

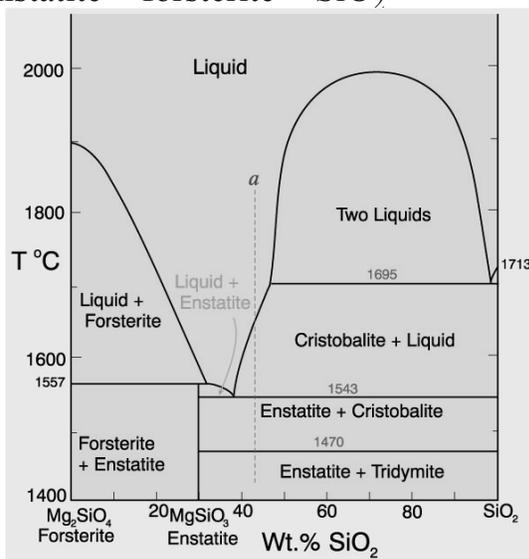
Lecture 8 More on Binary Systems

Friday, February 11th, 2005

Binary Peritectic Systems

Two components but three phases

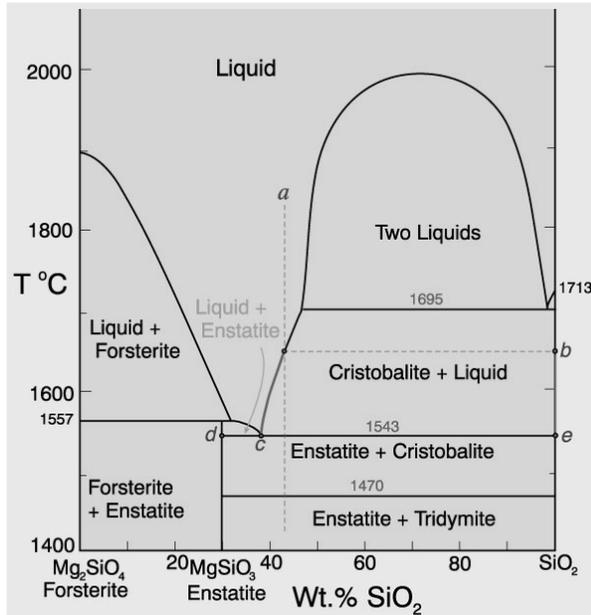
enstatite = forsterite + SiO₂



In this system in addition to the eutectic there is a second inflection on the liquidus the peritectic. This means that under equilibrium conditions quartz could never co-exist with forsterite. They would react to produce enstatite.

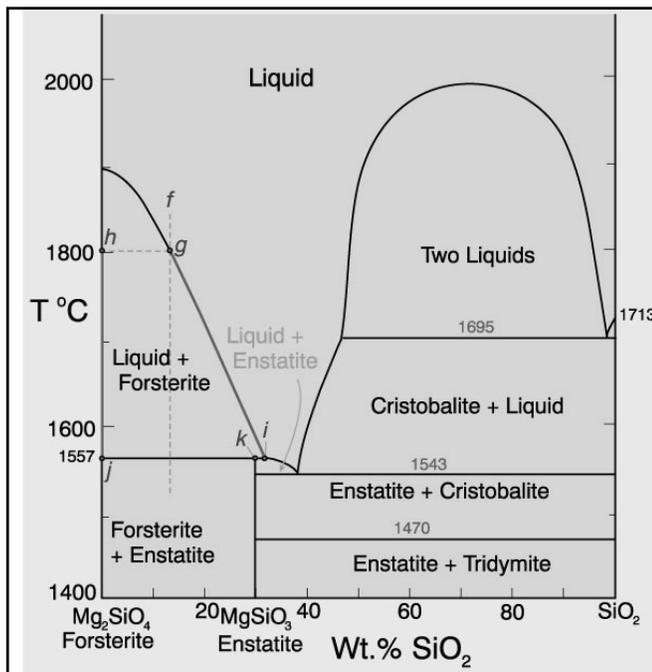
Figure 6-12. Isobaric T-X phase diagram of the system Fo-Silica at 0.1 MPa. After Bowen and Anderson (1914) and Grieg (1927). Amer. J. Sci.

C. Binary Peritectic Systems



Cooling of liquid (a) results in the crystallization of cristobalite (point b) at 1550°C
 Further cooling leads to crystallization of cristobalite (e) and enstatite (d) at the eutectic (c)

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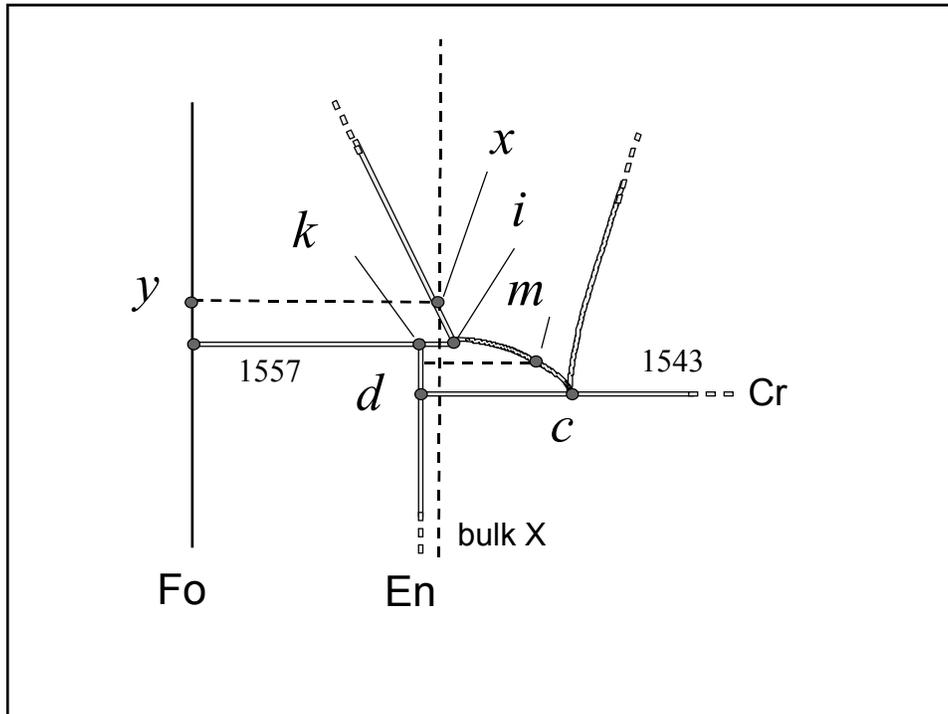


Liquid (f) cools to (g) at which point forsterite (h) begins to crystallize.

Continuing forsterite crystallization leads to liquid (i) at the peritectic and forsterite (j) is joined by enstatite (k)

With continuing crystallization the liquid remains at (i) at 1557°C (WHY?). Olivine reacts with the liquid producing enstatite (k). Eventually the liquid is exhausted leaving a mixture of olivine and enstatite

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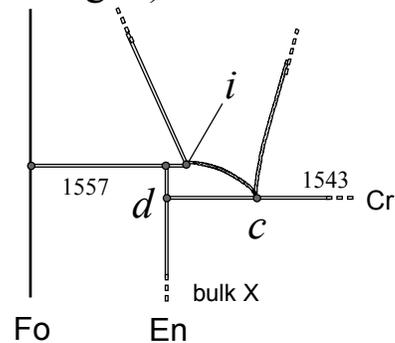


Incongruent Melting of Enstatite

- ◆ Melt of En does not \rightarrow melt of same composition
- ◆ Rather $\text{En} \rightarrow \text{Fo} + \text{Liq } i$ at the peritectic

Partial Melting of Fo + En (harzburgite) mantle

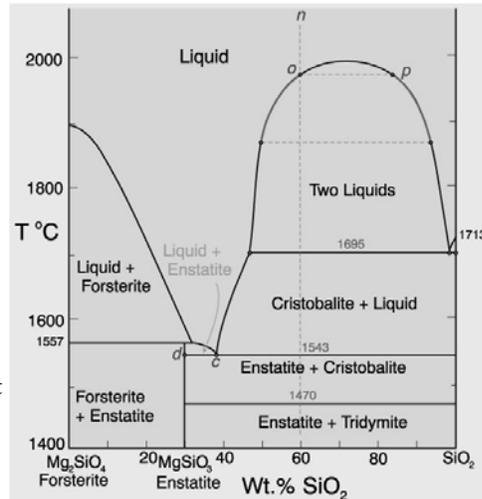
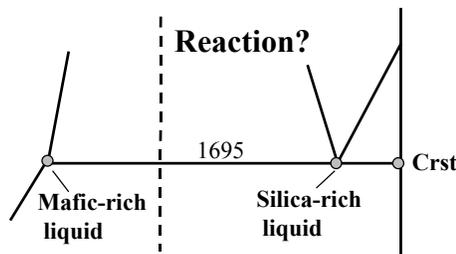
- ◆ $\text{En} + \text{Fo}$ also \rightarrow first liq = i
- ◆ Remove i and cool
- ◆ Result = ?



Cool X = n Immiscible Liquids

- At 1960°C hit solvus
exsolution
→ 2 liquids o and p
 $\phi = 2$ $F = 1$
both liquids follow solvus

At 1695°C get Crst also



Pressure Effects

Different phases have different compressibilities
Thus P will change Gibbs Free Energy differentially

- Raises melting point
- Shift eutectic position (and thus X of first melt, etc.)

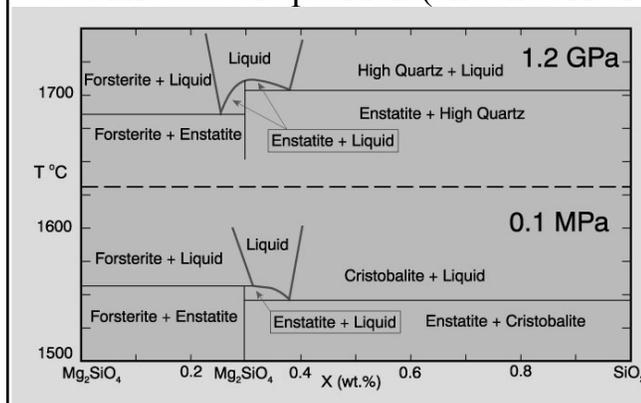
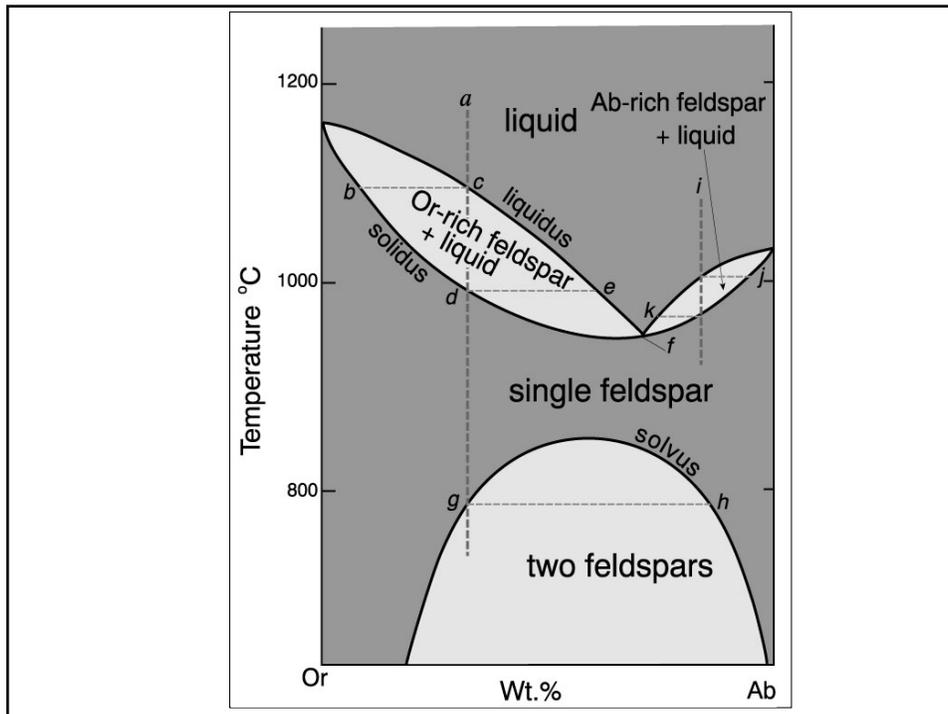
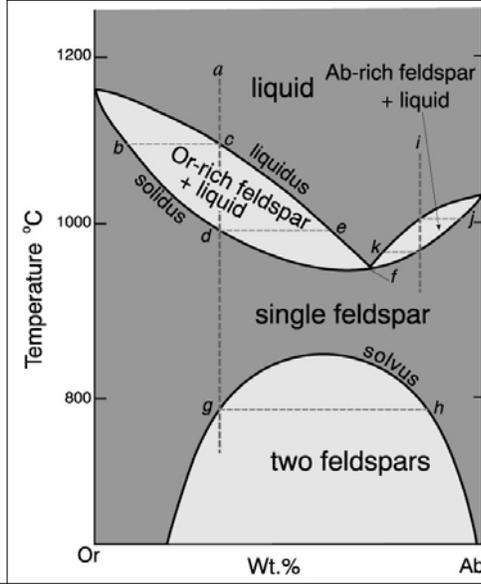


Figure 6-15. The system Fo-SiO_2 at atmospheric pressure and 1.2 GPa. After Bowen and Schairer (1935), Am. J. Sci., Chen and Presnall (1975) Am. Min.

D. Solid Solution with Eutectic: Ab-Or (the alkali feldspars)

Eutectic
liquidus
minimum

Figure 6-16. T-X phase diagram of the system albite-orthoclase at 0.2 GPa H₂O pressure. After Bowen and Tuttle (1950). *J. Geology*.



Effect of P_{H_2O} on Ab-Or

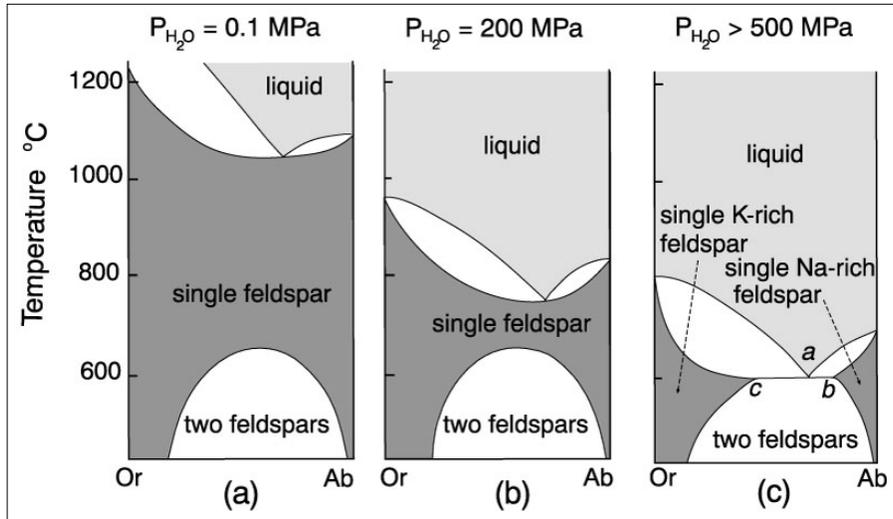


Figure 6-17. The Albite-K-feldspar system at various H_2O pressures. (a) and (b) after Bowen and Tuttle (1950), *J. Geol.* (c) after Morse (1970) *J. Petrol.*