MINING GEOLOGY

(THEORY 3)

Chapter -3:: Prospecting And Exploration

Prospecting.

Prospecting means looking for ores minerals of value of importance. Prospecting is a sum total of systemic process under taken in a sequential manner to discover new ore deposit.

Differentiate between prospecting & exploration.

Prospecting	Exploration
Prospecting is a sum total of systemic process under taken in a sequential manner to discover new ore deposit.	Exploration is a incorporates set of operation take drilling, trenching keeping sampling assaying, core, ranger, estimated of determining the availability of the ore deposite.

Various criteria for geological exploration.

Geochemical prospecting :

This method aims of plotting on suitable map such dispersion pattern of farce metal in sample of soil ground water or vegetation (usually leaves) collected of suitable interval from the area to be prospected aromatizes are indicated by a marked in the concentration of farce metal from the back ground valve. It deals with examination with the earth crush consist of not only rock but also water & gases.

It is divided into two primary and secondary processes. Primary process are connected with magnetism. Metamorphism. Secondary process are associated with superegos agent of rock degradation of water.

On primary geochemical prospecting important to dated difference in the distributor of element in the earth crust. Dispersion is influenced both mechanical as well as chemical process, primary cone of mineral is due to pressure and temperature condition.

Element under normal differentiation separate group oxy phallic, chalo phyllic (sulpher) phylllic side rophyllic (iron) and phylllic.

Methods of Geophysical prospecting.

Geophysical exploration :

It take the help of natural physical parameters of earth side like gravity magnetism or natural electric field. Artificial physical field is created by electrical radioactivity.

There are major type of geophysical exploration method such as

(a) Gravity Method, (b) Magnetic Method, (c) Seismic Method,

(d) Geothermal Method, (e) Radiometric Method (f) Electrical Method.

Gravity Method :

1. It represented a set of geophysical method which makes use of the natural gravity field of the earth. Density is the physical prospers which helps in gravity method.
2. In gravity method the nature of distribution of gravity on the surface is analyzed. The gravity influenced positively by heavier longer & shallow depth ore bodies.
3. If the gravity field deviates from the normal value then bodies can be present below the surface.
4. The geophysical unit of gravity is villigals & cotors.
5. The different kinds of gravity methods are gravity prospecting gravity logging air born gravity & sea burn gravimetric.
6. It fonds application for exploration of ore deposit oil & natural gas regional geological structure sub surface geology solving engineering problems etc.

Magnetic Method :

1. It makes use of the natural magnetic field of the earth.
2. The physical properties with operates upon his method is based on the fact.
3. The magnetic method is based on the fact that magnetic bodies present in the earth sub surface continue to the magnetic field of the earth.
4. When the magnetic field of the earth is measured on the surface bodies processing magnetic moment different form those of surrounding rock contribute.

5. Magnetic instrument use are magnetic meter tension magnetometer & fluxgate magnetometer.
6. Unit Gamma & Orestar.
7. It is used for locating iron nickel, tin chromites.

Seismic Method :

1. The elastic property, difference in rocks the controlling properties.
2. It is based on the principled that sub surface rock formation bear different elastic properties.
3. The velocity of propagation of seismic ways through them changes with change in lithology.
4. In seismic method artificial explosion are made in ground.
5. The waves this practice travel through the sub surface layer critical refraction.
6. With the help of geophones fixed suitable intervals on the ground, the different seismic way reaching the surface are recorded & from the time of the arrival time distance curve are constructed.
7. These graph known as hodographs seismic waves are of 4 types, (a) Primary wave, (b) Secondary wave, (c) Long wave, (d) Reflected wave.

Radiometric Method :

1. The controlling parameter is the natural radioactivity of rock & ore.
2. The normal radioactivity is different types of rocks.
3. If rock contains radioactive are bodies such area will show very high radioactivity given rise to anomalies.
4. Igneous body have relatively more radioactivity than basic & ultra basic roads.
5. There are two types of natural radiometric method employed in the field. These are (a) Gamma method and (b) An Emanation method.

Gamma method : In which the intensity of gamma rays from rocks or ores in a area is measured.

A Emanation method :

1. In this method the concentration of radioactive emanation of solid & air are measure.

2. The instrument used as Geiger miller counter or scintillation counter or Gamma ray spectrometer.

3. Unit : Milicurie or Microcurie

4. It is used in exploration of uranium theorirare earth metal like Berrilium. Lithium, Tanteium, Neobium.

5. In the exploration of oil & natural gas the radioactive tracer techniques is utilize to measure velocity of ground water direction of flow & salt water instruction.

Geothermal Method :

1. Here the controlling factors thermal conductivity.
2. The temperature distribution on the surface of the earth is occurred in three sources.

   (a) Insulation : in coming solar radiation.

   (b) Heat conveyed from the intercoring earth by conduction & convention.

   (c) Due to radioactive mineral.
3. The reodual value of temperature distribution on the earth surface can be interrupted in forms of sub surface geology.
4. The instrument used as thermister thermometer, platinum thermometer, radiometer and crystal defector.
5. It used in deep structural ore deposite and ground water.

Electrical Method :

It is based on the fact that the sub surface formation & ore deposite contain different electrical properties. The different methods are as follows :

(a) Electrical resistivity method : Electrical resistivity is of sub surface formation varies from one another.

(b) Werrer : Unit – ohm x meter, Instrument used is electrical resistivity meter.

(c) Electromagnetic Method :

- The alternative emf is established ground using an artificial source.
- The electromagnetic field unduces feddy current is the conducting ore body.

- The different method includes (a) Sargram, (b) Enslin, (c) Turam, (d) Sundberg.

(d) **Self potential** : It uses the natural method electric field of the earth sulphide one like pyrite, pyrchilite, chaleophrite. The instrument used a pair of non pollarisable electrodes & potentiometer. Unit is Millivolt.

(e) **Induced pollarisation** : Based on the study of secondary electro chemical process that takes place on the sub surface due to flow of electric current. When direct electric current is passed in the ground the current is ionic electrolyte & electric solid minerals. Thus at the electrolyte conducting particle boundary the change is transformed from ion to the particle. Thus (+ve) ion change pole of at the particle boundary when the current is stopped the accumulated charge is the material give rise to reodual voltage which decrease with time. Unit is Millivolt. It is used in exploration of sulphide & ground water.

Geochemical prospecting.

It deals with the examination of the earth crust consisting not only of rocks but also water gases. Geochemical processes are divided into primary & secondary processes. Primary processes are connected with magnetism and metamorphism. Secondary processes are associated with super gane agent rock degradation as well as magnetic water. In primary geochemical prospecting it is important to detect difference in the distribution of elements in the crust. Dispersion in influence by both mechanical as well as chemical. Primary concentration of ore minerals is due pressure & temperature condition. Element under normal condition magnetic differentiation separate out as group like oxy phyllic, chalcophyllic, lethophyllic, sidenophyllic, atmophyllic, which plug a significant path lock for emplacement and concentration of economic mineral deposit.

Biogeochemical & Geobotanical prospecting.

Biogeochemical Prospecting: Roots, barks, leafs, concentrate, elements from the ground uniform of nutrient elements like as CO, Zn, Ca, K, P, Fe, Mg, Mn, etc are important for the growth of plants to be surveyed to be assayed using various chemical and weight chemical method. First this plant parts are dry in the sun burnt under errabic condition. Then the ash is finaly powdered & leached with hydrochloric & hydrogen sulphide. The organic part are washed a ray leaving behind elements residue. Then this residue are analysed or assyed using weight chemical & instrumental techniques. The concentration of a particular element in the plant parts we give the picture about the concentration the element below.

Geobotanical Prospecting : Plants depend for their growth on geological CO_2 moisture and mineral nutrients. Certain elements are essential & important for its growth & development where as some elements are toxic to plant growth the different morphological modification are visible.

For Cu, osmium humble is a indicator of Cu mineralization in below. A crocephylus Roberto, polycarpea, spira styles, poly, carpea, corymboso are indicator of Cu.

For CO, Critotoria cobalticola & silence cobalticola.

For Pb & Zn, Plantgo lanceolate, lobilla inflate, sorghustram Neutrons (grass)

For Mo, Molitus alba, trifolium repens, lotus carniculates.

Chapter 4:: Economic Geology

Tenor :

The metal content of an ore is called the tenor of the ore. It is generally expressed in percentage of the metal. It say pays for the extraction cost of the ore.

Grade :

Signifies the commercial classification of an ore where by the physical and chemical parameters are taken into account beside its qualitative aspect.

Mineralogy, mode of occurrence, distribution & use of iron ore deposits in India.

Mineralogy :

The chief economic iron ore minerals are :

Magnetite	Fe_3O_4	(containing 72.4% of iron)
Hematite	Fe_2O_3	(Fe=70%)
Limonite	$2Fe_2O_3, 3H_2O$	(Fe=59.8%)
Goethite	Fe_2O_3, H_2O	(Fe=62.9%)
(Spathic ore)		
Siderite	$FeCO_3$	(Fe=48.2%)
Pyrite	FeS_2	(Fe=46.2%)

Chamosite and thuringite are examples of iron silicate minerals.

Mode of occurrence :

Iron ore deposite occur as magma tic deposits, as bedded deposits, as residual concentration deposits or sometimes as nodules and concretions in shales associated with coal-seams.

Distribution in India :

1. The biggest iron ore field of India is situated in the Singhbhum district of Bihar and the adjoining districts of Keonjhar, Sundergarh and Mayurbhanj of Odisha. The important mining centres of Odisha and Bihar are Barbil, Gua, Bonai, Joda, Kiriburu, Suleipat, Gorumahisani, Noamundi, Barajamda etc.
2. Madhya Pradesh: In the Bailadila hill ranges.
3. Maharashtra: Ratnagiri district.
4. Goa: Bicholim- Pale in Goa.
5. Karnataka: Bananudan hills in Chikmagalur district, and in Sandur, Bellary, Hospet districts as well as Shimoga and Chitaldrug districts. Important one is that of Kudermukh.
6. Andhra Pradesh: Cuddapah, Kurnool, Chitnoor, Nellore, Anantapur, Warangal and Adilabad districts.
7. Tamilnadu: Salem district, and Tiruchirapalli district.
8. West Bengal: Deposit of lateritic ores mostly occur in West Bengal.
9. Assam: Iron stone clay are found as nodules and thin beds in the coal measures of Eocene age and in the Tipam series of Miocene age.

Use of Iron :

1. Smelting for steel.
2. Srenge iron.
3. Rail, coaches, wagons, ships.
4. Heavy machineries.
5. Koaol breezes & buldings dums.
6. Weapons and reaitors.
7. High speed steel.
8. Utensils & forming equipments.

9. Coal iron, Pig iron, wrought iron.

Mineralogy, mode of occurrence & description of Chromites deposits in India & its uses.

Mineralogy:

It is an important alloying element in the manufacture of steel Chromite is the only ore-mineral of chromium.

Chromite – FeO, Cr_2O_3, Cr_2O_3 = 68.0% and Cr = 46.66%.

Mode of occurrence:

Chromite deposits occur as lenses, masses, veins and disseminated grains in host rocks. The deposits are regarded as the early or late magma tic segregation or injection product.

Distribution in India:

The largest shromite deposit in the country is located in the Sukinda ultrabasic belt of Cuttack and Dhenkanal district of Odisha, and also in the Keonjhar district of the state. The belt extends over a distance of about 20km, the width of the belt is about 2km. the ore bodies are lenticular in shape and occur as lenses and patches within the lateritised ultrabasic rocks.

The other important deposits occur in:

(i) Andhra Pradesh: Kistna district (Kondapalle)

(ii) Bihar: Singhbhum district.

(iii) Karnataka: Chitaldrug, Hassan and Shimoga districts.

(iv) Tamil Nadu: Salem districts (Sittampundi).

(v)

Economic uses:

1. In the metallurgical industries in the production of various non ferrous alloys of chromium and also in the form of ferro chrome for manufacturing chrome steel.
2. In refractory industries, due to its high resistance against corrosion, high temperature and sudden temperature changes and its chemically neutral character.
3. In chemical industries, for the manufacture of chromium compounds like chromates and bi-chromates and chrome acid etc.

Mineralogy, mode of occurrence & distribution of copper deposits in India & uses of this metal.

Mineralogy:

It is the most important non-ferrous metal and was the earliest metal used by man. In nature copper occurs in four principle formes, sulphides, carbonates, oxides and as native copper. Of these the bulk of cooper is obtained from the sulphide ores. To be economically exploited a cooper ore should contain at least 2.5% of copper. In modern times ores with 1% of copper are also used.

Mode of occurrence:

Copper deposits may occur as.

(a) Disseminated ore bodies: Where the copper minerals are generally dispersed in a large volume of rock. They are generally of low grade. The porphyry copper deposits of USA are of this type.

(b) Massive, irregular or lenticular ore bodies, which are formed by the process of replacement.

(c) Vein deposits or lodes: In which the copper hearing solutions percolating along shear zones and rock fractures deposit copper mineral with changes of temperature and pressure forming fissure veins, copper deposits of Singhbhum.

(d) Deposits following stratigraphic beds, as is the case with the deposits of Khetri (Rajasthan).

Distribution in India :

1. In Andhra Pradesh, the most important copper deposits are the Agnigundla deposits.

2. In Bihar, in the Singhbhum district, a copper bearing belt of about 80 miles long occurs. Here the copper ores occur as veins in the country rock consisting of mica achists, quartz-schists, chlorite-schists, biotite-schists, granite and granite-gneisses.

3. In Madhya Pradesh, the important deposit is the Malan Jhakhand copper deposit, where copper ores occurs in the form of veins within dolomitic limestone.

4. The Khetri copper deposit of Rajasthan is one of the important copper deposit in the country. This belt has 3 richly mineralized sections - Madhian, Kolihan and Akhwali.

5. Other important copper deposits of the country are as follws

(a) Himachal Pradesh: Kangra, Kulu valley.

(b) Mysore: Chittaldrug, Hassan, Bellary districts.

(c) West Bengal: Darjeeling, Jalpaiguri districts.

(d) Sikkim: Rangpo and Dickchu deposits which are found to occur in association with the metamorphic rocks belonging to the Daling series.

Economic Uses:

The metal is of great industrial importance, because of its high electric conductivity, high ductility and malleability. Thus it is mostly used in electrical manufactures. Besides, the copper alloys are used in buildings, automobiles, air planes, naval ships, house hold utensils as well as in metallurgy and paints.

Mineralogy, mode of occurrence, distribution of lead & zinc deposits in India & the uses of these metals.

Mineralogy:

The two metals lead and zinc rarely occurs in native state, they generally occur in combination with other elements. The ore minerals of lead and zinc are usually found to occur in association with each other. The following are the important minerals of lead and zinc:

Lead	**Zinc**
Galena-PbS-Pb 86.6%	Sphalerite or zinc blende – ZnS, Zn – 67%.
Cerussite-$PbCO_3$-Pb 77.5%	Smithsonite or Eng. Calamine – $ZnCo_3$, Zn-52%.
Anglesite-$PbSO_4$, Pb 68.3%	Hemimorphite or Americanname
	Calamine Zincite- ZnO – $2ZnO_2SiO_22H_2O$, Zn– 54.2%

Mode of occurrence:

Most of the lead ore mines of the world are also zinc ore producers and nearly all zinc ore deposits carry lead ore. Both lead and zinc ore bodies usually occur as veins and massive or tabular lodes, and as disseminations, mostly in limestone or dolomites. Majority of these ores occur as cavity fillings and replacements formed by low temperature hydrothermal solutions.

Distribution in India:

The most important lead zinc deposits of economic value in India is the Zawar deposit of Udaipur district of Rajasthan. India' s reserve of these ores is meager compared to her needs.

In the Zawar area, the Mochia Marga, Barai Magra and Zawar Mala hills contain most extensive deposits.

The ore minerals consist of argentiferous galena associated with sphalerite and chalcopyrite. The ore contains 1.5 to 2% of lead and 4.5 to 5% zinc.

Other important occurrences in the country are as follows:

(a) Lead copper ore deposits in Agnigundla area of Guntur district of Andhra Pradesh.

(b) Lead zinc copper belt of 3 km long in Ambamata Devi area of Gujarat and Rajasthan.

(c) Sargipalli area in the district of Sundergarh (Odisha).

Economic uses:

(i) Lead is used in the construction of accumulators, for lead piping and sheeting cable covers, as pigments in glass making, in medicine etc.

(ii) Zinc is used for coating, galvanizing iron and steel products, in the manufacture of pigments and alloys with other metals, in the manufacture of batteries and electric appliances. Besides they are widely used in textile industry, timber preservation etc.

Methods of sampling as outlined by Bureau of Indian Standards. (BIS).

The different methods of sampling are as follows:

1. **Grab sampling:**

- It is the random collection of broken chips from the expose surface of an out crop from the mine working or from stock material.
- The material from the stock can be obtained by a small hand shovel.
- Grab sample is generally obtained during the preliminary survey.
- The grade of the deposit can' t be relied upon from the assay valve of such sample.

2. **Chip Samples:**

- Chip samples closely resemble grab sampling accept that the sample is collected from a fresh rock surface.
- The surface of an ore body is first clean by a wire brush and then a chip or fragment is broken by a hammer.
- This is also used in preliminary survey.

3. **Channel or Groove Sampling:**

- It is collected from groove cut systematically across the exposure of the ore body.
- It is used in sampling of frenches, pits, drifts, winzes, raises, shafts.
- The purpose of cutting a groove or channel is to ensure that uniform quantity of material is drawn the entire ore body.
- A channel of 10cm with and 2.5cm depth is cut.
- After cutting a groove across the ore body parallel to the true with samplers drawn by further deepening the groove by means of a chisel to a uniform depth.
- When the ore body consists of a alternate bend if reached and liner and each type is separately sample.

4. **Bore Hole Sampling:**

- It is carried out by drilling bore & hole in the leased hole area.
- It is the most modern method of examination of mineralization under neat the surface of the earth.
- The horizontal extension and the vertical persistency of ore body is easily de-marketed by bore hole sampling.
- Drill holes are place at suitable intervals preferably on a grid pattern to determined on easy valve of the ore.
- Bore hole cores are taken out and preserved in core box.

5. **Bulk Sampling:**

- A few tones of the ore either from the French pit channel or from run of mine ore taken out all are collected to determined ore for its physical properties and its accumulative to beneficiation techniques by pilot plant foot.

- For iron ores the bulk sample is taken to examine the ratio of fines to total mass of core mines.

6. **Car and Wagon Sampling:**

- It is obtained by taking a predetermined on quantity of run off mine from each car load or wagon load.
- It is done to determine the quality of ore dispatched to the mill of beneficiation.