Quadrant II – Notes

Programme: **Bachelor of Science (Third Year)**

Subject: **Geology**

Paper Code: **(DSE) GED-103**

Paper Title: **Mining Geology**

Unit: **Mining Geology I**

Module Name: **Mineral Exploration**

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Notes:

Mineral Exploration

- The exploration for any mineral deposit involves four stages namely, Reconnaissance Survey (G4), Preliminary Exploration (G3), General Exploration (G2) and Detailed Exploration (G1).

- These stages of exploration lead to four resource categories namely Reconnaissance Mineral Resource, Inferred Mineral Resource, Indicated Mineral Resource and Measured Mineral Resource respectively reflecting the degree of geological assurance.

- Reconnaissance Survey (G4) identifies areas of enhanced mineral potential 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.

- The objective is to identify mineralised areas worthy of further investigation towards deposit identification.

- Estimates of quantities should only be made if sufficient data are available and when an analogy with known deposits of similar geological character is possible, and then only within an order of magnitude.

- General Exploration (G2) involves the initial delineation of an identified deposit.

- Methods used include surface mapping, pitting/ trenching/drilling, followed by sampling for evaluation of mineral quantity and quality (including mineralogical tests on laboratory scale if required), and limited interpolation based on indirect methods of investigation.

- The objective is to establish the main geological features of a deposit, giving a reasonable indication of continuity and providing an initial estimate of size, shape, structure and grade.

- Detailed Exploration (G1) involves the detailed three-dimensional delineation of a known deposit achieved through sampling, such as from outcrops, pits, trenches, boreholes, shafts and tunnels etc.

- Sampling grids are closely spaced such that size, shape, structure, grade, and other relevant characteristics of the deposit are established with a high degree of accuracy.

- Processing tests involving bulk sampling may be required.

- Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction.

- The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.

- Mineral Resources are subdivided, in order of increasing geological confidence into Reconnaissance, Inferred, Indicated and Measured resource categories.

- **Reconnaissance Mineral Resource** are estimates based primarily on indirect evidence and includes data and information generated through a reconnaissance survey. The quantity of data available is generally not sufficient to allow any reasonable estimates of Mineral Resource.

- **Inferred Mineral Resource** is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling achieved through a stage of preliminary

exploration. An Inferred Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and shall not be converted to a Mineral Reserve. The majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.

- **Indicated Mineral Resource** is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation. An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve.

- **Measured Mineral Resource** is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit. Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation.

- A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. It may be converted to a Proved Mineral Reserve or to a Probable Mineral Reserve.

Geological parameters for exploration:

1. **Aerial reconnaissance**: Satellite imagery/ remote sensing/ airborne geophysical survey etc. using appropriate technology (applicable mainly for reconnaissance exploration (G4) stage).

2. **Topographic & Geological survey (Mapping)**: On 1 : 50,000 or smaller scale for reconnaissance (G4) stage; on 1:25000 to 1 : 10,000 or larger scale for preliminary exploration (G3) stage; 1:4000/1 : 5,000 or larger scale for general exploration(G2) stage; on 1 : 2,000 or larger scale for detailed exploration (G1) stage.

3. **Ground Geophysical and Geochemical survey**: Geophysical and geochemical survey using appropriate techniques as may be necessary.

4. **Technological** : Exploration and sampling using appropriate techniques from locations such as outcrops, trenches, pits, old workings and drill holes. The sampling locations are spaced suitably (in a grid pattern to the extent possible and may be modified depending on structural complexity) for establishing existence of ore body and its lateral and vertical continuity. Part III of the schedule may be referred for further details. For General (G2) and detailed (G1) stages of exploration the depth continuity of mineralisation may be considered limited to the depth upto which direct evidence of mineralization is established. The lateral extension to be considered for resource assessment shall depend on geological considerations supplemented by geological continuity by mapping or by other means and in any case shall not be more than 50% of the grid spacing of the probe points. Assessment based on selected information such as isolated assays, isolated drill holes, assays of panned concentrates etc. is not recommended.

5. **Sampling & sub sampling**:

    1. Random grab/chip/channel sampling from surface exposure/escarpments/ nullah cuttings/ pit/channel etc. for reconnaissance stage.

    2. Systematic sampling from pits/trenches/outcrops/workings etc. spaced closely enough to confirm geological and grade continuity for other stages of geological assessment.

    3. Geological logging and sampling of drill core/chip samples at regular interval, preferably meter wise or less for the mineralized portions.

    4. The drill technique to be deployed shall depend on the rock type to be penetrated and with an aim to achieve maximum sample/core recovery.

    5. The exploration samples including surface samples, drill core/ chip samples shall be preserved, for future use.

6. **Assay data & Laboratory tests**: Analysis of all samples generated for major radicals appropriate to the mineral under investigation. Analysis of

byproducts such as Ga in bauxite, Ni, PGE in chromite, Au in iron ore, Ag in lead and zinc, Au in copper ore etc. and other deleterious elements wherever necessary.

7. **Petrographic & Minerographic studies**: Petrographic analysis of mineralized portions to ascertain the rock types and mineral assemblages including grain size, texture, gangue and its liberation characteristics etc. if considered necessary.

8. **Bulk density study**: The bulk density must be measured by methods that adequately account for incipient void spaces (vugs, porosity, etc.)in mineral /ore body

9. **Bulk Sampling for Beneficiation studies**: Bulk sampling if necessary for testing processing technology.

10. **Environmental setting**: Details about local infrastructure, host population, historical sites, forests, sanctuaries, national park and base line information on environmental setting of the area to be collected.

11. **Any other relevant data**: Groundwater, geotechnical and rock characteristics etc. that may be relevant.