METMAT

PMT 3205

Físico-Química para Metalurgia e Materiais I

METMAT

Equação de Clausius-Clapeyron

Para uma transformação de fase qualquer:

$$\mu_{(\alpha)} = \mu_{(\beta)}$$

No equilíbrio:

$$G(\alpha) = G(\beta)$$

$$dG_{(i)} = -S_{(i)}.dT + V_{(i)}.dP \Rightarrow$$

$$\Rightarrow -S_{(i,\alpha)}.dT + V_{(i,\alpha)}.dP = -S_{(i,\beta)}.dT + V_{(i,\beta)}.dP$$

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Equação de Clausius-Clapeyron

$$-S_{(i,\alpha)}.dT + V_{(i,\alpha)}.dP = -S_{(i,\beta)}.dT + V_{(i,\beta)}.dP$$

$$\left(\frac{dP}{dT}\right)_{eq} = \frac{S_{(\beta)} - S_{(\alpha)}}{V_{(\beta)} - V_{(\alpha)}} = \frac{\Delta S_{(\alpha\rightarrow\beta)}}{\Delta V_{(\alpha\rightarrow\beta)}}$$

$$\frac{dP}{dT} = \frac{\Delta H}{T.\Delta V}$$

Volume molar

1cal = 41,293 atm.cm³

Equação de Clausius-Clapeyron

$$V_{cond} << V_{vapor}$$

$$\Delta V \cong V_{vapor} = RT/P$$

$$\left(\frac{dP}{dT}\right)_{eq} = \frac{P.\Delta H}{R.T^2} \Rightarrow$$

$$\Rightarrow \frac{dP}{P} = \frac{\Delta H}{R.T^2}.dT \Rightarrow$$

$$\boxed{\log P = \frac{A}{T} + B.\log T + C}$$

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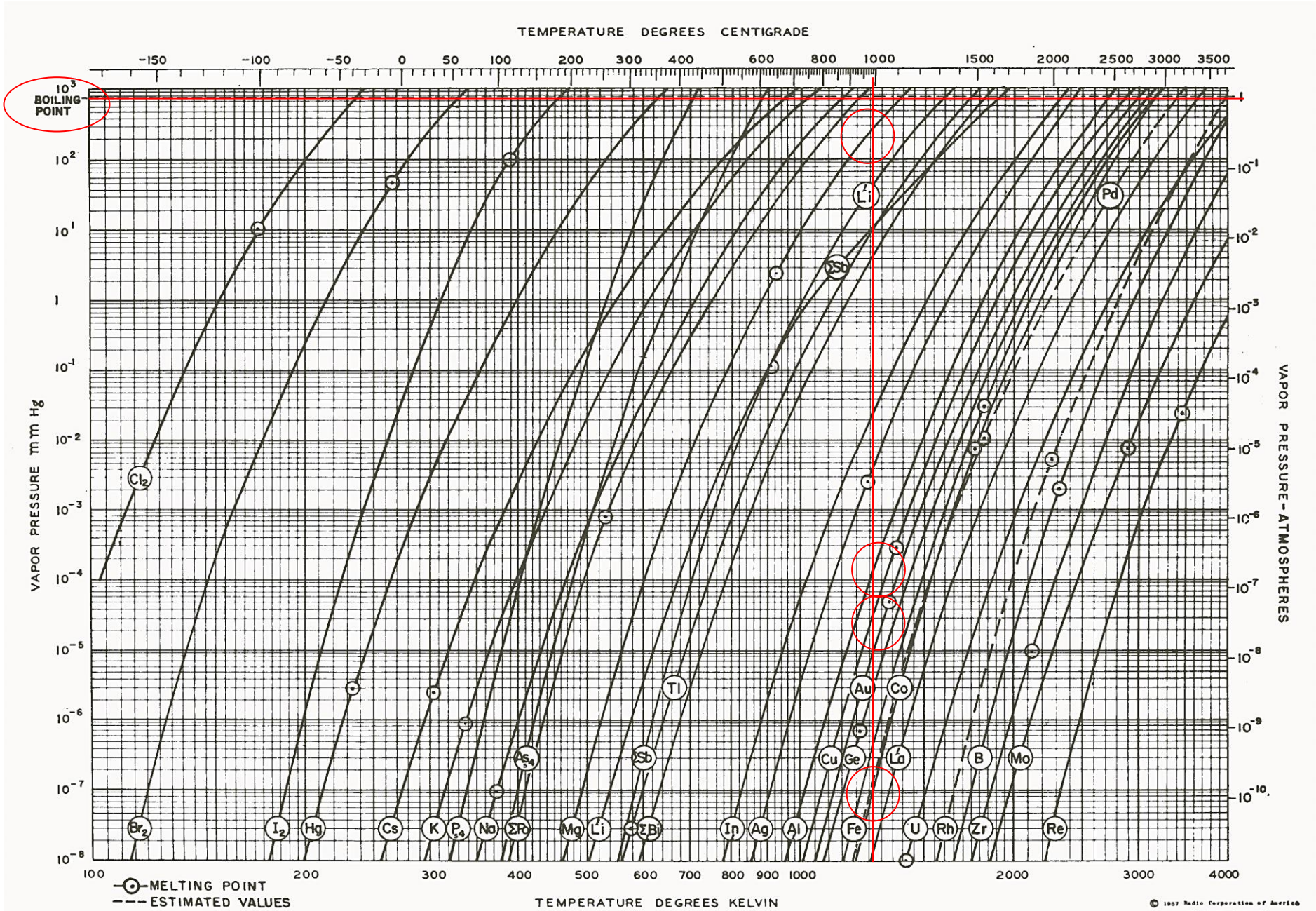
Equação de Clausius-Clapeyron



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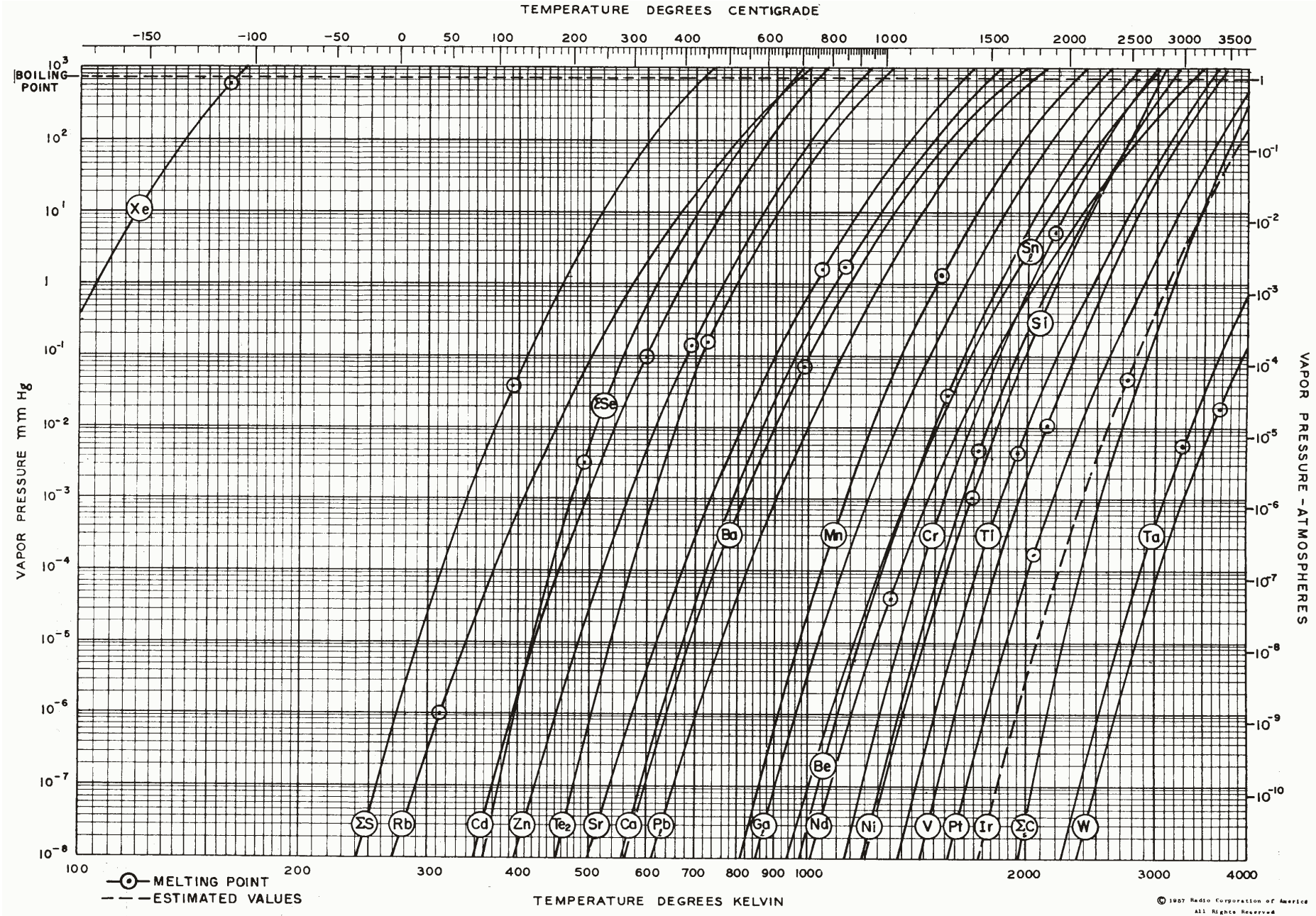
Equação de Clausius-Clapeyron



Equação de Clausius-Clapeyron

A 1 atm de pressão o sódio funde a 97,8ºC (370,8K). O calor de fusão é igual a 630 cal/atg e o aumento de volume específico é de 0,0279 cm^3/g. Calcular o ponto de fusão do sódio a 10 atm. [44]
DADOS: M_{Na} = 23 g/atg; 1 cal = 41,293 atm x cm^3;

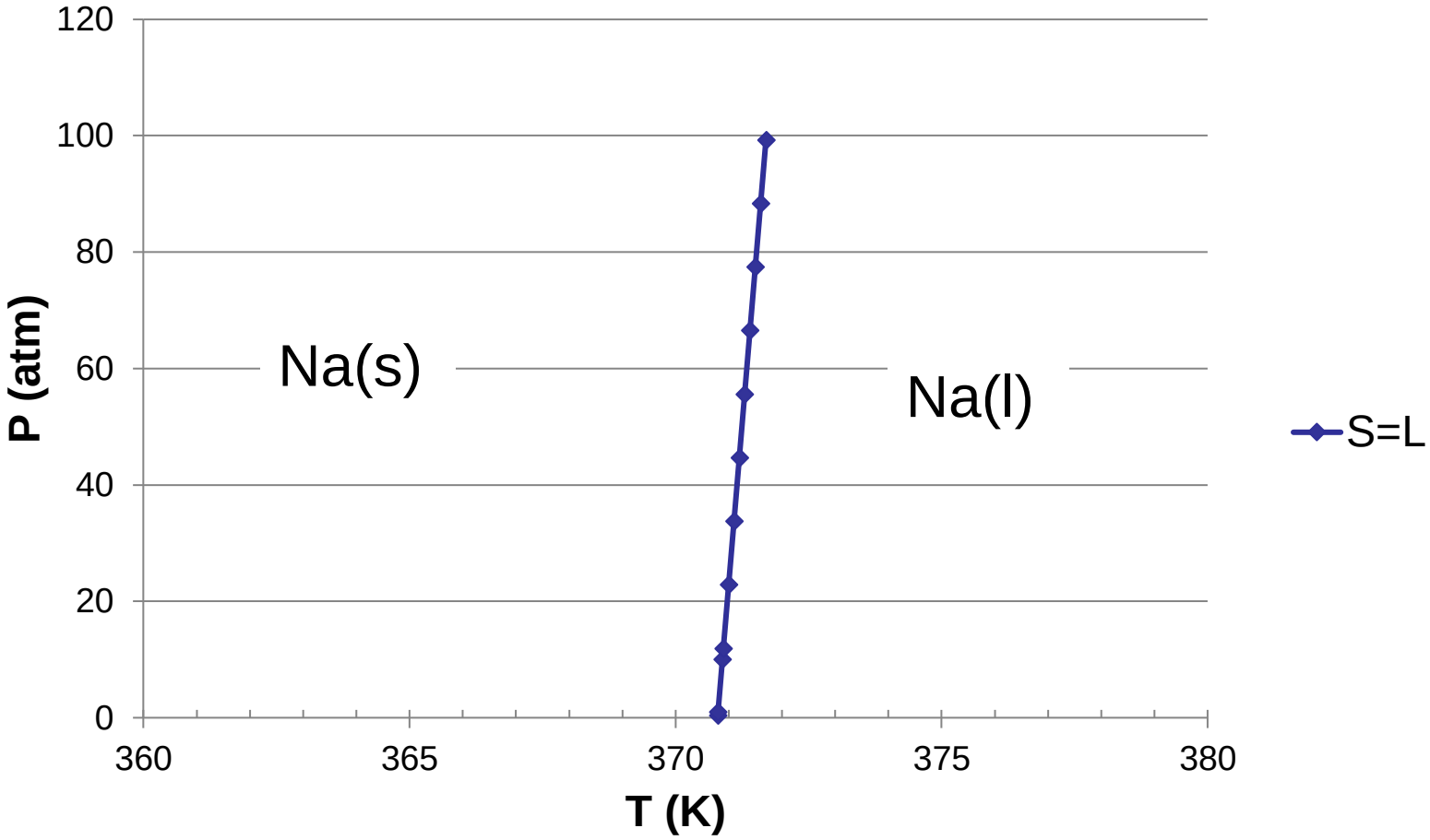
$$\Delta V = 0{,}0279x23 = 6{,}42x10^{-1}\ cm^3/atg$$

$$dP = \frac{630.dT.41{,}293}{6{,}42x10^{-1}.T}$$

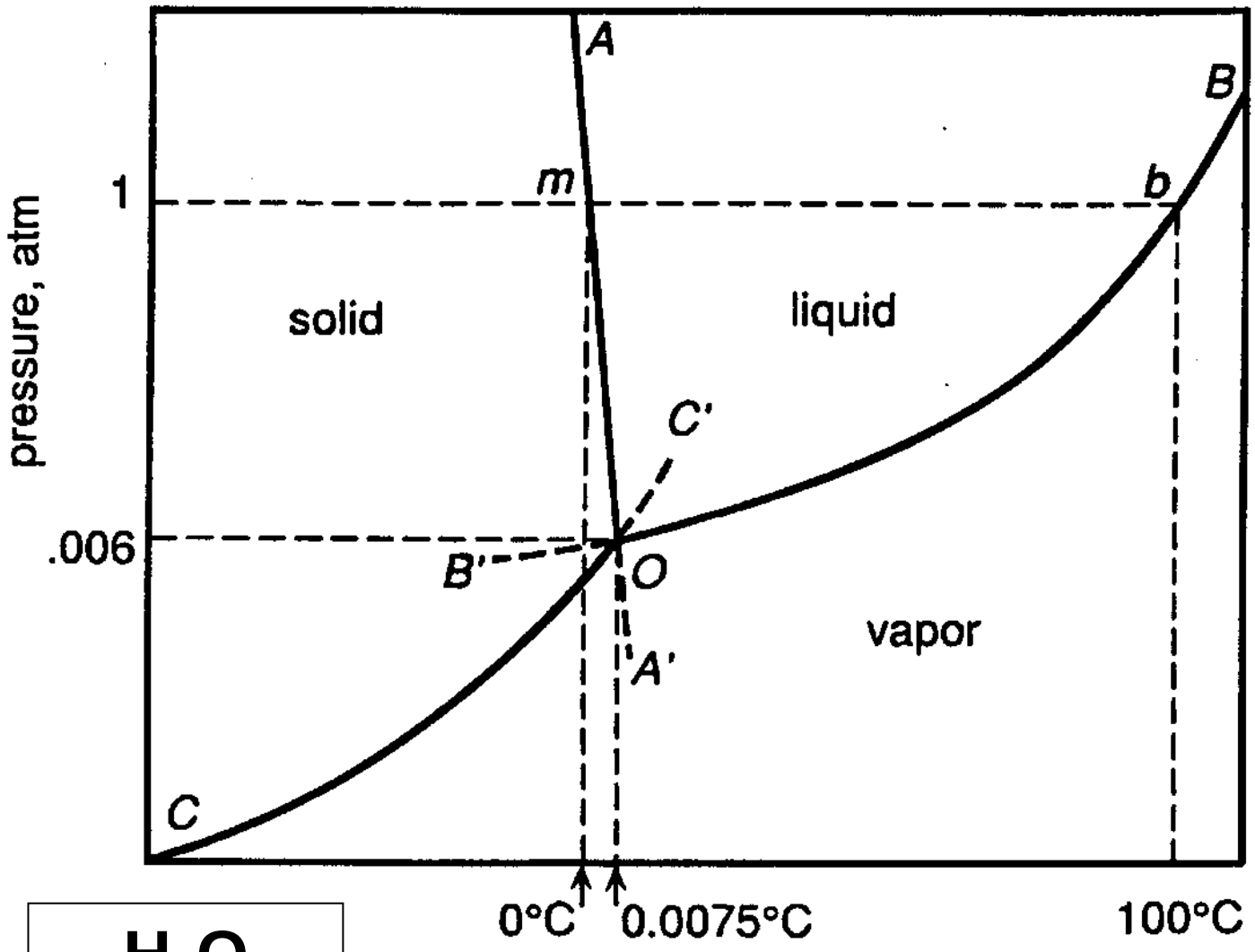
$$\int_1^{10} dP = 40540{,}1.\int_{370{,}8}^{T}\frac{dT}{T} \therefore (10-1) = 40540{,}1x(lnT - ln370{,}8)$$

$$\boldsymbol{T = 370{,}88K \equiv 97{,}88°C}$$

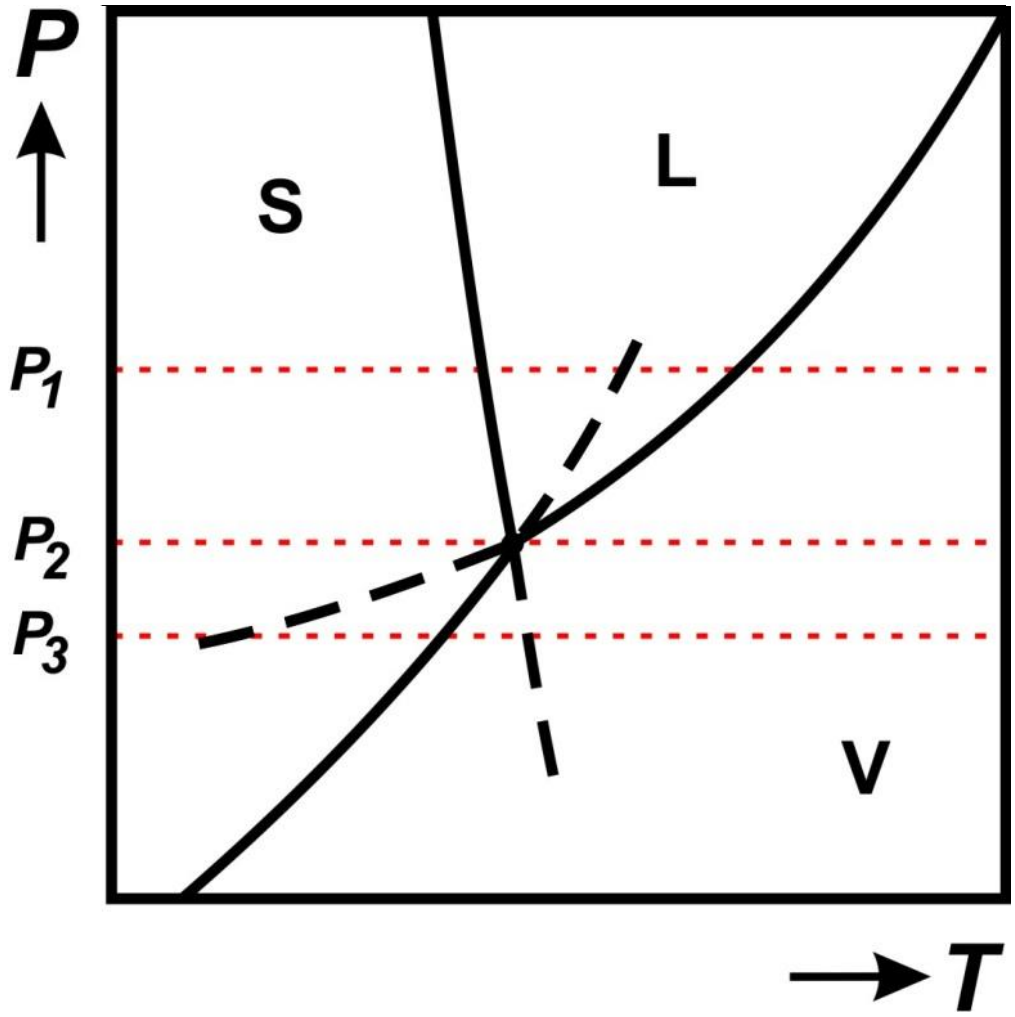
Equilíbrio
$Na_s = Na_l$



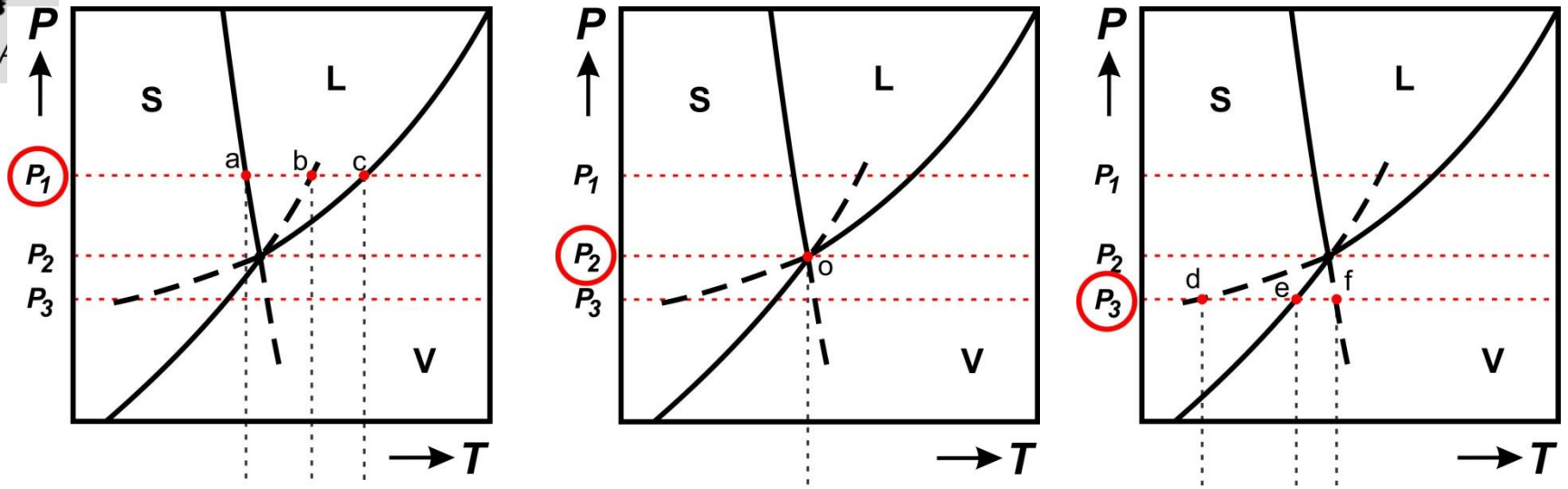
Diagramas de Equilíbrio Unários



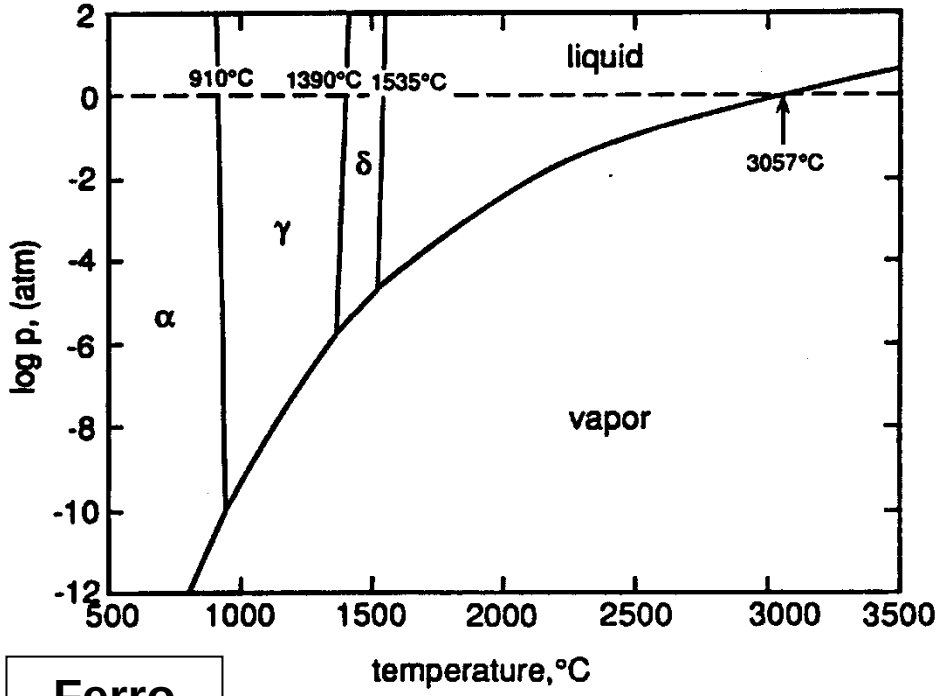
H_2O



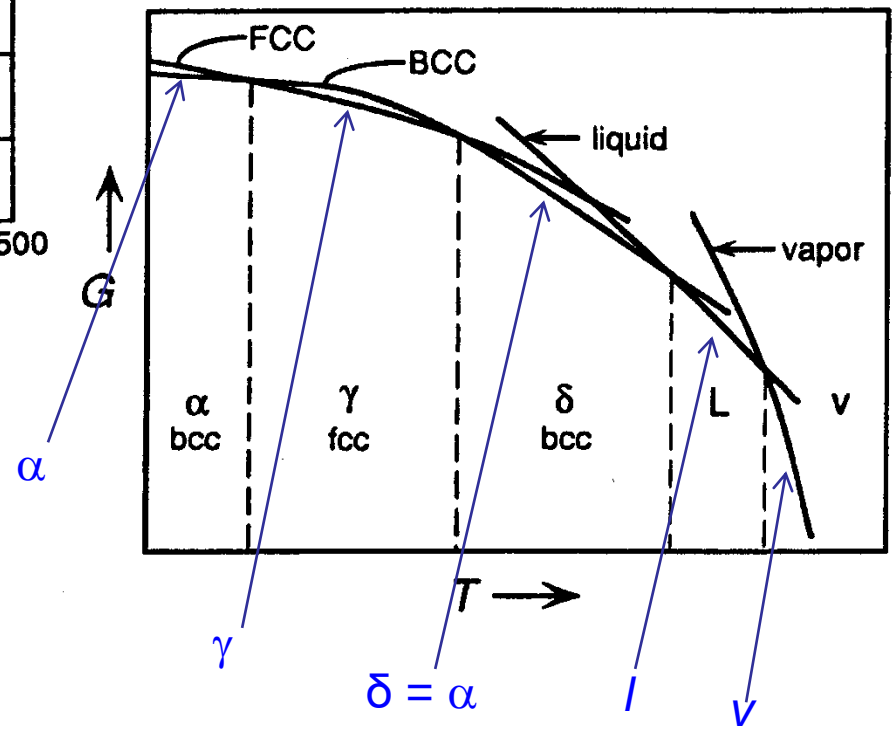
H_2O simplificado



G = f(T) a P cte


liquid
910°C
1390°C
1535°C
3057°C
δ
γ
α
vapor
log p, (atm)
2
0
-2
-4
-6
-8
-10
-12
500
1000
1500
2000
2500
3000
3500
temperature,°C

Ferro


FCC
BCC
liquid
vapor
G
α
bcc
γ
fcc
δ
bcc
L
v
T
α
γ
δ = α
l
v