Interpreting T-X Diagrams
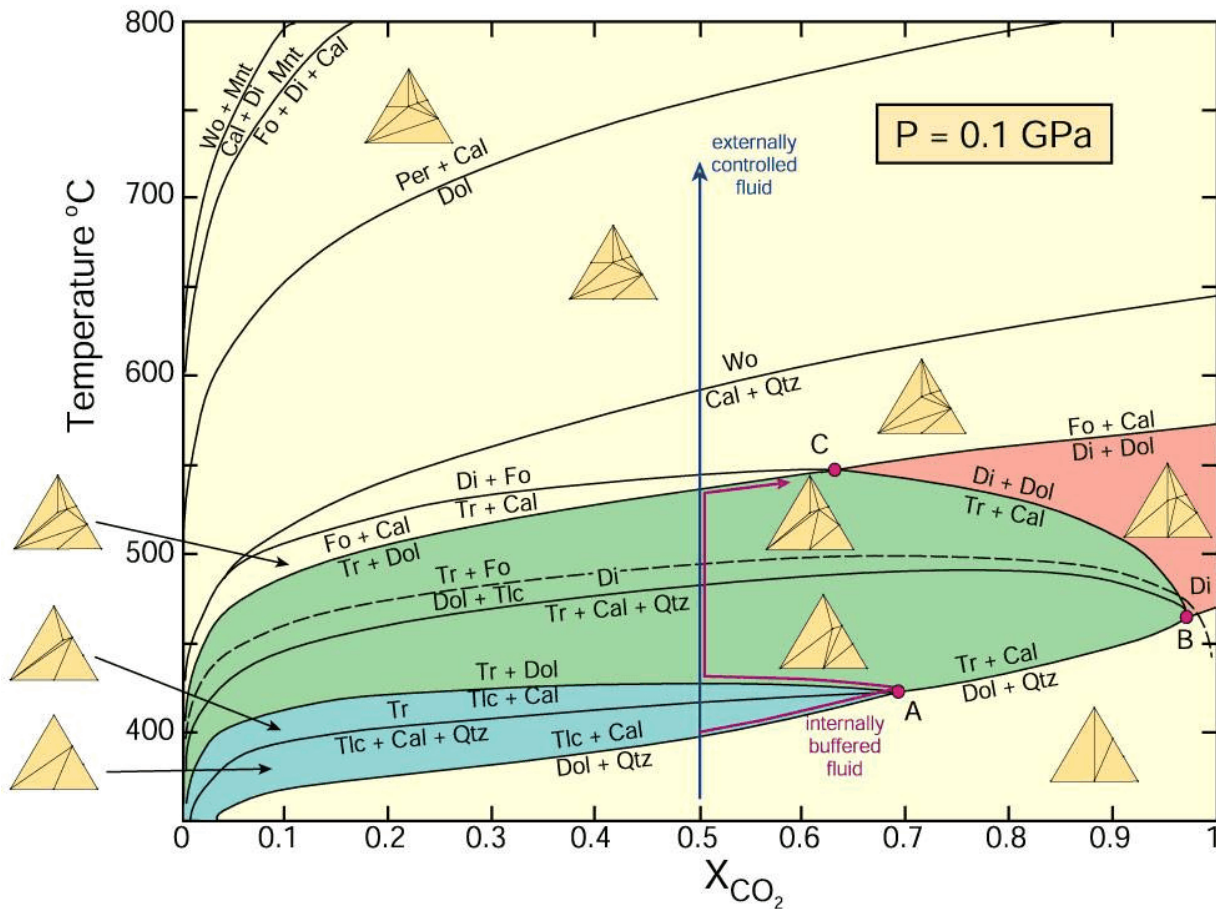
The chemical system is $CaO-MgO-SiO_2-H_2O-CO_2$ (C=5)

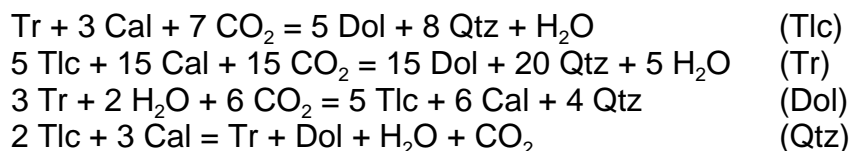1. Where on this diagram are the following minerals/assemblages stable?
a. talc
b. dolomite
c. diopside+dolomite
d. forsterite+diopside
e. diopside+tremolite+quartz
f. talc+quartz+dolomite
g. talc+ quartz+calcite+tremolite

2. Consider the invariant point (F=0) labeled A:

At this invariant point, we have the following seven phases
    tremolite
    quartz
    talc
    calcite
    dolomite
    H_2O
    CO_2

Reactions (F=1) can only contain six phases (P=6): Below are three of the reactions that go through point A. The phase in parenthesis is the phase NOT in the reaction.

Tr + 3 Cal + 7 CO_2 = 5 Dol + 8 Qtz + H_2O (Tlc)
5 Tlc + 15 Cal + 15 CO_2 = 15 Dol + 20 Qtz + 5 H_2O (Tr)
3 Tr + 2 H_2O + 6 CO_2 = 5 Tlc + 6 Cal + 4 Qtz   (Dol)
2 Tlc + 3 Cal = Tr + Dol + H_2O + CO_2 (Qtz)

Winter made a goof and left off other reactions. (The ones missing Cal, CO_2 and H_2O).

A. One way to see that reactions are missing is to note that you cannot get from the triangle up and to the left of point A to the triangle down and to the right of point A simply by crossing the reaction Tr+Cal=Dol+Qtz Try it and see.

B. Or, note that there is a reaction (labeled Dol above) that limits tremolite's stability. It comes into point A and stops. If one reaction limits tremolite's stability, either it must pass through the invariant point or some other reaction must leave point A that limits tremolite's stability too.

The above (B) is an example of the 180E rule: *a phase or assemblage (in this case we are talking about tremolite by itself) cannot be stable for more than 180E around an invariant point unless it is stable everywhere.*

2. Add and subtract the four reactions given above to derive the remaining ones. (One of them might be degenerate.)

Which one limits tremolite's stability (when tremolite is by itself)?

Sketch in the location of the reaction on the phase diagram and add the appropriate triangular diagrams with correct tie lines.   Things will get a bit crowded To help, I have enlarged the crucial part of the diagram around point A on the next page. And adjusted

the angles slightly.