A Note on Introduction to Mineral Exploration
&
Stages and Techniques of Exploration

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1. What is Mineral Exploration?

- ✓ It is the search for mineral deposits.
- ✓ Every new mine has its beginning as an exploration project; but all exploration projects will not lead to become mines.
- ✓ The purpose of exploration is to locate a new source of metal or useful minerals.
- ✓ This includes industrial minerals (such as silica for making glass or clay minerals for making ceramics), metals (such as iron, lead, zinc, copper, etc.), and precious metals and gemstones (such as gold and diamonds).
- ✓ The exploration process starts with identifying large areas that may have a certain type of ore deposit that could be developed as a resource.

2. What should be the exploration strategy now in India?

- ➢ Initially, the mineral deposits showing surface manifestations like gossan were discovered mostly by surface geological investigations and a drilling component for depth continuity.
- ➢ Now, it is becoming more challenging to bring out mineral potential blocks in the existing greenfield areas (sediment cover, basaltic cover, Bundelkhand craton, other regolith covered regions etc.) of our country.
- ➢ Rapid depletion of surface and shallow sub-surface deposits warrants adoption of modern techniques for exploration of buried and concealed deposits.

3. GREENFIELDS EXPLORATION

- ✓ Refers to activity undertaken in unexplored or incompletely explored areas.
- ✓ Key purpose- <u>to discover new mineral deposits</u>.
- ✓ It is the first step in the mining process, as all the mines that have ever existed were once greenfield discoveries.
- ✓ Involves searching for deposits in new & virgin geographical areas.
- ✓ Relies on the predictive power of the ore genesis model to find mineral deposits in previously unexplored areas or areas where they are not already known to exist.

- ✓ Is a high-risk, high-reward strategy that, if successful, increases the size of known mineral reserves and creates long-term value for the discoverers of new mineral deposits.

4. BROWNFIELDS EXPLORATION

- ➢ Occurs in areas with an established mineral endowment, such as existing mines.

- ➢ Objective- to extend an existing mine's operating life (by better defining the size or quality of a known mineral deposit) and to take advantage of existing mining infrastructure.
- ➢ Brownfields exploration is low-risk (as exploration takes place adjacent to or near existing, proven deposits
- ➢ 'Brown-field' exploration activities particularly in the lateral and depth-ward exploration of the already working mines viz., Gold in Hutti - Maski belt, lead-zinc in Agucha (Pb-Zn), lead-zinc-silver in Rajpura-Dariba (Pb-Zn-Ag), copper (Cu) in Khetri and iron ore, bauxite, coal and limestone in already discovered mineral belts have augmented the resources of the country.

5. STAGES OF MINERAL EXPLORATION (UNFC Guidelines)

G4 stage - Reconnaissance

G3 stage - Prospecting

G2 stage - General Exploration

G1 stage - Detailed Exploration

5.1 G4 (Reconnaissance)

A 'Reconnaissance' means the systematic process of identifying areas of enhanced mineral potential on a regional scale based primarily on results of regional geological studies, regional geological mapping, airborne and indirect methods, preliminary field inspection, as well as geological inference and extrapolation.

5.2 G3 (Prospecting)

Prospecting is the systematic process of searching for a mineral deposit by narrowing down areas of promising enhanced mineral potential.

5.3 G2 stage (General Exploration)

The main objective in G2 stage is to establish the main geological features of a mineral deposit and provide an initial estimate of size, shape, structure and grade of the mineral for consideration for prospective mining

5.4 G1 stage (Detailed Exploration)

This is the more detailed exploration stage for providing the expected of size, shape, structure and grade of the mineral in higher degree of confidence for taken up for mining

6. Techniques of Exploration

- Surveying/Detailed Mapping
- Pitting and Trenching
- Borehole Planning/Drilling
- Sampling

6.1 Surveying/Detailed Mapping

- ✓ Direction Survey and Geographic North alignment.
- ✓ Elevation calibration, RL flying, benchmarks and agency figures.
- ✓ Establishing survey stations. Grid and coordinate systems.
- ✓ Detail mapping, litho contact, structural data & density of collection of data.
- ✓ Importance of anthropological data on the Detailed Map.
- ✓ Baseline selection and measurement.
- ✓ Outcrop boundary

6.2 Pitting/Trenching

- ✓ If fresh rocks occur at shallow depths under a thin veneer of soil cover or weathered rock
- ✓ The depth of the pits varies depending on the extent of weathering and the nature of the rocks.
- ✓ The pits are sampled by cutting channels in the middle of either wall
- ✓ Walls or on all four sides depending upon the type of deposit and nature of mineralization.
- ✓ Trenches are excavated to expose the rock to be sampled if it is close to the surface.
- ✓ Trenches are generally made across the strike of the prospect to expose the bed rock/regolith and to know the strike continuity of ore body/bodies.
- ✓ Channel sampling is carried out on the floor of the trenches.

6.3 Drilling

- ➢ The aim of drilling in mineral exploration is to establish the subsurface mineralization.
- ➢ Drill plan in general depends on the ollowing factors -
- ✓ Purpose: The main purpose of drilling in mineral exploration is to know the subsurface geology & estimate the total resources of the area.

6.4 Planning of Borehole

- ➢ A good Detailed Geological Map required for bore hole planning depends on stages of exploration & commodity being explored. It may be on 1:5000, 1:2000 or 1:1000 scale.
- ➢ Surface geochemical map or profile, and/or both preferably should be on the same scale.

- ➢ Available geophysical data, aero geophysical and/or ground geophysical are consulted.
- ➢ And finally integrated geological, geochemical and geophysical map is prepared.
- ➢ Important factors to be considered during planning & locating the boreholes in the field
    - ✓ Geological Profile
    - ✓ The Azimuth of the borehole
    - ✓ Angle or inclination of the borehole.
    - ✓ Geochemical / geophysical anomaly.
    - ✓ Presence of old working
    - ✓ Most importantly the structure of the area.
    - ✓ Depth of the intersection of the ore body/anomaly

7. SAMPLE AND SAMPLING

- ✓ Sample is a small part or quantity intended to show what the whole is like.
- ✓ A sample is a finite part of a statistical population whose properties are studied to gain information about the whole (Webster, 1985).

7.1 What is sampling?

Generally sampling is the art (process) of selecting a part of a whole such that the measured value for the part is an unbiased estimate for the whole.

Some important points on sampling..

- Systematic Sampling is one of the most important aspect of mineral exploration.
- Sample, keeping the objective in mind.
- Samples should be representative of the population but in geology it can never be true representative.
- Sampling should be unbiased. But is it?
- Accuracy and Precision? (Standard and Check)
- Can we apply normal statistics to geological samples?

7.2 Sample Media

- ✓ Stream sediments (rapid evaluation of large areas, cost effective, NGCM)
- ✓ Soil (Near surface)
- ✓ Water (Useful in soil covered areas, ME)
- ✓ Vegetation (Geobotany and Biogeochemistry, ME)
- ✓ Gas-Vapour(Mercury for Sulphides, Radon for Uranium)
- ✓ Minerals, ores & rocks (All kinds of projects)

7.3 Various types of sampling

1. Petrological Sampling (PS)
2. Sampling for petrography & ore microscopic study (ORM) samples for polished thin section
3. Random Bed rock sampling (BRS)
4. Rock chip sampling or grid bedrock sampling
5. Pitting Trenching samples (PTS)
6. Channel sampling
7. Core sampling
8. Bulk sampling
9. Samples for isotopic study
10. Samples for fluid inclusion study

7.4 Sample Preparation

- A geological sample is generally of a large size, which can't be readily handled by a laboratory for chemical analysis.
- Besides, the individual chips and blocks range in such sizes that they do not mix easily. In order to overcome these, it is necessary to reduce the bulk of the sample to a convenient size ensuring at the same time a proper admixture of the various fractions.
- The operations are achieved by the processes of sizing, coning, and quartering.