The cost of implementing proposed environmental regulations in the AREA.

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Nautilus Minerals Ltd

• With its active exploration program over next 12 to 18 months, Nautilus seeks to collaborate with MSR groups to study the data collected.

• Environmental management is a significant element of these work programs.

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David Heydon
Talk Outline

- Land based permitting – current practices.
- The “seafloor mine”.
- Sea based prospecting – activities vs impacts.
- Compliance costs – land vs sea.
- Conclusions.
Exploration and the Environment

- Land based exploration programs are “graded” according to “expected impact” prior to the start of work.
  
- Minimal cost in the early low impact phases ($5 - 20K per program).
  
- **Main cost** is in the preparation of the EIS (environmental Impact Statement), which is produced once the company thinks it has a project that on preliminary numbers looks economic.
  
- ISA needs to have a similar approach in the AREA.
Land based Mine - EIS

The cost, size and length of time spent doing an EIS for a land based mine varies enormously due to:

- Varying “land use conflicts”,
- Type of mine and it’s impacts,
- Processing options,
- Etc,etc.

- Generally takes min. 12 months, commonly 12 to 18, plus 6 mth govt review.
- Costs vary enormously, but commonly range from $3 to 10+ million.
# PNG Environment Permitting

## Environment Act - Permitting Process

<table>
<thead>
<tr>
<th>No Permit Required</th>
<th>Fast Track (Non EIA)</th>
<th>Permit (Non EIA)</th>
<th>Environment Impact Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Codes of Practice</td>
<td>Registration of intention to carry out preparatory work</td>
<td>Lodgement of application for a permit</td>
<td>Registration of intention to carry out preparatory work</td>
</tr>
<tr>
<td>e.g. Environmental Code of Practice for the Mining Industry</td>
<td>Acceptance of application for a permit</td>
<td>Acceptance of application for a permit</td>
<td>Notice to undertake an EIA</td>
</tr>
<tr>
<td></td>
<td>Assessment</td>
<td>Assessment</td>
<td>Inception Report</td>
</tr>
<tr>
<td></td>
<td>Grant of Permit, Permit conditions (Director) (Acceptance to Grant: 30 days)</td>
<td>Grant of Permit, Permit conditions (Director) (Acceptance to Grant: Minimum 90 days)</td>
<td>Environmental Impact Statement</td>
</tr>
<tr>
<td></td>
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<td>Environment Consultative Group (discretionary)</td>
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<td></td>
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<td></td>
<td>Provincial Environment Committee</td>
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<td></td>
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<td></td>
<td>Public review (compulsory)</td>
</tr>
</tbody>
</table>

## Prescribed Activities Regulation - Classification of Mining and Petroleum Activities

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2, Category A</th>
<th>Level 2, Category B</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mineral Exploration</strong></td>
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<td><strong>Mining and Processing</strong></td>
<td><strong>Mining and Processing</strong></td>
</tr>
<tr>
<td>Geological and geochemical surveys; seismic and other surveys; trenching, pitting or other small excavations for exploration purposes.</td>
<td>Any drilling program at a defined prospect where the aggregate depth of all holes drilled is less than 2,500m.</td>
<td>Mechanized mining on a ML involving non-chemical processing of less than 50,000 tpa.</td>
<td>Mechanized mining on a ML involving chemical processing of less than 50,000 tpa.</td>
</tr>
<tr>
<td><strong>Mining</strong></td>
<td><strong>Mining and Processing</strong></td>
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<td><strong>Petroleum and Petrochemicals</strong></td>
</tr>
<tr>
<td>Non mechanised mining</td>
<td>Mechanical mining on a ML involving non-chemical processing of less than 50,000 tpa.</td>
<td>Mechanized mining on a ML involving chemical processing of more than 50,000 tpa.</td>
<td>Recovery, processing, storage or transport of petroleum requiring a PDL or PL.</td>
</tr>
<tr>
<td>Alluvial mining on an AML</td>
<td>Gravel extraction operating continuously for more than 6 months and involving the extraction of less than 10,000 tpa.</td>
<td>Gravel extraction operating continuously for more than 6 months and involving the extraction of more than 10,000 tpa.</td>
<td>Liquefaction of natural gas requiring a PPFL.</td>
</tr>
<tr>
<td><strong>Petroleum Exploration</strong></td>
<td><strong>Petroleum Exploration</strong></td>
<td><strong>Petroleum and Petrochemicals</strong></td>
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</tr>
<tr>
<td>Geological and geochemical surveys</td>
<td>Drilling of oil and gas wells</td>
<td>Manufacture of organic chemicals requiring a Petroleum Processing Facility Licence (PPFL)</td>
<td>Recovery, processing, storage or transport of petroleum requiring a PDL or PL.</td>
</tr>
<tr>
<td>Seismic and other surveys</td>
<td></td>
<td>Pipeline transport and storage using facilities with a holding capacity of more than 0.5 ML.</td>
<td>Refining of petroleum or manufacture and processing of petrochemicals requiring a PPFL, except where the activity is a category B, level 2 activity.</td>
</tr>
</tbody>
</table>
Land based

- Environmental Permitting.

• **Low impact** activities (not ground disturbing) are permitted on application.

• **Higher impact** activities are **graded**, with lower range activities having “**accepted**” impact levels, and remediation/monitoring (eg drilling, sampling).

• **High impact** (bulk sampling and trial mining), commonly have some form of limited **EIS/approval** prior to work commencing.
The “mining cycle”.

Exploration.
   – Low impact assessment of potential.

Resource delineation.
   – Detailed testing of deposit to determine if economically viable.

Permitting.
   – Obtaining the various approvals to mine

Mining.
   – Extracting the ore

Closure
   – Activities and planning to ensure the site achieves acceptable long term environmental status.
Suggested impacts - seafloor

Low impact:
• Geophysics, video tows, modest sampling,

Moderate Impact:
• Sampling, scout drilling,

Higher Impact:
• Bulk sampling, trial mining – area specific

Mining:
• ongoing monitoring
The seafloor mine

Key points:
• High grades
• small volumes
• Small footprint
• No waste dumps
• Remote mining units
• Ore transported to land for processing
• No “land use conflicts”
• mobile
Land vs Seafloor Mine

Seafloor mine = smaller Footprint

= less waste rock, tailings, land owner/social, greenhouse gases,

Less impact than onshore mine for similar metal production
Environmental Impacts - exploration

- **GEOPHYSICS**: Mostly ‘non grounded’ ie no contact with seabed (like airborne survey over land)
- Passive measurement of natural features
Environmetal Impacts - exploration

- **SAMPLING:**
  - Disturbance of a very *limited area*
  - Used by MSR groups as well.
  - Various techniques.
Environmental Impacts - Exploration

• **DRILLING:**

  - Ship or ROV based.
  - **Limited** surface disturbance (70mm – 2” core holes), and impact.
  - Sample collected at depth.

  - No need for access tracks – as on land.
  - Consumables these days are all biodegradable.
Environmental Impacts – trial mining

• **TRIAL MINING**:  
  • In practice would only involve disturbing a small amount of the total resource.  
  • Provides valuable data on project economics before any mining lease is applied for.  
  • Detailed monitoring of environmental impacts will greatly aid mine permitting.
Potential Environmental Stresses - during mining
Environmental compliance - costs for seafloor mine

- Location will be a significant influence on costs.
- The ability to collaborate with MSR groups has the potential to reduce costs.
- The level of impact is similar to MSR groups up to bulk sampling, or serious resource drilling.
- use what we know.
Environmental compliance - costs on land.

- Low impact work – minimal added cost ($5 to 20K per program).
- EIS – costs vary widely depending on country and setting. Costs increase as project advances. (common ranges $3 to 10+ million).
- Land use conflict studies – another cost for land based operations. Can have a “human impact”. Cost can be significant.
- Other competing issues can be significant (water quality/use, ARD, dust, etc).
- Closure costs – can be significant for large surface mines (>US$20 mill).
Conclusions – seafloor exploration.

- Mobilisation is a major cost for any program studying seafloor polymetallic sulphides.

- $US2 to 5 million+ per cruise is common. 3 to 4 cruises would be needed to complete a 12 month EIS (so likely cost range $US8 to 20 million!).

- Specialist equipment can be expensive

- Land based exploration programs have their environmental impact “graded”, and accepted before work starts, and allow for “progressive rehabilitation”.

- Programs in the AREA should follow a similar pattern so money and resources are not wasted.

- Collaboration is vital (MSR’s and miners).

- Cost of compliance is significantly reduced once the project is in production.
Conclusions

• ISA has a vital job
  – will need to manage all data, tenements, etc, make all this information available to workers in the AREA so we can improve our environmental compliance and monitoring.

• Classify “expected impacts” as on land, to aid permitting and compliance.

• The first mines, like exploration, are likely to be within Territorial Waters and/or EEZ’s.

• These use modified existing “land based” legislation (eg PNG), and work well.

• Why not learn from these!
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