

## Lab.No.4

Nature of the Ore-bearing hydrothermal fluid and the form in which metals are transported in these fluids

The solubility product of PbS in a saturated aqueous solution of PbS is  $16 \times 10^{-22} \text{ mol}^2 \text{ l}^{-2}$  at  $25 \text{ C}^\circ$ .  $\text{PbS(s)} \leftrightarrow \text{Pb}^{+2}(\text{aq}) + \text{S}^{-2}(\text{aq})$  (Atomic weight of Pb=207, S=32)

Q1) Assuming that metals in hydrothermal Ore deposits are transported by (a) normal aqueous solution (b) in simple sulphide forms, Calculate:

- The concentration of Pb in a saturated aqueous solution of lead sulphide at this temperature in ( $\text{g.l}^{-1}$ )?
- The volume of aqueous water that would be necessary to transport and deposit the Pb in a small ore body containing  $10^3 \text{ t}$  of Galena (PbS)?

Q2) Assuming that the metals are transported by brine fluids (similar to the Salton Sea brine fluids in a simple sulphide forms, Table 1):

Table (1) Analysis of possible Ore fluids compared with ocean water

Element symbol	Ocean water ( $\text{mg l}^{-1}$ or ppm)	Salton sea brine ( $\text{mg l}^{-1}$ or ppm)
Fe	0.01	2290
Mn	0.002	1400
Ca	400	28000
Cu	0.003	8
Pb	0.00003	102
Zn	0.01	540
Ag	0.00004	1
Na	10500	50400
K	380	17500
SO <sub>4</sub>	2650	5
Cl	19000	155000
S(as H <sub>2</sub> S)	-	16
pH	~ 8.5	~ 7

- a) Compare between the chemical composition of brine fluids and seawater?
- b) Determine the concentration of the elements (Pb, Cu, Zn, and S) in Salton Sea brine in (mol/l)? (Atomic weight Cu=64, Zn=65, Pb=207, S=32)
- c) What proportion of the total metal content (Zn, Cu, and Pb) could be directly precipitated from Salton Sea brine as sulphide with the available S?
- d) The lead-Ore deposits were deposited as metal sulphides (ZnS, PbS, and CuS), what do you suggest for the source of S needed to deposit most of the Pb present in the brine fluid?
- e) Using Table 1 calculate the volume of water with the chemical composition of the Salton Sea brine that would be necessary to deposit the Pb in a small Ore body containing  $10^3$  t of Galena (PbS)?
- f) Compare between your results in Q1 (b) and Q2 (e)?

Q3) Assuming that metals in hydrothermal Ore deposits are transported and deposited by brine fluids in a simple chloride form:

- a) Use the data in Table 1, Calculate the concentration in mol/l of Silver ( $\text{Ag}^+$ ) and Chlorine ( $\text{Cl}^-$ ) present in the Salton Sea brine? (Atomic weights Ag=108, Cl=35.5)
- b) How does the product of these concentrations compare with the solubility? product of AgCl which is  $(1 \times 10^{-10}) \text{ mol}^2/\text{l}^2$ ?
- c) Does this suggest that the metals are transported as simple Chloride or complex Chloride?