Soviet submarine K 19
8th March 1968 explosion
Is marine mining a commercial viability for developing countries?

Anton Löf, Magnus Ericsson, Olof Löf
Agenda

- What is marine mining?
- Deep Seabed Mining (DSM)
- Observations
Marine mineral deposits

- Mid-Oceanic ridges
- Sea floor
- Continental shelf

Sea level
Depth 2000-4000 m

- Polymetallic nodules
- Hydrocarbons
- Phosphorites
- Placers: tin, diamonds, sand/gravel

Depth 4000 m
Mponeng deepest mine gold, South Africa
Marine mineral deposits

- Mid-Oceanic ridges
- Sea floor
- Continental shelf

- Depth 2000-4000 m
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- Polymetallic nodules
- SMS
- Placers: tin, diamonds, sand/gravel
- Phosphorites
- Hydrocarbons

Deep seabed mining (DSM)  Offshore

- Mponeng deepest mine gold, South Africa
- Depth 4000 m
Offshore mining and DSM projects

Notes:
1. The Metals Company
2. Nautilus (closed down)
3. JOGMEC
4. Early stage Norwegian projects
## Value of offshore extraction 1972/2018

<table>
<thead>
<tr>
<th>Commodity</th>
<th>1972</th>
<th></th>
<th>2018</th>
<th></th>
<th>Tendency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commodity</td>
<td>Volume</td>
<td>Value (USD M)</td>
<td>% of total production of each raw material</td>
<td>Volume</td>
<td>Value (USD M)</td>
</tr>
<tr>
<td>Oil &amp; gas</td>
<td>10,300</td>
<td>18</td>
<td>600,000</td>
<td>30</td>
<td>Increase, flattening</td>
</tr>
<tr>
<td>Sulphur (Frasch)(^1)</td>
<td>25</td>
<td>33</td>
<td>Low</td>
<td>Low</td>
<td>0</td>
</tr>
<tr>
<td>Sand &amp; gravel (Mt)</td>
<td>na</td>
<td>100</td>
<td>&lt;1</td>
<td>4,500</td>
<td>10-15</td>
</tr>
<tr>
<td>Tin (kt)</td>
<td>14</td>
<td>53</td>
<td>7</td>
<td>56</td>
<td>1,300</td>
</tr>
<tr>
<td>Titanium sands</td>
<td>76</td>
<td>20</td>
<td>\</td>
<td></td>
<td>\</td>
</tr>
<tr>
<td>Iron ore (Mt)</td>
<td>3</td>
<td>10</td>
<td>&lt;1</td>
<td>3</td>
<td>200</td>
</tr>
<tr>
<td>Diamonds (Mct)(^2)</td>
<td>0</td>
<td>0</td>
<td>1.2</td>
<td>230</td>
<td>1.6</td>
</tr>
<tr>
<td>Salt (Mt)</td>
<td>42</td>
<td>173</td>
<td>29</td>
<td>100</td>
<td>12,000</td>
</tr>
<tr>
<td>Magnesium (kt) (^3)</td>
<td>143</td>
<td>75</td>
<td>61</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>SUM(^4)</td>
<td>512</td>
<td>\</td>
<td>\</td>
<td>\</td>
<td>\</td>
</tr>
<tr>
<td>SUM</td>
<td>33,730</td>
<td>\</td>
<td>\</td>
<td>\</td>
<td>\</td>
</tr>
</tbody>
</table>

\(^1\) Frasch = Sulphur extracted from crushed oil and gas deposits.

\(^2\) Mct = Metric carat.

\(^3\) kt = Kilogram.

\(^4\) SUM = Summation of all commodities.
# Area covered by DSM exploration

<table>
<thead>
<tr>
<th>#</th>
<th>Contracted exploration areas (ISA)</th>
<th>km²</th>
<th>Total km²</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Poly Metallic Nodules (PMN)</td>
<td>75,000</td>
<td>1,425,000</td>
<td>0.4</td>
</tr>
<tr>
<td>7</td>
<td>Poly Metallic Sulphides/Seafloor Massive Sulphides (PMS/SMS)</td>
<td>3,000</td>
<td>21,000</td>
<td>negligible</td>
</tr>
<tr>
<td>5</td>
<td>Cobalt Rich Crusts (CRC)</td>
<td>10,000</td>
<td>50,000</td>
<td>negligible</td>
</tr>
<tr>
<td></td>
<td><strong>Sum</strong></td>
<td></td>
<td>1,496,000</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>Reserved area (ISA)</td>
<td></td>
<td>1,165,000</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td><strong>Total seabed under exploration contract with the ISA</strong></td>
<td></td>
<td>2,661,000</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Marine mining conclusions

DSM
• Technologically difficult and unproven after 50 optimistic years
• No mineral reserves
• ISA unique global, ex ante mineral regime

Offshore
• Offshore mining for LICs and MICs

Marine
• Serious environmental issues, continued studies necessary
• Lowest cost producer, land based or marine, will supply
• Blue economy perspective
Thank you

Magnus Ericsson
RMG Consulting
www.rmgconsulting.org
magnus@gladtjarnen.se
+46-70-558 0065

Full study: