Mole %, Wt. %, Compositions and Projections ANSWERS

C:\Courses\320\fall2007\in class\020-ProjectionsAnswers.wpd; August 23, 2007 (3:29pm)

Consider the minerals/fluids listed in Table 1, at the end of this handout.

1. Calculate the mole % of each element in each phase and fill in the table**. Attached**

2. Calculate the weight % of each element in each phase and fill in the table. **Attached**

3. *Answer question 4 before doing this:* For those phases that do not contain water: Plot their compositions on the two triangular diagrams provided later on in this handout, and label the points with the phase abbreviations. One plot uses mole % values, the other uses Wt %.

4. BUT WAIT! BEFORE YOU DO THE PLOTTING, ANSWER THIS QUESTION: Make a prediction -- What do you think the differences will be between the two plots. Will they be the same? If so, why? If not, will they be completely different? Or, only a little different? Why? Explain.

The plots look pretty close to the same except that all points move toward Al_2O_3, because it is the heaviest oxide.

5. For plotting mineral compositions and thinking about how they compare and mineral reactions, etc., which kind of plot do you think would be most valuable: mole% plots or weight% plots?   Why?

Moles are best if you are considering reactions. Because they balance in terms of moles.

6. Under what circumstance would the other kind of plot be useful?

The only time wt % values are better is when you are dealing with weight. For example, if you were mixing up reagents to make a particular mineral composition, weight % would be used as you figure out how much of each to add.

7. Now redo the mole% diagram you just plotted but add the phases that include H_2O as well. The problem is that we now have four components. Must come up with a plan. What to do? Hmmm.

BEFORE YOU START PLOTTING AGAIN, PREDICT WHAT YOU WILL FIND. YOU ARE GOING TO MAKE FOUR PLOTS (READ BELOW): WILL THE FOUR PLOTS COME OUT TO BE SIMILAR, DIFFERENT, OR SOMEWHERE BETWEEN?

8. How do the four plots you just made compare? Very similar, different, close . . . ? Which do you think would be most valuable when considering mineral compositions, reactions, etc.?

It is hard to say what to predict. The reality is that they all come out different and many phases plot on top of each other. The plot ignoring H2O looks a bit like the original plot that we made that had no hydrous minerals. Other than that, there are not many similarities.

Try plotting the compositions (use mole%) ignoring H_2O. Just add up the other three and *normalize* (multiply by a fudge factor) so they total 100%. Then plot. (The ones you plotted before will not move because they already total 100% – they contain no H_2O.) By ignoring a component, you are creating a *projection*. The idea is that if H_2O (or something else) is unimportant, we can just ignore it for plotting purposes.

9. What do you think about using projections to plot 3-D compositions on a 2-D piece of paper? Is this useful, misleading, hairy, fun, etc.? Discuss, briefly.

Personally, I think it looks like a bad idea. But, maybe it is the best that can be done.

			Mole %				Weight %			
			CaO	Al2O3	SiO2	H2O	CaO	Al2O3	SiO2	H2O
quartz	Qz	SiO2	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0
corundum	Co	Al2O3	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0
lime	Li	CaO	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
water vapor	H2O	H2O	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
kyanite	Ky	Al2SiO5	0.0	50.0	50.0	0.0	0.0	62.9	37.1	0.0
sillimanite	Sil	Al2SiO5	0.0	50.0	50.0	0.0	0.0	62.9	37.1	0.0
andalusite	And	Al2SiO5	0.0	50.0	50.0	0.0	0.0	62.9	37.1	0.0
diaspore	Dsp	AlO(OH)	0.0	50.0	0.0	50.0	0.0	85.0	0.0	15.0
wollastonite	Wo	CaSiO3	50.0	0.0	50.0	0.0	48.3	0.0	51.7	0.0
grossular	Gr	Ca3Al2Si3O12	42.9	14.3	42.9	0.0	37.3	22.6	40.0	0.0
anorthite	An	CaAl2Si2O8	25.0	25.0	50.0	0.0	20.2	36.6	43.2	0.0
gehlenite	Ge	Ca2Al2SiO7	50.0	25.0	25.0	0.0	40.9	37.2	21.9	0.0
margarite	Mg	CaAl4Si2O10(OH)2	16.7	33.3	33.3	16.7	14.1	51.2	30.2	4.5
zoisite	Zo	Ca2Al3Si3O12(OH)	28.6	21.4	42.9	7.1	24.7	33.7	39.7	2.0
lawsonite	Lw	CaAl2Si2O7(OH)2·H2O	16.7	16.7	33.3	33.3	17.8	32.4	38.2	11.5
prehnite	Pr	Ca2Al(AlSi3O10)(OH)2	28.6	14.3	42.9	14.3	27.2	24.7	43.7	4.4

			Mole % ignoring H2O			
			CaO	Al2O3	SiO2	H2O
quartz	Qz	SiO2	0.0	0.0	100.0	
corundum	Co	Al2O3	0.0	100.0	0.0	
lime	Li	CaO	100.0	0.0	0.0	
water vapor	H2O	H2O	ERR	ERR	ERR	
kyanite	Ky	Al2SiO5	0.0	50.0	50.0	
sillimanite	Sil	Al2SiO5	0.0	50.0	50.0	
andalusite	And	Al2SiO5	0.0	50.0	50.0	
diaspore	Dsp	AlO(OH)	0.0	100.0	0.0	
wollastonite	Wo	CaSiO3	50.0	0.0	50.0	
grossular	Gr	Ca3Al2Si3O12	42.9	14.3	42.9	
anorthite	An	CaAl2Si2O8	25.0	25.0	50.0	
gehlenite	Ge	Ca2Al2SiO7	50.0	25.0	25.0	
margarite	Mg	CaAl4Si2O10(OH)2	20.0	40.0	40.0	
zoisite	Zo	Ca2Al3Si3O12(OH)	30.8	23.1	46.2	

lawsonite	Lw	CaAl2Si2O7(OH)2·H2O	25.0	25.0	50.0
prehnite	Pr	Ca2Al(AlSi3O10)(OH)2	33.3	16.7	50.0

			Mole % ignore CaO CaO	Al2O3	SiO2	H2O
quartz	Qz	SiO2		0.0	100.0	0.0
corundum	Co	Al2O3		100.0	0.0	0.0
lime	Li	CaO		ERR	ERR	ERR
water vapor	H2O	H2O		0.0	0.0	100.0
kyanite	Ky	Al2SiO5		50.0	50.0	0.0
sillimanite	Sil	Al2SiO5		50.0	50.0	0.0
andalusite	And	Al2SiO5		50.0	50.0	0.0
diaspore	Dsp	AlO(OH)		50.0	0.0	50.0
wollastonite	Wo	CaSiO3		0.0	100.0	0.0
grossular	Gr	Ca3Al2Si3O12		25.0	75.0	0.0
anorthite	An	CaAl2Si2O8		33.3	66.7	0.0
gehlenite	Ge	Ca2Al2SiO7		50.0	50.0	0.0
margarite	Mg	CaAl4Si2O10(OH)2		40.0	40.0	20.0
zoisite	Zo	Ca2Al3Si3O12(OH)		30.0	60.0	10.0
lawsonite	Lw	CaAl2Si2O7(OH)2·H2O		20.0	40.0	40.0
prehnite	Pr	Ca2Al(AlSi3O10)(OH)2		20.0	60.0	20.0

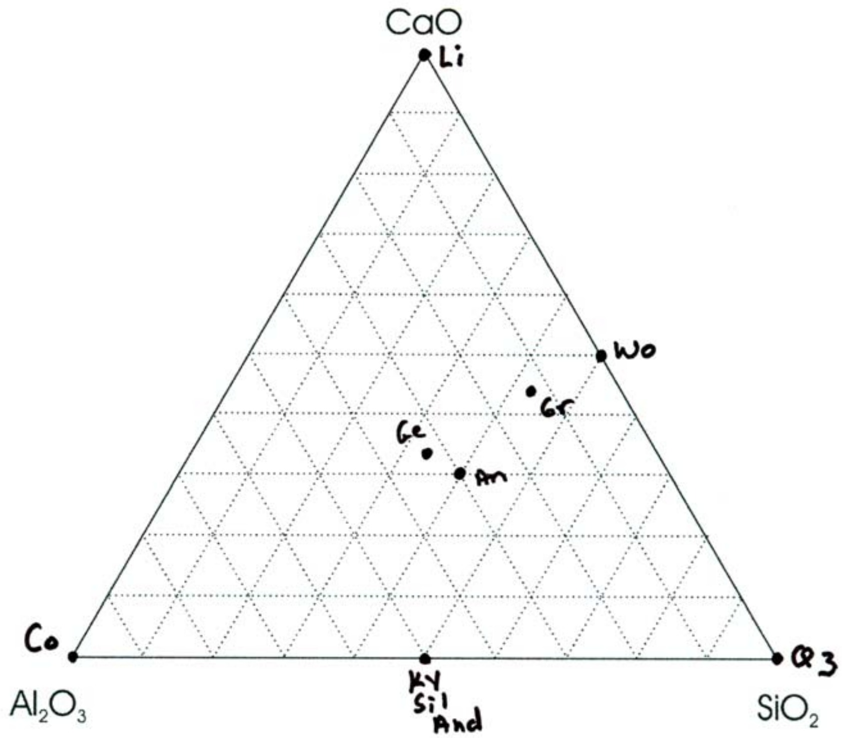
			Mole % ignore Al2O3 CaO	Al2O3	SiO2	H2O
quartz	Qz	SiO2	0.0		100.0	0.0
corundum	Co	Al2O3	ERR		ERR	ERR
lime	Li	CaO	100.0		0.0	0.0
water vapor	H2O	H2O	0.0		0.0	100.0
kyanite	Ky	Al2SiO5	0.0		100.0	0.0
sillimanite	Sil	Al2SiO5	0.0		100.0	0.0
andalusite	And	Al2SiO5	0.0		100.0	0.0
diaspore	Dsp	AlO(OH)	0.0		0.0	100.0

wollastonite	Wo	CaSiO3	50.0		50.0	0.0
grossular	Gr	Ca3Al2Si3O12	50.0		50.0	0.0
anorthite	An	CaAl2Si2O8	33.3		66.7	0.0
gehlenite	Ge	Ca2Al2SiO7	66.7		33.3	0.0
margarite	Mg	CaAl4Si2O10(OH)2	25.0		50.0	25.0
zoisite	Zo	Ca2Al3Si3O12(OH)	36.4		54.5	9.1
lawsonite	Lw	CaAl2Si2O7(OH)2·H2O	20.0		40.0	40.0
prehnite	Pr	Ca2Al(AlSi3O10)(OH)2	33.3		50.0	16.7

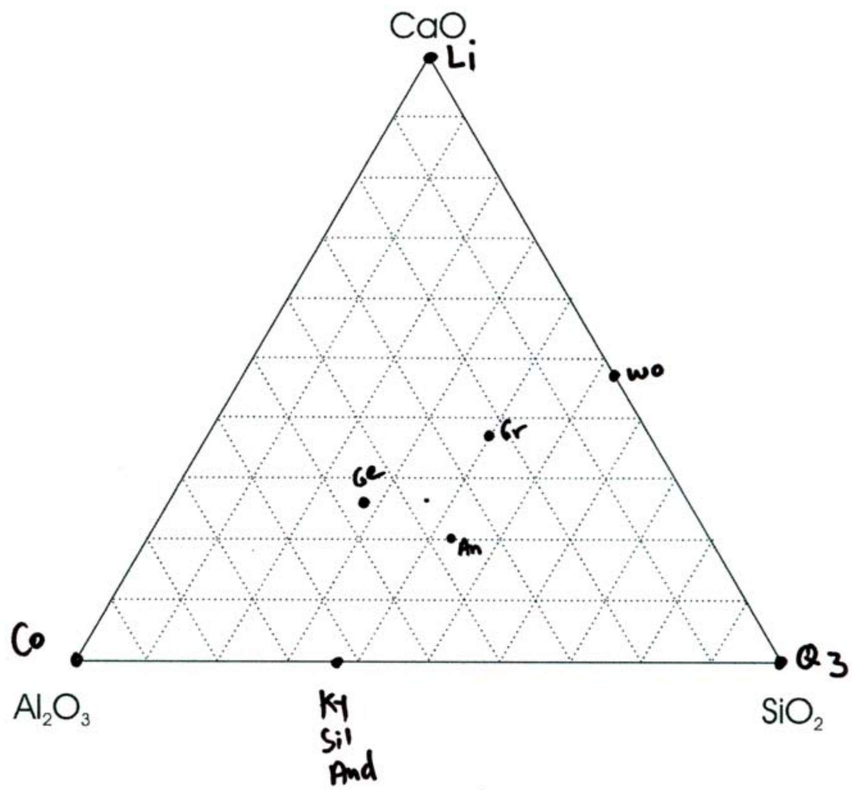
			Mole % ignore SiO2 CaO	Al2O3	SiO2	H2O
quartz	Qz	SiO2	ERR	ERR		ERR
corundum	Co	Al2O3	0.0	100.0		0.0
lime	Li	CaO	100.0	0.0		0.0
water vapor	H2O	H2O	0.0	0.0		100.0
kyanite	Ky	Al2SiO5	0.0	100.0		0.0
sillimanite	Sil	Al2SiO5	0.0	100.0		0.0
andalusite	And	Al2SiO5	0.0	100.0		0.0
diaspore	Dsp	AlO(OH)	0.0	50.0		50.0
wollastonite	Wo	CaSiO3	100.0	0.0		0.0
grossular	Gr	Ca3Al2Si3O12	75.0	25.0		0.0
anorthite	An	CaAl2Si2O8	50.0	50.0		0.0
gehlenite	Ge	Ca2Al2SiO7	66.7	33.3		0.0
margarite	Mg	CaAl4Si2O10(OH)2	25.0	50.0		25.0
zoisite	Zo	Ca2Al3Si3O12(OH)	50.0	37.5		12.5
lawsonite	Lw	CaAl2Si2O7(OH)2·H2O	25.0	25.0		50.0
prehnite	Pr	Ca2Al(AlSi3O10)(OH)2	50.0	25.0		25.0

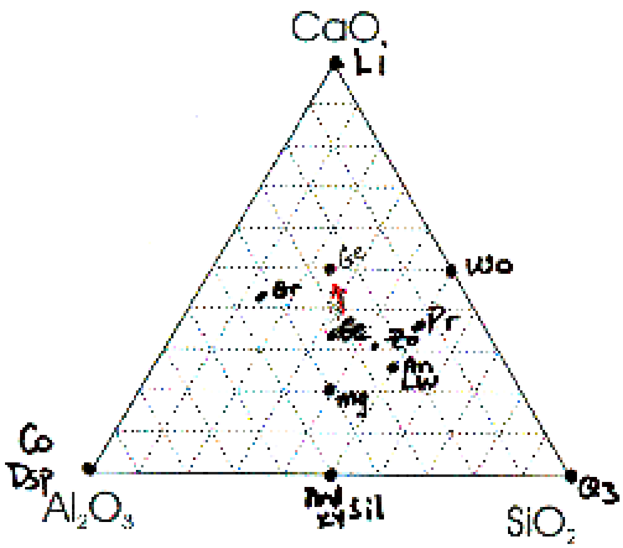
3. Plotting the minerals that do not contain H_2O.

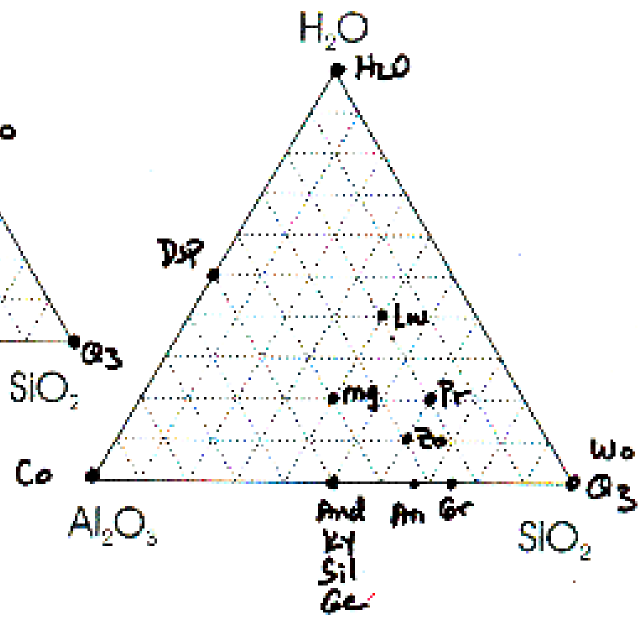
Mole % ==>



Wt % ==>




CaO
Li
Wo
Gr
Pr
Zo
An
Lw
mg
Co
DSP
Al_2O_3
And
Ky
Sil
Q3
SiO_2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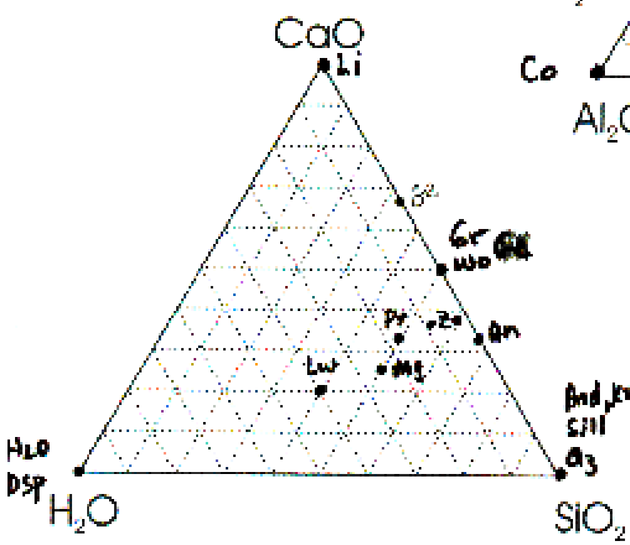
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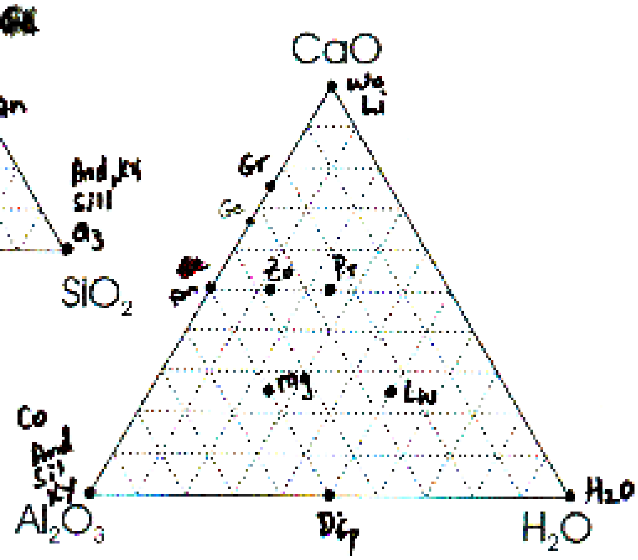
CaO
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