DEEP OCEAN SEAFLOOR MINERAL EXTRACTION: SOLWARA 1 CASE STUDY

ISA INTERNATIONAL WORKSHOP ON ENVIRONMENTAL NEEDS FOR EXPLORATION AND EXPLOITATION OF DEEP SEABED MINERALS

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Why Go to the Sea?

- World’s demand for metals continues to rise
- Land resources are stretched
- Every human activity impacts on the environment
Seafloor Production Makes Sense

- Nautilus is the first company to commercially explore for Seafloor Massive Sulphide (SMS) deposits – HIGH GRADES of copper, gold, zinc & silver
- Minimal overburden
- Smaller physical footprint than land-based counterparts
- Minimal social disturbance
- First project: Solwara 1
- Bismarck Sea, PNG
- 1600 m depth
- 30 km from nearest coast
- Small extraction area: 0.11 km²
Project Setting

- Solwara 1:
- 5 mineralised zones
- Weakly active hydrothermal vent site
- Near active subsea volcano
- South Su = reference area
1. Cut up ore on the seafloor.

2. Ore and seawater go up the pipe to the ship.

3. Ore is separated from seawater on board the ship.

4. Seawater is filtered and discharged back to the deep sea (where it came from).

5. Ore is put onto a barge and taken for temporary storage.

6. When there is enough ore, the ore is taken to a pre-existing processing plant overseas.
Approvals

Legal

Social License
**Legal Process**

- **Mining Act 1992**
  - Governs the exploration, development, processing and transportation of minerals

- **Environment Act 2000**
  - Outlines environmental requirements of an activity
  - EIS → takes into account social considerations
Project Stages

**Exploration**
- What’s there? (Resource, Environment)
- Low Impact, similar to MSR activities

**Feasibility**
- EIS and Project Feasibility stages
- More detail → Define Project, impacts and benefits

**Extraction**
- Higher impact activities
EMP must be submitted and approved before operations can commence
EIA Objectives

- Define the existing environment
- Estimate impacts of the project to the environment
- Develop strategies to minimise impacts
- Integrates social, economic and environmental factors into a ‘sustainable’ development proposal
EIS Decision Making

*Site Specific*

- Impacts
- Benefits
EIAs Today

A Test of Project’s legitimacy

- More weight on social license
- Diverse values and opinions
- Multi-stakeholder approach, including anti-development NGOs/civil society groups (local and international)
- What people think matters

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Social

Environment

Economic

Bearable

Equitable

Sustainable

Viable
Value means different things to different people

Geologists:
- A puzzle?
- A deposit?

Biologists:
- Ecological value?
- Something to protect?

Engineers:
- A challenge?

Host Country:
- Income —> schools, hospitals, roads etc.
- Employment?

Company:
- Au/Cu/Zn/Ag
- Income
- A chance to make a difference

Conservationalists/NGOs:
- Ecological value?
- A cause?

General Public:
- Who do we believe?
- Do we need this?
What are we seeking acceptance for?

1. Disaggregate seafloor material.
2. Transport the material to a ship.
3. Transport the material to market.

Image: Seafloor Production System
Developing the Strategy

- Risk assessment workshops; stakeholder mapping
- Going beyond legal compliance; Precautionary Approach
- Multi-stakeholder approach
- Get the science right
Nautilus Approach

• Early, transparent and inclusive stakeholder engagement
• Inclusive multi-stakeholder workshops
  – Communities
  – World-renowned experts in various fields, from anthropologists to hydrothermal vent ecologists
  – Government
  – NGOs
• Ongoing Community Awareness and Consultations
• Established CARES

www.cares.nautilusminerals.com
Identify Studies Needed (note this is not an exhaustive list)

- Biology Studies:
  - Macrofauna (incl., DNA/genetic studies)
  - Benthic Habitat Assessment
  - Bioaccumulation
  - Bioluminescence
- Existing Resource Utilisation
- Hazard and Risk Assessment
- Hydrodynamic Modelling:
  - Cutting
  - Dewatering
- Noise and Light
- Oceanography (12 mo, full column)
- Sedimentation Rates (36 mo, ongoing)
- Sediment Chemistry
- Video Survey (>100,000 obs)
- Water Quality

Additional objective: science will also benefit from additional deep sea studies conducted to obtain data for the EIS
Achieving Independence

- Independent researchers
  - Freedom to publish
- Independent reviewers
  - Engaged by DEC
- Transparency
  - EIS and all supporting studies on website

- Duke University
- Scripps Institution of Oceanography
- University of Toronto, Canada
- WHOI
- CSIRO, Australia
- Hydrobiology, Australia
- University of Papua New Guinea
- Coffey Natural Systems, Australia
- Rabaul Volcano Observatory, PNG
- Asia Pacific Applied Science Associates (APASA), Australia
- Australian National University
- Curtin University of Technology, Australia
- James Cook University, Australia
- Charles Darwin University, Australia

Images: Collecting chimney sample; collecting snail sample
Solwara 1: Defining Features

- Small scale (0.11 km²)
- Avoids land clearance activities compared to typical land-based mining
- No construction of haul roads
- Minimal overburden/waste removal
- No toxic chemicals, no blasting
- Infrastructure can be relocated (mobile)
- No direct impact to communities
Seafloor Communities – ACTIVE SITES

Alvinconcha sp. – aka “Hairy Snails”

Infremeria nautilaei – aka “Black Snails”

3 Main Habitat Zones at SW1 and SS

Eochionelasmus ohtai – “Barnacles”
No significant difference between samples taken from Solwara 1 and South Su (reference site) with respect to the numerically dominant species.
Main Baseline Findings

- Venting activity is variable
- Effects life: piles of dead snails observed
- Animal communities adapted to, or tolerant of, variability
Deep Sea Water Quality

- Ambient baseline concentrations of some metals (e.g. Cu, Zn, Pb) exceeded ANZECC/ARMCANZ guidelines near vents
- Plumes occur naturally
- Naturally high sedimentation rate
Limiting the Impacts on the Seafloor

Mitigation strategies developed with a team of world experts.

All strategies suggested were accepted by Nautilus.

Protection measures include:

- Setting aside a reference site (South Su)
- Refuge Areas
- Animal relocation
- Artificial substrates
Residual Impacts

- Possible changes to local venting
- Loss and recolonisation of fauna
- Habitat loss
- Sediment re-suspension from SPT
- Plumes from dewatering discharge (these will be minimised) – none above 1300 m
- Some avoidance or attraction of animals from/to light and noise
Testable Propositions

- It will recover
  - Venting will continue
  - Chimneys will reform
  - Animals will return
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2008

2010

2 years later....
Consultation Undertaken in PNG – Since 2007

Map showing areas visited as a part of project's stakeholder consultation program.
Coastal, Shallow- and Mid- Water

- Issues raised during community consultations:
  - Protect marine environments:
    - reefs and fisheries
    - whales, sharks and turtles
  - Benefits

- Review of animals present (shallow) showed:
  - Surface (0 to ~400 m) schooling pelagic fish (e.g. tuna)
  - Occasional passage of dolphins (no turtles observed)
  - Other species: plankton, small shrimps, fish and squid
  - Some vertical migration in search of prey
Responses to Locally Based Issues

• “Engineer out” impacts to surface waters:
  – Fully enclosed ore delivery system (riser pipe)
  – Filter water prior to discharge (no toxic chemicals)
  – Dewatering discharge – near the seafloor
  – No extraction impact shallower than 1300 m water depth at Solwara 1 (below where tuna, etc live)

• Only impact to surface waters: presence of vessel, supporting vessels and riser pipe
What Makes Good Minerals Policy Framework?

- Clear guidelines, timelines
- Transparency
- Consistency
- Efficiency
- Benefits justify risk(s)
  - Environmentally and Socially responsible
  - Economically viable
- Independence of reviewers
- Agreement from governing body/ies and affected stakeholders
- Provision for Adaptive Management
Successful Outcome - Key Messages

- Project is going ahead
- Refer to world experts
- Take time to develop trust
- Collaborative, one team, approach with a shared goal to manage the project responsibly
- Be adaptable – things change
- Be Transparent
- Publish
- Unknowns can be managed
- We have 2 years (2012: EMP, offshore campaign) – it’s not too late to have input