Suggested Answers to Week 1 Assignment 1

1. Mineral deposits are not only important from economic point of view, they sometimes are important indicators of evolution of the earth. Attempt to justify this statement with reference to some known types of deposits.
   Ans: Mineral deposits are useful indicators of the evolution of the earth’s lithosphere – hydrosphere – atmosphere. The two deposit types – the BIF and the detrital U-deposits in quartz pebble conglomerates, which are restricted to the Precambrian are examples.

2. Bring out the important differences between the rock forming silicate and ore-forming sulfide/oxide minerals.
   Ans: Silicates consisting of SO₄ tetrahedral building blocks are bonded to cations by ionic bonding which plays a dominant role in most of their properties. In case of oxide and sulphide minerals of transition metals, the bonding is mostly by metal-sulfur or metal oxygen weak bond along with weak van der Waal bond that is responsible for many of the properties.

3. From the periodic table, pick up elements which constitute (i) energy resources and (ii) resources for fertilizer and chemical industries.
   Ans: Energy resources elements are C, H and transuranic elements having spontaneous radioactivity. N, P, S, K are the elements constituting fertilizer industry.

4. What is enrichment factor and describe it's relation with crustal abundance of elements and mineral resources?
   Ans: Enrichment factor is the value corresponding to the ratio of concentration of any element between a fraction that separates from a parent material and the parent material itself. Elements are concentrated in subsequent fractions till the formation of the crust and that is the crustal abundance. The crustal rocks need to be further enriched by various processes to form ores.

5. Why tectonic boundaries are susceptible to mineralisation? Also, state some world class examples of important Mineral deposits associated with them.
   Ans: Tectonic boundaries such as the divergent and convergent regimes are the locales of magmatism and fluid channelization. Therefore, they host mineralizations. World class examples of mineralization in divergent settings are the VMS (Noranda, Quebec) deposits, convergent settings are porphyry copper deposits in the Andes and Cordillera regions.

6. What do you mean by enrichment factor? How is this parameter manifested in formation of ore deposits of variable quantity in the earth’s crust? Explain with examples.
   Ans: Refer Question number 4

7. Why is the type of ore deposits of a metal like Cr so restricted as against copper, which forms deposits in widely varying crustal environments?
Ans: Cr is essentially a compatible metal and has very restricted mobility in fluid. Thus it is only mobilized in an orthomagmatic process. Cu is less compatible and is very mobile in crustal fluids and thus forms deposits in widely varying environments.

8. Some metals formed their deposits quite early in the history of evolution of the crust whereas some others formed their deposits quite late. Why?
   Ans: It can only be explained based on their values of enrichment factor such as Pb, Sn, W and Mo.

9. What is the reason behind restricted occurrence of Banded Iron Formations (BIF) in the temporal spectrum?
   Ans: BIFs are essentially chemogenic sediments and thus in order that they will form in huge quantity, enormous amount of Fe needs to be dissolved which would require the environment to be quite reducing on a global scale, that was the case in the early earth.

10. A plot of reserve base of metals versus upper crustal abundances shows the distribution of points on distinctly near-parallel linear trends, instead of falling on a single straight line. Discuss the probable reason for such observed trends depicting such a plot.
   Ans: Such trends are observed since different metals form their deposits in environments with variable preservation potentials.

11. Although crustal abundance is a first order control of occurrence of mineral deposits in their observed quantities, there are some exceptions to the general rule. Explain why it is so, especially for metals like Cr and Cu which occur in larger quantities than what would be expected from their crustal abundance.
   Ans: Cr forms its deposits with the highest preservation potential in continental interior. Cu forms in diverse environments and gets enriched in secondary weathering cycle rather than getting destroyed.

12. Although Fe occurs in the form of oxide and sulfide minerals at comparable abundance in nature, the sulfide of Fe is not considered as a resource for Iron at the moment – why?
   Ans: Pyrite has less Fe per formula weight than hematite/magnetite. Besides, extraction of Fe from pyrite and other Fe-sulfide minerals will be more energy intensive and unfriendly to environment.

13. Ore deposit formation can be visualized as the Earth’s own mechanism of beneficiation. Justify this statement citing one each of deposits resulting from endogenous and exogenous processes.
   Ans: One example of endogenous process is formation of chromite deposits in mafic/ultramafic complexes. Example of exogenous process is bauxite deposit formation.

14. What do you understand by ‘paragenetic sequence’? How is the paragenetic sequence in an ore body deduced? Why is it necessary to deduce the paragenetic sequence in a mineral deposit?
   Ans: Paragenetic sequence is the temporal order in deposition of different minerals / mineral assemblages in an ore body. The sequence of deposition of minerals is deduced from systematic study of texture of the ore-gangue mineral assemblages.
Paragenetic sequence gives the first hand information about the physicochemical environment of formation of the ore deposit.

15. Distinguish between ‘concordant’ and ‘discordant’ ore bodies and examples. Are all concordant ore bodies ‘syngenetic’? Give reasons to justify your answer.

Ans: Concordant ore bodies who are conformable to the host rock whereas discordant ore bodies are not conformable to the host rocks – their attitude are intersecting in nature. All concordant ore bodies may not be syngenetic. For example, some mineralization processes are stratabound – meaning preference of a particular stratum in hosting mineralization caused by later fluid activity.