

Lab.No.5

Geothermometry and Geobarometry

The chemical composition of Arsenopyrite and the coexisting Sphalerite taken from the Swedish metamorphosed Cu-Zn sulfide ore deposits were determined by an electron microprobe (Table 1):

Sample no.	Arsenopyrite (wt %)			Sphalerite (wt %)			Mineral Assemblages
	Fe	As	S	Fe	Zn	S	
1	32.3	47.06	20.64	6.55	60.19	33.24	asp + lo + po
2	32.27	48.81	19.52	7.14	59.57	33.36	asp + lo + po
3	33.5	44.7	21.8	6.81	60.04	33.14	asp + py + po
4	32.31	47.68	20.01	10.62	55.86	37.52	asp + lo + po
5	33.58	46.8	19.67	5.94	60.07	33.54	asp + +
6	33.87	45.16	19.93	5.18	60.84	33.69	asp + +

asp –Arsenopyrite, lo –Loellingite, po--Pyrrhotite, py—Pyrite

Atomic weights (Fe=55.85, As=74.92, S=32.06, Zn=65.38)

Unit cell parameters (dimensions) of Arsenopyrite (Monoclinic system) (a=5.2, b=5.7, c=5.8Å°, sinβ=0.923, V= a*b*c*Sinβ, G=6.01 g/cm³)

Unit cell (dimensions) dimensions of Sphalerite (Isometric or Cubic system) (a=5.23Å°, V= a³), G=3.92 g/cm³)

- 1) Find the chemical formula of the Arsenopyrite and the Sphalerite in each sample?
- 2) Calculate the atomic weight percentage of Arsenic (Atomic As %) in Arsenopyrite for each sample?
- 3) Using Figure (1), find the temperature of formation of Arsenopyrite in each sample?
- 4) Calculate the molecular weight percentage of FeS (Mol. FeS %) in Sphalerite for each sample?
- 5) Using Figure (2), find the pressure of formation of Sphalerite in each sample?

Methods of determination the temperature & pressure. One of these methods is using certain sulfide minerals

Geothermometers: Are specific minerals having chemical and /or physical properties that are sensitive to changing in temperature. Example: Arsenopyrite FeAsS

The Arsenic content in Arsenopyrite decreases with decreasing temperature for all tested Sulfur buffers.

Sulfur buffers: Mineral association that indicate a stability in sulfur fugacity with the coexisting Arsenopyrite and Sphalerite. For example, the presence of Pyrrhotite (FeS) with Arsenopyrite and Sphalerite indicates that the system is sulfur buffer.

Geobarometers: Are specific minerals having chemical and /or physical properties that are sensitive to changing in pressure. Example: Sphalerite ZnS

The molecular FeS content in Sphalerite decreases with increasing pressure at constant (definite) temperature.

$$Z = \frac{P * G * V}{N * 166.02}$$

a, b, c, β --- unit cell parameters (dimensions)

G --- Density of the mineral

V --- Volume of unit cell

Avogadro's number --- The weight in (g) of an imaginary atom having atomic weight equals one.

Avogadro's number = 1.6602×10^{-24}

Z --- the number of atoms of the element in the unit cell

N --- atomic weight of element

P --- the weight percentage of the element