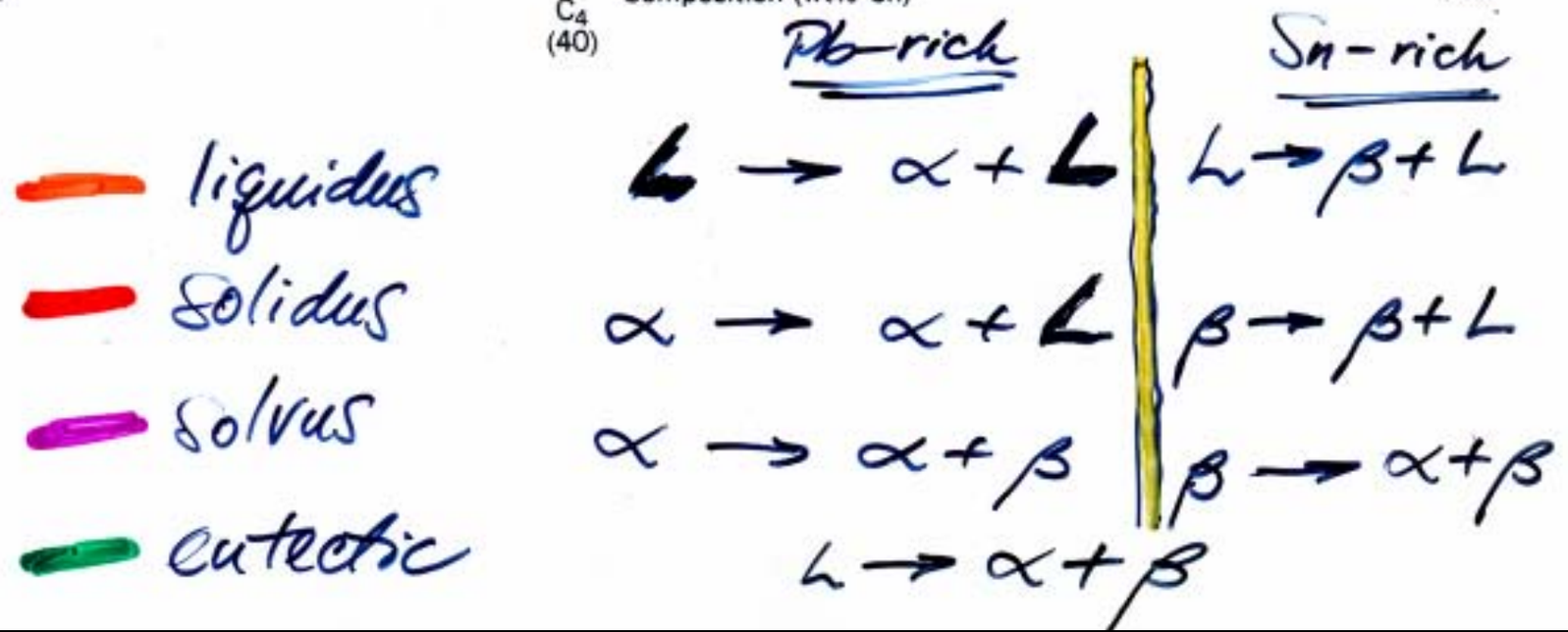
eutectic

solvus









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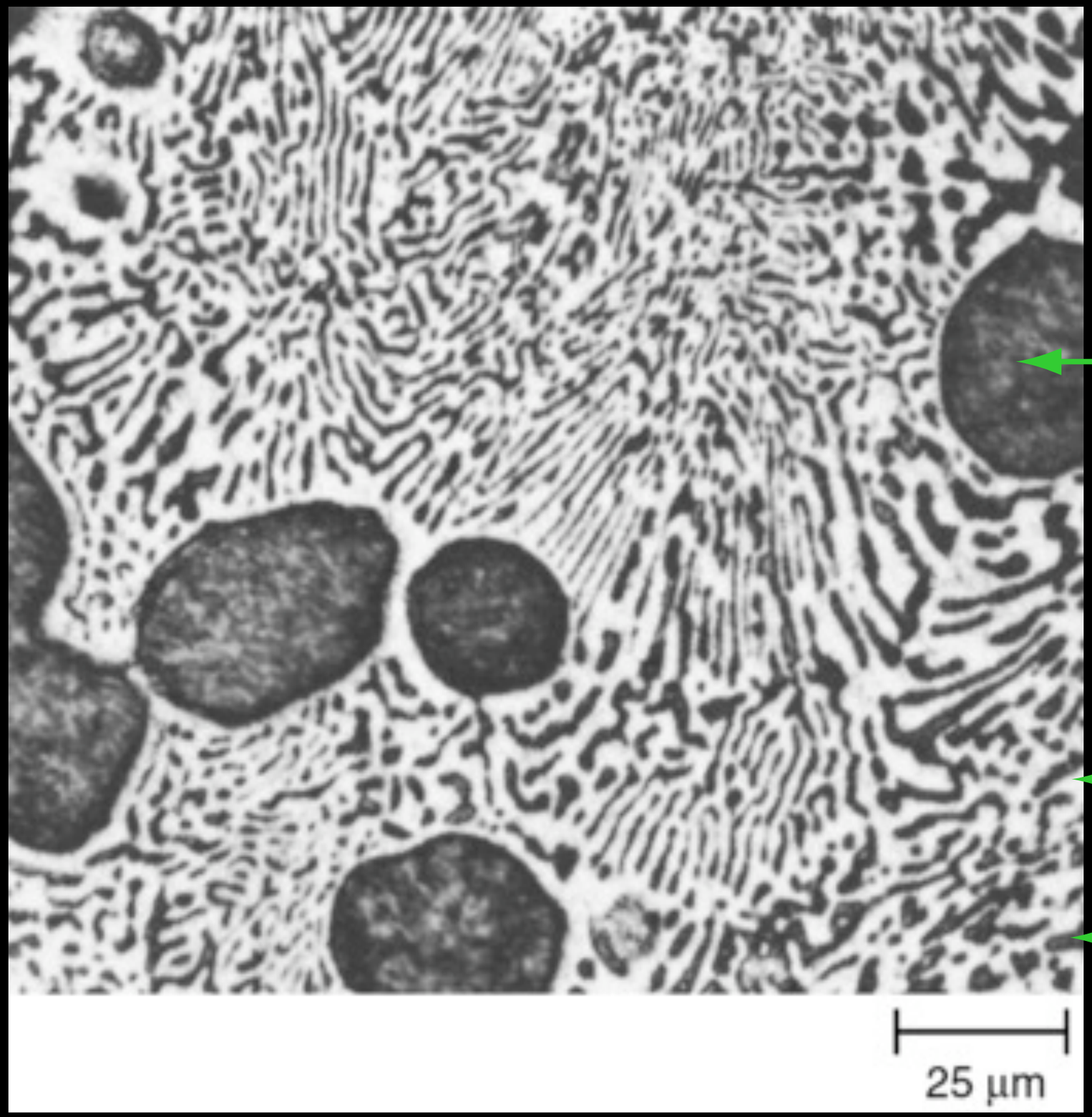
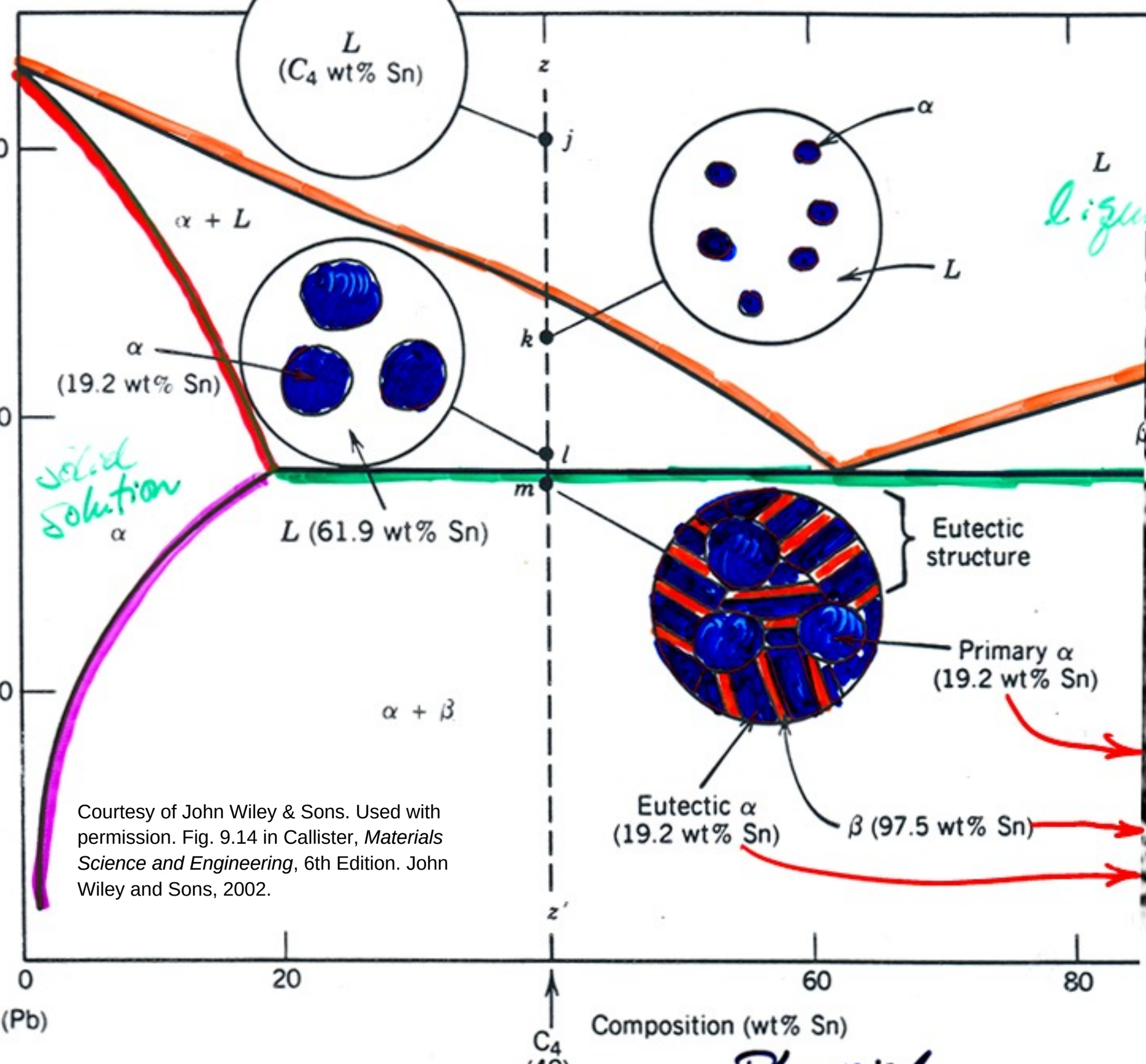
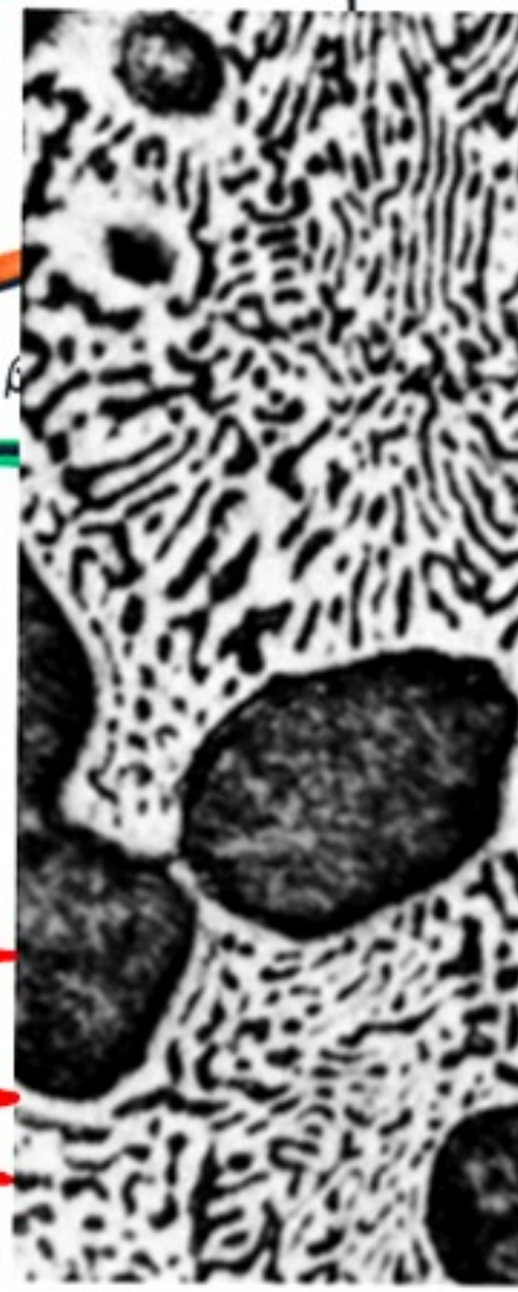
50 wt% Sn - 50 wt % Pb



cut, polish, etch





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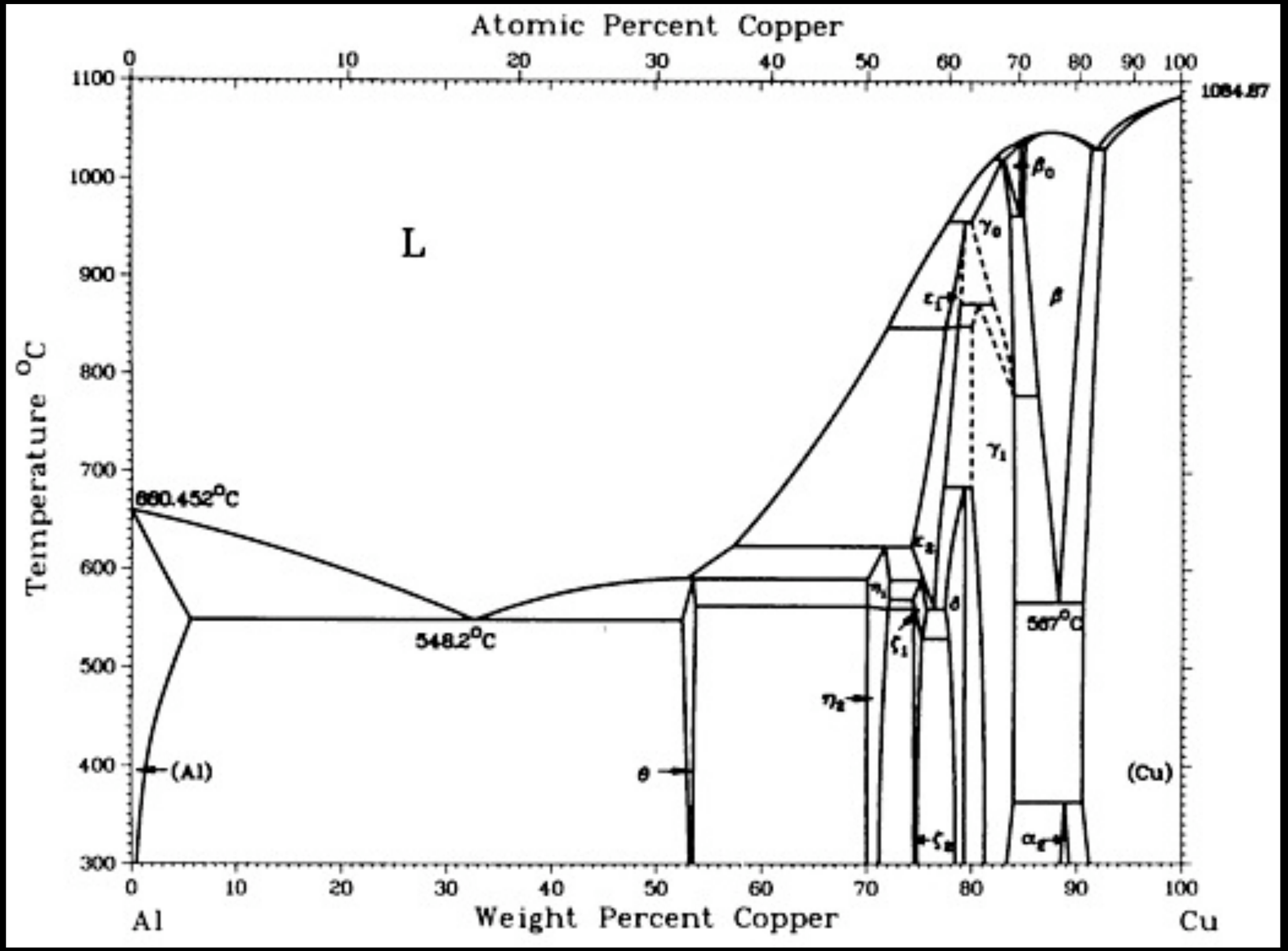

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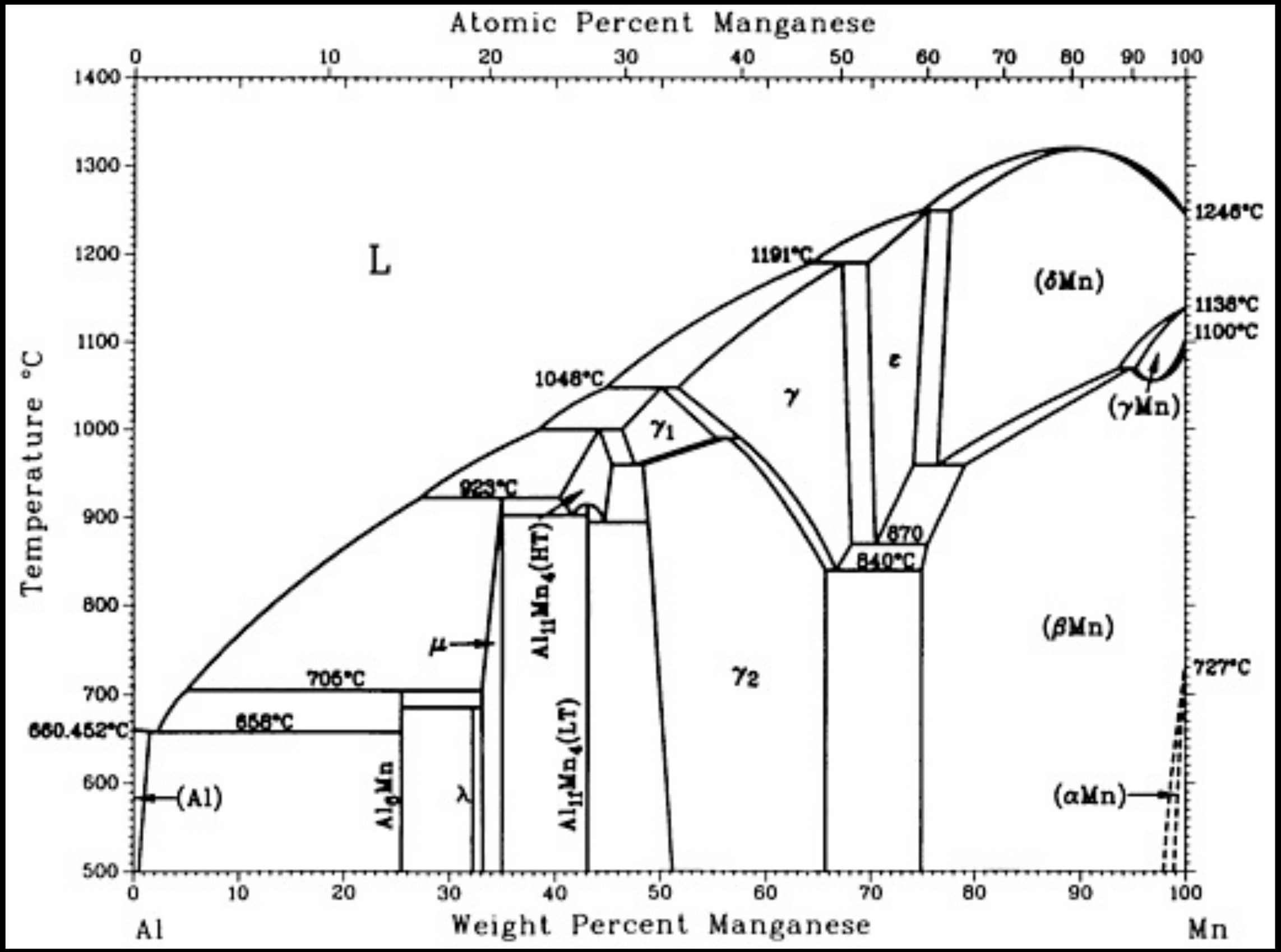

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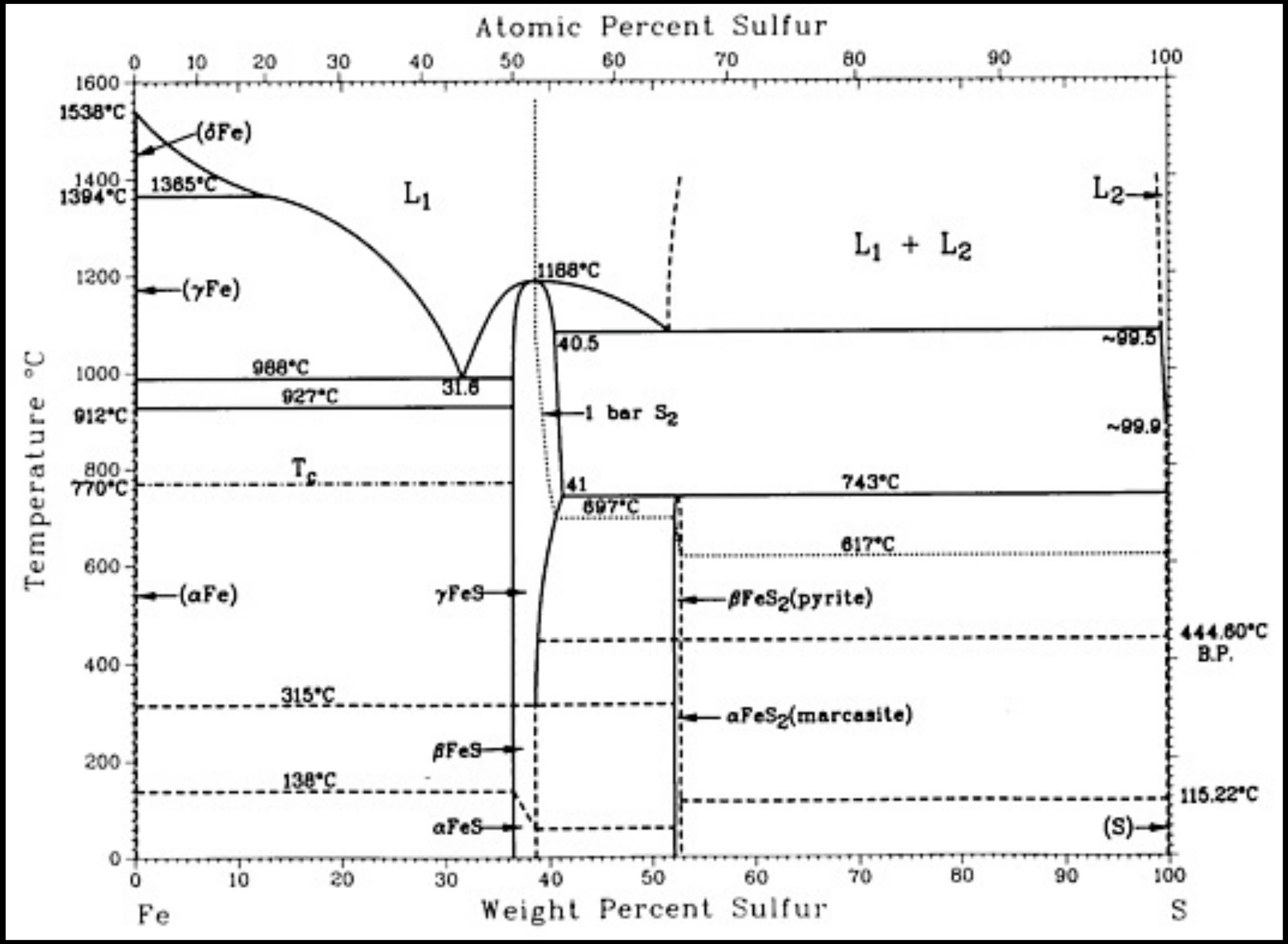

Source: ASM Handbook, Volume 3: Alloy Phase Diagrams.
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Nicole Barbe Ponsardin (1777-1866)

-1798 married François Clicquot

- widowed at age 27 & took control of the winery bold, imaginative management

1. marketing champagne to all the great courts of Europe: **mythmaking**
2. bought land in the best vineyards
3. fought fiercely against counterfeiting
4. established strict quality control procedures
5. produced the first rosé champange
6. oversaw invention of new technology: *remuage* (riddling)

Problem:

champagne is cloudy -- how to clarify without losing the sparkle?

a little chemistry....

sugar + yeast ➡ alcohol + CO_2 ↑

grape juice grape skin

byproducts include sundry insolubles, sedimentary & suspended

removal treatments

mechanical

chemical

(siphon)

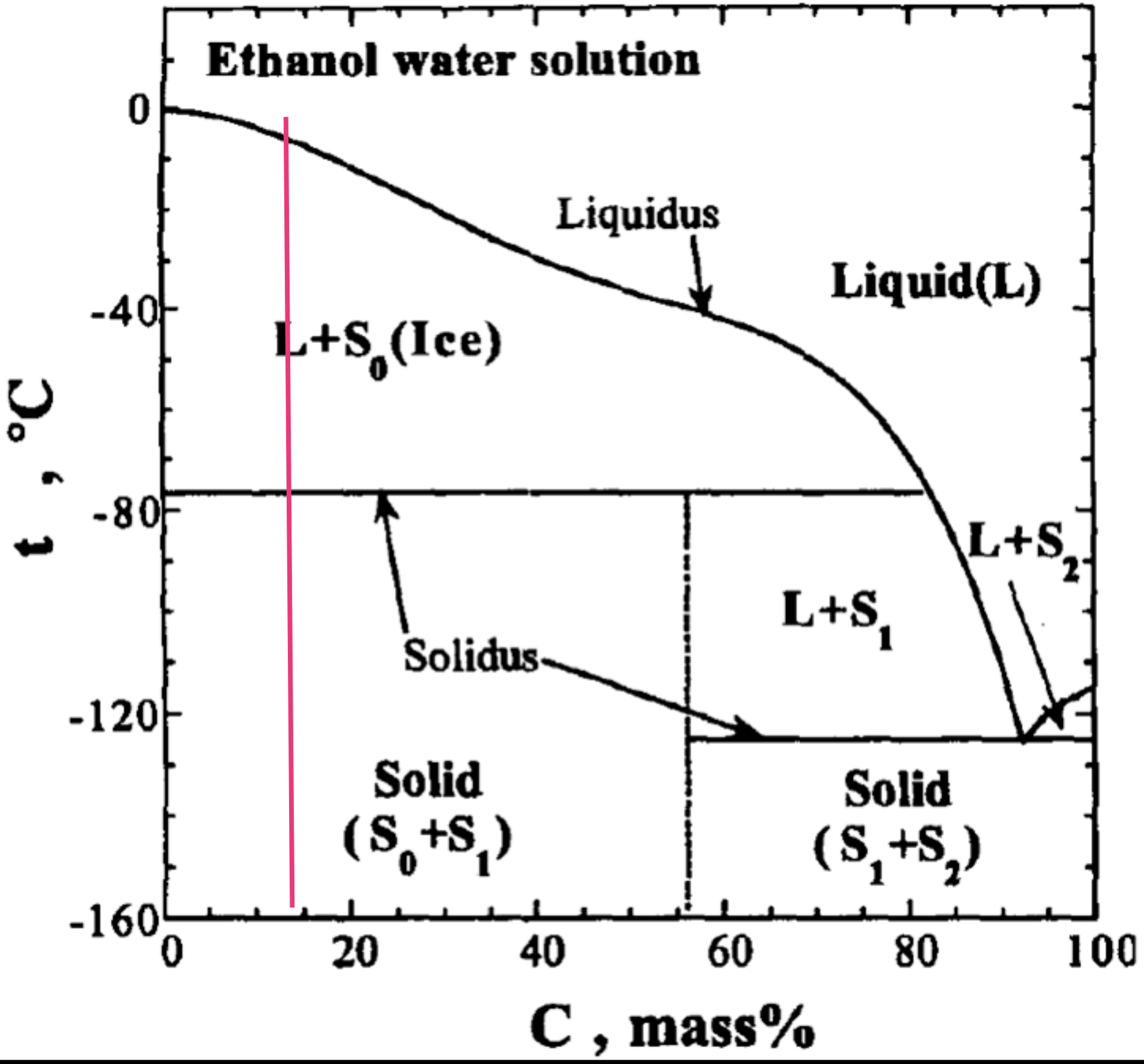
(coagulants)

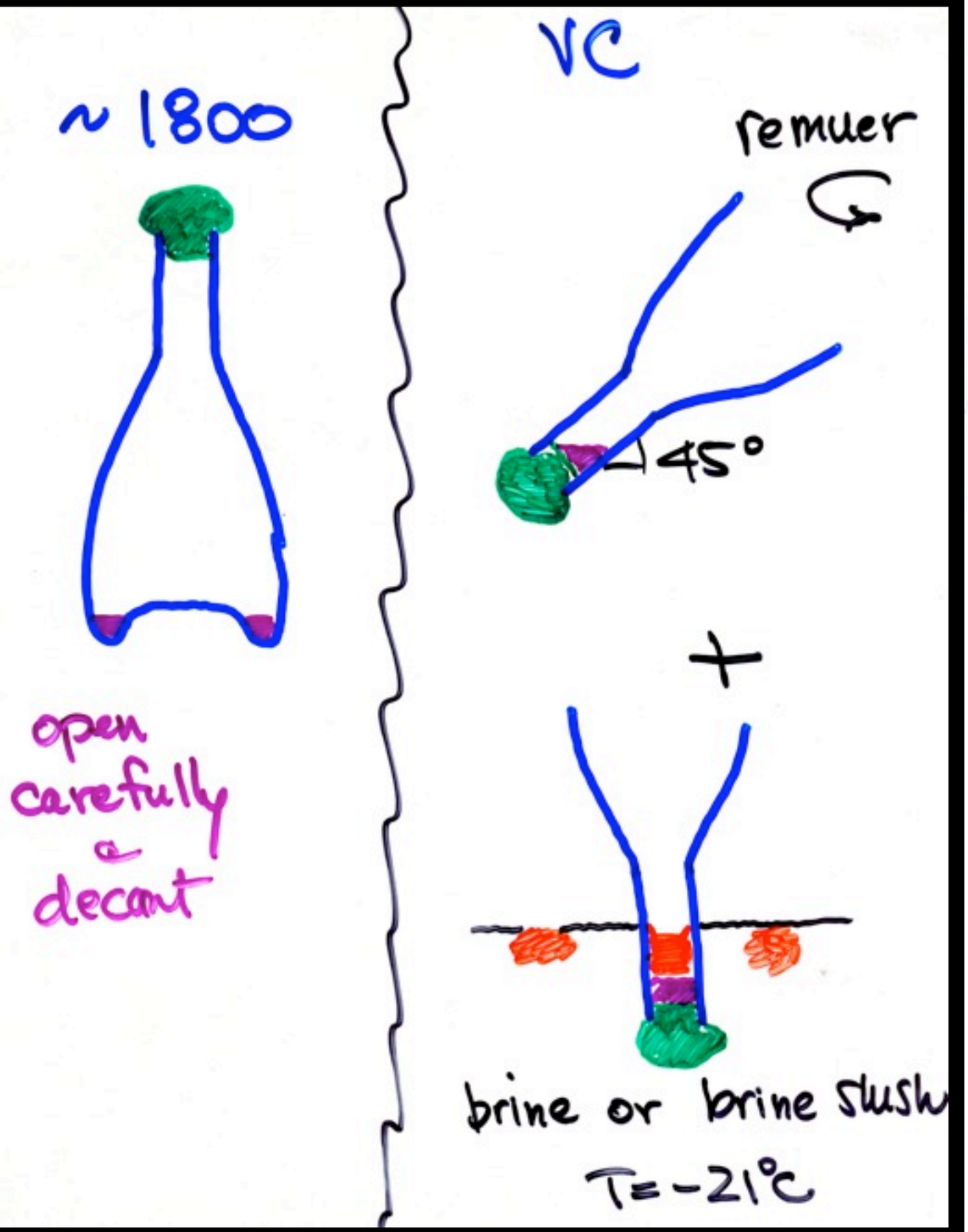
won't work for champagne!

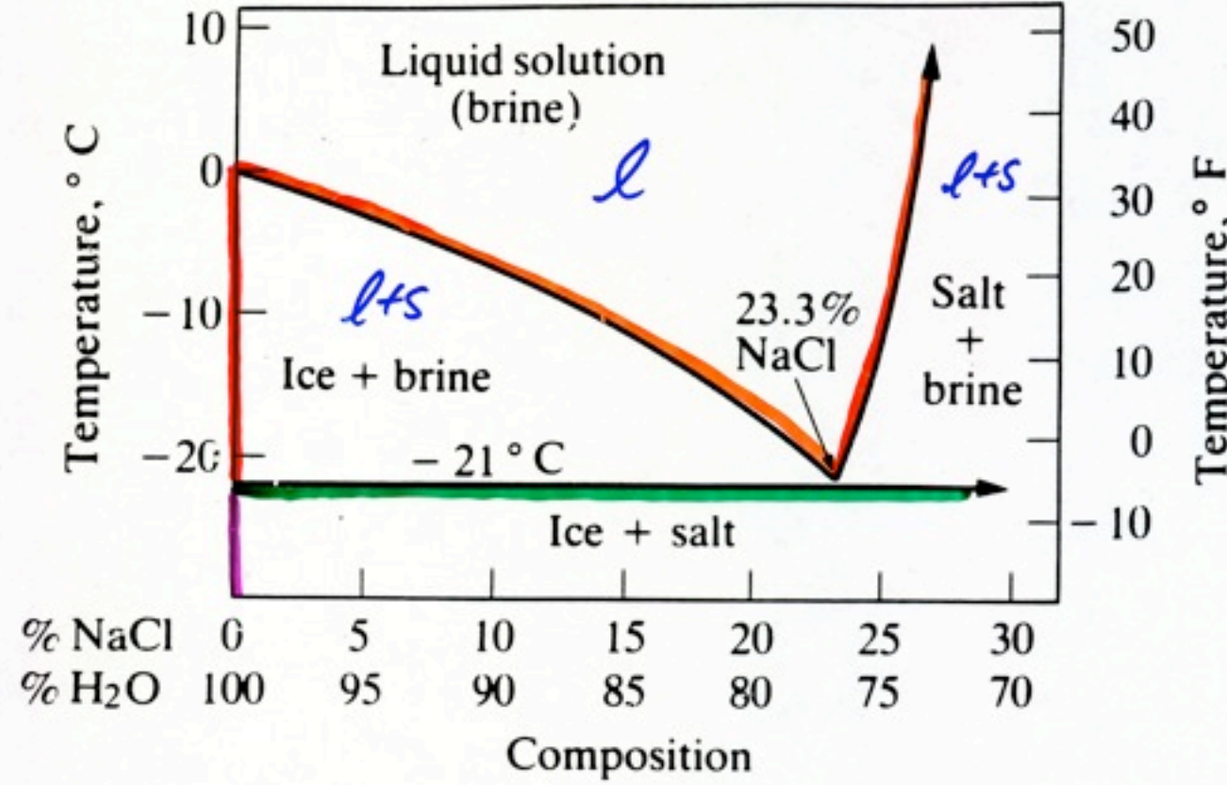
F_b αr^2

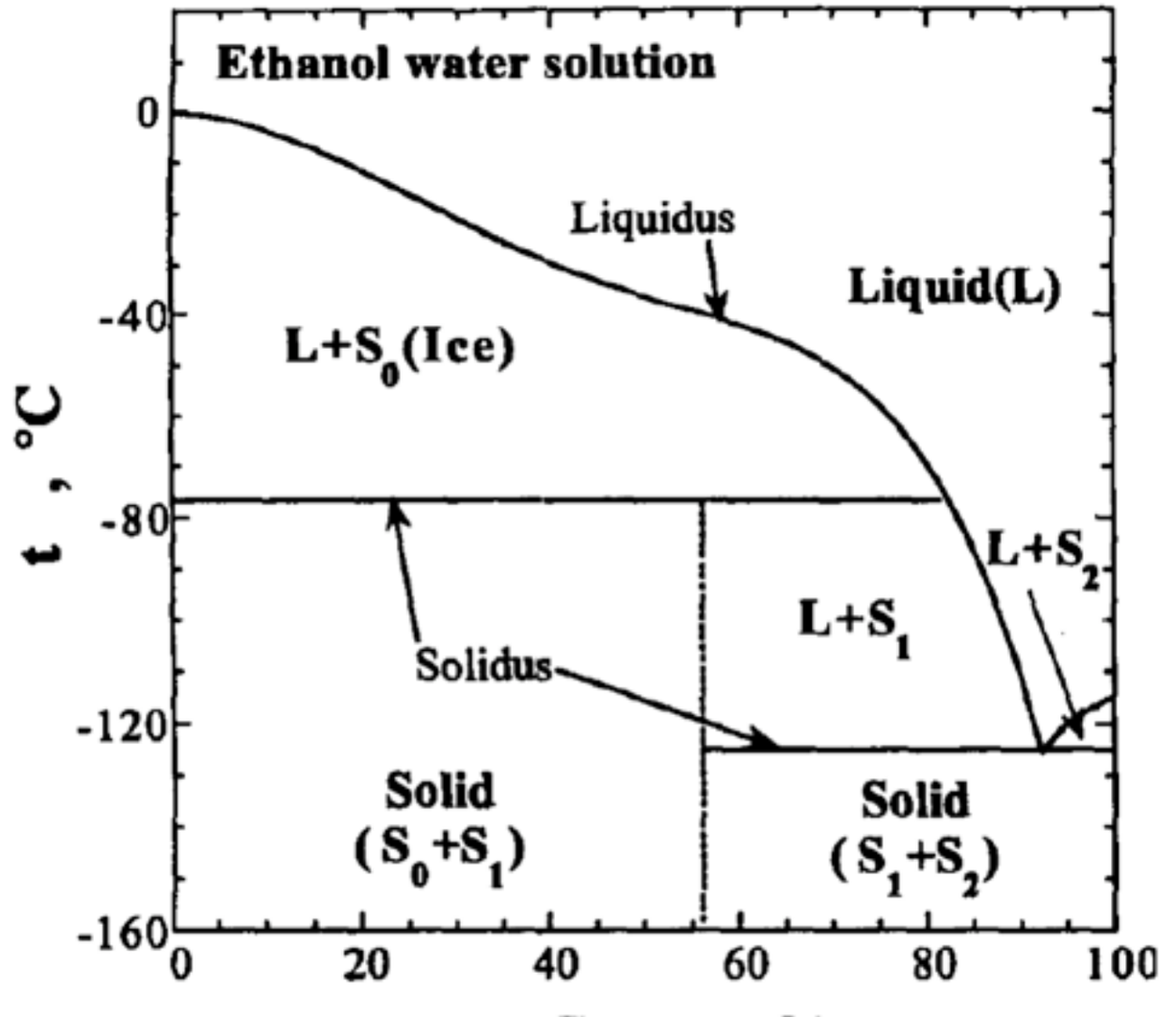
F_g αr^3

at small r, $r^2 > r^3$









Invention of Mme. Clicquot

❶ ***invert*** bottle in order to collect sediment at the top

❷ *to assist with* ❶ ***angle*** *the bottle at 45°,* ***turn*** *periodically (remuage/riddling)**

❸ *to contain the lees* ***freeze*** *a plug of ice in bottle neck at time of disgorgement*

✦ *two binary systems intersecting:*
salt - water **&** *ethanol - water*

* *motorized riddling: Gyropalette/VLM*

💣 3.091 final exam 💣

Tuesday, 15 December, 9:00 a.m. – 12:00 noon

Johnson Athletic Center

- ✏ 3 hours but not 3× work of monthly test
- ✏ intensive coverage since T3
- ✏ extensive coverage of everything
- ✏ aid sheet permitted, 8½" × 11"
- ✏ bring Periodic Table, Table of Constants, calculator, and a pen
- ✏ no headphones, no audio

3.091 final exam

- ✏ comparable difficulty to monthly tests
- ✏ read the entire exam
- ✏ show your work & justify your conclusions
- ✏ solve algebraically
- ✏ remain confident
- ✏ academic honesty

3.091 final exam

✏ overall grade based on many factors, including trends

✏ claim exam papers starting January 4

✏ no time limit for appeals ☞security measures

some personal observations

That's all, Folks!

Happy Holidays

3.091SC Introduction to Solid State Chemistry

Fall 2009