

Consider the following chemical analyses of some greenish minerals.

Oxides	Sample #1	Sample #2	Sample #3	Sample#4
SiO ₂	40.99	38.11	33.72	31.85
FeO	8.58	31.48	47.91	58.64
MnO	0.2	0.22	0.41	0.85
MgO	50.00	30.50	18.07	8.49
Totals ->	99.77	100.31	100.11	99.83

Each of the bottle green minerals are found as well formed, Orthorhombic crystals in dense phaneritic (igneous) rocks.

Let us determine the chemical formula for these minerals (all are in the same mineral group!!!). These data illustrate a significant limitation with analyses of oxygen-containing compounds (compared to the analyses we worked with for sulphide minerals). There is no convenient method of analyzing for oxygen (O) so that the analyses are expressed as oxides of each element instead of the weight percent of the elements themselves.

Instead of converting the analyses to gram atomic weight proportions we convert to gram molecular weight proportions. This is convenient because the various silicate mineral subclasses (neso, soro, ino, cyclo, phyllo, and tecto- silicates) have specific ratios of metals to silica (as we will see). The conversion to gram molecular proportions (gmp) is accomplished by dividing the weight percent oxide by the gram formula weight of each oxide {i.e. for SiO₂: (40.99)/(28 + (2*16)) = 0.68 }

Determine the gram molecular proportions (gmp) for each oxide for each sample in the table below

Oxide	#1 (gmp)	#2 (gmp)	#3 (gmp)	#4 (gmp)
FeO				
MnO				
MgO				
Total Metals (TM)				
SiO ₂				
TM/SiO ₂				

1. What is the ratio of molecular proportions of total metal oxides to silica (SiO₂), that is molecular proportion of total metals/molecular proportion of SiO₂ in each sample? (This is a **WHOLE NUMBER**! for these samples, analytical error may result in slight variation from **WHOLE NUMBER RATIOS**)

2. What is an appropriate generic chemical formula for this mineral?
 (Hint: remember that the oxygen atoms from the metal oxides, as well as the 2 oxygen atoms in SiO_2 , should be assigned to the silica complex ion part of the formula as in SiO_x , where x is the total oxygen atoms in all analyzed oxides). What the heck is this mineral (group) anyway?
3. If we ignore the minor amounts of Manganese in each sample use the molecular proportions to **write a chemical formula for each analysis** using the model of: $(\text{Mg}_x\text{Fe}_{1-x})_-\text{SiO}_-$. This is done by calculating the molecular proportion (mp) of Mg to molecular proportion of total metals: $\text{Mg}_{\text{mp}}/\text{Mg}_{\text{mp}}+\text{Fe}_{\text{mp}}$, where Mg_{mp} is the molecular proportion of Mg in each sample, etc. and using this value as x

Chemical formula for:

Sample #1 _____

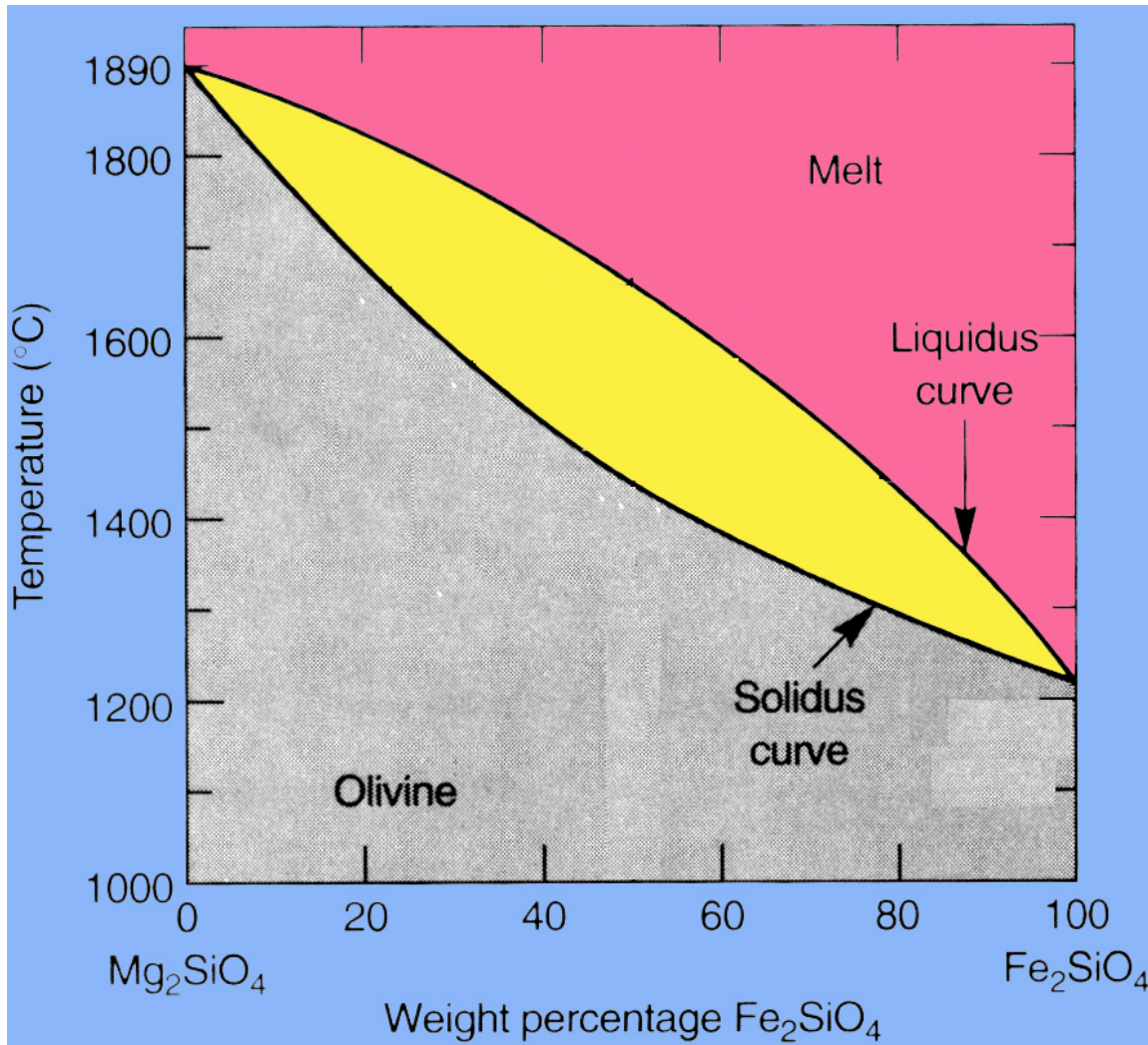
Sample #2 _____

Sample #3 _____

Sample #4 _____

Show all your calculations below.

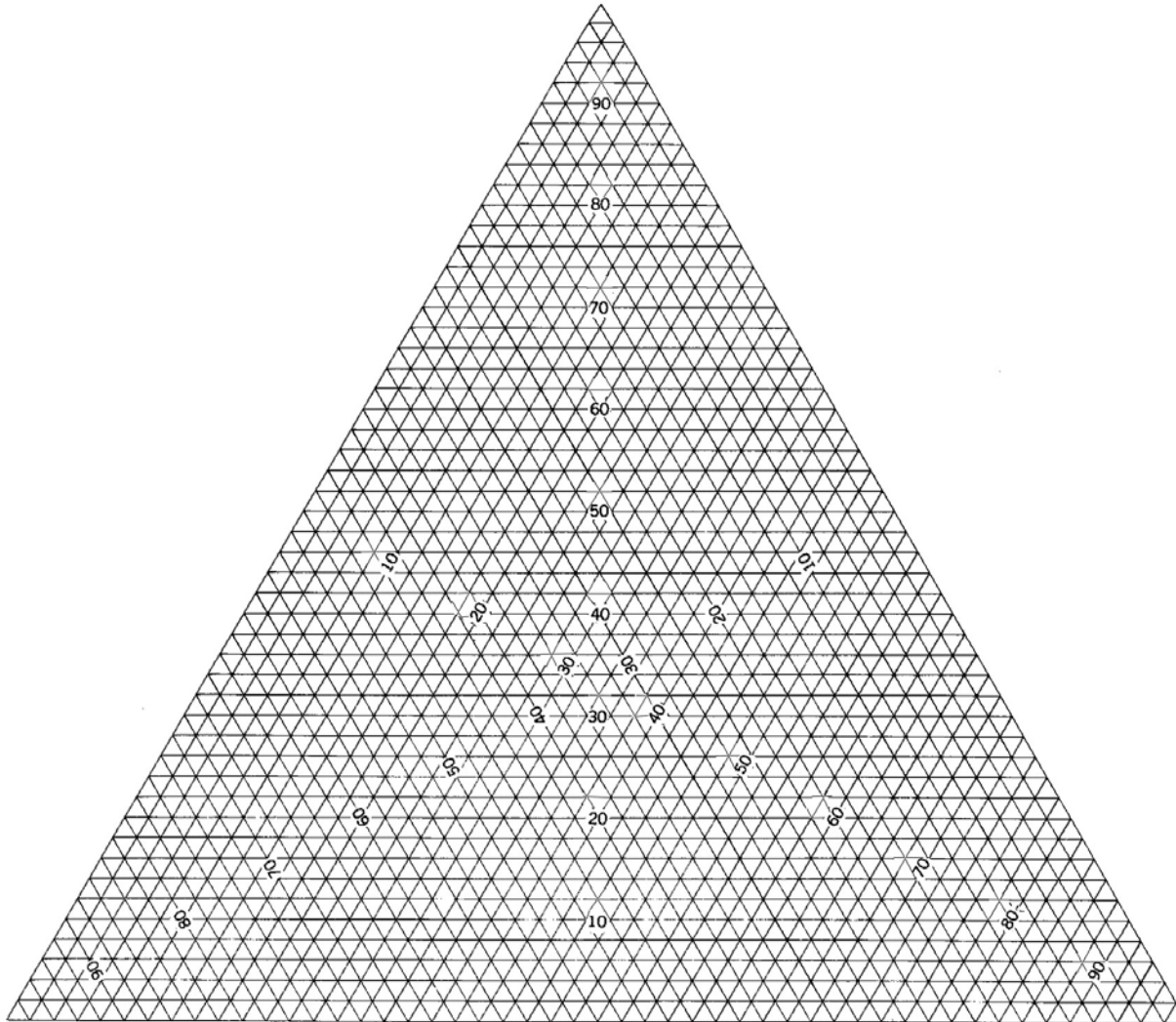
Use the binary T-X phase diagram below to answer the following questions.



4. Starting with a solid rock composed entirely of the mineral in sample #1 (yes, this is hypothetical), at what temperature will this rock melt? What is the initial composition of this melt?
5. Starting with a liquid that has a composition of sample #3, at what temperature will crystals begin to form? What is the initial composition of these crystals?

6. Plot the following mineral formulas on the ternary diagram and label each point with the appropriate letter

Wollastonite $\{Ca_2Si_2O_6\}$



Enstatite $\{Mg_2Si_2O_6\}$

Ferrosillite $\{Fe_2Si_2O_6\}$

- q. $(Ca_{.5}Mg_{.5})_2Si_2O_6$
- r. $(Ca_{.5}Fe_{.5})_2Si_2O_6$
- s. $(Ca_{.2}Fe_{.4}Mg_{.4})_2Si_2O_6$
- t. $(Ca_{.02}Fe_{.50}Mg_{.48})_2Si_2O_6$

- a. What is (are) the mineral group(s) represented on this phase diagram?
- b. Which mineral or minerals (q, r, s, t) are the most likely to be found in naturally occurring rocks?
- c. Which mineral or minerals (q, r, s, t) are not found in naturally occurring rocks?
- d. What is the explanation for your answer to "c". Hint: The term "miscibility" should be in your answer