International Standards for Resource and Economic Evaluation

Applications for Deep Seabed Mining

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Standards and Stakeholders

Over years, standards have been developed and adopted to insure stakeholders that evaluations regarding prospects for economic development of mineral deposits are:

- An **accurate presentation** within the limits of the data available
- **Assumptions and uncertainties** clearly identified
- Assessments are carried out in line with **widely accepted international standards and best practices**
Resource and Reserve Assessments

- Sought by governments and organizations to assess supply vulnerability, encourage development, promote research and develop conservation policies

- Sought by mineral developers to plan development of individual deposits and to guide investment decisions

- Sought by investors and by securities regulators to prevent misleading or false information from disrupting stock exchanges and securities markets
Milestones

• **1533**: Agricola Identifies Importance of Mineral Evaluation and Reporting

• **1909**: Herbert Hoover Defines Mineral Reserves as Proved, Probable or Possible

• **1976-80**: National Supply Concerns Lead to New Taxonomies of Mineral Resources Based on Geologic Certainty and Economic Feasibility

• **1989**: Scandals in the 1960s and 1980s Lead to First National Code on Reporting of Ore Reserves
Forces for Change

**Business:**

- Scale of investment capital required to develop new mines
- Role of Securities Exchanges in Financing Mineral Development
- Role of “Junior Exploration Companies”

**Government:**

- Mineral Resources in Warfare and in the Modern Economy
- Minerals as a Factor in International Development
Commercial Focus on Resource Classification

Stakeholders

- **Professional Societies** in Geology, Mining, Law, Industry and Accounting
- Mining Industries, Investors, Securities Exchanges

Common Stakeholder Classification Model

- CRIRSCO Template

Reinforced in National Legislation or Regulation

- e.g. Australia’s Joint Ore Reserves Committee, Canada’s NI-43-101
Industry Best Practices

- Competent/Qualified Person
- Standard Definitions
- Resource Database
- Geological Interpretation & Modeling
- Mineral Resource Estimation
- Modifying Factors
- Mineral Reserve Estimation
- Reporting Standards
- Reconciliation
## Industry Resource Definitions

<table>
<thead>
<tr>
<th>Mineral Resource</th>
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<tbody>
<tr>
<td>• Inferred Mineral Resource</td>
<td>• Probable Mineral Reserve</td>
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<tr>
<td>• Indicated Mineral Resource</td>
<td>• Proved Mineral Reserve</td>
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<tr>
<td>• Measured Mineral Resource</td>
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Modifying Factors

- Harvesting/Recovery Technology Capabilities
- Environmental and Social Regulations
- Government Regulations for Mining Operations
- Investment and Operating Costs
- Commodity Markets and Mineral/Metal Sales
- Financial Regulations for Exploitation
- Legal Rights (exclusivity, tenure, title)
Government and Agency Interests

- National Inventory of Mineral Resources
- Land Use Planning
- Economic Development
- Infrastructure
- Environmental Regulation
- Social Impact
- National Security
The “McKelvey Box”

- Published in 1980 by the US Geological Survey to support government policy-making on resource management and security of supply
- Used economic and geologic measures to categorize mineral deposits
- Informed UNCLOS III in addressing reserves and resources

Two Dimensional Depiction of Mineral Inventory
X-axis: Assurance of Mineral Presence
Y-axis: Economic Outlook
Two Paths of Resource Assessment

Exploration Results

Mineral Resources

- Inferred
- Indicated
- Measured

Ore Reserves

- Probable
- Proved

Consideration of mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors (the “modifying factors”)

National scheme | JORC scheme | Mining losses | Milling losses
--- | --- | --- | ---
Proved Ore Reserves | deducted | not deducted - but are considered in assessing economic viability
Measured Resources | Measured Mineral Resources | not deducted | not deducted
Probable Ore Reserves | deducted | not deducted - but are considered in assessing economic viability
Indicated Resources | Indicated Mineral Resources | not deducted | not deducted
Inferred Resources | Inferred Resources | not deducted | not deducted

Decreasing degree of geological assurance

Commercial Assessment

Government Planning
Resource Reporting Systems and the ISA

- Industry and government interests in Mineral Resource categorization are different but can be compatible.

- CRIRSCO Taxonomy and the UNFC are in place

- The ISA has interests in both industry and resource management perspectives and may find both systems useful
Four Take-Aways

• Reserves and Resources are not just a mineral determination - they are financial measurement reflecting a comprehensive commercial assessment.

• Critical Components include
  • Industry Standards and Best Practices
  • Resource Database
  • Competent Person
Standards and Practices for Deep Seabed Minerals

- Guidance for sampling and interpolation
- Projection of mineral and metal prices
- Environmental Standards and Practices
- Cost Engineering and Estimation of Mining System Costs
The Resource Database

- Geospatial Database
- Measured Data
  - Mineral, Topography, Soil Properties, etc.
  - Biological and Environmental Resources
- Inferred Data
  - Interpolation System
- Level of Uncertainty
The Competent Person

A “Competent Person” is a minerals industry professional:

• a member at *an appropriate classification* of an organization *specified by the national authority* with *enforceable disciplinary processes including the powers to suspend or expel a member*.

• a minimum of *five years* relevant experience in the style of *mineralisation or type of deposit* under consideration and *in the activity* which that person is undertaking.
Resource Reporting

- ISA Regulations Require Submission of Resource and Reserve Estimates at End of Contract

- Public Reports of Resources and Reserves are Governed through National Law and Regulation

- CRIRSCO Provides a Template for Reporting of Reserves and Resources to Promote Compatibility

- Quality of Reports depends upon Industry Best Practices and Oversight by Competent Professionals in fields such as Geology, Mineral Processing and Cost Engineering
Next Steps

- *Update ISA Regulations* defining Reserves and Resources


- *Promote Professional Competence* in Exploration and Evaluation of Seabed Mineral Deposits through Development of Criteria and Professional Education

- Adopt a *Common Taxonomy for Seabed Resource Databases*, including mineral, biological and environmental factors

- Integrate Industry Reports into an *ISA Model of Seabed Mineral Provinces of the Area*
Thank You