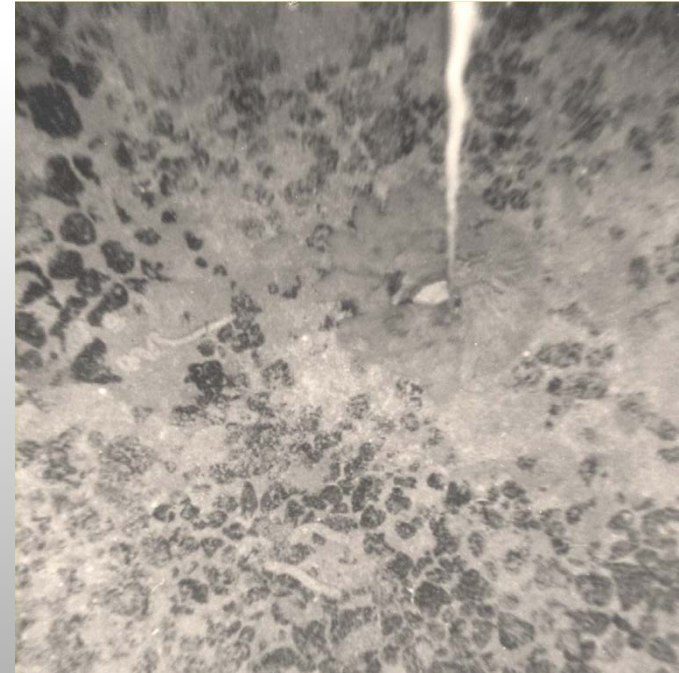


APPLICATION OF CRIRSCO TEMPLATE FOR REPORTING OF MANGANESE NODULE DEPOSITS: SOME SUGGESTIONS



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Agenda

- ✓ Salient Features of Nodule deposits
- ✓ Technologies for Exploration/ Engineering Data Generation
- ✓ Current Status of Development
- ✓ CRISCO Template
- ✓ Suggested Incorporations
- ✓ Current Classification
- ✓ Reporting Responsibility

Salient Features of Nodule Deposits

- Occur on Seafloor (4 Km- 6Km water depth)
- Fe-Mn oxides Typically containing % Cu : 1.1, % Ni : 1.2, % Co : 0.2, % Mn :25, % Fe :10

(Equivalent Cu = 4%)

Rich Deposits ?

- Seabed Bathymetry : Flat to Rugged
- Mechanical Strength of Seabed : Very Poor
- Exploration/Exploitation Regulated by ISA

Technologies for Exploration/ Engg Data Generation

(i) Ship Borne Surveys:

- Physical Sampling : Free fall grabs/ Corers
(Measurement of Abundance as kg/m²)
 - Still Photography
 - Bathymetry : Single Beam/ Multi Beam Mapping Systems
 - Mech. Properties on Sediment Cores
-
- Rapid but low accuracy except for Physical sampling

Technologies for Exploration/ Engg Data Generation

(ii) Near Seabed Surveys:

- Continuous Photography (Videography)
 - Multibeam Mapping of Bathymetry
 - In-Situ measurements of Mech. Strength (under vibration?)
-
- High accuracy level but highly demanding (Time+Cost)

Current Status of Development

A. Exploration:

- Size of Contract Area : 75,000 sq.km (Max.)
- All investigations limited to Ship borne surveys, Near Seabed Surveys for entire contract area not warranted
- Nodule fields of size 7,500 sq.km (approx.) good for initial Mine life of 20 years, say, FGM
- Results of Ship borne surveys potentially useful for identification of FGM where near Seabed surveys could be planned.
- A sampling grid of 15km x 15km in the contract area produces an accuracy of +/- 10% of estimated abundance.

For 7,500 Sq.km area, 7kmx7km grid needed to achieve similar accuracy

Current Status of Development

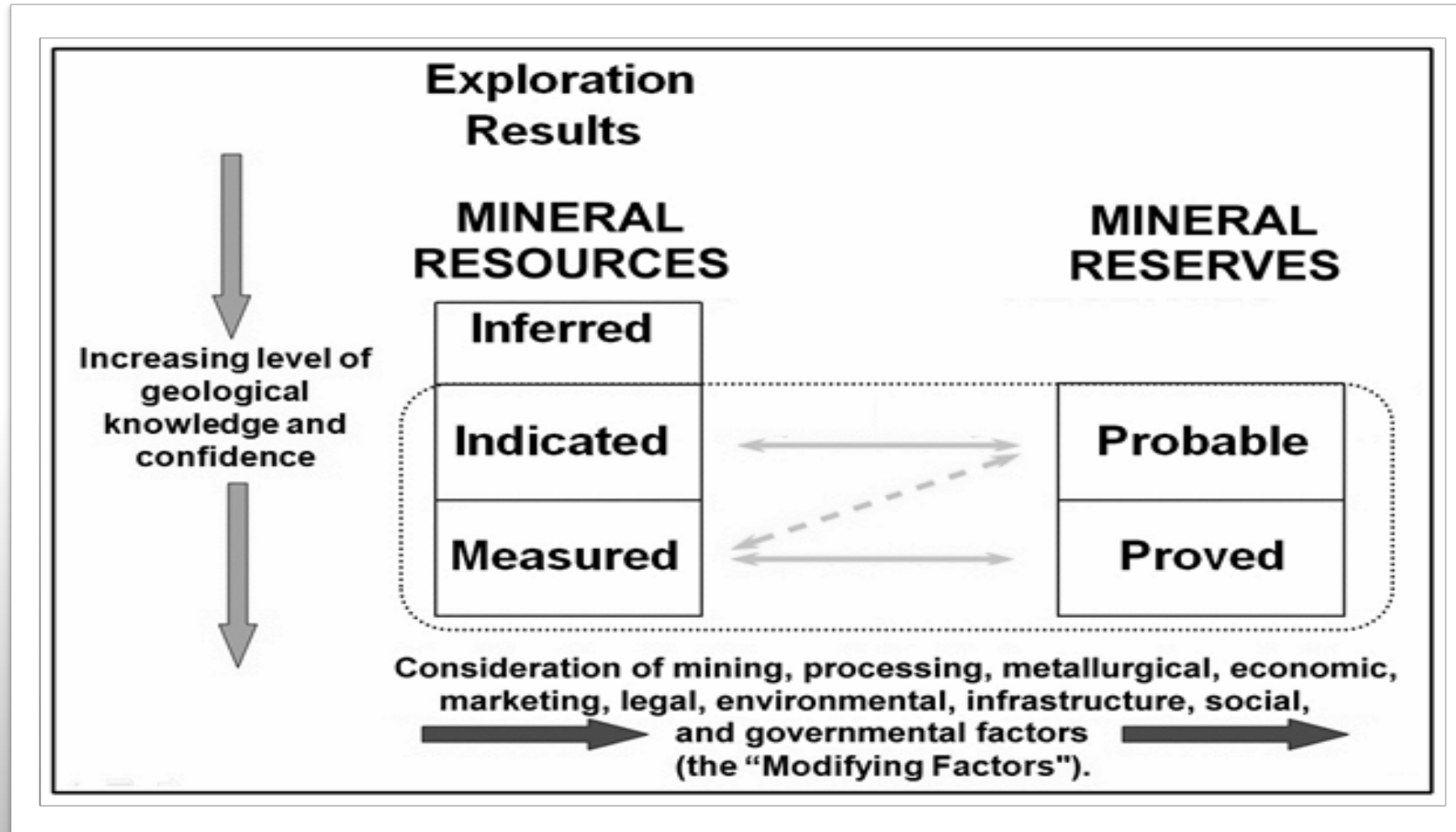
B. Mining Technology

- Most Tests on Land/ Shallow sea
- No definitive plan of undertaking integrated pilot mining of nodules in next 5 years.
- Hence no design basis may be available in next 5 years

C. Extractive Metallurgy

- Considerable work done but no large scale test reported for the production of final product mix (Cu, Ni, Co, Fe-Mn Alloys?)

CRISCO Template for Nodules



General relationship between Exploration Results, Mineral Resources and Mineral Reserves

CRISCO Template for Nodules

- Elements Specific to Reporting of Nodule deposits
- “Portions of Mineral Deposit that do not have reasonable prospects of eventual economic extraction must not be included in a Mineral Resource” – Similar to concept of Mineable Resource?

Suggested Incorporations

(i) Bathymetry:

- Must form part of Geological knowledge and not clubbed with modifying factors.
- Unlike the land based deposits, Bathymetry determines that portion of deposit that may not have reasonable prospect of eventual economic extraction (Mineability)
- Currently, neither the threshold slope angle of mining system nor the high resolution slope angles data are available. Only sea mounts identifiable.

Suggested Incorporations

(ii) Continuous Mapping of Abundance

- Requirement under two cases
 - Mapping of selected strips to generate data on the net nodule collection efficiency
 - Eventually for mining operation prior continuous mapping is essential to control speed of the collector system.

(iii) In- Situ measurements of Mech strength of Seabed (Vibrating Condition?)

(iv) Estimation accuracy of abundance estimate must be quantified at the contract area level and at the selected nodule fields level (FGM)

Current Classification:

- Based on the ship borne data generally available with the contractors, the nodule resources of any contract area of the selected nodule fields may only be classified as inferred resource on account of
 - Low confidence level of bathymetry data.
 - No visibility of any definitive technical feasibility studies being initiated.

- “Confidence in the estimate of inferred mineral resource is usually not sufficient to allow the results of the application of technical and economic parameters to be used for detailed planning.”
- Position is unlikely to change in next 5 years.
- Resource classification based entirely on sampling grids not justifiable.

Reporting Responsibility

- **Under CRIRSCO Code**

- Reporting in accordance with Code.
- Documentation by competent person as defined by Code.

- **Reporting for Nodule Deposits to ISA**

- Flexibility for Documentation (Institutional Responsibility for Govt. funded Project, No public reporting etc.)
- However, domain expertise and experience of competent persons/ organizations accepted by the contractor need to be assured along with documentation of their qualification and experience.

Thank You