D.N.R.COLLEGE (AUTONOMOUS), BHIMAVARAM
III B.Sc., GEOLOGY

MINERAL EXPLORATION

Mineral exploration is the method of scientific and systematic investigation of mineral deposits for their size, shape, depth and economical viability. Mineral exploration is combinational process of prospecting and exploration

PROSPECTING:

This process also called as primary exploration. In this method includes the following steps

I) Choosing the mineral deposit
II) Choosing the area/location

Prospecting is includes the process from license obtain from government to exploitation of mineral deposit. In this stage, identified the mineral deposit and its position.

EXPLORATION:

Prospecting is followed by exploration during this phase investigation is the prospector attempts to obtain such information as shape, size, structure, composition, reserve and value of a deposit with a view to its developing or driving openings for mining and handling of ores. Ores and minerals thus mined are next exploited or subjected to extraction of valuable metal or metals or put to industrial use directly.

GEOCHEMICAL DEPERSION

Geochemical prospecting for minerals includes any method of mineral exploration based on systematic measurement of chemical properties of naturally occurring materials.

The mobility of elements/geochemical elements from one environment to another environment is called Geochemical dispersion. In geochemical prospecting, the primary object is to detect differences, in the distribution of the elements, in the crust. Hence, the factors controlling dispersion are of immediate consequence. Dispersion is influenced by both mechanical as well as chemical processes and this can happen under primary as well as the secondary petrogenic conditions.

Primary dispersion:

Primary dispersion takes place in an environment of high pressure and high temperature in deep seated rocks. In primary dispersion, the channel ways and sites of redepositing are generally the fissure and inter granular openings of deep seated rocks.

Primary concentration of ore minerals is mainly according to the P and T conditions, when the elements under normal magnetic differentiation separate out in groups such as lithophilic, chalcophyllic, siderophyllic etc.

In addition various controls like structural, lithologic and stratigraphic also play a significant part as loci for emplacement and concentration giving rise to economic mineral deposits. The primary dispersion controlled by the following factors

- Origin
- Dispersion pattern
- Chemical composition
- Physio-chemical conditions

Secondary dispersion:

Secondary dispersion takes place at or near surface at low pressure and low temperature conditions. Secondary dispersion pattern may further be classified as syngenetic or epigenetic and genetically they may further be classified as

a) Clastic-dispersion by movement of solid particles
b) Hydromorphic-movement in aqueous media
c) Biogenic- where patterns are the results of biological activity.

Secondary dispersion takes place at/near the surface of the Earth. Patterns are formed in the fissures and joints of near surface rocks, in the pore spaces of overburden/even in the open air.

GEO-BOTONICAL METHODS:

The process of locating mineral deposits based on the morphology of plant species and their distribution. The geo-botanical method depends on the direct observation of plants morphology and distribution of plant species. These methods have very great advantages over other geo-chemical methods of prospecting the result of the survey are immediately available without further treatment of sample.

The geo-botanical method is based on the fact that contain species of vegetation grown on soils of a certain chemical composition some plants grow much larger on soil fertilized by manganese and their vegetative growth is very abundant.

Some plants change the shape of their leaves on Zinc soils and change their color yellow or read, brown-dark green leaves. The geo-botanical methods can be classified as

- Direct indication
- Indirect indication (Bio-Geo chemical)

Direct indications are classified as a) The method of universal indicators

b) The method of local indicators

UNIVERSAL INDICATIONS:

These plants confined extremely to soils and rocks containing certain definite elements. For example, calamine violet which grow only on soils with rich in Zn-content

LOCAL INDICATORS: These are widely distributed plants which way be used certain conditions as indicators of some definite environments in soils and rocks. Example for local indicators are gypsum bearing clays, sands, saline areas boron rich areas etc…

BIO GEOCHEMICAL METHODS:

Indirect indication is also known as Bio-geochemical methods. Biogeochemical methods are the process of locality mineral deposits based on the study of elements concentration of plants. Uptake availability of any element for plant is increased either by determining the amount of elements that can be removed from the soil by leaching with chemical reagents/by growing the plants in the soil and determining the amount of elements taken by the plants.

PROCESS: uptake the plant species from every part of the plant, such as roots, leaves, trunks, and branches. Analyze the burned powder of these species for elemental concentration. The elemental concentration of the plants gives the elemental methods of soil or rocks of the area.

By these biogeochemical methods we can find out the chromium, manganese, iron, nickel, copper and zinc deposits present beneath the earth surface. These methods are more useful for quaternary sedimentary formations.

PATH FINDER ELEMENTS

In the case of certain minerals, especially those containing the elements which do not respond to chemical weathering and are poor in concentration, the practice has been to find out the concentration of an associated elements known as the "path finder" elements.

Generally, the mineral deposits formed with the following elements:

a) Main elements/related elements
b) Associated elements
c) Non related elements

In Geochemical exploration, the associated elements are helps as path finder elements. Some times the common elemental rations also used as path finder elements.

1) NI-CO RATION:

NI-CO are commonly associated with pyrites ferrous rocks and with a basic rocks. If the measure the ratio of NI-CO, we can find out the silver ore deposits beneath the surface.

2) **BA-SR RATIO:**

A mineral deposit is distinguished from hydrothermal to sedimentary process, the Ba:Srration is useful. In hydrothermal deposits the Ba concentration is more, and Sr concentration more in sedimentary deposits

3) **Pb-Zn RATIO:**

Lead and zinc elements commonly associated with each other. If we find the any one of these elements, estimate other elements concentration.

Ba useful in searching ifPb-Zn deposits, sulphide deposits.

Cadmium useful in Zn deposits. Chromium associated with Ni, Mg in ultrabasic rocks, and associated with Fe, Al sedimentary rocks.

SAMPLING METHODS

Sampling is an art of collecting smaller pieces of the material which represents a large extent. Samples should have un-weathered, fresh surface always, samples should be of **3"x4"x5"** dimensions. It should be of an approximate bricks size. Samples should be 50% for repository and 50% should be used for laboratory purpose or storage for microscope analysis

TYPES OF SAMPLING METHODS:-

1. Grab/chip sampling
2. Channel/groove sampling
3. Borehole sampling/drill hole sampling/pit/trench
4. Bulk sampling

5. Car/wagon sampling
6. Muck sampling.

Grab/chip sampling:-

Grab/chip sample is in the reconnaissance stage. It is preliminary random collection of samples which is collected from the outcrops. A series of chips of rock is taken either in a continuous line across the exposure or at random interval along a face. The method is less laborious. But, this method should never be used until it has been thoroughly checked against channel sampling. It has no place in examination work except perhaps when quick preliminating reviews are needed.

Channel/groove sampling:-

Channel/groove sampling is the advanced stage of sample collection. It is collected in the strike direction of the channel. The width is 10 cms and depth is 2.5 cms. We have to cut the channel for samples by the above dimensions. The channels have to be cut systematically throughout the body.

Bore hole/drill hole sampling:-

Drill hole samples can be collected at different depths when a drill bit makes holes into the ground surface. Samples can be collected even from deeper depths. Drill hole sampling is taken in the final stage of exploration. Bore hole sample is also called as core sample.

Bulk sampling:-

Bulk sampling is the method of collecting the samples in bulk quantity. The sample is dugged in an exploratory mining area with a diameter of 4x5 mts. Samples can be reduced from tonnes to a few grows by coning and quatering.

Car/wagon sampling:-

Car/wagon samples are a reference of everyday sample collected regarding it's grade, quality etc. Every car leaving from the mine site brings 2-3 kgs of sample every day. This sample is powdered and it is taken to the chemical lab where analysis report of the ore is given. This sampling gives a fairly large sample it stands a chance of being reliable though the usual tendency is to take too much either of the cause or the fine material. A check may be obtained by averaging all the car samples for a day and comparing with the corresponding will head sample for the daily mill head sample is likely to be correct. Even with this check. The car sample from a single heading may be is correct though balanced by compensating errors from other sources.

Muck Sampling:-

A grab sample of the muck pile after blasting is sometimes taken instead of a cannel sample of a face. This is usually done very crudely by picking up pieces of rock of convenient size. While it is theoretically unreliable, a muck sample may give correct results in some axes whose qualities evenly distributed or are independent of breaking qualities. It is used gold ornaments. It is one type of sample. Sample mining is muck sample, it is help of grade sampling.

ERROS IN SAMPLING:-

Sampling results may go wrong at anyone of the several points during the process of estimating are values, for one or more of the following reasons.

a) In-sufficient number of samples
b) Improper location of sample
c) Improper or salted chemical analysis
d) Incorrect weighing of samples
e) improper analysis
f) ignorance (in-experience)
g) laziness

RECONNAISSANCE SURVEY

A reconnaissance survey is defined as "an examination of all or part of an area accomplished in sufficient detail to make generalizations about the types and distribution of geologic properties or elements that may be present within a field area." Reconnaissance surveys represent a type of field survey that is often used together initial information regarding the presence or absence of geologic properties within a field area. The result of reconnaissance survey should inform details about the types of resources that are likely to be found within a field area of the need for additional survey.

A reconnaissance survey should document the following documents:-

- The kinds of properties looked for
- The boundaries of the field are surveyed
- The method of survey, including the extent of survey coverage.
- The kinds of geological properties present in the surveyed area.
- Specific features that were identified and the categories of the information collected.
- Places examined that do not contain geologic properties.

The degree of accuracy with which field mapping is done is open to wide variation. In some kinds of work every outcrop and every geologic contact must be located with precision. Where as in other cases only a sketch is requested of the position and size of the larger structures and rock formations. In general, the more precise methods are included under the term detail mapping and the less precise methods are reconnaissance mapping.

In detail mapping program is slower and more time is needed for covering a given area. Even a small error is consistent with the limits of error of the geologic structure where in reconnaissance work. Speed is often paramount importance and a large limit of error is permissible.

Reconnaissance surveying, if properly done, is for more difficult than detail work. It requires wide experience, through training, quick judgment. Constant observation of soils, vegetation, outcrops and topography and the ability to remember the imprecision's obtained during the part of the work already completed. The geologist must able mentally to picture in

three dimensions structures and formations which can actually see, usually poorly exposed, in but two dimensions. In geologic training one should become proficient in detail mapping before attempting reconnaissance mapping. A person who is doing reconnaissance surveying should always be on the alert.

GUIDES TO ORE SEARCH
(Geological Methods in Mineral exploration)

An ore can be found most simply and cheaply if it is known where to look for guide have in common the fact that they are associated with ore in one way or another.

The guides can be grouped as:-

1. Physiographic guides.
2. Mineralogical guides (alteration, mineralization, oxidation products)
3. Stratigraphic and lithologic guides.
4. Structural guides (fracture patterns, contacts, folds)

PHYSIOGRAPHIC GUDIES:-

Physiographic features may serve either as direct or as indirect evidence of the presence of ore. Direct indicators, such as the surface expression of an ore body are at most immediate use. Indirect evidence may also be of value. Features such as fault scraps, hogbacks, and cuestas serve as dues to geologic structures.

Evidence bearing on the physiographic history of the region may indicate the conditions under which the ore was accumulated or enriched.

EXAMPLES

- Depressed grounds indicate sulphides, copper deposits.
- Colour variations on the ground indicate mineral deposits.

Yellow – limonite
Brown – goethite
Red - hematite
Green, azure blue – copper
Apple green – nickel, secondary uranium
Orangish yellow – arsenic
Copper stains – lead.

MINERALOGICAL GUIDES:-

The minerals that are present and their relative abundance serve as very practical guides in ore search. Certain mineral associations are useful for identification of ores.

Eg:- malachite is generally associated with azurite .

Zinc and lead are found commonly in association with copper.
Niobium is found in association with tantalum.
Presence of gold specks indicates gold.
Smoky quartz indicates tungsten and also rare minerals like niobium, tantalum.

STRATIGRAPHIC GUIDES:-

If the ore occur exclusively in a given sedimentary bed, the bed constitutes an ideal stratigraphic guide.

Eg:- coal in India is found only in Gondwanan which belongs to the Permian which belongs to tertiary age hence coal should be searched for only in the premium and tertiary sands and rocks. Thus eliminating other rocks and sands belonging to different age.

Chromite in India is present only in Archean rocks. Within Archean rocks it is again found only in ultramafic, hence, chromite should be searched for only in Archean ultramafic.

LITHOLOGIC GUIDES

Certain minerals occur only in a certain rock. There unique occurrences serve as lithological guides.

Eg:- primary uranium present in granites of Archean rocks.

Diamonds are present only in kimberlites.

Sedimentary phosphorite is present between shale and dolomites.

Lead – zinc is present in dolomite limestones.

Copper is present in calcareous quartzites.

STRUCTURAL GUIDES:-

Structures such as fractures contacts for entry of solutions. The receptacles for ore deposition and the starting placers for replacement. The shapes of fractures and fractures systems provide the key to the structure of many types of ore deposits. Contacts are favorable places for ore deposition because they are to be surfaces of weakness. A vein may follow a contact for a long distance or may merely take advantage of it for part of its course.

Eg:- Hydrothermal veins.

Contacts between igneous masses and intruded host rocks are especially favorable to ore occurrence even when the ore is not genetically related to the intrusive.

AVERAGE ASSAY

Single elemental concentration in a given sample is termed as assay value.

The elements may be Ai, Zn, As, Cr etc depending on the type of sample and the area to be explored.

Generally samples are collected in a grid pattern.

All these samples collected in the grid pattern are analyzed and the assay values for particular elements are determined.

The average of the assay values of all the samples collected in the grid pattern.

Average assaying is a part of geochemical prospecting.

Assay values are useful for establishing the anomaly of the deposit and for suggesting the drill sites for exploration.

The formula for calculating the average assay value is

Average assay value = $Total\ of all\ assay\ values/number\ of\ samples.$

Examples:-

Sample No:	Assay values of A.S
1	4.5
2	5.0
3	4.8
4	4.5
5	4.5

Avg. Assay values of As = $\frac{4.5+5.0+4.8+4.5+4.5}{5} = 4.66$

GEOLOGICAL MAPPING

Geological mapping is the process of mapping all the geological features of a particular area.

Geological mapping involves:

1) Field survey
2) Transfer of surveyed information onto map
3) Map symbolization

Field survey:-

* Field survey involves the field visit, go for non-detailed and detailed survey.
* In the non-detailed survey we just move two foot all the area to be mapped.
* We just need to be exposed to all the features in the area to be mapped.
* Coming to detailed survey. The area to be mapped divided into many traverse lines.
* These traverse lines are always across the strike of the formation in order to encounter various formation
* Various litho units have to be identified, contacts between those litho units have to be marked and the attitude of the beds limestones. Planes and structures are to be measured.
* All these involve field survey.

Transfer of Surveyed Information onto Map:-

***** Now all the information observed, obtained and measured in the field are to be transferred onto the map.

* The map onto which all this information is transferred is generally to toposheet.
* Though all the information cannot be transferred onto the map, depending upon the scale, but all the features are to be completely observed.
* Lithounits, lithological contacts, structural information is to be plotted on the map.

Map Symbolization:-

* Now, this plotted information, must be given symbols in order to distinguish one feature from another.

* Only lithological variation can be represented on the map but not the grain size variations.

* Various types of lithologies, various types of contacts inferred and various structural features are represented by various symbols.

GEOLOGICAL PROSPECTING

Prospecting is the initial stage of mineral exploration. Geological prospecting for any mineral deposit either metallic (Bauxite, Iron, Chromite, Lead & zinc, Copper, Manganese) or non-metallic (Mica, Diamond, Barytes, Palcer) involves, the following steps.

1. Literature survey
2. Reconnaissance survey
3. Geological mapping
4. Geological sampling
5. Study of sub-surface geology through Bore hole samples
6. Reserve estimation.

LIETERATURE SURVEY:-

Literature survey involves the study of all the literature available about that particular area to be explored for metallic or non-metallic deposits. Literature involves the previous exploratory results. Photograph, types of rocks, minerals in that particular area, and also stratigraphic and lithologic information. For literature survey one need not to go field, he can do it just sitting in a room. This is the primary survey before going to the field. This is the first step of mineral prospecting knowing about the area before visiting it physically is the literature survey.

Examples: The least literatures are the journals produced by government organization such as geological survey of India, oil and natural gas corporation etc.

RECONNAISSANCE SURVEY:-

Reconnaissance survey in the first and the ultimate step in the field, walking through all the area, where the deposit is to be explored are known as reconnaissance survey. It involves generalized visit and detailed visit. In the generalized visit a geologist just walks along all the directions, covering all the area, just to know which part of that area is favorable for the existence of the ore deposit is known, he goes for detailed survey. In the detailed survey, the favorable area is divided into many traverses across the strike and the observations are done in a very detailed way.

GEOLOGICAL MAPPING:-

Simultaneous with reconnaissance survey mapping must also be done. In the generalized survey, all the area including the unfavorable area is to be mapped on small scale. Once the favorable area for exploration have been known, the favorable area is to be mapped on large scale giving each and every minute detail

Example:-

Large scale map – 1:5,000

Small scale map – 1:50,000

GEOLOGICAL SAMPLING:-

Along with reconnaissance survey and geological mapping, geological sampling, must be also be done. Geological sampling is the collection of a fraction of a rock in order to

represent the whole maps. Geological sampling is also down in generalized and detailed ways, in generalized sampling, the samples are collected here and there, where every outcrops are exposed without any particulars order. But in detailed sampling, a particular trend is followed. These samples are numbered and are sent for analysis.

STUDY OF SUB-SURFACE GEOLOGY THROUGH BORE-HOLE SAMPLES:-

After the favorable area have been located in order to know the depth of the deposit, continuity of the deposit, boreholes are suggested to be drilled. The samples obtained from the boreholes are known as well logs. These logs are numbered according to the depth and they are cut vertically. Half of which is preserved in wooden boxes and half of it is sent for analysis.

RESERVE ESTIMATION:-

Calculating of the quantity of the ore and the grade of the ore is known as reserve estimation. It is done on the basis of the bore hole data obtained. The product of the area and the average width of the deposit gives the volume. Now the product of this volume and specific gravity of that particular area. This is how ore reserve is estimated.

Area x average width = volume

Volume x specific gravity = tonnage.

GEOLOGICAL PROSPECTING FOR BAUXITE

Literature Survey:-

* Bauxite mineralization takes place only on flat topped hills.
* So, if we are looking for bauxite deposit, we should search for them only on flat topped hills.
* Conical hills are not at all the suitable place for bauxite mineralization.
* Bauxite mineralized zones are generally devoid of vegetation.
* Older formations are more suitable for Bauxite mineralization, as it takes millions and millions of years for its formation.
* Any type of rock rich in Al, existing in a flat hilly terrain may give rise to Bauxite.
* Bauxite mineralization is the result of residual process present can be observed on the slopes of the hills.
* Short palm trees are the characteristic species that grown on the Bauxite mineralized zones.

Reconnaissance Survey:-

* As Bauxite deposit occurs as a continuous sheet or blanket, unfavorable area can be easily demarked from the favorable area.

Geological Mapping:-

*As the unfavorable area can be easily demarked from the favorable area, geological mapping also become easy.

Geological Sampling:-

*Huge number of samples need not be collected as the deposit is continuous, samples are collected in grid pattern with longer spacing.

Study of sub-surface geology through bore-hole sampling:-

*Bore holes are drilled only to know the depth of formation but not the lateral continuity.

Reserve Estimation:-

***B**oring on the bore hole data, reserve of the deposit is estimated.

* As it is a blanket deposit it may obvious show same grade horizontally but the grade may vary vertically.

RESERVE ESTIMATION

The reserves are known mineral assets readily available for exploitation. It implies quality and quantity available within certain dimensions. For the estimation of reserves, it is necessary to have qualitative picture of a deposit besides tonnage available within its dimensions. Qualitative picture is obtained by sampling. A careful assemblage of the sample data helps in blocking out areas with particular grade. The degree of assurance depends both on the frequency of sampling and geological nature of the deposit.

Reserve estimates are placed under three categories, namely proved, probable and possible.

Proved: when the estimate is based on sufficient data, such that it will not vary much from the actual tonnage and grade when mined, the reserves thus estimated are called as 'proved' (or measured). Material for which estimates of the quality and quantity have been computed within the margin of error of less than 20 percent is known as proved estimation.

Probable: The estimation which carry a lesser degree of assurance and is based on a limited data of sampling are called as 'probable' (or indicated). Material for which estimates of the quality and quantity have been computed partly from sample analyses, measurements and reasonable geologic projections is known as probable estimation.

Possible: The reserve estimation when done from extrapolation of sampling data to areas where there is no data of sampling available is termed as 'possible' (or inferred). Material in unexplored extensions of demonstrated resources for which estimates of the quality and size are based on geologic evidence and projection is known as possible estimation.

Reserve estimation can be determined by various methods and broadly placed under two groups, namely i.) Geometric method

ii.) Graphic method

Under the geometric method, the common methods used are:

a.) Included area method

b.) Extended area method

c.) Triangle method

d.) Polygon method

Under the graphic method, the common methods used are:

e.) use of isochore maps

f.) use of stratum contours

g.) use transverse sections

Included Area Method:

Included area method is used when the pits (sample collected point) are in a grid pattern. In below fig. pits have been put at 25m intervals in a 5x5 grid pattern. All the pits are mineralized. Assuming that the total reserves can be estimated only inside the big square area enclosed by the sample points, the area of influence of each of the sample points is shown in figure. Therefore the total mineralized area is 100 x 100 = 10000 sq m.

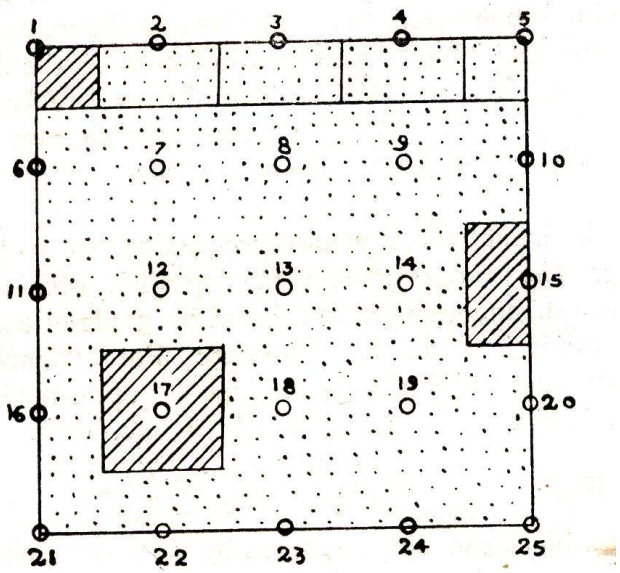


Fig. 25. Calculation of reserves by included area method. (The area of influence by each of central, corner and side pits has been shown by hatching.)

Extended Area Method:

Extended area method is used when the pits (sample collected point) are in a grid pattern. In below fig. pits have been put at 20m intervals in a 5x5 grid pattern. All the pits are mineralized. Assuming that the total reserves can be estimated inside the area enclosed by the sample points and also taking 50% (half of the average interval) of interval area from the sample points extended outside from the sample point, the area of influence of each of the sample points is shown in figure. Therefore the total mineralized area is 100 x 100 = 10000 sq m.

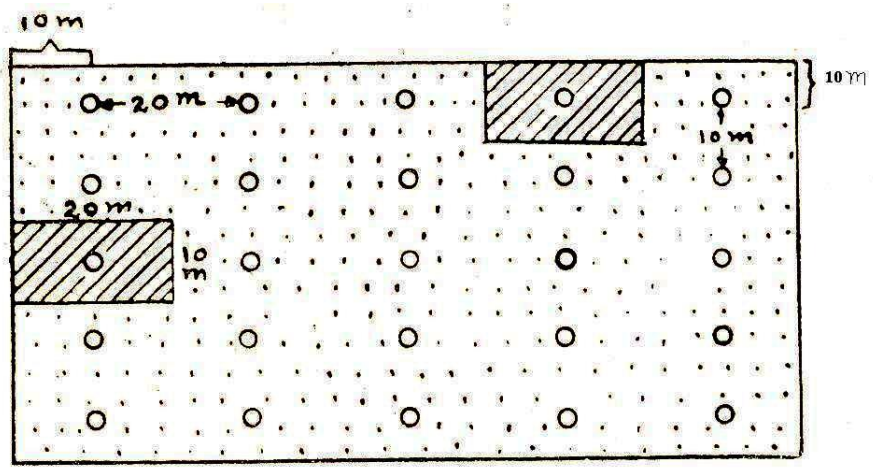


Fig. 27. Calculation of reserves by extended area method

Triangle Method:

In the triangle method, which is generally used when the sampling points are not in a grid pattern, the area is divided into a number of triangles as shown in Fig. 28 and in each triangle the arithmetic mean of the widths of the three sample points is taken as the average width. The average grade of the area is obtained by taking average from width of the each triangle.

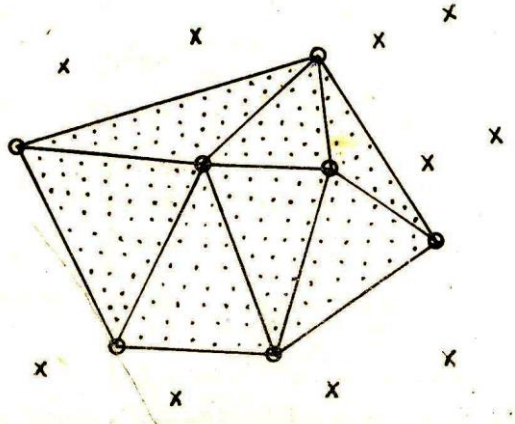


Fig. 28. Calculation of reserves by triangular method.

Polygon Method:

In the polygon method, polygons are constructed by drawing perpendiculars to the lines joining each of the pits with surrounding pits which is shown in the Fig. 29. The average grade of each polygon is calculated as we calculated in the extended area method.

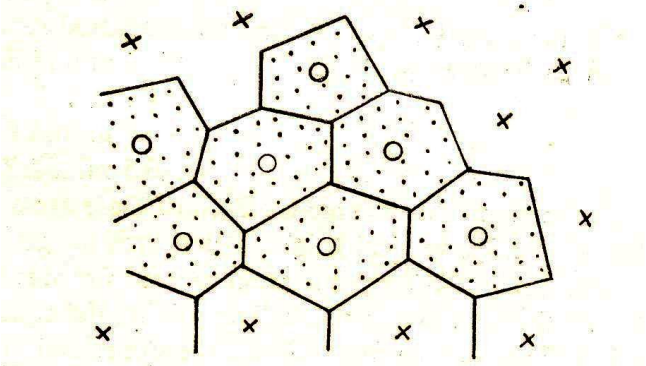


Fig. 29. Calculation of reserves by polygon method.

Isochore maps:

Isochore plans are used in more or less uniform grade. Isochores are lines joining points of equal vertical thickness. Isopachs are lines joining the points of equal true thickness.

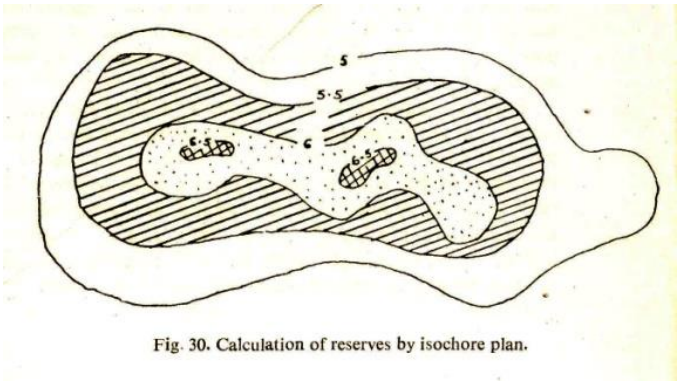


Fig. 30. Calculation of reserves by isochore plan.

The area between the isocores of 5 & 5.5 will have a average vertical thickness of 5.25 mts. We assume it as A1, Similarly vertical thickness between 5.5 & 6 is 5.75 mts and named it as A2. Then calculate the area covered between all the points with the help of graph sheet. Then the resultant volume will give us the tonnage factor which gives the reserves.

Stratum Contours: (Strike line)

Stratum contours are lines joining the equal elevation of a bed which shows the upper (roof contours) and lower (floor contours) of a bed.

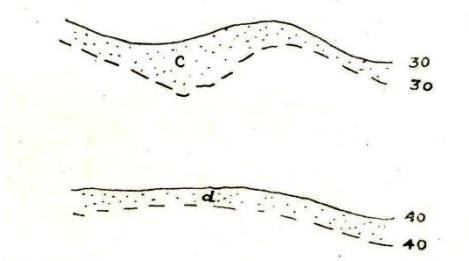


Fig. 31. Calculation of reserves by stratum contour plan.

Transverse Section:

In this method we divide a bed into some sections and collects the borehole sample of each transverse section as we shown in the Fig. 32

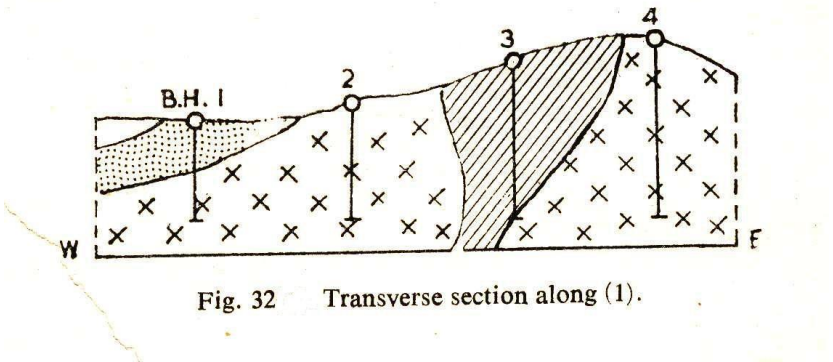


Fig. 32 Transverse section along (1).

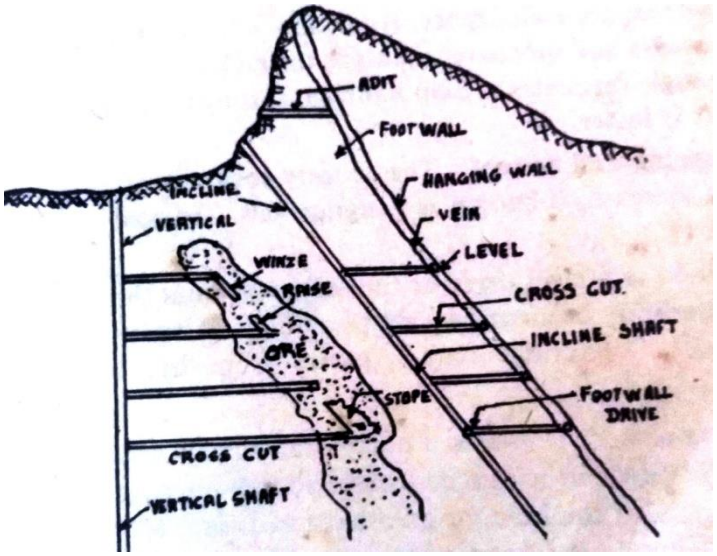
MINING

Mine : Mine is a place where geological material can extract.

Mining : Mining is a process of extraction of a material.

Quarry : Quarry is a place where building material can extract.

Quarrying : Quarrying is a process of extraction of a building material.



Over burden : In mining overburden (also called waste or spoil) is the material that lies above an area of economic or scientific interest**.**

Shaft : An entrance to a mine which is horizontal or inclined, by which the mine can be entered.

Hanging Wall : the country rock occurring above the vein or ore body or seam is known as hanging wall. In coal mining it is called as roof.

Foot Wall : the country rock occurring below the vein or ore body or seam is known as hanging wall. In coal mining it is called as floor.

Ore Body : A more or less solid mass of ore that may consist of low-grade as well as high-grade ore and that is of different character from the adjoining rock.

Load : load is a mineralized zone.

Adit : An adit is a level drive made from the hill side to meet the lode or ore body occurring inside the hill. It opens to the surface only at one end.

Tunnel : It is an opening, which is nearly horizontal. It is driven from one side of a hill and opens out on other side.

Drive: Horizontal tunnel parallel to the strike of the load and it is located in the country rock.

Level : Level is horizontal line which is parallel to the strike of the load and it is in load itself

Cross cut : In mining unstratified deposits, the term cross cut is used to describe a tunnel or drive. Also, a tunnel driven from one seam to another.

Raise : Driven upward form a level to connect with the level above.

Winze : Driven downward from a level to connect with the level below.

Ore bin : It is an excavation of a constructing a special design for storing ore mined from a part of a mine.

Chute : chute is a small channel shaped projection at the bottom of the storage bin.

Stope: An area where ore has been removed or is being prepared to removed. Sizes of stopes are related to the ore body and mining method.

Air crossing : It is the arrangement by which the intake (fresh air) is made to cross the return (used air) in the underground workings.

Ventilation stopping : It is a wall built across an underground excavation to prevent the air current from flowing into unwanted places.

Fire stopping : It is a solid masonary wall used for sealing off workings and tunnels , leading to any area of a mine under fire.

Assay Width : Assay width of the entire mineralized zone whether strongly mineralized or not.

Stoping Width : It is that width of the ore body which can be economically mined.

Cut off grade : It is that grade of ore below which it is considered that economic mining is not feasible.

Average Grade : It is that grade which is obtained by working out the arithmetic mean, giving weightage to the quantities available in each grade taking either the stoping width or the assay width as it is decided.

Mill Grade: It is that grade of ore which will ultimately be fed into the beneficiation plant.

Classification of Mining Methods

- **Alluvial mining**
- **Opencast mining**
- **Underground mining**

Alluvial miming

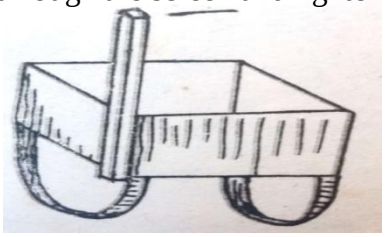
Pan and Batea:

Pans of various shapes and sizes are employed in this method of mining. The soft alluvial material dug up, is placed in the pan or batea and washed. This process is called panning

.

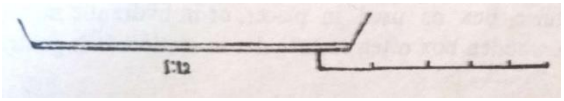
Rocker:

The rocker consists of a metal screen mounted at the bottom of a strong wooden box. The box is made to stand on two semi circular iron hopes. A handle is fitted to one side of the box. The alluvial material is poured on the metal screen together with water, and with the help of the handle the rocker is rocked from side to side. The thinner portion of the alluvium, containing the values passes through the screen and lighter fraction flows over the riffles.



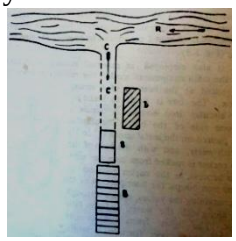
Long tom:

This consists of an open box 10ft. to 12ft. long, from 15" to 20" wide at the upper end and nearly doubles this width at the lower end where there is inclined screen. The finer material passing through the screen falls on to a riffle box. Here the separation of the heavies is affected.



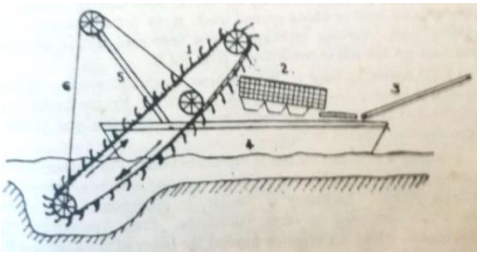
Sluicing:

Water from flowing stream is diverted into the area occupied by the alluvial deposit through a channel and men standing on the banks of the channel shovel the placer material into the water. The material disintegrates and the muddy water now flows into a sluice box and riffle box from where the concentrate is recovered.



Dredging:

This method is essentially employed for mining placers particularly thin. The dredge is a large flat bottomed barge or pontoon.



Opencast or surface miming

Bench-cut method:

Benches which describe vertical levels of the hole. These benches are usually on four to sixty meter intervals, depending on the size of the machinery that is being used. Many quarries do not use benches, as they are usually shallow.

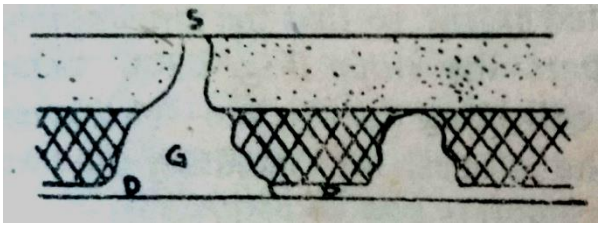
Glory Hole:

In the glory hole method, the pit os opened up and developed in such a way, that the working faces are arranged in the form of concentric steps, descending to the deepest or central portion.

Underground mining

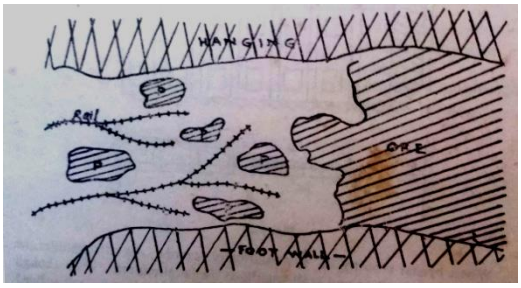
Grophering:

The term is applied to small sized, irregular and unsystematic underground workings. It may just comprise drifts, or other openings, which follow the ore shoot or vein.



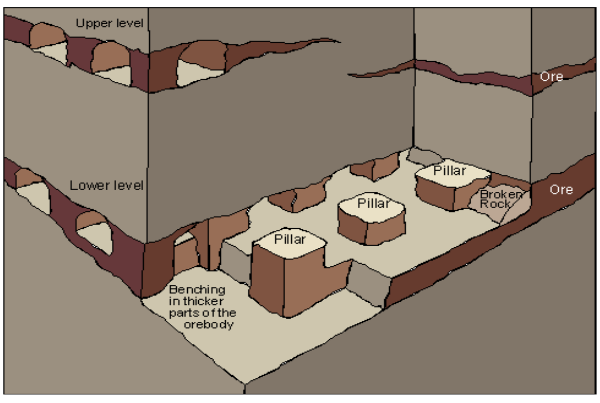
Breast stoping:

Breast stoping is a mining system, in which the working face is vertical, with a maximum height of about 10 – 12 ft. The stopes advances horizontally, low dipping ore bodies, Upto 15 – 18 ft. tick.



Pillar and room method:

This method is mainly used in Coal mining. Coal is mined by extracting “Rooms” of coal separated by “Pillars”.



Longwall method:

This method is mainly used in Coal mining. Extracts a full section of the coal face.