Earth Notes

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1 Review

Know for the Test Most Abundent Elements in the Crust:

Element	**Charge**	**Coordination Number** (fold coordination)
Si	4	4
O	-2	X
Na	1	8
Ca	2	6 (or 8)
K	1	12
Al	3	6/4
Mg	2	6
Fe	2/3	6

2 Mineral Composition

Mineral Chemical Site Assignment (more examples in p. 198-200)

ex: Sphalerite (ZnS)

Actual analysis sample that we collected:

Element	Weight Percent	(Grams per Mole)		Normalized
Fe	18.25%	55.85	0.327	.312
Mn	2.66%	54.94	0.048	.046
Cd	.28	112.41	.002	.002
Zn	44.67	65.58	0.683	.651
S	33.57	32.07	1.047	1.0
Total	99.43%			1.011

Final Formula: $(Zn_{.651}\ Fe_{.312}\ Mn_{.046}\ Cd_{.002})S$

That is an easy one. Most of the time, when we're dealing with something like Silicates, we have a situation like this:

Silicate Analysis: Olivine

0.99

Elem.	WP	AW	MAP	xOxy	AO	CFP
SiO_2	40.99	/ 60.08	.6822	x2	1.3642	.999
FeO	8.58	71.85	.1194	x1	.1194	.115
Fe_2O_3	.50	159.69	.0031	x3	.0093	.009
MgO	50.00	90.31	1.2403	x1	1.2401	1.816
MnO	.20	70.94	.0028	x1	.0028	.004
Total	100.27				2.732	

Key	Value
Elem.	Element Normalization FActor
WP	Weight Percent
AW	Atomic Weight Cadion Formula %
MAP	Molecular Atomic Proportion
xOxy	xOxygens
AO	Atomic Opop(?)
NF	Normalization Factor (4.0/2.732)
CFP	Cadion Formula Percentage

2.732 → .999

Normalize everything to 4 Oxygens.

Normalize to 4 oxygens. Normalizing factor is 2.732.

Normalize to exactly 1.0 S.

If done right, all the cadions should add up to 1.

$$\frac{1}{1.047}$$

Between 99% and 100% is a good analysis.

Final Formula {(mg1.816Fe.175^{2+}Fe.009^{3+}Mn.04)Si.999O4}

2.1 Why Minerals Grow

→ Depends on P,T,X conditions

2.1.1 Thermodynamics

Used to describe and predict the equillibrium state of a system.

ex: Si, Al, Ca, O

CaO

Si_2

Al_2O_3

Al_2SiO_5

$CaSiO_3$

etc...

Gibbs Free Energy One of the ways we can quantify free energy using thermodynamics.

G = f(P, T, X) (x means composition)

Every substance, including minerals, has some Δ G_i = f(P,T,X)

Stable Equillibrium of a system is the one with the lowest <should be sum of some sort sumdeltaG> Δ G <Insert Picture of Stability graph>

Diamond wants to break down to graphite.

All this allows us to write REACTIONS

ex: $C_{Diamond} = C_{Granite}$

at the surface P,T: $\Delta\ G_{graphite} < \Delta\ G_{Diamond}$

ex: $CaAl_2Si_2O_8 = CaAl_2Si_2O_8$ anarthite melt

at surface P,T $\Delta\ G_{\_amorthite} < \Delta\ G_{anothite}$ <—————————- reaction proceeds

ex: $KAl_2(AlSi_3)O_{10}(OH)_2 + SiO_2 = KAlSi_3O_8 + Al_2SiO_5 + H_2O$ muscovite quartz feldspar sillimanite

at very high Temp > 700 degrees Celsius $\Delta\ G_{ksparSilliminH20} < \Delta\ G_{muscovitequartz}$

so Kspasr is stable or reaction ————————> reaction proceeds

ex: $2\ KAlSi_3O_8 + H_2O + 2H^+ = Al_2Si_2O_5(OH)_4 + 2K^+ + 4SiO_2$ Feldspar watah acid kalimite clay classified k+ Dissolved Silicon