



**Polymorphism** (See S&S Field Guide, pp 27-31)

1. The analyses for several other samples of marcasite (in wt %) are presented below.

	1	2	3	4	5
Fe	46.54	46.55	46.53	47.22	46.56
S	53.46	53.05	53.30	52.61	53.40
	100.00	99.60	99.83	99.83	99.96

a. What are the atomic and relative proportions (A-P/R-P) of Fe and S in each sample and what is the chemical formula for each sample of marcasite?

	A-P/R-P 1	A-P/R-P 2	A-P/R-P 3	A-P/R-P- 4	A-P- 5/RP- 5
Fe					
S					
Chemical Form					

b. What do you think is the reason for variation in analyses? Do you think there is any atomic substitution or is the composition of marcasite fixed?

c. Iron always occurs as either the ferrous,  $\text{Fe}^{+2}$  or ferric,  $\text{Fe}^{+3}$  ion in nature. Is marcasite a simple ionically bonded mineral phase? What type of bonding do you think occurs in this sulphide mineral? Hint: what is marcasite's luster?

d. Is there another common sulphide mineral closely related (in chemical composition) to marcasite? What is it? What is that relationship called?

Atomic substitution and Solid Solution

2. Let's take a look at chemical composition in a more complicated material system, the zinc sulphide mineral, Sphalerite.

	1	2	3	4
Fe	.015	7.99	11.05	18.25
Mn	-	-	-	2.66
Cd	-	1.23	0.3	0.28
Zn	66.98	57.38	55.89	44.67
S	32.78	32.99	32.63	33.57
	99.91	99.59	99.87	99.43

As the analyses indicate Sphalerite may be almost pure zinc sulphide or may contain a lot of iron and small amounts of other transition metals.

- a. What is the chemical formula shown for Sphalerite in your R&M guide? What type of bonding do you think exists in Sphalerite?
  
- b. Calculate the atomic proportions (round off to the 0.001 place) for each element in each analysis and enter it in the table below

	1	2	3	4
Fe				
Mn				
Cd				
Zn				
Total metals (add above columns)				
S				

- c. What are the relative proportions of total metals to sulfur for each sample?
  
- d. What are the (most probable) valences of each element?

- e. For analysis #4 calculate the decimal fraction of each metal (omit Cd) relative to total metals (divide each atomic proportion by total metals atomic proportion).
- f. How might you write the chemical formula for this sample of Sphalerite to show actual metals composition?
- g. Do ZnS and FeS (typically written  $\text{Fe}_{1-x}\text{S}$ , what is this mineral?) share the same crystal structure? What is this chemical relationship called?